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and a Natural Experiment

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Opinions expressed in this paper are those of the author(s) and do not necessarily reflect views of the institute.

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The effects of family policy on mothers' labor supply: Combining evidence from a structural model and a natural experiment

Johannes Geyer*, Peter Haan†, Katharina Wrohlich‡

March 6, 2014

Parental leave and subsidized child care are prominent examples of family policies supporting the reconciliation of family life and labor market careers for mothers. In this paper, we combine different empirical strategies to evaluate the employment effects of these policies for mothers in Germany. In particular we estimate a structural labor supply model and exploit a natural experiment, i.e. the reform of parental leave benefits. By exploiting and combining the advantages of the different methods, i.e the internal validity of the natural experiment and the external validity of the structural model, we can go beyond evaluation studies restricted to one particular methodology. Our findings suggest that a combination of parental leave benefits and subsidized child care leads to sizable employment effects of mothers.

Keywords: labor supply, parental leave benefits, childcare costs, structural model, natural experiment

JEL Classification: J22, H31, C52

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1. Introduction

In the face of a shrinking working-age population, increasing female labor force participation is high on the political agenda of many countries. For example, the EU 2020 strategy sets a target participation rate of 75% for the population aged 20 to 64 by 2020. This goal can only be achieved if countries succeed in raising female employment. One central factor behind the lower participation rates of women are child-related employment interruptions of mothers. Therefore an important goal of family policies is to improve the reconciliation of family life and labor market careers for mothers. Reflecting this, the German government has introduced several family policies with a clear focus on increasing employment of mothers with children older than one year: In particular a parental leave benefit reform influenced by the Swedish system, implemented in 2007, and the expansion of subsidized public child care, mainly targeted at children older than one year. The parental leave reform encourages mothers to reduce their employment in the short run, i.e. in the first year after giving birth, while it sets incentives to return to work in the second year after giving birth.¹ The same incentives are induced by the introduction of a legal claim to subsidized child care for all children aged one year or older starting from August 2013 on.

It is the aim of this paper to empirically evaluate these reforms with a particular focus on the labor market effects of mothers with young children. The central value added of this evaluation study is that we combine different empirical methods, namely a structural model of labor supply behavior and a reduced form estimation exploiting quasi-experimental variation. By exploiting and combining the advantages of the different methods, i.e the internal validity of the quasi-experimental study and the external validity of the structural model, we can go beyond evaluation studies restricted to one particular methodology.

In this respect, we follow studies that suggest exploiting all available evidence rather than being categorical about the “right” empirical approach for policy evaluation, e.g. [Lise et al. \(2005\)](#), [Todd and Wolpin \(2006\)](#), [Hansen and Liu \(2011\)](#) or [Pronzato \(2012\)](#). As argued by [Blundell \(2012\)](#), researchers should base their policy evaluation on descriptive evidence, quasi-experimental evaluations and also on structural model estimation, if possible. For example, exogenous variation should be used for identification or validation of structural models. Our evaluation strategy is in line with this paradigm. To be more precise, we estimate a structural labor supply model of maternal employment based on

¹Note, in this paper we focus on the effects of a specific parental leave benefit reform. For a more general discussion about the efficiency of paid maternity leave, see [Dahl et al. \(2013\)](#)

data from the German Socio-Economic Panel Study (SOEP) and simulate the employment effects of the 2007 parental leave benefit reform. We then validate these simulations with causal estimates that we obtain by exploiting this reform as a natural experiment. The natural experiment is analyzed with data from the German Microcensus. Finally, we use the validated structural model to study the employment effects of the new parental leave benefit combined with the introduction of a legal claim to subsidized child care for all children aged one year or older which became effective in August 2013.

For the structural model we impose the standard structural assumptions, in particular that individuals maximize a specific utility function with respect to income and leisure, i.e. choose the employment status that yields the highest utility. In order to validate this model, we draw on the parental leave reform in Germany that significantly altered work incentives for mothers during the first two years after giving birth. Before the reform families received a means-tested transfer amounting to 300 euro per month that was paid to the parent on leave for a maximum period of 24 months. After the reform the transfer is paid only for a maximum period of 12 or 14 months (there exists a 2 months “father quota”) and the amount of this transfer depends on the earnings of the parent on leave prior to birth. Due to the timing of this reform, it can be interpreted as natural experiment. We provide evidence that a causal effect can be identified by comparing mothers who gave birth shortly before and shortly after the implementation of the reform. These results can be compared to the predictions that we obtain based on our structural model.

As [Keane \(2010\)](#) points out, there is no clear formal statistical test stating whether or when a structural model is validated. Therefore, in line with [Todd and Wolpin \(2006\)](#), we take confidence intervals of point estimates obtained in the structural model and the quasi-experimental approach as the criterion of comparison. According to this criterion the structural model can be validated. Moreover, we can provide supportive evidence beyond the comparison of the mean effects: with both methods we find the same pattern of behavioral responses across different socio-economic groups. In particular, for women with low income there is a positive and significant labor supply effect of the parental leave reform, whereas the effect is negative but not significant for women with high income. In this respect the results from the quasi-experimental evaluation show that mothers react to financial incentives according to the imposed theoretical assumptions of the structural model of labor supply.

Thus, our paper makes two main contributions to the literature: First, our results imply that the imposed assumptions of our structural model – in particular with respect to the link between financial incentives and labor supply behavior – are consistent with

causal behavioral changes induced by a policy reform. This is empirical evidence against the criticism of structural models and gives support for the use of structural models for policy evaluations.

Second, our results add to the literature on the labor market effects of family policies and therefore contribute to the discussion about the consequences of different family policy reforms and their interaction effects on employment of mothers. Overall, there exists a fairly large literature from many different countries that focusses on the effects of family policy on the behavior of mothers² and their children. As far as parental leave policies are concerned, two studies for Austria (see [Lalive et al. \(2013\)](#)) and Norway [Dahl et al. \(forthcoming\)](#)) are of particular interest. In the study for Norway [Dahl et al. \(forthcoming\)](#)) focus not only on the direct effect of the reform but identifies social interaction effects. The analysis of [Lalive et al. \(2013\)](#) goes beyond the related literature as they combine results from a natural experiment with a structural search model to study the optimal design of parental leave.

The employment effects of the German parental leave reform that we look at are studied by [Bergemann and Riphahn \(2011\)](#) and [Kluve and Tamm \(2013\)](#). Both studies exploit the fact that the introduction can be interpreted as a natural experiment. The studies rely on different data sets with different potential problems. [Bergemann and Riphahn \(2011\)](#) use data from the SOEP with only very few births around the introduction of the reform and [Kluve and Tamm \(2013\)](#) use non-representative data from a health insurance company. More importantly and in contrast to our analysis, these studies do not focus on the realized employment effects but the desire of mothers to work in the future. [Raute \(2014\)](#) and [Cygan-Rehm \(2013\)](#) extend the evaluation of the parental leave reform and focus on the fertility effects of that reform. The results suggest that fertility rates respond to the financial incentives induced by the reform. Additional evidence about the effects of parental leave legislation in Germany is provided by [Schönberg and Ludsteck \(forthcoming\)](#) and [Dustmann and Schönberg \(2012\)](#). They analyze the short- and long-run outcomes of several expansions in maternity leave coverage in Germany during the 1980s and 1990s by exploiting quasi experimental variation. They find a significant reaction of female employment behavior in the short run but only weak evidence for long run employment effects. [Dustmann and Schönberg \(2012\)](#) find no support that the expansions in leave coverage improved children's outcomes.

A large body of literature analyzes the effects of childcare policies on mothers' labor supply. Many earlier studies are based on structural models where identification relies

²In addition, a small number of papers, e.g. [Ekberg et al. \(2013\)](#) and [Cools et al. \(2011\)](#) focus on the behavior of fathers.

on the heterogeneity of wages and childcare costs in the cross-section and over time (see, among many others, [Ribar \(1995\)](#), [Blau and Robins \(1988\)](#), [Michalopoulos et al. \(1992\)](#) and [Powell \(2002\)](#) for the US, [Kornstad and Thoresen \(2007\)](#) for Norway, [Lokshin \(2004\)](#) for Russia, [Apps et al. \(2012\)](#) for the Netherlands and [Wrohlich \(2011\)](#) for Germany). Other studies use quasi-experimental approaches and identify the effect of childcare policy on regional variation in the availability or expansion of child care (see, among others, [Havnes and Mogstad \(2011\)](#) for Norway, [Berlinski and Galiani \(2007\)](#) for Argentina, [Cascio \(2009\)](#) for the U.S., [Baker et al. \(2008\)](#) for Canada, [Schlosser \(2005\)](#) for Israel and [Nollenberger and Rodriguez-Planas \(2011\)](#) for Spain). As far as childcare reforms in Germany are concerned, there are only a few studies evaluating the effect of the increase in the supply of child care on mothers' employment. [Wrohlich \(2011\)](#) estimates a structural model based on SOEP data and finds a positive employment effect. [Bauernschuster and Schlotter \(2013\)](#) exploit the introduction of the legal entitlement to part-time care for children at the age of three and find quite large effects on maternal labor supply. Exploiting a reform that took place in one federal state and implicitly increased costs of child care (by providing a subsidy for children who are not in public child care), [Gathmann and Sass \(2012\)](#) find that increasing costs for child care significantly reduces labor supply of mothers with two-year old children.

Our results support the finding of the previous literature that family policy can affect maternal employment. In particular we find that the parental leave benefit reform had modest positive effects on the labor supply of mothers in the second year after their child was born. The participation rate of mothers with children of this age group increases by 2 percentage points due to this reform. Much larger effects, however, can be attributed to the childcare reform that increases labor supply by further 5.5 percentage points. We thus conclude that the combination of both reforms has large effects on mother's labor supply and therefore is in line with the government's goals to increase female labor supply.

The paper proceeds as follows. In the next section, we provide information about family policy in Germany and the recent parental leave and childcare reforms. In section 3 we discuss the two different methods and section 4 introduces the different data source. The empirical results, the validation and the policy simulations are discussed in section 5. Finally, section 6 concludes.

2. Institutional Background

This section provides an overview of the family policies that are in the focus of this study. First we describe the parental leave legislation, and then the childcare institutions. Finally we document how these policies affect the disposable income and the working incentives of mothers.

2.1. Parental Leave Legislation

In contrast to the United States but similar to other European countries, parental leave legislation in Germany is very generous with respect to both job protection and monetary benefits during leave.³ In Germany, both parents are entitled to take parental leave (“*Elternzeit*”) for a maximum period of three years after childbirth. During the leave they are protected against dismissal and have the right to return to the same or similar job as before their leave. The 2007 parental leave reform did not change the total length of the leave but replaced the means-tested benefits by an earnings related system. This is important for our evaluation design. As discussed in (Lalive et al., 2013), if both the period of job protection and the benefits change, it is difficult to identify the relative importance of cash benefits versus job protection.

During the leave, parents can claim parental leave benefits from the government. Through 2006, there was a child-rearing benefit (“*Erziehungsgeld*”) amounting to 300 euro per month that was paid to the parent on leave for a maximum period of 24 months. This transfer was means-tested with income thresholds below the median income of a one-earner family. Thus, less than half of all families with newborn children were entitled to this transfer.⁴ The transfer was only paid to families in which at least one parent was working less than 30 hours per week.

In 2007, the child-rearing benefit was replaced by the “parents’ benefit” (“*Elterngeld*”). In contrast to the old scheme, this transfer is paid only for a period of 12 or 14 months. Mother and father can either share their entitlement, in which case the leave is extended to 14 months, or, if only one parent takes the leave, it amounts to 12 months.⁵ While receiving the parents’ benefit, the parent is not allowed to work more than 30 hours

³For an overview of the development of parental leave legislation in Germany, including developments since 2007, see Kluge and Tamm (2013), Schönberg and Ludsteck (forthcoming) or Spiess and Wrohlich (2008).

⁴The income thresholds during the first 6 months after childbirth were higher and about 77% of all parents claimed the child-rearing benefit. Starting from the 6th month, only about 50% were entitled to full benefits.

⁵Note, in this paper we do not analyze the behavior of the father nor the effect of this “partner quota”, the focus is only on the employment effects of mothers.

per week. In contrast to the old scheme, the parents' benefit is not means-tested on household income and the amount of the benefit depends on earnings prior to birth. It replaces 67% of previous net earnings, but does not exceed 1,800 euro per month. There is a minimum of 300 euro per month that is paid to parents whose parents' benefit would otherwise be less than 300 euro, including parents without prior earnings. If the parent who is receiving the benefit is working part-time, the benefit is reduced. It then replaces 67% of the difference in net earnings before and after birth. Families with two children under three years of age or those families with three or more children under six years of age receive an extra bonus of 10%. For parents with prior-to-birth earnings of less than 1,000 euro per month, the replacement rate increases gradually until it reaches 100% for parents with a pre-birth income of 340 Euro per month. In addition, the restriction that parents are only eligible for benefits if they work less than 30 hours per week stayed in place with the parent' benefit.

Consistent with the very generous parental leave schemes that have been in place in Germany for many years, the share of mothers who withdraw from the labor market more than two years was relatively high (more than 50 % in the years 2001-2006, see Table 2).⁶ The government's goal for the reform in terms of female employment was to increase the share of mothers returning to work one year after giving birth. In contrast the intention for the first year was to provide the household with sufficient income to provide care for the child without needing both parents to work.

2.2. Childcare Institutions

Traditionally, the supply of public or publicly subsidized formal child care for children under the age of three has been very low, at least in West Germany. While in East Germany child care was traditionally available for a larger fraction of children, even in the youngest age group, the prevalent care arrangement in West Germany was to look after children under the age of three in private settings. Public or publicly subsidized child care for children under the age of three years was only available for 2 % of the children in West Germany, and 35 % in East Germany. Since 2005, several laws have been passed that aim at increasing public childcare slots, in particular for children between the ages of one and three years. As we show in Table 1, starting from 2006 on, availability of childcare slots for children under the age of three years has been increased in East and West Germany. While in 2002, there were childcare slots available only for 2 % of all

⁶For a detailed description of this development, see [Schönberg and Ludsteck \(forthcoming\)](#); there is also an overview in [Kluve and Tamm \(2013\)](#).

children aged 0-3⁷ years in West Germany, this number increased to 24 % in 2013. In East Germany, childcare slots increased from 35 to 52 % over the same period. The most recent reform in the field of childcare policy has been the introduction of a legal claim for subsidized child care for all children after their first birthday, unconditional on employment status or income of the parents.

Table 1: Childcare enrolment rates for children under three between 2002 and 2013 by region

Year	Germany (overall mean)	West Germany	East Germany
2002	0.12	0.02	0.35
2006	0.16	0.07	0.41
2007	0.18	0.09	0.42
2008	0.21	0.12	0.43
2009	0.21	0.14	0.47
2010	0.24	0.17	0.49
2011	0.26	0.20	0.50
2012	0.28	0.22	0.52
2013	0.29	0.24	0.52

Source: Federal Statistical Office. Data for the years 2003–2005 are not available.

2.3. Changes in Work incentives due to family policy reforms

Before we turn to the empirical analysis, we first describe in more detail how net household income and incentives to work are affected by i) the parental leave reform and ii) an increase of subsidized child care, i.e. universal child care.⁸ On the one hand, this helps to better understand the design of the specific reforms and, on the other hand, based on the changes in working incentives it is possible to derive hypotheses how the employment behavior of different groups changes when assuming a standard theoretical labor supply model.

In order to illustrate the incentives, we derive hypothetical budget lines for several stylized households. Note that in the empirical evaluation based on the structural model, we apply these rules and derive budget lines for the representative micro population. In this section we focus on the following types:

- couple household, both spouses earn median wages (Figures 1 & 2, Panel a)

⁷Unfortunately the data do not allow to focus only on children between the ages of one and three years.

⁸Note: For simplicity, in this descriptive analysis we consider an increase of subsidized child independent of the age of the child. In the policy simulation in the final section we focus on the specific reform targeted at children aged between one and three years.

- couple household, both spouses earn low wages (Figures 1 & 2, Panel b)
- single mother who earns median wage (Figures 1 & 2, Panel c)
- single mother who earns low wage (Figures 1 & 2, Panel d)

We present the budget lines for the first (Figure 1) and second (Figure 2) year after a child is born. The graphs show monthly disposable household income as a function of the mother's working hours. The working hours of the father are assumed to be constant at 40 hours per week. We define disposable income as net household income (gross income less taxes and social security contributions plus social transfers) less childcare costs. Further, we assume that there are no childcare costs if the mother is not working; if the mother is working less than 20 hours per week, parents have to pay for part-time care; if the mother is working 20 or more hours per week, parents have to pay for full-time care. For the calculation of childcare costs we follow the approach suggested in [Wrohlich \(2011\)](#) and use "expected costs of child care". Expected costs are the weighted sum of the relatively cheap fees to subsidized child care and the relatively expensive costs for privately organized child care. We use the individual probability to be rationed with respect to subsidized child care as weights. A detailed description of the estimation of childcare costs is given in [Appendix A](#). In the structural model, developed in the following section, we impose the same assumptions with respect to childcare costs.

Each graph shows budget lines for three scenarios: The solid line "Child rearing benefit" represents disposable income under the old parental leave benefit scheme (year 2006) and under the childcare regime of the year 2006. The dashed line "Parents' benefit" refers to the legislation of the year 2007 (new parental leave benefit scheme), holding childcare costs constant. The dotted line "Parents' benefit and universal child care" refers to the hypothetical scenario of the new parental leave benefit scheme and childcare costs that would occur if there was no rationing any more.

The change in work incentives due to the parental leave benefit reform (the difference between the solid and the dashed line) depends on several characteristics, such as household income, mothers prior-to-birth earnings and number of children, and on the time since childbirth. In the first year after giving birth, work incentives have generally decreased, while incentives to work have increased in the second year, in particular for low-income mothers.

In [Figure 1](#) we show how incentives to work have changed in the first year after childbirth for the four different types of households. First we focus on the comparison of the different parental leave benefits schemes, holding childcare costs constant. Panel (a) shows budget lines for a couple household with median income. For mothers with median

wages (whose partner earns also median wage and works full-time), work incentives during the first year after birth are lower with the parent's benefits than with child-rearing benefits. In the post 2006 regime, the household gets a higher out-of-work income, and the transfer is withdrawn at a high rate, such that the budget line is relatively flat. Panels (b) to (d) show budget lines for couples with low wages or single mothers. As these panels show, in contrast to the couple household with median income, the parental leave benefit reform hardly affected incentives to work for these groups in the first year after childbirth.

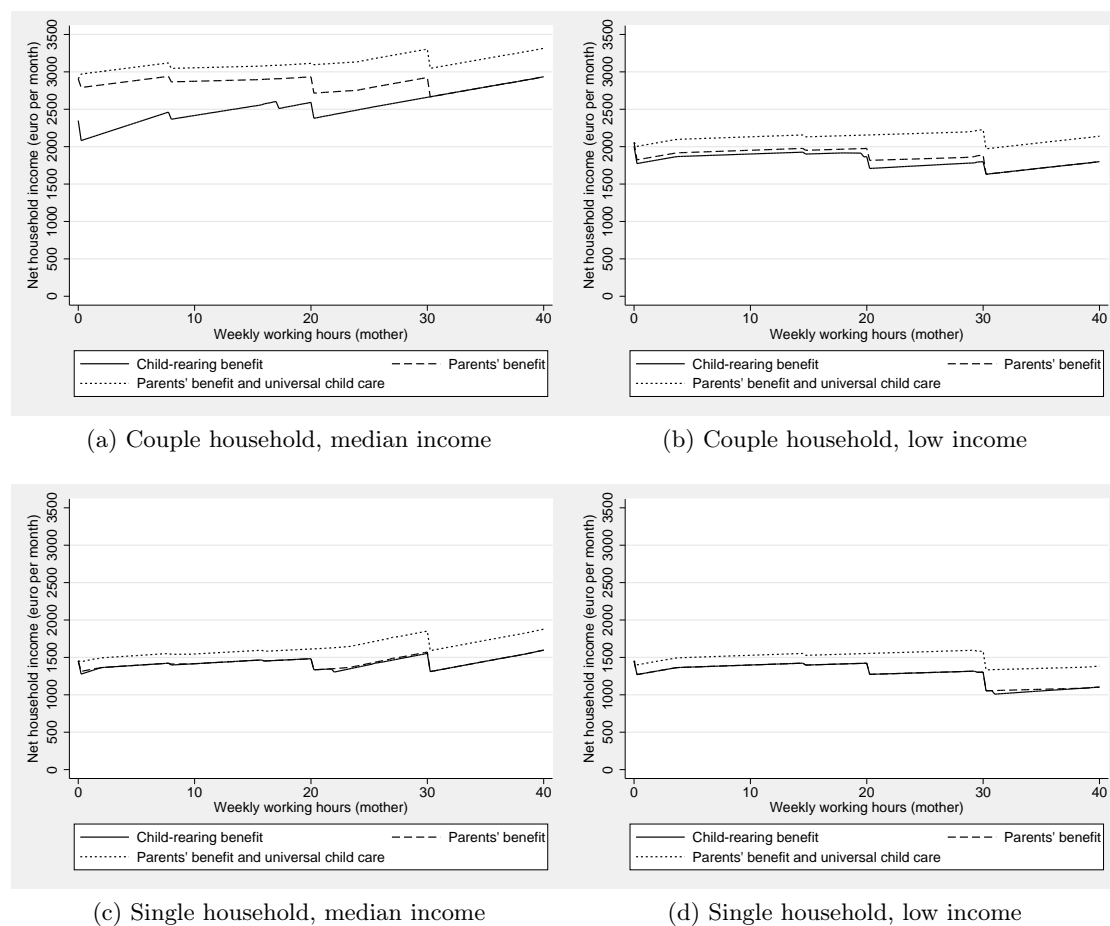


Figure 1: Household budget constraint with respect to mothers' working hours, first year after first childbirth

If we additionally take into account the reduction in childcare costs, (dotted line), work incentives increase for all types of households. Subsidized child care is not rationed any more under this scenario and thus childcare costs simply amount to the relatively

inexpensive parental fees to childcare centers. Therefore, the opportunity costs of work are considerably reduced.

In Figure 2 we turn to budget lines for families in the second year after a child is born. In this time period, couple households with median income (such as shown in Panel (a) of Figure 2) and above do not face any changes in work incentives, since they were not entitled to benefits in the second year under the old scheme. For this household type, we do not expect the 2007 parental leave reform to affect labor supply behavior in the second year. Incentives to work for mothers in these households, however, increase substantially under the childcare reform, as the dotted line shows.

For lower-income households and for single mothers the graphs indicate that work incentives have increased not only due to the childcare reform, but also due to the parental leave benefit reform. The budget lines for the relevant households in panels (b) to (d) in Figure (2) imply strong disincentives to work under the old parental leave benefit scheme, in particular to work more than 20 hours per week. Between 20 and 30 hours, the slope of the budget line is even negative, i.e. marginal tax rates exceed 100%. If the mother works full-time, net household income is about the same as when she was not working. These strong disincentive effects are reduced with the parents' benefit. Still, the budget line of these household types are very flat, because at low earnings the family can draw means-tested social transfers. However, the slope of the budget line is positive over the whole range of working hours. Thus, we would expect an increase in labor supply in the second year after childbirth.

Ceteris paribus, for families with more children, work incentives induced by the parental leave benefit reform should be higher, since the income threshold of the old benefit scheme increased with each additional child. For example, a family with three children would have received the old benefit even at incomes above the median. Additionally, the reduction in childcare costs should have even stronger positive effects on work incentives for families with more than one child.

If we combine the described working incentives with a standard theoretical model of labor supply behavior with positive preferences for income and leisure, we can derive hypotheses about the potential labor supply effects of the reforms. In general, it is to be expected that mothers reduce labor supply in the first year after childbirth. We expect this effect to be particularly large for mothers with high prenatal earnings. In the second year, incentives to work have changed only for mothers who have a partner with below-median earnings (or for mothers with more than two children and partners with earnings in the first three quarters of the wage distribution) and for single mothers. For all other families, work incentives in the second year after childbirth have not changed due to the

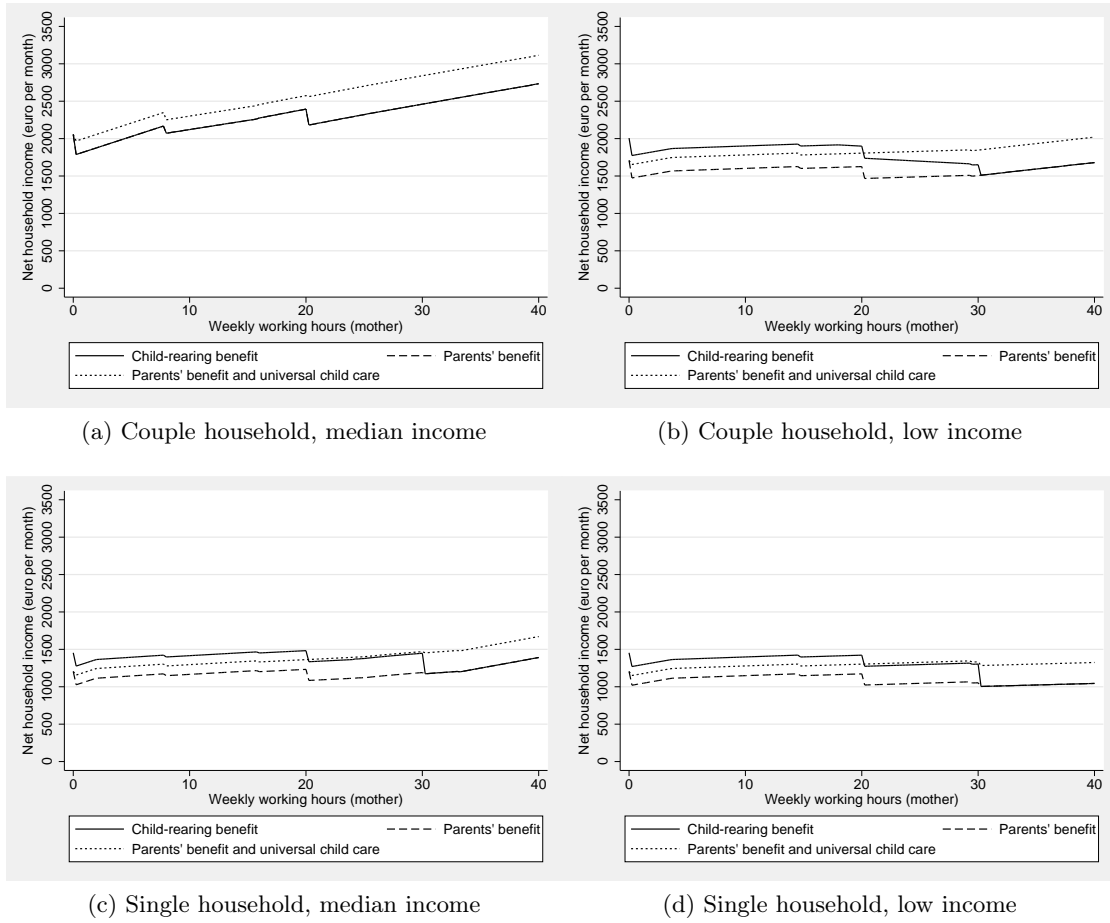


Figure 2: Household budget constraint with respect to mothers' working hours, second year after first childbirth

reform. Thus, we expect to find the labor supply of mothers in low-income families to increase. For single mothers, we expect that, in particular, full-time work increases in the second year after childbirth. An increase in subsidized child care, on the other hand, should increase employment of mothers in all types of families since working incentives increased for all groups.

3. Estimation strategy

In the following we discuss two different methodologies to evaluate the employment effects of the parental leave reform. First we present a structural model of maternal labor supply that is derived from economic theory. This model relies on several structural

assumptions that are imposed on the model. Based on this structural model we can estimate preferences of households which allows us to simulate the employment behavior of mothers and responses to specific family policy reforms. Based on the estimated parameters, in a first step, we simulate the employment behavior under the pre-reform child-rearing benefit scheme of 2006 and, in a second step, we simulate behavior under the newly introduced “parents’ benefit” . All other rules of the tax and transfer system in both scenarios are identical (law as of 2006). This procedure allows a *ceteris paribus* analysis of the change in the labor supply incentives introduced by the parental leave reform. The difference in labor supply behavior can be interpreted as the reform effect. We will use the same simulation technique for the evaluation of the parental leave reform combined with a reduction in the childcare costs (see Section 5.4).

The second method we use in the empirical analysis does not rely on imposed structural assumptions; here we directly exploit the variation induced by the parental leave reform. This reform can be interpreted as a natural experiment and our strategy is to compare the employment behavior of mothers who gave birth just before and after the introduction of the reform on January 1, 2007. In contrast to the structural approach, however, this identification strategy relies on the assumption that the introduction of the reform can truly be interpreted as a natural experiment, i.e. there were no other factors affecting mothers’ employment decisions in the treatment group as compared to the control group.

Note that for the estimation of the structural model, we only use data from the pre-reform period; in this sense this is a clean *ex ante* evaluation of this reform. This is important since we use the natural experiment to validate the predictions of the *ex ante* evaluation.

3.1. Structural model

The structural model is based on the assumption that mothers maximize a household utility function U_{ijt} , which is a function of the net household income and her leisure time l in a discrete labor market status j . According to the empirical specification, we define four discrete labor market states, namely inactivity, marginal employment [$0 < \text{weekly working hours } (h) < 13$], part time employment [$13 \leq h < 30$], and full time employment [$h \geq 30$]. The distribution of working hours categories of mothers is shown in Table 2. In this set up we assume that the labor supply of partners is exogenously given, i.e. a mother maximizes the household utility conditional on the behavior of their partner.⁹ In line with e.g. van Soest (1995) or Blundell et al. (2000), the utility function

⁹At first glance this often applied simplification, which Killingsworth (1983) named the male chauvinist model, might seem restrictive. However, empirical evidence suggests that cross elasticities between

has the following functional form

$$U_{ijt} = \beta_l l_j + \beta_y y_{ijt} + \beta_{ll} l_j^2 + \beta_{yy} y_{ijt}^2 + \beta_{ly} l_j y_{ijt} + \epsilon_{ijt} \quad (1)$$

where l_j is the leisure time of the wife in labor market status j , y_{ijt} the disposable net income of household i at time t , and ϵ_{ijt} is an error term. The disposable household net income, which is a function of gross wages, the tax and transfer system and childcare costs, describes the financial incentives for working. Gross wages are estimated in a first step before the estimation of the structural model, the specification and estimation results are discussed in more detail in the next section and Appendix B. The incentives vary between households by demographic characteristics and over time. The time variation adds to the cross-sectional variation and improves the identification of the model. In more detail, the variation over time is related to several changes in the tax and transfer system in the observed period (2001 – 2006). In particular a reform in the “child-rearing benefit” in 2004, when income thresholds were significantly reduced, is important since similar mothers before and after the reform had different incentives to return to work.¹⁰ Moreover, there is significant variation in childcare costs across regions and over time, which directly affects the disposable net household income (see Table 1 and Appendix A).

We introduce preference heterogeneity, as described in equation 2, and specify female leisure time as a function of demographic characteristics: X_{it} includes the mother’s age, her nationality, region of living, number of siblings of the newborns and the age of the newborn.

$$\beta_l = \alpha_0 + \alpha_l X_{it}. \quad (2)$$

The preference for leisure varies nonparametrically with the age of the newborn. We include quarterly dummy variables of age of the youngest child. This specification is comparable to a discrete time hazard rate model that describes the quarterly transition of mothers with newborns from non-employment into different employment states. In particular, our specification captures the dynamics of employment behavior that vary with the the elapsed time after giving birth. It is important to analyze the employment behavior of mothers with newborns in a dynamic context since persistence and state

spouses are either not significant or of little importance (Steiner and Wrohlich, 2004) and this provides justification for this assumption.

¹⁰In 2004, the income threshold for eligibility to the child-rearing benefit for the first six months after birth of a child was reduced from 52,130 euro per year to 30,000 euro for a couple.

dependence might affect the behavior of mothers. Moreover the pecuniary and non-pecuniary transaction costs of working are in particular important and vary significantly by the age of a newborn.

Assuming that, conditional on y_{ijt} , l_j , and X_{it} , all observations are independent,¹¹ the model can be estimated as a conditional logit model with maximum likelihood where the sample likelihood function is the probability of chosen employment state in period t .

3.2. Evaluation of the natural experiment

The second estimation strategy fundamentally differs from the structural model. Instead of simulating the employment effects based on estimated parameters, we directly estimate the employment effects of the parental leave reform. We argue that the timing of the reform allows us to interpret the setting as a natural experiment: First, the reform was introduced for all newborns at one point in time. If children were born on or before December 31, 2006, parents were entitled to the old scheme, while if children were born on or after January 1, 2007, parents were entitled to the new scheme. Second, as is documented in great detail in [Kluve and Tamm \(2013\)](#), mothers who gave birth in the first three months of 2007 did not know that there would be a new benefit scheme at the time of conception. Thus, the introduction of the new benefit scheme can be evaluated by a comparison of the employment behavior of a treatment and a control group: the treatment group consists of mothers who gave birth in the first quarter of 2007, and the control group consists of mothers who gave birth in the fourth quarter of 2006.¹²

More formally, we estimate the labor supply (ls) of mothers with a child in the first and second year after birth separately. To be more specific, we define ls as the employment status of mothers with children aged 3-12 months or 13-24 months at the time of the

¹¹[Baker and Melino \(2000\)](#) discuss the difficulties of identifying unobserved heterogeneity in a discrete duration model with unknown duration dependence. The same argument applies to our model with a nonparametric specification of the elapsed time after giving birth.

¹²Theoretically, there is a chance that some mothers tried to delay births that would otherwise have taken place in December 2006 to January 2007 because of the reform. If this were the case, it would imply self-selection into the treatment group, which would bias our estimates. Actually, there are two studies claiming that the parental leave reform in fact led to a significant delay of births. [Neugart and Ohlsson \(2013\)](#) estimate that the probability to give birth the first seven days of 2007 rather than the last seven days of 2006 increased by 5 percentage points for employed mothers. Another study by [Tamm \(2013\)](#) quantifies the number of delayed births due to the reform at around 1,000. However, we think that this problem is negligible for the following reason. Even if it was true that these births have been delayed due to the reform, this fraction of births is very small. Since our treatment and control group include mothers who gave births three months before and three months after the reform, respectively, the “delayed” births have a very small weight. To be more precise, according to the Federal Statistical Office, there were 57,578 births in January 2007 in Germany. Thus, the proportion of delayed births is less than 2 %. If we take the number of births of our treatment group, i.e. births from January to March 2007, this fraction is less than 0.01 %.

interview.¹³ The treatment dummy D_i depends on whether the child was born in the last three months of 2006 ($D_i = 0$) or in the first three months of 2007 ($D_i = 1$):

$$ls_i = \beta D_i + \gamma X_i + \varepsilon_i \quad (3)$$

The vector of control variables, X_i , includes demographic characteristics, such as education, age or region of living. The identifying assumption for the causal effect that is captured by β is that no other factors that potentially influence labor supply are correlated with D_i , in other words individual unobservables factors measured by ε_i are not correlated with the treatment. This assumption cannot be tested. However, it is plausible in this setting because there are no selection effects (since the reform was not known at the time of the conception) and there is no time trend since the time period in which we compare treatment and control group is very small (six months). In particular the continuous increase in subsidized child care (see Table 1) is not a problem since we compare mother within a very short time window.

Table 4 shows the distribution of several mothers' characteristics such as income, education, living in East Germany and marital status across the two groups. There are no large differences in characteristics between treatment and control groups.

4. Data

The two proposed methods have quite different requirements with respect to data. For the estimation of the structural model we need a rich data set that allows us to determine gross wages and net household incomes under several policy scenarios and to observe working hours of mothers. The policy evaluation based on the natural experiment, on the other hand, requires a large data set, such that enough observations are available despite of the narrow definition of the treatment and the control group. Therefore we use two different representative data sources for the estimation of the two models. The structural model is estimated based on panel data from the SOEP, the policy evaluation based on the natural experiment used data from the German Microcensus.

¹³Interviews in the microcensus are distributed across the whole year. Therefore, seasonal employment effects that could differ between treatment and control groups are not a problem in our case since we analyze the average employment outcome of all mothers with children aged 3-12 months and children 13-24 months, respectively. To analyze employment effects of the reform for mothers in the first year after giving birth, we only look at employment outcomes of mothers whose child is at least 3 months old since in the first 8 weeks after birth, mothers are not allowed to work due to maternity leave legislation ("Mutterschutz").

4.1. Data for the Estimation of the Structural Model: SOEP

The SOEP is a representative longitudinal micro database that provides a wide range of socio-economic information on private households in Germany. In 2010, the sample included about 19,000 respondents living in 12,800 households.¹⁴ The SOEP provides information about employment status and working hours of individuals. Moreover, it includes detailed income information on the individual and household level and other demographic characteristics. For our analysis, we use the SOEP waves from 2001 to 2006. In our sample we include mothers who have a child under the age of three at the time of the interview. With this restriction, we end up with 1,779 observations, i.e. person-years.

Table 2: Distribution of working hours categories of mothers by age of the youngest child

Labor market status	Number of observations	Age of the youngest child			
		Overall	$age < 1$	$1 \leq age < 2$	$2 \leq age < 3$
Inactivity	1129	64%	81%	62%	55%
Marginal employment	237	13%	10%	15%	14%
Part-time employment	278	16%	7%	15%	21%
Full-time employment	135	8%	2%	8%	11%
Total	1779				
Other descriptive statistics	Mean				
Mother German	0.89				
East Germany	0.22				
Age of the mother	32.6				
No. of children under 18	1.99				

Source: SOEP.v27, waves 2001 to 2006.

As Table 2 shows, about two-thirds of mothers with children under the age of three do not work. The employment status, however, strongly depends on the age of the youngest child. While 80% of all mothers are not working in the first year after their youngest child is born, this share is only 62% in the second and 55% in the third year after the birth of the child.

¹⁴A description of the SOEP is provided by [Wagner et al. \(2007\)](#).

Disposable net household income

Disposable net household income y_{ijt} is calculated using the STSM tax and benefit microsimulation model.¹⁵ Based on variables drawn from the SOEP, gross earnings, taxable income, amount of income taxes, all important transfers, and, finally, net household income can be derived. Gross household income consist of the observed earnings of the father, the alternative specific gross earnings of the mother and other non labor income, such as rental and capital income. The employment state specific gross labor earnings of the mothers are calculated on basis of the alternative specific working hours and a constant hourly gross wage.

To calculate the gross hourly wage we estimate a standard Mincer wage equation with selection effects using the information of the working population and interpret the predicted hourly wages of the non-working individuals as the mean of the distribution of offered wages. Note that in order to have sufficient observations we estimate the wage equation for all women but control in the selection equation for marital status and in detail for the number of children.¹⁶

The income tax is computed by applying the income tax function to the taxable income of the household. In Germany married spouses are taxed jointly. The income tax of a married couple is calculated by applying the tax function to half of the sum of the spouses' incomes; the tax is then doubled to determine the tax liability of the couple. Income tax and employee's social security contributions are deducted from gross income, and social transfers that depend on the employment status are added to derive net household income. Social transfers include, e.g., child benefits, child-rearing benefits, unemployment compensation, housing benefits and social assistance.

From this net household income we deduct childcare costs in order to calculate disposable net household income. As mentioned above, we follow [Wrohlich \(2011\)](#) and use the concept of "expected costs of child care" that account for the fact that subsidized child care is rationed, in particular for children under the age of three in West German communities. A more detailed description of the calculation of these childcare costs can be found in [Appendix A](#).

[Table 3](#) summarizes average disposable household income in the four working hours categories defined above. Consistent with the budget lines discussed in [section 2.3](#), work incentives are very low for mothers with young children. The difference between not working and marginal employment increases disposable household income only by roughly 35 euro (+1%) per month. This is mainly related to the relatively high childcare costs

¹⁵For a detailed description of this model, see [Steiner et al. \(2012\)](#).

¹⁶The specification and the estimation results are reported in [Appendix B](#).

Table 3: Distribution of disposable household income across working hours categories

Labor market status	Age of youngest child		
	Overall	$0 < age < 1$	$1 \leq age < 2$
Inactivity	3006.41	3111.23	3030.88
Marginal employment	3041.28	3164.22	3010.34
Part-time employment	3374.88	3451.97	3330.14
Full-time employment	3468.59	3478.69	3398.53

Source: SOEP.v27, waves 2001 to 2006.

for children in this age group. Since we assume that child care can only be bought part-time or full-time, even marginally employed mothers have to pay – by assumption – for part-time child care, which amounts on average to 228 Euro per month. If the mother is not working we do not deduct childcare costs from household income. Part-time employment (20 hours per week) leads to an increase of 368 euro (+11%) compared to non-participation, and full time employment (40 hours) increases disposable household income by 462 euro (+14%) per month. This relatively small difference in the income gain between part-time and full-time work is due to high costs for full-time child care, which amount on average to 384 Euro per month (see Appendix A).

4.2. Data for the evaluation of the natural experiment: The Microcensus

The German Microcensus is a 1-percent random sample of the population living in Germany and includes about 830,000 observations per year living in approximately 390,000 households.¹⁷ We use the 2007 and 2008 waves in order to select mothers who gave birth to children in the fourth quarter of 2006 (control group) and in the first quarter of 2007 (treatment group).

From this subsample, we further select mothers whose youngest child was 3-12 months old (to analyze the effect on labor supply in the first year after birth) or when their children are between 13-24 months old (to analyze the effect on labor supply in the second year after birth) at the time of the interview.¹⁸

¹⁷For more information on the microcensus, see <http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/EN/Content/Statistics/Mikrozensus/Aktuell.psml>.

¹⁸Unfortunately, the exact month of the interview is not available – due to data protection – in the Microcensus, but only the quarter of the interview. Thus, although we know the exact month of birth of a child, which is necessary to define mothers in the treatment and control group, we do not know the exact age of the child at the time of the interview. We assume that all interviews take place in the last month of each quarter, thus generally overestimating the exact age of the child by 1.5 months

Table 4: Descriptive statistics of mothers in treatment and control group (Microcensus)

Characteristics	Control group	Treatment group
Residence in East Germany	19%	21%
Income Below Median	45%	45%
Low Education	30%	28%
Married	78%	75%

Source: Microcensus, waves 2007 and 2008.

As Table 5 shows, we have 993 observations in the treatment group and 851 in the control group for the analysis of labor supply of mothers with 3-12 months old children. For mothers with children between 13 and 24 months we have about 50 % more observations, 1,231 in the treatment and 1,321 in the control group.

Table 5: Employment rates of mothers by age of the youngest child (Microcensus) – treatment and control group

Mothers with children...	aged 3-12 months		aged 13-24 months	
	control group	treatment group	control group	treatment group
Number of obs.	851	993	1,231	1,321
Employment rate	15%	10%	30%	32%
Part-time employment	11%	6%	22%	23%
Full-time employment	4%	4%	8%	9%

Source: Microcensus, waves 2007 and 2008.

5. Results

5.1. Results from the structural model

Table 6 reports the estimated coefficients of the structural model described above. The coefficients of the income terms are significant and have the expected sign. Because of the many interaction terms, the interpretation of the coefficients of the leisure terms is not straight-forward, instead we will discuss simulated labor supply elasticities below. As expected we find remarkable preference heterogeneity. In particular, mothers in East Germany have a significantly lower preference for leisure than do mothers in West Germany, which reflects the different historical and social backgrounds of the two regions. Labor market attachment of women in East Germany is generally higher than in West Germany. Moreover, we find a clear pattern related to the age of the youngest child. As detailed above we introduce the age of the youngest child in a flexible way using quarterly dummies. Overall, women with a child younger than two years have a higher preference

for leisure time than mother whose child is 33 to 36 months old. More specifically, during the first two years this age effect is monotonically decreasing. As expected mothers with children aged under 12 months have the highest preference for leisure, as shown by the coefficients of the dummy variables indicating the child's age. This age related heterogeneity underlines the necessity to model the labor supply of mothers in a flexible and dynamic specification.

Turning to the labor supply elasticities: As common in this literature, we conduct a simulation showing how labor supply behavior reacts to changes in income. This statistics allows a clear interpretation and comparison of estimation results. In particular we impose a 1% increase in mother's gross wages and based on the estimated coefficients we simulate the related labor supply responses. The overall labor supply elasticity amounts to 0.48 which is in line with previous findings for mothers with children in this age group (see e.g. [Bargain et al. \(2014\)](#)).

In a similar way, as described above, we use the results of the structural model to evaluate the labor supply effects of the introduction of the parental leave reform in 2007: We calculate the net income of all households under the counterfactual parental leave scenario and predict the induced labor supply behavior of mothers. This method allows to simulate the *ceteris paribus* effect of the parental leave reform or, in other words, the causal effect of this reform conditional on the structural assumptions. As discussed above, the introduction of the new parental leave benefit had heterogeneous impacts on the labor supply incentives of different households, e.g. depending on income, employment prior to the birth, or the number of children. Therefore, in [Table 7](#) we report the effects for the average of all women with children in the first and second year after birth as well as results for different subgroups.

According to our simulation, mothers reduce labor supply in the first year after giving birth as a reaction to the reform. On average, the labor force participation rate of mothers with children aged up to 12 months is reduced by 2.2 percentage points. There is no significant difference of this effect between East and West Germany. However, we find differences by household income: The negative labor supply effect is larger for mothers from families whose income is above the median (see [Table 7](#)). This is in line with the financial incentives that changed more for mothers with higher income (see also [Section 2.3](#)).

The picture changes, however, for the second year after giving birth. On average, the labor force participation of mothers with children aged 13-24 months increases by almost two percentage points. Again, we find the expected differences in the labor supply effects across income groups: Mothers from families with income below the median increase their

Table 6: Structural labor supply estimation: regression results (Clogit)

Variable	Coefficient	Standard error
Net income	1.755***	(0.292)
Net income squared	-0.0658***	(0.0194)
Net income * leisure	-0.000649	(0.00165)
Leisure	0.150	(0.0836)
Leisure squared	-0.000313	(0.000264)
Leisure * German	-0.0123	(0.00807)
Leisure * East German	-0.0368***	(0.00516)
Leisure * Mother's age	-0.000901	(0.00458)
Leisure * Mother's age squared	-0.000748	(0.00688)
Leisure * child aged 0-2 months	0.133**	(0.0481)
Leisure * child aged 3-5 months	0.0575***	(0.0157)
Leisure * child aged 6-8 months	0.0532***	(0.0136)
Leisure * child aged 9-11 months	0.0393***	(0.0113)
Leisure * child aged 12-14 months	0.0224*	(0.00958)
Leisure * child aged 15-17 months	0.000662	(0.00848)
Leisure * child aged 18-20 months	0.0110	(0.00927)
Leisure * child aged 21-23 months	-0.00402	(0.00854)
Leisure * child aged 24-26 months	0.00396	(0.00852)
Leisure * child aged 27-29 months	-0.00129	(0.00769)
Leisure * child aged 30-32 months	0.000272	(0.00784)
Leisure * child aged 33-36 months	<i>base category</i>	
Leisure * number of children under 14	0.0100***	(0.00273)
Leisure * 2001	-0.00201	(0.00810)
Leisure * 2002	-0.00815	(0.00830)
Leisure * 2003	-0.00535	(0.00891)
Leisure * 2004	-0.00311	(0.00955)
Leisure * 2005	-0.00406	(0.00955)
Leisure * 2006	<i>base category</i>	
Dummy marginal employment	-0.935***	(0.0863)
Log likelihood	-1704.8	
LR chi(27)	1522.8	
Number of households	1779	

Notes: Standard errors in parentheses. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Note that the number of households differs from Table 2 since we included also mothers with children up to three years in the sample.

Source: SOEP.v27, waves 2001 to 2006

Table 7: Simulated effects of the parental leave reform on mothers' labor supply

	Change in ...			
	total employment	marginal employment	part-time employment	full-time employment
Mothers with children aged 0-12 months				
Average	-2.20 (-2.67; -1.76)	-0.88 (-1.06; -0.68)	-0.73 (-0.91; -0.55)	-0.59 (-0.84; -0.44)
West	-2.15 (-2.63; -1.71)	-0.90 (-1.08; -0.70)	-0.71 (-0.88; -0.53)	-0.55 (-0.79; -0.40)
East	-2.36 (-2.88; -1.86)	-0.83 (-1.01; -0.59)	-0.80 (-1.00; -0.58)	-0.73 (-1.08; -0.54)
Below median	-1.93 (-2.34; -1.54)	-0.87 (-1.04; -0.66)	-0.61 (-0.76; -0.46)	-0.45 (-0.65; -0.33)
Above median	-2.57 (-3.18; -2.03)	-0.91 (-1.11; -0.68)	-0.89 (-1.12; -0.66)	-0.77 (-1.13; -0.58)
Mothers with children aged 13-24 months				
Average	1.77 (1.39; 2.13)	-0.15 (-0.21; -0.10)	1.07 (0.82; 1.28)	0.85 (0.66; 1.09)
West	1.46 (1.14; 1.78)	0.00 (-0.04; 0.03)	0.96 (0.74; 1.17)	0.50 (0.37; 0.65)
East	3.11 (2.43; 3.68)	-0.78 (-0.98; -0.59)	1.54 (1.12; 1.81)	2.35 (1.82; 3.03)
Below median	2.64 (2.07; 3.18)	-0.26 (-0.36; -0.19)	1.60 (1.21; 1.92)	1.31 (1.01; 1.68)
Above median	0.57 (0.45; 0.68)	0.01 (-0.00; 0.02)	0.34 (0.27; 0.41)	0.21 (0.16; 0.28)

Notes: 95% confidence intervals in parentheses. Confidence intervals were simulated by parametric bootstrap.

Source: SOEPv27, waves 2001-2006, own calculations

labor force participation rate by almost three percentage points. For mothers in families with income above the median on the other hand, we only observe a moderate increase of the employment rate by 0.6 percentage points. The large difference between labor supply effects in East and West Germany is consistent with the differences in household income. Since more families with income below the median live in East Germany, incentives to take up work in the second year after giving birth are larger in this region. Moreover, there is a larger supply of child care for children in this age group (below three) that is reflected in lower effective childcare costs making it easier for mothers to react to the incentives of the parental leave reform.

5.2. Results of the Evaluation of the Natural Experiment

In the following, we discuss the results of the estimation exploiting the natural experiment. The results show a significant and negative effect of the parental leave reform on maternal employment in the first year after giving birth. More specifically, we find that employment rates in the first year after birth declines by five percentage points. This effect is solely driven by the decline in part-time employment. For full-time employment the effect is close to zero and not significant.

In order to analyze the influence of socio-economic variables on this effect, we estimate the effect on overall, part-time and full-time employment not just for the whole sample but also for four different subgroups: Mothers in West Germany, mothers in East Germany, mothers with household income below the median of the income distribution, and mothers with income above the median of the income distribution.¹⁹ As Table 8 shows, the decline in overall employment is higher in East than in West Germany and higher for mothers with income above the median. For mothers with income below the median, we do not find significant changes. As far as part-time employment is concerned, we find a significant change only for the subgroup of mothers with income below the median. We do not find any significant changes in full-time employment, neither for the whole sample nor for any of the subgroups.

The lower panel of Table 8 presents the estimation results for mothers in the second year after giving birth. Generally, employment rates of mothers with children aged 13 to 24 months are higher than in the first year after giving birth. Before the reform, the

¹⁹Unfortunately, information on income is not as detailed in the Microcensus as in the SOEP. There are only two questions on income in the Microcensus questionnaire. The first one is the amount of the personal net income, the second one on the amount of the household net income. The personal income (and therefore also the household income) is endogenous since it depends on the mother's employment status. Thus, we take the difference between the household and the personal net income in order to net out the influence of the mother's employment.

Table 8: Estimation results from the natural experiment: Change in labor supply of mothers with children aged 3-12/13-24 months (marginal effects of the parental leave reform).

	Total employment	Part-time employment	Full-time employment	Obs.
Mothers with children age 3–12 months				
Average	-0.053 (-0.083; -0.023)	-0.050 (-0.075; -0.025)	-0.003 (-0.021; 0.015)	1844
West	-0.050 (-0.083; -0.016)	-0.045 (-0.073; -0.016)	-0.005 (-0.025; 0.015)	1486
East	-0.065 (-0.128; -0.002)	-0.072 (-0.125; -0.018)	0.006 (-0.036; 0.048)	358
Below median	-0.040 (-0.081; 0)	-0.040 (-0.072; -0.008)	0 (-0.028; 0.027)	865
Above median	-0.062 (-0.105; -0.020)	-0.057 (-0.095; -0.019)	-0.006 (-0.029; 0.018)	979
Mothers with children age 13–24 months				
Average	0.020 (-0.016; 0.056)	0.013 (-0.019; 0.046)	0.007 (-0.015; 0.028)	2552
West	0.010 (-0.030; 0.049)	0.002 (-0.035; 0.038)	0.008 (-0.013; 0.029)	2033
East	0.056 (-0.027; 0.138)	0.065 (-0.002; 0.131)	-0.008 (-0.074; 0.057)	519
Below median	0.060 (0.007; 0.113)	0.049 (0.004; 0.095)	0.011 (-0.025; 0.047)	1149
Above median	-0.013 (-0.061; 0.036)	-0.016 (-0.061; 0.029)	0.003 (-0.023; 0.029)	1403

Notes: 95% Confidence intervals in parentheses. The sample consists of mothers of children born in 2007.

Source: Mikrocensus 2007 and 2008, own calculations

employment rate of mothers with children aged 13-24 months is 30%; 22% are working part-time and 8% are working full-time. As the descriptive statistics in Table 5 show, after the reform, the employment rate increased by two percentage points to 32% (23% part-time and 9% full-time). However, as our estimation results show, this increase is not statistically significant. The only subgroup for whom we find a significant increase in employment is for mothers with below-median income. For this group, we find an increase by six percentage points. If we look only at part-time employment, we find a significant increase also for mothers in East Germany (plus seven percentage points).

5.3. Interpretation of Results from Both Methods

Comparing the results from the structural model with those from the natural experiment evaluation shows that both methods come to very similar results. In the first year after giving birth, labor supply declines for mothers of all socio-economic groups, and in the second year we find positive effects especially for low income mothers. The point estimates – if significant – are usually higher in the reduced form estimation, but are estimated with lower precision than those from the structural model. The confidence intervals from both methods, however, overlap in all cases.

In particular, we find on the basis of the evaluation of the natural experiment that the employment rate dropped by 5.3 percentage points in the first year after giving birth, which is not significantly different from the findings based on the structural model. This model suggests a reduction by 2.2 percentage points. The same is true for the results for the second year: Based on the evaluation of the natural experiment we find that employment increases by six percentage points for mothers with low incomes in the second year after giving birth. The structural model predicts an increase of 2.6 percentage points for the same group. This point estimate, however, lies within the confidence interval of the evaluation study estimate.

To sum up, we find that the results from both methods have the same sign and more importantly show the same pattern across different socio-economic groups, in particular when differentiating between low and high income households. Although the point estimates of the evaluation of the natural experiment are larger in magnitude, we find that the confidence intervals of the estimates resulting from both methods overlap in all cases. Following [Todd and Wolpin \(2006\)](#), we conclude that based on this criterion the structural model has a good performance at the out-of-sample prediction, i.e. predicting the behavioral change implied by a major policy reform.

Furthermore, the results of both methods are consistent with changes in incentives to work as described in Section 2.3. In the first year after giving birth, incentives to

work decrease due to the new benefit scheme, therefore we find a large negative effect on participation. Incentives to work decrease more strongly for women who had high prior-to-birth earnings, and this is why we find the strongest effect for mothers with high income and mothers living in West Germany. In the second year, however, incentives change only for those who were entitled to the old scheme, i.e. low income households. This is the reason why we do not find significant changes in average employment of mothers or for mothers in West Germany or mothers with income above the median. However, for the subgroup of mothers with income below the median we do find a significant increase in labor supply.

5.4. Evaluation of parental leave and childcare reforms

As argued above, paid parental leave schemes provide an incentive to withdraw from the labor market for a certain period of time. The incentives change strongly when the transfers expire even if, as it is the case for Germany, employment protection is still in effect. However, the presence of a young child in the household implies opportunity costs of working if child care is very expensive and subsidized child care is rationed. Therefore, in this last section, we use the validated structural model to simulate the joint effect of the parental leave benefit reform and the introduction of a legal claim to a subsidized childcare slot for all children aged one year or older (“universal child care”). This can be interpreted as an *ex ante* analysis of the August 2013 reform that guarantees a slot in a formal childcare facility for every child aged at least one. For the calculations we use again the pre-reform child-rearing benefit scheme of 2006 as the base line scenario and in the simulations we keep all rules of the tax and transfer (law as of 2006) except the parental leave benefits and childcare costs.

With the data currently available this reform can only be evaluated using a structural approach. The presented out-of sample validation however is central for providing credible interpretation of the results.

Before, we discuss in detail the employment effects of this reform we first describe the induced financial incentives. Note, since the specific childcare reform is only relevant for children older than twelve months, in the following we will only focus on mothers with children aged 13-24 months. As detailed above, in contrast to the parental leave benefit reform, the childcare reform increased financial attractiveness of employment for all mothers, since childcare slots are heavily subsidized and thus formal child care is much cheaper than privately organized child care. As shown in Appendix A, average monthly costs for full-time child care decreased from 384 to 130 Euro (-66%) for a family with one child aged one year. Table 9 shows average disposable incomes under the pre-reform

status quo (see as well Table 3), under the parental leave reform (isolated), under the childcare reform (isolated) and if both reforms were combined. The childcare reform (column three) leads to a stronger increase in disposable income in employment states with positive working hours as compared to not working than the parental leave reform. For example, mothers in the second year after giving birth can on average increase the household’s disposable income by 300 euro (+10%) if they work part-time (as compared to not working) under the pre-reform scenario. If the parental leave benefit reform is considered, the difference in disposable income between non-working and part-time work increases to 374 euro per month (+13%). If only the childcare reform is considered, this difference is as high as 464 Euro per month (+15%). The differences between full-time work and non-working are even more pronounced. Under the pre-reform scenario, a mother can increase her family’s disposable income only by 368 euro (+12%) by taking up full-time work (compared to not working). After the parental leave reform, this amount increases to 490 euro (+17%) because out-of-work income is reduced. Under the childcare reform (isolated), however, this amount increases to as much as 708 euro per month (+23%). The combination of both reforms results in an income difference between full-time employment and not working of 830 euro (+29%). We expect positive labor supply effects of the childcare reform that exceed the reactions to the parental leave benefit reform for mothers with children in the second year for all income groups.

Table 9: Disposable incomes by working hours category for families with children aged 13-24 months: parental leave and child care reforms

Employment category	Pre-reform	Parental leave reform only	Childcare reform only	Both reforms
not employed	3030.88	2908.81	3030.88	2908.81
marginal employment	3010.34	2905.02	3174.78	3069.46
part-time employment	3330.14	3283.01	3494.58	3447.45
full-time employment	3398.53	3398.52	3738.64	3738.64

Source: Calculations based on SOEP, waves 2001 to 2006.

Table 10 shows the simulation results for both reforms and their combination for mothers with a child aged between 13 and 24 months. As expected we find positive labor supply effects for the childcare reform. The effect of the childcare reform – an increase in the employment rate by more than five percentage points – is stronger than the isolated effects of the parental leave reform for all groups that we compare. As explained above, the positive labor supply effects of the parental leave reform in the second year result

mainly from mothers in low income households. They are no longer entitled to benefits in the second year after childbirth. However, childcare costs affect the budget constraint of these households even more strongly. The overall effect of the childcare reform turns out to be relatively homogeneously distributed across households. This is due to the fact that the financial benefits from the childcare reform are similar across the income distribution. The strongest effects are found for the simulation of both reforms at the same time. In this scenario employment rates of mothers increase by about seven percentage points in the second year after giving birth.

Table 10: Simulated effects of child care and parental leave reforms on mothers' labor force participation rates

	Mothers with children aged 13-24 months		
	parental leave benefit reform only	child care reform only	Both reforms
Average	1.77 (1.39; 2.13)	5.45 (4.39; 6.41)	7.38 (5.92; 8.70)
West	1.46 (1.14; 1.78)	5.38 (4.33; 6.35)	7.01 (5.64; 8.33)
East	3.11 (2.43; 3.68)	5.74 (4.58; 6.70)	8.94 (7.12; 10.45)
Below median	2.64 (2.07; 3.18)	5.50 (4.34; 6.52)	8.40 (6.61; 10.04)
Above median	0.57 (0.45; 0.68)	5.38 (4.36; 6.32)	5.97 (4.85; 7.01)

Notes: Standard deviation in parentheses. Confidence intervals were simulated by parametric bootstrap.

Source: SOEPv27, own calculations

6. Conclusion

Most industrialized countries need strategies to react to the ageing of their societies and the shrinking of the working age population. While male employment is already high both in terms of employment rates and working hours, female employment – despite a considerable catching- up process – is still lagging behind. This means however, that there is further growth potential that could mitigate the economic consequences of demographic ageing. One of the key factors behind the gender gap in employment rates are child-related employment interruptions. Thus, one goal of family policies is to improve the reconciliation of family life and employment of mothers. In this paper we look specifically at two different policy measures. First, we analyze the effect of Germany's 2007 parental leave reform. Second, we simulate how employment would react if additionally child care for very young children, between one and three years of age, would be available at low

costs to all mothers.

We base our policy evaluation on a structural model of labor supply, as is widely used in the literature. The advantage of structural models – as compared to reduced form models – is that they allow for more general conclusions and counterfactual policy analysis. However, the advantage relies crucially on the strong assumptions underlying these models. One way to empirically strengthen the credibility of such a model is to compare its predictions to the outcomes of models that rely on different or fewer assumptions. The German parental leave reform provides a very good opportunity to implement this validation strategy. We can show that the structural model predicts actual employment behavior reasonably well. We base the validation of our structural model on comparing the predictions of labor supply under the parental leave policy reform to results from the evaluation of the natural experiment. We find that estimates from both methods are not statistically significantly different from one another.

The parental leave reform did not change the total length of employment protected leave, which amounts to three years in Germany. However, it changed the benefit scheme from a means tested transfer to an income replacement that depends on previous earnings. Furthermore the maximum length of paid leave was shortened to 12 month (14 if both parents share the leave). The economic incentives to reenter the labor market after childbirth changed differently for different subgroups. In particular mothers with higher pre-natal earnings now have more incentives to withdraw from the labor market in the first year after giving birth than before the reform. However, in the second year, mothers in low income households have more incentives to work. We can show that the reaction in terms of labor supply fits this pattern using both empirical approaches.

Our results are comparable with those from other studies using the natural experiment evaluation approach for the identification of the labor supply effects of the parental leave benefit reform, [Bergemann and Riphahn \(2011\)](#) and [Kluve and Tamm \(2013\)](#).

Although the parental leave reform seems to strengthen the labor market attachment of mothers, the question remains if parents have access to affordable child care. Germany represents an interesting example in this respect because subsidized child care has been relatively scarce for the under three years olds but has started to increase the subsidized childcare slots over the last years. In the years before and after the parental leave benefit reform, Germany experienced a dramatic increase in the availability of publicly subsidized child care for children under three years. From 2013 onwards, all children have a legal entitlement for a subsidized childcare slot after their first birthday. This reform changes work incentives for mothers with young children even stronger than the parental leave benefit reform. We use the structural model to predict the isolated effect of the

parental leave benefit and the childcare reform, respectively, as well as the joint effect of both reforms. Our results show that the positive labor supply effects of the childcare reform are even larger than the effects of the parental leave benefit reform for mothers in the second year after giving birth. Both reforms together increase the labor supply of mothers with children aged 13 to 24 months by more than 7 percentage points.

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A. Calculation of childcare costs

Following [Wrohlich \(2011\)](#) and [Haan and Wrohlich \(2011\)](#), we argue that, given the considerable excess demand for subsidized childcare facilities²⁰ in Germany in the years 2001 to 2006, we have to calculate a measure of childcare costs that takes rationing explicitly into account. In Germany, parents' fees to subsidized childcare facilities are relatively low, however, access to these slots has been rationed in many regions in Germany, in particular for children less than three years old (see [Wrohlich \(2008\)](#)).

Families who do not have access to subsidized child care must rely on the private market of nannies and babysitters, which comes at considerably higher costs. Since we do not know in the data whether a family is restricted in the access to subsidized child care or not, we use a measure of "expected costs of child care", ec that consist of a weighted average of parents' fees to subsidized child care and costs of private child care, i.e.

$$ec_i = c_i^s \cdot p_i + c_i^{ns} \cdot (1 - p_i) \quad (4)$$

where ec_i are the expected childcare costs for child i , c_i^s are the fees for a childcare slot in a subsidized facility, p_i is the probability that a child has access to a slot in a subsidized childcare facility and c_i^{ns} are the costs for privately organized child care.

The fees for subsidized childcare slots mostly depend on household income, number of children and region of residence. We estimate parents' fees based on data from the SOEP from the years 2005 and 2007²¹ separately for part-time and full-time care using Tobit models. This method is chosen since about a third of all parents do not have to pay at all for center-based child care. [Table 11](#) shows the regression results.

p_i is the probability that a child has access to a slot in a subsidized childcare facility, whereas $(1 - p_i)$ is the probability that a child is rationed with respect to subsidized child care, i.e. the probability that parents demand a childcare slot but are not offered one. This probability is harder to estimate since it is not observed in the data. In the SOEP, we only observe whether a child is in a subsidized childcare facility or not. If the child does not attend childcare, we do not know whether there is no demand for childcare or whether there is demand but no supply. Thus, the probability has to be estimated based on a partial observability model that has been suggested by [Wrohlich \(2008\)](#). The likelihood function of the partial observability model is

²⁰Since there are hardly any non-subsidized childcare centers in Germany, we use the terms subsidized child care and center-based child care synonymously.

²¹Information on parents' fees is not available in every SOEP wave.

Table 11: Estimation of parents' fees for center-based childcare (Tobit)

Explanatory Variables	Part-time care		Full-time care	
	Coeff.	St. Err.	Coeff.	St. Err.
dummy variable child is aged 0-1	-186.62	19.71	-202.42	21.14
dummy variable child is aged 2	-96.76	7.09	-114.80	8.19
dummy variable child is aged 3	-42.06	6.17	-57.24	7.36
number of siblings in child care	-14.11	4.38	-17.11	5.48
total number of children in household	-19.70	2.72	-27.77	3.43
net household income	0.001	0.00001	0.001	0.0001
constant	52.05	7.61	69.02	9.37
s.e. (ancillary parameter)	87.04	1.81	96.73	2.26
Log-Likelihood	-8004.3368		-1062.62	
Number of observations	1888		1585	
Left-censored	598		551	

Notes: Dummies for state of residence are included in the estimation but not reported.

Source: SOEP.v27, waves 2005 and 2007.

$$L = \prod_{NC=1} [\Phi(X_D \beta_D)]^C [1 - \Phi(X_D \beta_D)]^{1-C} \cdot \prod_{NC=0} [\Phi(X_D \beta_D, X_S \beta_S)]^C \cdot [1 - \Phi(X_D \beta_D, X_S \beta_S)]^{1-C}$$

where $NC = 1$ are the children who are known to be not restricted in their access to subsidized child care and $NC = 0$ are the children who might be restricted. Children are known not to be restricted in their access to childcare if (i) they have attended a childcare center already the year before or (ii) they live in a county where in their age group the share of available slots per 100 children is more than 90. X_D denotes the variables in the demand equation, X_S the variables in the supply equation and β_D and β_S the respective coefficients. C is the outcome variable “child is in center-based child care,” which is the joint outcome of the two latent variables demand for and supply of center-based child care. Identification of β_D and β_S comes from exclusion restrictions (e.g. X_D includes individual characteristics such as education level of the mother that are not part of X_S , while X_S includes regional availability of childcare slots, which is not part of X_D), as well as from the fact that some children are known not to be restricted since they have attended a childcare center already the year before. Estimation results are reported in Table 12 below.

The costs of private child care c^{ns} , i.e. costs for a nanny or other forms of privately

organized day care is set at 5 Euro per hour. Table 13 below shows predicted parents' fees, predicted rationing probabilities and predicted expected costs of child care for several subgroups. These costs are deducted from net household income that enters the mothers' utility function as described in section 2.3.

Table 12: Estimation results of demand and supply of center-based childcare (partial observability model)

Explanatory variables	Demand equation		Supply equation	
	Coeff.	St. Err.	Coeff.	St. Err.
mother holds university degree	0.0567	0.0792	–	–
mother holds university degree*child aged 0-3	0.8123	0.2686	–	–
net household income (equivalized)	0.0002	0.00004	–	–
mother has German nationality	0.3022	0.0630	–	–
father is living in the same household	–0.0618	0.0773	–	–
child is aged 0-1	–1.060	0.2170	–	–
child is aged 2	–0.4860	0.1552	–	–
number of siblings aged 0-3	0.2380	0.0679	–	–
number of siblings aged 4-6	–1.0959	0.0848	–	–
number of siblings aged 7-10	–0.1311	0.0466	–	–
number of siblings in child care	0.4657	0.0767	0.1677	0.0668
local availability of child care slots	–	–	1.3200	.1074
dummy for the year 2002	–0.4743	0.0543	–0.3692	0.1184
child is aged 0-1 * year 2002	–1.2804	0.3097	–	–
child is aged 2 *year 2002	–0.3227	0.2497	–	–
constant	1.1528	0.1022	–0.5786	0.0881
Number of observations	8858			
Log pseudolikelihood	–3838.8062			
Wald chi2(24)	534.46			

Notes: Dummies for the state of residence and for the urbanicity of the county of residence are included in both equations but not reported.

Source: SOEP.v27, waves 2002 and 2006.

Table 13: Components of child care costs for children under three years

	parents' fees in euro/month	probability of being rationed (1-p)	expected costs of child care in euro/moth
Part-time care	107	0.38	228
Full-time care	130	0.38	384

Source: SOEP.v27, waves 2002, 2005 and 2007.

B. Wage estimation

In the following table we present the results of the wage estimation. These are based on Mincer-wage equations controlling for selection into employment (exclusion restrictions: number of children, marital status and other household income). Wage equations are estimated separately for East and West Germany.

Table 14: Wage regression

Variable	West Germany		East Germany	
	Coeff.	St. err.	Coeff.	St. err.
Wage regression				
Age	0.029***	(16.40)	0.041***	(11.99)
Age squared	-0.000***	(-16.62)	-0.001***	(-11.69)
<i>Education</i>				
No degree		<i>Reference cat.</i>		
General elementary	0.047*	(2.31)	0.140	(1.81)
Middle Vocational	0.055**	(2.69)	0.162*	(2.11)
Vocational + Abi	0.078***	(3.58)	0.243**	(3.05)
Higher vocational	0.073***	(3.34)	0.215**	(2.74)
Higher education	0.185***	(8.24)	0.323***	(4.12)
<i>Experience (years)</i>				
Full-time	0.007**	(3.00)	0.002	(0.82)
Full-time squared	0.001	(0.15)	0.004	(0.97)
Part-time	0.001	(0.31)	0.006*	(2.27)
Part-time squared	-0.006	(-0.41)	-0.011	(-1.31)
Tenure	0.015***	(4.97)	0.021***	(14.92)

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Table 14 – continued from previous page

Variable	West Germany		East Germany	
	Coeff.	St. err.	Coeff.	St. err.
Tenure squared	−0.032***	(−3.34)	−0.034***	(−8.88)
Past unemployment	−0.037***	(−4.89)	−0.072***	(−12.54)
Disability degree	0.001*	(2.05)	−0.001	(−0.82)
Disability degree squared	−0.002**	(−2.66)	0.000	(0.23)
German nationality	−0.206***	(−7.42)		
Firm size dummies		<i>yes</i>		
Occupation dummies		<i>yes</i>		
Industry dummies		<i>yes</i>		
Region dummies		<i>yes</i>		
Year dummies		<i>yes</i>		
Selection regression				
Age	0.056***	(10.75)	0.065***	(6.12)
Age squared	−0.002***	(−25.29)	−0.002***	(−16.12)
<i>Education</i>				
No degree		<i>Reference cat.</i>		
General elementary	0.114*	(2.42)	0.555***	(3.97)
Middle vocational	0.351***	(7.65)	0.908***	(6.70)
Vocational + Abi	0.615***	(12.16)	1.494***	(10.22)
Higher vocational	0.527***	(10.19)	1.489***	(10.48)
Higher education	0.884***	(18.23)	1.746***	(12.73)
<i>Experience</i>				
Full-time	0.078***	(32.27)	0.095***	(18.96)
Full-time squared	−0.003	(−0.41)	0.032*	(2.45)
Part-time	0.215***	(68.68)	0.180***	(27.01)
Part-time squared	−0.464***	(−38.10)	−0.232***	(−7.82)
Disability degree	0.002	(1.24)	0.001	(0.37)
Disability degree squared	−0.007**	(−2.90)	0.003	(0.71)
Health status				

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Table 14 – continued from previous page

Variable	West Germany		East Germany	
	Coeff.	St. err.	Coeff.	St. err.
Very good	<i>Reference cat.</i>			
Good	0.005	(0.22)	0.024	(0.54)
Satisfactory	-0.054*	(-2.18)	-0.133**	(-2.83)
Bad	-0.196***	(-6.59)	-0.384***	(-6.98)
Very bad	-0.726***	(-13.88)	-0.739***	(-7.98)
Married (1=yes)	-0.223***	(-13.03)	0.202***	(7.38)
<i>No. of children</i>				
No children	<i>Reference cat.</i>			
1	-1.728***	(-57.22)	-1.294***	(-25.54)
2	-1.126***	(-39.61)	-0.569***	(-10.42)
3	-0.674***	(-35.67)	-0.342***	(-9.86)
4+	-0.263***	(-10.44)	-0.203***	(-4.62)
Other household income	-0.000***	(-17.97)	-0.000***	(-12.81)
German nationality	0.217***	(10.06)		
Region dummies			<i>yes</i>	
Year dummies			<i>yes</i>	
λ	0.057***	(5.36)	0.065**	(2.89)
Observations	54921		17526	

t statistics in parentheses

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