RUHR

ECONOMIC PAPERS

Julia Bredtmann

The Intra-household Division of Labor – An Empirical Analysis of Spousal Influences on Individual Time Allocation

RUHR UNIVERSITÄT BOCHUM

RUB

RWI

#200

Imprint

Ruhr Economic Papers

Published by

Ruhr-Universität Bochum (RUB), Department of Economics
Universitätsstr. 150, 44801 Bochum, Germany

Technische Universität Dortmund, Department of Economic and Social Sciences
Vogelpothsweg 87, 44227 Dortmund, Germany

Universität Duisburg-Essen, Department of Economics
Universitätsstr. 12, 45117 Essen, Germany

Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI)
Hohenzollernstr. 1-3, 45128 Essen, Germany

Editors

Prof. Dr. Thomas K. Bauer
RUB, Department of Economics, Empirical Economics
Phone: +49 (0) 234/3 22 83 41, e-mail: thomas.bauer@rub.de

Prof. Dr. Wolfgang Leininger
Technische Universität Dortmund, Department of Economic and Social Sciences
Economics – Microeconomics
Phone: +49 (0) 231/7 55-3297, email: W.Leininger@wiso.uni-dortmund.de

Prof. Dr. Volker Clausen
University of Duisburg-Essen, Department of Economics
International Economics
Phone: +49 (0) 201/1 83-3655, e-mail: vclausen@vwl.uni-due.de

Prof. Dr. Christoph M. Schmidt
RWI, Phone: +49 (0) 201/81 49-227, e-mail: christoph.schmidt@rwi-essen.de

Editorial Office

Joachim Schmidt
RWI, Phone: +49 (0) 201/81 49-292, e-mail: joachim.schmidt@rwi-essen.de

Ruhr Economic Papers #200

Responsible Editor: Thomas K. Bauer

ISSN 1864-4872 (online) – ISBN 978-3-86788-227-9

Ruhr Economic Papers #200

Julia Bredtmann

The Intra-household Division of Labor – An Empirical Analysis of Spousal Influences on Individual Time Allocation

RUHR UNIVERSITÄT BOCHUM RUB

RWI

Bibliografische Information der Deutschen Nationalbibliothek

Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über: *http://dnb.d-nb.de* abrufbar.

ISSN 1864-4872 (online)
ISBN 978-3-86788-227-9

Julia Bredtmann[1]

The Intra-household Division of Labor – An Empirical Analysis of Spousal Influences on Individual Time Allocation

Abstract

Regarding total working hours, including both paid and unpaid labor, hardly any differences between German men and women exist. However, whereas men allocate most of their time to market work, women still do most of the non-market work. Using the German Time Use Surveys 1991/92 and 2001/02, this paper aims to analyze the interactions between the time use decisions of partners within one household. Thereby, an interdependent model of the partners' times allocated to paid and unpaid work that allows for simultaneity and endogeneity of the time allocation decisions of the spouses is applied. The results suggest that male time in market and non-market work is unaffected by their wife's time use, while women adjust their time allocation to the time schedule of their partner. These findings might partly explain why in Germany – and other European countries as well – gender differences in employment and wages still persist.

JEL Classification: J16, J22, C34

Keywords: Intra-household division of labor; time allocation; structural equation model

August 2010

1 Ruhr University Bochum and RWI. – The author is grateful to Thomas K. Bauer, Daniel S. Hamermesh, Sebastian Otten, and Harald Tauchmann, as well as to participants at IATUR conference 2009, the ESPE 2010 Annual Congress, and seminars at RWI for helpful comments and suggestions. – All correspondence to Julia Bredtmann, Ruhr University Bochum, Chair for Empirical Economics, 44780 Bochum, Germany, E-Mail: julia.bredtmann@rwi-essen.de.

1 Introduction

In terms of their total daily workload, including both market and non-market work, hardly any differences between German men and women exist. However, whereas men perform most of the paid work, women still do most of the unpaid work (Statistisches Bundesamt, 2003). According to Becker's theory of the allocation of time (Becker, 1965), such a specialization of the partners within one household is efficient, as private households represent economic institutions that maximize their utility by optimizing the members' time allocation to market and household production. Hence, the household's decision about its members' times in paid and unpaid work is defined taking the relative productivity of the household members into account, i.e. the partner that can offer a higher potential income specializes in market work, whereas the partner with a lower potential income specializes in non-market work.[1]

Although such a specialization might be efficient for the household as a whole, the partner who specializes in non-market work will be disadvantaged against the other in terms of future labor market opportunities. In most instances it will be the wife who specializes in housework and childcare, while the husband concentrates on market work. While withdrawing from the labor market and specializing in housework, the wife's marketable human capital stays constant or even decreases, so that her chances to get back to the labor market are reduced. Hence, this traditional division of labor between partners may serve as an explanation for remaining differences in labor market opportunities and wages between men and women. The consequences of such a specializations of the partners with women withdrawing from the labor market become even more serious if the household breaks apart at any time, necessitating that the wife makes a living from being gainfully employed. Thus, it might be one of the reasons why women are affected by old-age poverty more than men are. As divorce rates have increased considerably during the last decades and are still on a high level today, solving this problem might be of high relevance for Germany in the following years.

Using the German Time Use Surveys 1991/92 and 2001/02, this paper analyzes the determinants having an impact on the way partners within one household share their work between each other. Whereas the bulk of the existing research on the division of labor within couple households focuses on the effect of wages on time allocation, the aim of this analysis is to shed light on the interrelations between the time uses of the partners, i.e. it is analyzed how one spouse's time spend in paid and unpaid work respectively is affected by his partner's times spend in these activities. While – due to the time budget constraint – an individual's amount of time dedicated to paid and unpaid work is assumed to be negatively correlated with each other,

[1] Due to the assumption of the household maximizing one utility function, which implies that the members of the household are driven by pure altruism within their families, Becker's theory has been liable to considerable criticism (see among others Chiappori, 1988; McElroy and Horney, 1981).

the way the partners' times are interacted is ambiguous. On the one hand, in the presence of assortative mating in regard to preferences for market and non-market work respectively, the partners' times spend in market and non-market work constitute complements. Furthermore, if the partners derive utility from spending time together, they will adapt their time schedules to each other, also resulting in a positive correlation between the time allocations of the partners. On the other hand, the spouses' times in paid and unpaid work could constitute substitutes, which would be in line with Becker's theory of a specialization of partners within the household.

To address the problems of simultaneity and endogeneity of the partners' time use decisions, a structural interdependent model of the spouses' time allocation to market and non-market work is applied, whose parameters are estimated via instrumental variables. The validity of these instruments is then tested by applying over-identification tests to all of the time use equations. While the problem of left-truncation in time use data is mostly solved by estimating a Tobit model, I follow a different approach. Since the consistency of the Tobit model rests on the assumption that an individual's decision of whether to participate in an activity is determined by the same mechanism that determines the amount of time spent with this activity, conditional on participation, a dubble-hurdle model proposed by Cragg (1971) is applied here instead. This model allows both outcomes to be determined by different processes and therefore relaxes the strong assumptions of the Tobit model. The results suggest that the amount of time men allocate to market and non-market work is unaffected by their wife's time use. Women, in contrast, adjust their employment hours to the time schedule of their partner: The more time her husband spends with non-market work, the less time the wife spends with non-market work and the more time she spends with market work.

The outline of the paper is as follows. Section 2 provides a brief overview of the existing evidence on intra-household time allocation. In section 3, the method used in the empirical analysis is described. The underlying data are presented in section 4, along with a descriptive analysis of German couples' time allocation. Estimation results are discussed in section 5, and section 6 concludes.

2 Literature Review

In recent years, intra-household time allocation and in particular the division of labor between partners within a household has become subject of a growing strand of theoretical as well as empirical literature. The bulk of the empirical time use research focuses on wage effects, i.e. it is analyzed whether own and spouses' wages do have an impact on the partners' time allocation (cf. Hersch and Stratton, 1994; Kalenkoski *et al.*, 2006; Bloemen and Stancanelli, 2008). Thereby, the partners' wages serve as a proxy for the individuals' relative bargaining

power within the household, following modern economic theories that model intra-household time allocation as the outcome of a bargaining process between the partners.

However, relatively little is known about the interrelations between the time allocations of the partners or more precisely, the reactions of the individual's time use on changes in the time allocation of the partner. An exception is Connelly and Kimmel (2007), who analyze the effect of spouse's characteristics on active leisure time, childcare time, and home production time for a sample of married couples with young children drawn from the American Time Use Survey (ATUS). Using out-of-sample-predictions to address the problem of missing spousal information in the data and endogeneity of the parters' time uses, they find that on weekdays, mothers whose husbands have more leisure time also have more leisure time. At the weekend, however, a negative correlation between husband's and wife's leisure time exists. Furthermore, the authors find that on weekdays, fathers spend more minutes in caregiving when their wife works more hours in the market. Accordingly, fathers engaging in childcare can relieve their wifes by decreasing her minutes spend on caregiving. Husbands' time spend on housework, in contrast, increases their wives' time in the same activity, but this effect is only significant for weekend days. Using alternative ways to address the problem of missing spousal information (in-sample-prediction, matching approach), the authors find hardly any effects of spousal factors on the the partners' time use choices.

Bloemen and Stancanelli (2008) estimate the impact of wages on the time allocation to paid work, childcare, and housework of French parents, allowing the errors of these equations to be correlated with each other. Estimates of these correlations reveal a negative correlation in unobservables between husband's time in paid and unpaid work as well as between wife's time in these activities. This indicates the existence of unobservable characteristics that either select individuals into market or into non-market activities. In contrast, a positive correlation between fathers' and mothers' time dedicated to paid work as well as between their times dedicated to housework is found, which is explained by assortative mating in regard to high preferences for market or non-market work of both spouses. The unobservables in the wife's paid work equation are also positively correlated with the unobservables in the husband's childcare equation, suggesting that wives whose husband has an unobserved preference for caregiving are able to enlarge their times dedicated to market activities.

Deding and Lausten (2006) are the first to explain intra-household time allocation by including the partners' times in market and non-market work as explanatory variables in the individuals' time use equations. For a sample of Danish couples they investigate the interrelations between the partners' time allocated to paid and unpaid work. To address the problem of endogeneity of the partners' time uses, Amemiya's Generalized Least Squares is applied. The

authors find a positive correlation between the spouses' times in unpaid work, again supporting the assortative mating theory. Furthermore, male time in paid work (unpaid work) is found to increase female time in unpaid work (paid work), while men's time allocation is unaffected be the time use of their partner. However, to identify the time use equations, strong assumptions regarding the exclusion restrictions on each of the equations have to be made. Among other things, the authors assume that the presence and number of children do only affect the partners time allocation to non-market work, but not their time spend in market work. At least in case of female time allocation, this assumption is debatable.

3 Empirical Specification

The question of main interested is, how one partner's time in one activity is affected by changes in his own time in another activity (were these activities are paid and unpaid work respectively) and – even more interesting – his partner's times in these activities. Hence, the individual's level of time in a given activity is expected to be a function of his own as well as his partner's time use. Due to the time budget constraint of 24 hours per day, an individual's time spent with one activity is highly correlated with his time spent with another activity. Within the household correlations between the time-use equations may arise from unobserved household specific correlations in preferences (i.e. positive assortative mating in regard to a high preference for market or non-market work of both spouses) or productivity (i.e. individuals who are productive in the labor market might also be productive in the household, or the opposite might be the case). Moreover, some work to be done within the household (e.g. doing the laundry) can only be carried out once, either by the man or by the woman, leading to a correlation of the time uses of the partners. By estimating the time use equations simultaneously, we allow the times spent on different work activities to be interdependent, both for the individual and between the partners.

A special feature of time use data is that a large fraction of zero values for the time spend on some activities is observed.[2] Hence, the partner' times spend in the respective activities are truncated at a value of zero. Taking these features into account results in a system of four linear time-use equations characterized as:

$$
\begin{array}{lllllllll}
t^*_{imp} & = & + \alpha_{fp1} t^*_{ifp} & + \alpha_{mu1} t^*_{imu} & + \alpha_{fu1} t^*_{ifu} & + \beta'_{mp} x_i & + \gamma'_{mp} z_{imp} & + \epsilon_{imp} & \\
t^*_{ifp} & = \alpha_{mp2} t^*_{imp} & + & + \alpha_{mu2} t^*_{imu} & + \alpha_{fu2} t^*_{ifu} & + \beta'_{fp} x_i & + \gamma'_{fp} z_{ifp} & + \epsilon_{ifp} & \\
t^*_{imu} & = \alpha_{mp3} t^*_{imp} & + \alpha_{fp3} t^*_{ifp} & + & + \alpha_{fu3} t^*_{ifu} & + \beta'_{mu} x_i & + \gamma'_{mu} z_{imu} & + \epsilon_{imu} & \text{(1a)} \\
t^*_{ifu} & = \alpha_{mp4} t^*_{imp} & + \alpha_{fp4} t^*_{ifp} & + \alpha_{mu4} t^*_{imu} & + & + \beta'_{fu} x_i & + \gamma'_{fu} z_{ifu} & + \epsilon_{ifu} &
\end{array}
$$

[2] As can be seen in Table A1 in the Appendix, 11% of the men and 21% of the women do not spend any time with market work on the survey day, although excluding weekend days frome the sample. For unpaid work, the fraction of zeros is smaller, with 9% for men and 1% for women.

$$t_{ijk} = \begin{cases} t^*_{ijk} & \text{if } t^*_{ijk} > 0 \\ 0 & \text{otherwise} \end{cases} \qquad (i = 1, ..., N; j = m, f; k = p, u) \tag{1b}$$

where t^*_{ijk} is the latent number of minutes spent on activity k (that is paid or unpaid work) by household member j (that is male or female) in household i ($i = 1, ..., N$). The actual observed minutes t_{ijk} will equal t^*_{ijk} if t^*_{ijk} is non-negative and zero otherwise. x_i and z_{ijk} represent vectors of explanatory variables included in all equations and equation-specific variables respectively. ϵ_{ijk} is the error term.

The coefficients of basic interest are α_{jk1}, α_{jk2}, α_{jk3} and α_{jk4}. They represent how an individuals time spent in activity k is affected by changes in its own time in the opposite activity and its partner's times in the same and the opposite activity. However, the corresponding variables t^*_{imp}, t^*_{ifp}, t^*_{imu} and t^*_{ifu} on the right hand side of equations (1) are not exogenously determined, but themselves choice variables. In order to identify causal effects of changes in the partners' time use, we need to search for exogenous variations in the partner's times in paid and unpaid work. The problem of finding such instruments will be discussed in more detail later.

In order to estimate simultaneous-equation models with limited dependent variables and endogenous regressors, different methods have been proposed; see Amemiya (1978, 1979), Heckman (1978), Smith and Blundell (1986) and – for a discussion of the asymptotic relative efficiency of these estimators – Blundell and Smith (1989). Here, a two-stage procedure developed by Nelson and Olson (1978) is applied. The advantage of this method is that it is relatively simple to implement. Nevertheless, estimates obtained by this method are consistent and asymptotic normal. The procedure is as follows.

In the first step, the reduced form representation from equation (1) is formed, that is:

$$\begin{aligned}
t^*_{imp} &= \pi'_{mp}x_i + \delta'_{mp1}z_{imp} + \delta'_{fp1}z_{ifp} + \delta'_{mu1}z_{imu} + \delta'_{fu1}z_{ifu} + \nu_{imp} \\
t^*_{ifp} &= \pi'_{fp}x_i + \delta'_{mp2}z_{imp} + \delta'_{fp2}z_{ifp} + \delta'_{mu2}z_{imu} + \delta'_{fu2}z_{ifu} + \nu_{ifp} \\
t^*_{imu} &= \pi'_{mu}x_i + \delta'_{mp3}z_{imp} + \delta'_{fp3}z_{ifp} + \delta'_{mu3}z_{imu} + \delta'_{fu3}z_{ifu} + \nu_{imu} \\
t^*_{ifu} &= \pi'_{fu}x_i + \delta'_{mp4}z_{imp} + \delta'_{fp4}z_{ifp} + \delta'_{mu4}z_{imu} + \delta'_{fu4}z_{ifu} + \nu_{ifu}
\end{aligned} \tag{2a}$$

$$t_{ijk} = \begin{cases} t^*_{ijk} & \text{if } t^*_{ijk} > 0 \\ 0 & \text{otherwise} \end{cases} \qquad (i = 1, ..., N; j = m, f; k = p, u) \tag{2b}$$

Equations (2) are estimated by applying maximum likelihood estimates to each of the four equations separately. From the estimates for π'_{jk} and δ', fitted values $\hat{t}^*_{imp}$, $\hat{t}^*_{ifp}$, $\hat{t}^*_{imu}$ and $\hat{t}^*_{ifu}$

are calculated. Thereafter, the t^*_{ijk} on the right hand side of equations (1a) are replaced by the corresponding $\hat{t}^*_{ijk}$. Estimators of the structural parameters in equation (1) are then obtained by again applying maximum likelihood estimates to each of the four equations separately.

The predominant approach to address the problem of left-truncation is to estimate a Tobit model (e.g. Kalenkoski *et al.*, 2006; Bloemen and Stancanelli, 2008). The Tobit model is motivated by assuming that individuals have preferred latent (positive or negative) amounts of time that they would like to spend on some activities, which are observed if they are non-negative but censored at a value of zero otherwise. However, in the case of time-diary data this argumentation might not be appropriate. Observing zero minutes to be spend on an activity does not necessarily imply that the individual does not spent any time on this activity at all. Some activities might be done at some days but not on others. Hence, zeros arise because the reference period of the data is shorter than the period of interest. Using simulated data, Stewart (2009) shows that in such a case Tobit estimates are biased. One of the main reasons for this result might be that the Tobit model assumes that an individual's decision of whether to participate in an activity is determined by the same mechanism that determines the amount of time spend with this activity, conditional on participation. If this assumption is violated, estimates from the Tobit model will be biased and inconsistent.

As an alternative to the Tobit model, Cragg (1971) proposed a two-part model. This model, which is often referred to as a "double-hurdle model", integrates the probit model to determine the probability of $t_{ijk} > 0$ and the truncated normal model for given positive values of t_{ijk},

$$\begin{aligned} f(w_{ijk}, t_{ijk}|x_{1ijk}, x_{2ijk}) = \left\{1 - \Phi(\rho'_{jk}x_{1ijk})\right\}^{1(w_{ijk}=0)} \Big[\Phi(\rho'_{jk}x_1)(2\pi)^{-\frac{1}{2}}\sigma_{jk}^{-1} \\ exp\left\{-(t_{ijk} - \theta'_{jk}x_{2ijk})^2/2\sigma^2_{jk}\right\}/\Phi(\theta'_{jk}x_{2ijk}/\sigma_{jk})\Big]^{1(w_{ijk}=1)} \end{aligned} \tag{3}$$

where Φ is the standard normal cumulative distribution function and w_{ijk} is a binary indicator that equals 1 if $t_{ijk} > 0$ and 0 otherwise. x_{1ijk} and x_{2ijk} are vectors of explanatory variables determining the probability of spending time in an activity and the amount of time spend in this activity, given that $t_{ijk} > 0$, respectively. By allowing both outcomes to be determined by separate processes (the vectors ρ'_{jk} and θ'_{jk}, respectively), Cragg's model relaxes the strong assumptions of the Tobit model and is therefore applied to estimate the parameters of equations (1) and (2).

As mentioned above, identification of the four structural equations requires exclusion restrictions on each of the equations. That is, to estimate the coefficients of the equations for the partners' times in paid work consistently, one has to find variables that affect the individual's time in paid work, but do not affect his time in unpaid work through any other channel than

through his time in paid work. Similarly, to estimate the equations for the partners' times in unpaid work consistently, one has to find variables that affect the individual's time in unpaid work directly, but his time in paid work only indirectly via the time spent on paid work. At this point it is worth noting that a structural form is only estimated for the second part of the dubble-hurdle model, since interest is directed towards the interrelations between the partners' time allocations for those who actually allocate time to these activities. For the selection equations, the unrestricted reduced form (2) is estimated instead.

The assumptions made regarding the exclusion restrictions on the structural equations are as follows: In order to identify the paid work equations, I assumed that the housing characteristics, i.e. the ownership of the house/flat the couple is living in, the existence of a dishwasher/dryer, the use of external help (domestic help, nanny, handcrafter etc.), whether additional persons are living within the household, and the distance to the nearest grocery store affect the partners' times in unpaid work, but do not have a direct impact on their times in paid work. Additionally, male time in paid work is assumed to be unaffected by the number and age of the children, while this doesn't hold true for female employment hours.[3] Likewise, in order to identify the unpaid work equations, I assumed that some job characteristics such as the individual's occupation, the commuting time to and from the workplace as well as the day of the week (Friday or not), do not have a direct impact on the partners' times in unpaid work. Moreover, the spouses' time dedicated to non-market work was assumed to be uncorrelated with their working time regulations, i.e. indicators on whether they are doing shift work or have fixed work schedules.

Identification of the structural equations requires at least as much instruments as endogenous regressors included in each of the four equations. Since the vectors z_{imp}, z_{ifp}, z_{imu} and z_{ifu} each consist of more than three elements, all of our four equations are over-identified. This allows for applying a test for over-identifying restrictions and thus validating the assumptions made regarding the exclusion restrictions. As Hoxby and Paserman (1998) show, standard over-identification tests statistics are biased in the presence of clustered data. To address this problem, a heteroscedasticity-robust variant of the Hausman test (cf. Wooldridge, 2002) is applied.

[3]When comparing the time allocation of employed couples with and without children, it becomes obvious that compared to childless women, mothers work significantly less hours in the market, while male working hours are not affected by parenthood.

4 Data and Descriptive Statistics

4.1 The German Time Use Surveys 1991/92 and 2001/02

The following analysis is based on the German Time Use Surveys (GTUS) that were conducted by the Federal Statistical Office in 1991/92 and 2001/02. Both surveys were carried out in the context of representative quota samples of all private households in Germany. The GTUS 1991/92 was conducted in 7,200 households that were interviewed between autumn 1991 and summer 1992. Information was collected on the time use of all household members aged 12 years and older, who were asked to describe the routine of the day in 5-minute intervals on two subsequent days. A total of 32,000 diary days were collected. The GTUS 2001/02 covers about 5,400 households who were interviewed between April 2001 and March 2002. All household members aged 10 years and older had to fill in three time diaries – two on working days and one on Saturday or Sunday – in order to describe the routine of the day in 10-minute intervals. Altogether, information about 37,700 diary days exists. Despite these methodological differences between the surveys both data sets are comparable to each other.[4] One distinctive feature that has to be noted here concerns the definition of childcare time. Whereas in the 1991/92-sample time spent with children under the age of 16 is defined as childcare time, in the 2001/02-sample time with children under the age of 18 is included. However, as it could be assumed that the time-intensity of children in that age is very small, this difference should not have an impact on the estimation results.

The advantage of the German time use data, as compared to other time use surveys (e.g. the ATUS), is that both partners' time uses and individual characteristics can be observed. Moreover, the information is very detailed. About 200 different activities can be distinguished and in addition to main activities, secondary activities as well as persons who are present and means of transport have been surveyed. However, in the following analysis main activities have been included only.

The following analysis aims to shed light on the connection between the partners' times allocated to paid and unpaid work. These time uses are defined as follows: Paid work includes time dedicated to main and secondary employment, work breaks as well as commuting time to and from the workplace. Furthermore, times for on-the-job training and job seeking are included. In the literature, unpaid work is usually defined according to the third-person-criterion (Reid, 1934), i.e. it includes all unpaid tasks that could in principle be delegated to a third person. We follow this categorization. Unpaid work consists of housework (preparing meals, cleaning/keeping up house and yard, doing the laundry, gardening, caring for pets, doing maintenance and repair, shopping, making use of external services, managing the household, travel

[4] A comparison of the GTUS 1991/91 and the GTUS 2001/02 can be found in Table A2 in the Appendix.

time in connection with these activities) and childcare (feeding the child, bathing the child, educating the child, playing/doing sports with the child, talking to the child, reading to the child, travel time in connection with child-related activities).[5] Analyzing the connection between paid and unpaid work of partners consequently means not including time spent sleeping and leisure time in the analysis.

The sample considered in the following analysis consists of married and cohabiting couples living within one household that were selected according to the following criteria:

- both spouses are aged between 18 and 64 years, i.e. they are of working age
- both spouses are employed (full-/part-time)
- both spouses had filled in the time diary on the same day
- both spouses had filled in the time diary on a normal day[6]
- the household does not contain adult persons in need of care

As interest is directed towards the connection between the partners' times in paid and unpaid work, weekdays (Monday till Friday) are included only.[7] Further excluding individuals with missing information on at least one of the variables used in the empirical analysis leads to a sample of 2,952 couples and 5,301 diary days.

4.2 Variables

In the empirical analysis several household and individual characteristics are controlled for. Since there are no theoretical arguments to suggest that some factors do either solely affect the probability to engage in paid or unpaid work or solely affect the amount of time allocated to these activities, the variables included in the first and the second part of the dubble-hurdle model are the same. On the household level, dummy variables for the region the couple is living in (East vs. West Germany), the sample period (1991/92 vs. 2001/02) and an interaction of

[5] Some authors argue that the utility associated with childcare is different from the utility generated by ordinary housework and thus the two have to be analyzed separately (see e.g. Deding and Lausten, 2006; Kimmel and Connelly, 2007). I would have followed this approach, but for lack of instruments solely affecting housework and childcare respectively, in this analysis both tasks had to be combined.

[6] As individuals themselves had to decide whether the day is a normal or a non-normal day, an exclusion of non-normal days is debatable. Therefore, the same analysis has been carried out including all diary days. However, the results didn't change significantly, thus they are not presented here.

[7] It is worth noting that this might result in underestimating male non-market work, since men tend to do relatively more household and childcare tasks on weekends. However, since time pressure is much higher during the week compared to the weekend, because many of the non-market tasks cannot be postponed until the weekend (e.g. taking the children to school, preparing meals etc.), but have to be done at fixed times of the week, main interest is directed towards the interrelations of the partners' time uses during the week.

both are included. Additionally, the household income, the couples' marital status (cohabiting or married), the number of children, and the age of the youngest child are controlled for. On the individual level, the age of the partners, their schooling and vocational education (4 and 6 dummies, respectively), and their net hourly wages are controlled for.

Concerning the income information, some remarks are necessary. First, information on monthly net earnings was collected both as a continuous variable and in intervals, for respondents who did not provide continuous earnings information. For them, earnings are set equal to the mid-point of each interval, and to the lower bound of the top interval. Second, earnings information was collected in *Deutsche Mark (DM)* in 1991/92 (1 euro equals 1,95583 DM) and in euros in 2001/02. Even if converting the 1991/92-earnings into euros, both measures are not comparable to each other, due to inflation and a considerable growth in wages over this period. In addition, this wage growth was much more pronounced in East compared to West Germany (Gernandt and Pfeiffer, 2008)). I address this problem by interacting the earnings variable with the dummy for the sample period.[8] Third, the direction of causality between an individual's earnings and its time allocation (especially its allocation of time to market work) is not clear cut. On the one hand, the partners' relative earnings could serve as a proxy for their bargaining power within the household and therefore affect the division of paid and unpaid work between the spouses. On the other hand, an individual's working time has a direct impact on its earnings, so that a reverse causation between earnings and working time exists. A common way to address this problem is replacing actual wages by predicted wages and using the latter as control variables in the regression. As information on standard wage predictors is scarce in the data (primarily, information on the working experience of the individuals is missing), predicting the partner's wages was not possible. However, as hourly wages, i.e. monthly net earnings divided by usual working hours, instead of monthly wages are included, the problem of reverse causality should be of minor relevance here.

In addition, instruments for the partners' times spent in paid and unpaid work are included in the regressions. As instruments for the unpaid work equations, dummy variables indicating the ownership of the house/flat the couple is living in, the existence of a dishwasher/dryer, the use of external help (domestic help, nanny, handcrafter etc.), whether additional persons are living within the household as well as a variable containing the distance to the nearest grocery store are included. As mentioned in Section 3, the number and the age of the children serve as additional instruments for male time dedicated to unpaid work, while they could not be approved to be valid instruments for female time in unpaid work. To identify the paid work equations, dummies for the spouses' occupation, their working time regulations (indicating whether they have fixed work schedules or shift work), the day of the week (Friday or not) and

[8] As both aspects also apply to the information on household income, the same was done for this variable.

a variable containing the individuals' commuting time to and from the workplace are included as instruments. Descriptive statistics of these variables are given in Table A3 in the Appendix.

4.3 Couples's Time Allocation

Figure 1 shows the daily minutes men and women allocate to paid and unpaid work as well as the total daily workload of the partners. In all cases, individuals spending non-zero minutes in the respective activity are included only. In 1991/92, West German men spend about 9 hours and West German women about 6 hours in paid work on an average working day. Ten years later, the difference between the sexes becomes smaller, since women increased their working hours (by about half an hour), while men's working hours stayed almost constant. In East Germany, both men and especially women do work longer hours in the market and the division of market work between the sexes is much more equal compared to West Germans. From the 1990s to 2001, both men and women slightly decreased their working hours (by about 20 minutes for men and 15 minutes for women), but the ratio between the sexes stays almost constant. The finding of East German women working considerably more hours in the market compared to West German women is not surprisingly and can be explained by the East Germans' institutional background prior to German reunification. In the former German Democratic Republic, almost all women had been full time employed, thus still today female (full-time) employment is much more usual in East Germany compared to West Germany.

< Figure 1 about here >

Regarding the partners' times in unpaid work in West Germany in the 1990s, one can see that with an average workload of 5.5 hours per day, women do the bulk of the couples' household work, while men spend less than 2 and a half hours. In 2001/02, the difference between the sexes becomes smaller, but this is mainly due to women having reduced their time in non-market work, while men's time in non-market work increased only slightly. Compared to West Germany, the division of unpaid labor between the sexes is more equal in East Germany, with men spending about 2.5 and women about 4.5 hours in non-market work. From 1991 to 2001, both men and women in East Germany reduced their time in unpaid work. But similar to the allocation of time to paid work, the female share of time in unpaid work stayed almost constant. In sum, both East and West German couples decreased their time in unpaid work over one decade, a fact that may partly be explained by technological progress, i.e. the increasing utilization of home appliances like dishwashers, microwaves etc. or the rise in demands on external home help.

The total working time of the couple is higher in the Eastern part of Germany, where men and women spend about 21 hours with paid or unpaid work per weekday, compared to 19.5

hours for West German couples. However, although East and West German couples differ in their intra-household allocation of time to market and non-market work, the total workload of the household is shared equally between the partners in both parts of the country. This goes against the widely held belief that – with an increase in female participation in the labor market – women have to bear a double burden of both being employed and being responsible for the household (and – if present – for the children).[9]

Despite these differences in the time allocation of the four subsamples, the following empirical analysis is conducted for the sample as a whole. For a separate analysis, the number of observations, especially in the East German sample, would have been too small. To allow for differences in the time allocation of East and West German couples and changes over time, dummy variables for the region, the sample period as well as an interaction between the two have been included in the regression.

5 Empirical Results

5.1 Reduced form estimates

Table 1 shows the estimation results of the reduced form equations (2) for the partners' times spend with paid work. Marginal effects of the probit regression in the first part of the dubble-hurdle model are included in columns 1 and 3 along with their standard errors. For men, hardly any variables show a significant impact on the probability of spending any time with employment on the survey day. In contrast, womens' employment probability is highly affected by the number and age of her children. Moreover, the probability of spending time with market work decreases by womens' age, probably reflecting that younger women are more likely to work full-time compared to older ones. Lastly, womens' employment probability is affected by their vocational education and increasing with their wage rate. The results indicate that the reason for not spending any time with employment on the survey day differs by gender. Observing a woman to spend zero minutes with market work might most likely be due to the woman working part-time and being observed on a non-working day. For men, a clear-cut reason for not working on the survey day cannot be found, since almost all men are full-time employed (only 3% of the men declared to work part-time, compared to 46% of the women). These results support the importance of applying an econometric specification that allows the decision of spending time with employment and the minutes of time spend with employment conditional on participation to be determined by different factors.

[9]However, it should be kept in mind that main activities are considered only. If women (or men) are more likely to do working tasks simultaneously, their total workload will be underestimated.

< Table 1 about here >

The results of the second part of the dubble-hurdle model for male and female minutes spend with market work are shown in columns 2 and 4 of Table 1. As expected, the couples' household income is positively correlated with both partners' working hours. Moreover, cohabiting women spend significantly more minutes in market work compared to those being married. On the individual level, both partners' employment hours are found to decrease by age. Moreover, men's employment hours vary by their vocational education. While female working hours are significantly decreasing with the number and presence of small children, mens' working hours are not affected by children. Regarding the effects of the instruments used in the paid work equations, doing shift-work is found to increase female employment hours. Furthermore, female blue-collar workers and women being self-employed work less minutes in the markets compared to white collar workers. In contrast to women, men being self-employed work longer hours in the market, while the opposite is true for civil servants. Compared to other days of the week, both men and women spend less minutes with employment on Fridays and their working time increases by the distance to the workplace. Joint significance of the instruments can be confirmed by the corresponding F-tests (values 39.55 and 18.73 for male and female working time respectively).

The results of the reduced form equations for male and female time spend with unpaid work are shown in Table 2. Since the proportion of women not spending any time with non-market work on the survey day is very low (less than 1%), the first-step probit model could only be estimated for men. For them, the probability of spending time with unpaid work is increasing with the presence of small children in the household. Moreover, self-employed are less likely to engage in non-market work compared to white collar workers.

< Table 2 about here >

Regarding the results of the second-part of the dubble-hurdle model (columns 2 and 4), the truncated regressions for the partners' minutes spend in unpaid work, cohabiting women are found to spend significantly less minutes in non-market work compared to those married. Together with the positive effect of cohabitation on female employment hours, this finding is contrary to Becker's theory of marriage (Becker, 1973, 1974). According to him, marriage leads to a specialization of two spouses within a household, in a way that the partner with the higher earnings potential (which will in most instances be the man) specializes in market work, while the one with the lower earnings potential specializes in housework. However, since the proportion of couples being married is increasing by the age of the partners, this might partly reflect a generational effect, with older couples having a more traditional division of labor compared to

younger ones. This finding is supported by the fact that female non-market hours are increasing by age. Moreover, both spouses' time spend with unpaid work is highly affected by the number and age of their children. From the other instruments, living in an owner-occupied dwelling is found to have a significant positive impact on both partners' time spend with unpaid work. Male time in non-market work is further increasing with the distance to the nearest grocery store. While having a dishwasher is reducing male time in non-market work, it is increasing female time in non-market work (both effects are significant at a 10-percent level only). Whereas toweling the dishes seems to be a typical male task, (un-)loading the dishwasher seems to be a female task. Moreover, women's time in unpaid work is significantly higher in households containing additional persons, which might be older people, e.g. the partners' parents, that are cared for. Regarding the results of the F-tests for joint significance of the instruments, instrument weakness can be ruled out for the female equation, while the value of 8.9 for the male equation is slightly below the critical threshold of $F = 10$ for power in IV models.

By and large, the estimation results of the determinants of the partners' times allocated to market and non-market work confirm those expected by theoretical consideration and found in previous studies.

5.2 Structural form estimates

Full structural form estimates for the partners' times allocated to paid and unpaid work can be found in Table A4. Since the reduced instead of the structural form is estimated for the selection equations, second-part results are reported only. The effects of main interest – the interdependencies between the time uses of the partners – are shown in Table 3.

< Table 3 about here >

Regarding male time in paid work, it becomes obvious that none of the coefficients of the endogenous regressors is significant. Male time spent in market work is fixed, i.e. men's employment hours are neither affected by their own time spent with non-market work, nor by their wife's time allocation (to market and non-market work). In contrast, female time in paid work is highly affected by her partner's time allocation: The more time the men dedicates to market work, the more time the women dedicates to market work as well. This could be an indicator for assortative mating being relevant in this context, in a way that individuals with a high preference for market work select themselves together. Moreover, it is consistent with the finding of Hamermesh (2002), who provides evidence that couples attempt to synchronize their work schedules in order to increase their joint leisure time. Female time in paid work is further increasing by male time allocated to unpaid work. Thus, men who engage in household and childcare tasks can take some time pressure off from their wife, who on her part is able to

increase her employment hours. Since for employees time pressure is considerably higher during weekdays compared to the weekend, this effect might partly be driven by restricting the analysis to weekdays. Lastly, the wife's own time allocated to non-market work is significantly reducing her time allocated to market work, which is merely a consequence of the time budget constraint.

The results for the partners' times spend with unpaid work show that mens' time allocation is unaffected by the time allocation of their partner. In contrast, female time dedicated to non-market work is found to be negatively affected by her partners' time in paid and unpaid work. Hence, womens' non-market workload is highly depending on the support by their partner. As expected, for both partners their own time in market work has a significant negative impact on their time in non-market work.

As mentioned above, the unbiasedness of the estimation results critically relies on the validity of the exclusion restrictions. The p-values of the respective χ^2-tests on over-identifying restrictions range from 0.36 for female time in paid work to 0.92 for male time in paid work. Hence, for all equations the null-hypothesis of valid exclusion restrictions can't be rejected and we can be confident about the validity of the instruments. For comparison, Table A5 shows the estimation results for the the interdependencies between the time uses of the partners applying a Tobit model instead of the double-hurdle model. The results are similar to those of the dubble-hurdle model, except for male time dedicated to market work, which is now significantly affected by female time allocated to market and non-market work. However, as the consistency of the Tobit estimates critically rests on the assumption that an individual's decision of whether to participate in an activity is determined by the same mechanism that determines the amount of time spent with this activity, these results are at risk of being biased.

In sum the results help us getting an idea of the couples' decision making process regarding the division of labor between the partners. It seems that in the first instance, the male partner determines his time allocated to market work. Consequently, the more time he spends with market work, the less time he spends with non-market work. Male non-market time, on the other hand, determines the amount of time the wife spends with unpaid work. Finally, on the basis of the amount of time left, the decision about her working hours is made. The interdependency between women's non-market and market hours might be particularly strong for couples with (small) children, as in most cases childcare tasks (such as feeding/dressing the children, taking them to the kindergarten and to the school respectively etc.) have to be done at fixed times of the day. Dividing non-market work into housework and childcare and analyzing both tasks separately may provide some further insights into the couples' time allocation decisions. However, due to the lack of instruments solely affecting housework and childcare respectively, analyzing both tasks separately wasn't possible here.

6 Conclusion

The aim of this paper was to shed light on the intra-household division of labor of German couples, more precisely, the interactions between the time allocations of the partners within one household. It contributes to the existing literature by employing a structural interdependent model of the spouses' time allocation to market and non-market work, that allows for simultaneity and endogeneity of the time uses of the partners. For estimation, a dubble-hurdle model proposed by Cragg (1971) is applied, that allows the probability of spending time in an activity and the amount of time spend in this activity, conditional on participation to be determined by separate processes and therefore relaxes the strong assumptions of the Tobit model.

The major finding is that men's time allocation to paid and unpaid work is unaffected by their wives' time allocation, while women adjust their working hours to the time allocation of their partner. This finding suggests that within the household, men can avail themselves of a "first mover advantage", i.e. they decide about their amount of time dedicated to market and non-market work first. On the basis of male time allocation, which constitutes a fixed parameter in the female time allocation decision, women in turn choose their optimal amount of time dedicated to market and non-market work. Thereby, the more their husband supports them in the field of non-market work, the more time and effort they are able to invest in market work.

Although the widely spread belief of women's total workload exceeding that of men's if both partners are employed doesn't prove true for the case of Germany, German women still bear a double burden of being responsible for household and children and being active in the labor market. The amount of time being left for the latter thereby substantially depends on the domestic support of her partner. This finding might provide a further explanation for still persisting gender differences in respect of wages and promotion prospects in Germany. On the one hand, employers may assume women to be less productive in the labor market and therefore be more likely to hire or promote men instead. On the other hand, women themselves may seek lower payed or less promising jobs that are characterized by a higher flexibility in scheduling and therefore compatible with their responsibility for household and children.

It is obvious that the division of labor of German spouses would become more equal if men increased their engagement in non-market work, which would raise their wife's amount of time disposable for market work. However, as policy makers cannot affect intra-household time allocation directly, they should at least aim for providing a working environment that offers a maximum of flexibility. This includes regulations regarding working time flexibilities, parental leave regulations as well as the provision of childcare services, which would lower the opportunity costs of market work for women. However, evidence also suggests that within the last decade, the division of labor between men and women has become much more equal in

(West) Germany. If this trend persists, gender differences in labor market prospects and wages may be diminishing.

References

Amemiya, T. (1978). The Estimation of a Simultaneous Equation Generalized Probit Model. *Econometrica*, **46** (5), 1193–1205.

— (1979). The Estimation of a Simultaneous-Equation Tobit Model. *International Economic Review*, **20** (1), 169–181.

Becker, G. S. (1965). A Theory of the Allocation of Time. *The Economic Journal*, **75** (299), 493–517.

— (1973). A Theory of Marriage: Part I. *The Journal of Political Economy*, **81** (4), 813–846.

— (1974). A Theory of Marriage: Part II. *The Journal of Political Economy*, **82** (2), S11–S26.

Bloemen, H. G. and Stancanelli, E. G. F. (2008). How Do Parents Allocate Time? The Effects of Wages and Income. IZA Discussion Paper No. 3679.

Blundell, R. W. and Smith, R. J. (1989). Estimation in a Class of Simultaneous Equation Limited Dependent Variable Models. *The Review of Economic Studies*, **56** (1), 37–57.

Chiappori, P.-A. (1988). Rational Household Labor Supply. *Econometrica*, **56** (1), 63–90.

Connelly, R. and Kimmel, J. (2007). Spousal Influences on Parents' Non-Market Time Choices. IZA Discussion Paper No. 2894.

Cragg, J. G. (1971). Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods. *Econometrica*, **39** (5), 829–844.

Deding, M. and Lausten, M. (2006). Choosing between his time and her time? Paid and unpaid work of Danish couples. *electronic International Journal of Time Use Research*, **3** (1), 28–48.

Gernandt, J. and Pfeiffer, F. (2008). Wage Convergence and Inequality after Unification: (East) Germany in Transition. SOEPpapers on Multidisciplinary Panel Data Research 107.

Hamermesh, D. S. (2002). Timing, togetherness and time windfalls. *Journal of Population Economics*, **15**, 601–623.

Heckman, J. J. (1978). Dummy Endogenous Variables in a Simultaneous Equation System. *Econometrica*, **46** (4), 931–959.

Hersch, J. and Stratton, L. S. (1994). Housework, Wages, and the Division of Housework Time for Employed Spouses. *The American Economic Review*, **84** (2), 120–125.

Hoxby, C. and Paserman, M. D. (1998). Overidentification tests with grouped data. National Bureau of Economic Research, Technical Working Paper 223.

Kalenkoski, C. M., Ribar, D. C. and Stratton, L. S. (2006). The Influence of Wages on Parents' Allocations of Time to Child Care and Market Work in the United Kingdom., IZA Discussion Paper No. 2436.

Kimmel, J. and Connelly, R. (2007). Mother's Time Choices. Caregiving, Leisure, Home Production, and Paid Work. *The Journal of Human Resources*, **42** (3), 643–681.

McElroy, M. B. and Horney, M. J. (1981). Nash-Bargained Household Decisions: Toward a Generalization of the Theory of Demand. *International Economic Review*, **22** (2), 333–349.

Nelson, F. and Olson, L. (1978). Specification and Estimation of a Simultaneous-equation Model with Limited Dependent Variables. *International Economic Review*, **19** (3), 695–709.

Reid, M. G. (1934). *Economics of household production*. New York, London: J. Wiley & Sons Inc. and Chapman & Hall Limited.

Smith, R. J. and Blundell, R. W. (1986). An Exogeneity Test for a Simultaneous Equation Tobit Model with an Application to Labor Supply. *Econometrica*, **54** (3), 679–685.

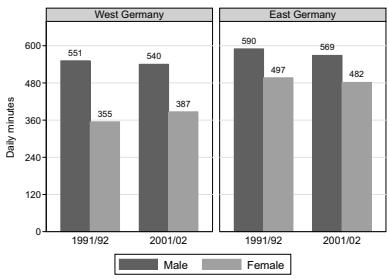
Statistisches Bundesamt (2003). Wo bleibt die Zeit? Die Zeitverwendung der Bevölkerung in Deutschland 2001/02. Statistisches Bundesamt. Wiesbaden, Germany.

Stewart, J. (2009). Tobit or Not Tobit? IZA Discussion Paper No. 4588.

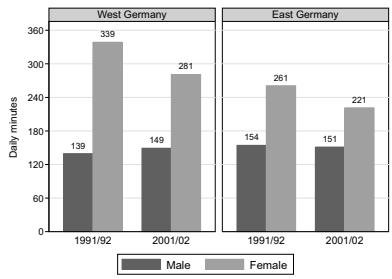
Wooldridge, J. M. (2002). *Econometric analysis of cross section and panel data*. Cambridge, MA: MIT Press.

Figures

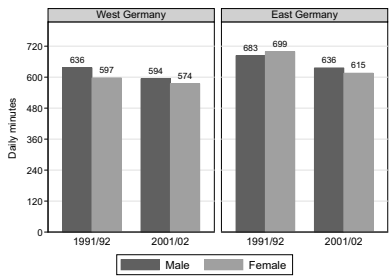
Figure 1: Partners' daily workload



(a) Paid work



(b) Unpaid work



(c) Total work

Tables

Table 1: Reduced form estimates – Paid work

	Male		Female	
	P(t>0)	E(t|t>0)	P(t>0)	E(t|t>0)
Exogenous regressors:				
Constant	1.225***	541.133***	1.691***	437.705***
	(0.29)	(24.43)	(0.23)	(29.87)
East Germany	0.031	19.329**	0.031	81.784***
	(0.02)	(9.84)	(0.03)	(10.81)
Wave 1991/92	0.107***	37.895*	−0.061	−7.419
	(0.04)	(19.65)	(0.05)	(23.03)
East Germany*Wave 1991/92	−0.041	−1.582	0.119***	46.362***
	(0.03)	(12.17)	(0.04)	(14.40)
Cohabiting	0.019	0.369	0.045	37.317***
	(0.02)	(11.74)	(0.04)	(11.77)
Household net income (in 1,000€)	0.004	10.900**	−0.005	15.490***
	(0.01)	(4.98)	(0.01)	(5.42)
Household net income (in 1,000€)*Wave 1991/92	0.003	15.230**	0.028*	16.556**
	(0.01)	(6.48)	(0.02)	(7.43)
Age	−0.001	−1.098***	−0.004***	−1.922***
	(0.00)	(0.35)	(0.00)	(0.47)
Net hourly wages (in €)	0.000	−0.050	0.001**	0.101*
	(0.00)	(0.06)	(0.00)	(0.06)
Net hourly wages (in €)*Wave 1991/92	−0.003**	−5.598***	−0.005**	−7.173***
	(0.00)	(1.14)	(0.00)	(1.50)
Schooling (ref.: lower school degree)				
No degree/other degree	0.000	3.835	−0.021	1.488
	(0.01)	(6.01)	(0.02)	(8.40)
Degree for professional college	0.007	−14.965	−0.034	12.659
	(0.02)	(10.80)	(0.03)	(13.68)
High school degree	−0.002	−10.069	−0.042*	−9.020
	(0.02)	(10.25)	(0.02)	(10.52)
Vocational education (ref.: apprenticeship)				
No education	−0.040	−9.476	−0.010	−10.302
	(0.03)	(15.77)	(0.03)	(15.43)
Master school	−0.040***	17.810**	0.033	13.389
	(0.01)	(7.05)	(0.04)	(18.57)
University of applied science degree	0.003	20.702*	0.085**	18.744
	(0.02)	(10.85)	(0.03)	(11.96)
University degree	0.012	2.672	0.131***	15.068
	(0.02)	(12.22)	(0.03)	(13.69)
Other educational degree	−0.026	24.045**	0.036	13.945
	(0.03)	(11.10)	(0.03)	(9.76)

To be continued on next page

Table 1: Reduced form estimates – Paid work (*continued*)

	Male		Female	
	P(t>0)	E(t|t>0)	P(t>0)	E(t|t>0)
Instruments:				
No. of children	−0.000	2.006	−0.027***	−30.271***
	(0.01)	(2.65)	(0.01)	(3.53)
Youngest child < 3 years	−0.027	−4.591	−0.239***	−77.499***
	(0.02)	(10.04)	(0.03)	(16.85)
Youngest child >= 3 and < 6 years	0.019	−13.273*	−0.066***	−49.492***
	(0.02)	(7.71)	(0.02)	(9.58)
Additional persons living in the household	0.032	−24.892**	0.027	−49.354***
	(0.03)	(11.74)	(0.04)	(16.05)
External help	0.021*	−4.832	0.013	3.895
	(0.01)	(5.14)	(0.02)	(6.42)
House owner	−0.002	13.181**	0.010	−16.491**
	(0.01)	(5.29)	(0.02)	(6.72)
Dishwasher	0.012	−6.466	−0.042**	−15.540*
	(0.01)	(6.00)	(0.02)	(7.97)
Dryer	0.014	−6.260	0.023	4.519
	(0.01)	(5.32)	(0.02)	(6.66)
Distance grocery store (in minutes)	−0.000	−0.058	0.000	0.109
	(0.00)	(0.14)	(0.00)	(0.17)
Fixed working hours	−0.016	−3.358	0.017	8.276*
	(0.01)	(5.17)	(0.01)	(4.40)
Shift work	−0.040***	−3.471	−0.025	19.518**
	(0.01)	(6.83)	(0.02)	(9.72)
Occupation (ref.: white collar worker)				
Self-employed	0.072***	19.444**	0.009	−30.344**
	(0.02)	(8.37)	(0.03)	(13.26)
Civil servant	−0.023	−36.559***	−0.019	−3.027
	(0.01)	(6.73)	(0.03)	(11.15)
Blue collar worker	−0.016	1.203	−0.049**	−22.572**
	(0.01)	(6.61)	(0.02)	(10.44)
Distance workplace (in minutes)	−0.000	0.645***	−0.001***	1.041***
	(0.00)	(0.06)	(0.00)	(0.13)
Friday	−0.027***	−59.448***	−0.055***	−34.859***
	(0.01)	(5.12)	(0.01)	(6.03)
F-statistic for joint significance of instruments	-	39.55	-	18.73
Observations	5,301		5,301	
Non-zero observations	4,729		4,114	

Notes: – Marginal effects, with robust standard errors in parenthesis.
*– Significant at ***: 1% level; **: 5% level; *: 10% level.*

Table 2: Reduced form estimates – Unpaid work

	Male		Female	
	P(t>0)	E(t|t>0)	P(t>0)	E(t|t>0)
Exogenous regressors:				
Constant	1.931***	−399.197***	-	147.016***
	(0.27)	(150.42)		(30.72)
East Germany	−0.018	6.988	-	−54.913***
	(0.02)	(8.15)		(11.14)
Wave 1991/92	−0.027	4.248	-	38.939**
	(0.03)	(16.94)		(18.16)
East Germany*Wave 1991/92	0.027	4.964	-	−26.311*
	(0.02)	(10.43)		(13.97)
Cohabiting	−0.007	−17.615	-	−61.835***
	(0.02)	(11.08)		(14.65)
Household net income (in 1,000€)	−0.006	−1.415	-	−14.646***
	(0.01)	(4.38)		(4.58)
Household net income (in 1,000€)*Wave 1991/92	−0.005	−9.571*	-	−5.910
	(0.01)	(5.31)		(5.84)
Age	−0.001*	0.449	-	1.660***
	(0.00)	(0.31)		(0.41)
Net hourly wages (in €)	−0.000**	0.075	-	−0.091
	(0.00)	(0.14)		(0.10)
Net hourly wages (in €)*Wave 1991/92	0.004**	0.476**	-	1.695**
	(0.00)	(0.19)		(0.81)
Schooling (ref.: lower school degree)				
No degree/other degree	−0.021*	9.730*	-	−1.228
	(0.01)	(5.56)		(6.85)
Degree for professional college	0.009	11.928	-	1.116
	(0.02)	(8.47)		(11.38)
High school degree	0.031*	15.535*	-	−0.653
	(0.02)	(8.33)		(8.75)
Vocational education (ref.: apprenticeship)				
No education	−0.018	−2.141	-	−9.820
	(0.03)	(11.23)		(10.81)
Master school	−0.008	7.530	-	−29.676**
	(0.01)	(6.41)		(13.07)
University of applied science degree	−0.030	−15.150*	-	−32.391***
	(0.02)	(8.66)		(11.36)
University degree	0.008	−8.599	-	−27.162**
	(0.02)	(9.65)		(12.23)
Other educational degree	−0.015	−3.677	-	−9.698
	(0.02)	(10.28)		(8.99)

To be continued on next page

Table 2: Reduced form estimates – Unpaid work (*continued*)

	Male		Female	
	P(t>0)	E(t|t>0)	P(t>0)	E(t|t>0)
Instruments:				
No. of children	−0.004	5.062**	-	38.368***
	(0.00)	(2.25)		(2.85)
Youngest child < 3 years	0.060***	36.112***	-	142.836***
	(0.02)	(7.19)		(11.28)
Youngest child >= 3 and < 6 years	0.042***	16.204***	-	61.961***
	(0.02)	(6.07)		(7.73)
Additional persons living in the household	−0.010	14.172	-	42.869***
	(0.02)	(10.75)		(12.56)
External help	0.018*	0.709	-	0.320
	(0.01)	(4.62)		(5.62)
House owner	0.004	7.492**	-	21.189***
	(0.01)	(3.31)		(5.74)
Dishwasher	−0.010	−4.786*	-	4.152*
	(0.01)	(2.62)		(2.32)
Dryer	−0.007	−3.627	-	−2.200*
	(0.01)	(4.72)		(1.31)
Distance grocery store (in minutes)	−0.000**	0.230**	-	0.046
	(0.00)	(0.11)		(0.16)
Fixed working hours	0.012	2.370	-	−5.541
	(0.01)	(4.66)		(5.29)
Shift work	0.020	23.701	-	0.108
	(0.01)	(15.29)		(8.18)
Occupation (ref.: white collar worker)				
Self-employed	−0.069***	−37.114***	-	19.717**
	(0.01)	(7.86)		(9.40)
Civil servant	0.020	15.418***	-	7.485
	(0.01)	(5.86)		(9.98)
Blue collar worker	0.006	3.395	-	10.438
	(0.01)	(5.64)		(8.23)
Distance workplace (in minutes)	−0.000	−0.231***	-	−0.242**
	(0.00)	(0.06)		(0.09)
Friday	0.004	25.669***	-	20.821***
	(0.01)	(3.87)		(5.13)
F-statistic for joint significance of instruments	-	8.92	-	13.13
Observations	5,301		5,301	
Non-zero observations	4,799		5,252	

Notes: – Marginal effects, with robust standard errors in parenthesis.
*– Significant at ***: 1% level; **: 5% level; *: 10% level.*

Table 3: Structural form estimates - Truncated regression

	Paid work		**Unpaid work**	
	male	female	male	female
Male paid work		0.834***	−0.438***	−0.284***
		(0.11)	(0.04)	(0.10)
Female paid work	0.153*		0.030	−0.423***
	(0.09)		(0.08)	(0.09)
Male unpaid work	−0.312	1.493***		−0.513***
	(0.26)	(0.21)		(0.18)
Female unpaid work	0.184	−1.371***	−0.057	
	(0.12)	(0.22)	(0.15)	
Observations	5,301	5,301	5,301	5,301
Non-zero observations	4,729	4,114	4,799	5,252
Overidentification-test (p-value)	0.92	0.36	0.66	0.50

Notes: – Marginal effects, with robust standard errors in parenthesis.
*– Significant at ***: 1% level; **: 5% level; *: 10% level.*
– Full estimation results are shown in table A4 in the Appendix.

A Appendix

Table A1: Partners' time allocation to paid and unpaid work

	Average minutes	Percentage of zeros	Average minutes if t>0
Male paid work	496.77	0.11	556.86
	(219.77)	(0.31)	(143.78)
Female paid work	314.34	0.22	405.04
	(227.98)	(0.42)	(173.86)
Male unpaid work	132.22	0.09	146.05
	(127.85)	(0.29)	(126.63)
Female unpaid work	294.14	0.01	296.89
	(169.78)	(0.10)	(168.16)

Table A2: German Time Use Surveys

	1991/92	**2001/02**
Sampling method	quota sample	quota sample
Collection period	autumn 1991 to summer 1992	spring 2001 to spring 2002
No. of households	7,200	5,400
Age of household members surveyed	12 years and older	10 years and older
No. of household members	16,000	12,600
No. of diaries per person	2	3
No. of activities	200	230
Childcare time	included for children under the age of 16	included for children under the age of 18
Intervals	5-minute	10-minute
Details	– main and secondary activities – means of transport – persons who are present	– main and secondary activities – means of transport – persons who are present

Table A3: Descriptive Statistics

Household level:	mean	sd
East Germany	0.27	(0.44)
Wave 1991/92	0.64	(0.48)
East Germany*Wave 1991/92	0.18	(0.39)
Household net income (in 1,000€)	2.74	(1.09)
Household net income (in 1,000€)*Wave 1991/92	1.53	(1.40)
Cohabiting	0.05	(0.21)
No. of children	1.35	(1.05)
Youngest child < 3 years	0.08	(0.27)
Youngest child >= 3 and < 6 years	0.13	(0.33)
Additional persons living in the household	0.04	(0.20)
House owner	0.62	(0.49)
External help	0.38	(0.49)
Dishwasher	0.65	(0.48)
Dryer	0.42	(0.49)
Distance grocery store (in minutes)	12.68	(17.50)

	male		**female**	
Individual level:	mean	sd	mean	sd
Age	43.47	(8.48)	40.72	(8.25)
Net hourly wages (in €)	10.26	(16.27)	7.81	(23.17)
Net hourly wages (in €)*Wave 1991/92	5.80	(6.71)	3.91	(4.37)
Schooling				
Lower school degree/other degree	0.37	(0.48)	0.26	(0.44)
Intermediary school degree	0.30	(0.46)	0.45	(0.50)
Degree for professional college	0.10	(0.29)	0.06	(0.24)
High school degree	0.24	(0.43)	0.22	(0.42)
Vocational education				
No education	0.03	(0.17)	0.07	(0.25)
Apprenticeship	0.49	(0.50)	0.59	(0.49)
Master school	0.16	(0.36)	0.05	(0.21)
University of applied science degree	0.12	(0.33)	0.08	(0.27)
University degree	0.16	(0.37)	0.11	(0.32)
Other educational degree	0.05	(0.21)	0.10	(0.30)
Occupation				
Self-employed	0.17	(0.38)	0.10	(0.30)
Civil servant	0.18	(0.38)	0.09	(0.28)
Blue collar worker	0.32	(0.47)	0.12	(0.33)
White collar worker	0.32	(0.47)	0.69	(0.46)
Fixed working hours	0.40	(0.49)	0.47	(0.50)
Shift work	0.17	(0.38)	0.11	(0.32)
Distance workplace (in minutes)	42.23	(38.40)	37.34	(33.82)
Friday	13.72	(0.34)	13.72	(0.34)
Observations	**2,952**			

Table A4: Structural form estimates – Truncated regression (continuation of Table 3)

	Paid work		Unpaid work	
	male	female	male	female
Exogenous regressors:				
Constant	132.697***	146.814***	259.287***	163.128***
	(3.13)	(2.69)	(29.70)	(3.00)
East Germany	18.508*	−16.653	18.475**	−10.393
	(10.85)	(16.00)	(9.36)	(12.67)
Wave 1991/92	40.186**	−0.458	45.454**	46.390**
	(19.47)	(24.78)	(18.47)	(19.82)
East Germany*Wave 1991/92	−6.063	−2.591	−7.114	8.764
	(13.56)	(16.08)	(12.08)	(16.19)
Cohabiting	−4.732	−3.297	−17.684	−44.139***
	(12.29)	(15.39)	(12.12)	(15.53)
Household net income (in 1,000€)	11.843**	−11.254*	2.718	−8.200*
	(4.89)	(6.28)	(4.59)	(4.67)
Household net income (in 1,000€)*Wave 1991/92	9.458	15.191**	−8.035	−0.245
	(6.47)	(7.28)	(5.45)	(6.29)
Age	−0.695**	1.293**	−0.279	0.019
	(0.32)	(0.62)	(0.34)	(0.50)
Net hourly wages (in €)	−0.082	0.007	0.086	−0.007
	(0.06)	(0.07)	(0.14)	(0.10)
Net hourly wages (in €)*Wave 1991/92	−5.051***	−4.876***	−0.940**	−0.858
	(1.11)	(1.45)	(0.44)	(0.96)
Schooling (ref.: lower school degree)				
No degree/other degree	3.885	0.032	12.205**	−3.987
	(5.95)	(8.25)	(5.42)	(6.85)
Degree for professional college	−12.588	15.967	5.866	−0.003
	(11.26)	(13.64)	(8.54)	(11.31)
High school degree	−5.859	−14.626	9.756	−9.690
	(11.12)	(10.39)	(8.35)	(8.90)
Vocational education (ref.: apprenticeship)				
No education	−14.740	−26.719*	−17.629	−14.198
	(15.79)	(15.29)	(11.41)	(10.83)
Master school	20.176***	−29.688	−0.300	−19.459
	(7.20)	(21.61)	(6.43)	(13.20)
University of applied science degree	16.432	−18.560	−9.790	−12.892
	(11.79)	(13.27)	(8.44)	(11.65)
University degree	0.796	−20.740	−9.833	−0.773
	(12.26)	(14.91)	(9.57)	(12.68)
Other educational degree	21.488*	0.759	−2.799	1.135
	(11.30)	(9.62)	(10.28)	(9.11)

To be continued on next page

Table A4: Structural form estimates – Truncated regression (*continued*)

	Paid work		Unpaid work	
	male	female	male	female
Instruments:				
No. of children	-	0.989	57.191**	39.169***
		(8.58)	(25.86)	(6.44)
Youngest child < 3 years	-	63.430*	228.061**	136.117***
		(36.90)	(95.40)	(26.52)
Youngest child >= 3 and < 6 years	-	3.667	120.152**	72.576***
		(17.95)	(52.00)	(14.93)
Additional persons living in the household	-	-	112.139	58.480***
			(74.44)	(21.01)
External help	-	-	25.442	8.174
			(26.33)	(8.45)
House owner	-	-	81.891**	33.687***
			(35.07)	(8.94)
Dishwasher	-	-	−25.715	−3.963
			(29.02)	(10.10)
Dryer	-	-	−1.365	8.691
			(28.27)	(8.29)
Distance grocery store (in minutes)	-	-	1.148*	0.305
			(0.50)	(0.24)
Fixed working hours	−2.117	−0.367	-	-
	(5.30)	(6.07)		
Shift work	4.638	13.387	-	-
	(9.83)	(9.55)		
Occupation (ref.: white collar worker)				
Self-employed	7.712	2.078	-	-
	(13.16)	(14.28)		
Civil servant	−30.502***	10.510	-	-
	(8.04)	(11.38)		
Blue collar worker	4.923	−9.464	-	-
	(6.83)	(10.41)		
Distance workplace (in minutes)	0.564***	0.699***	-	-
	(0.08)	(0.14)		
Friday	−47.593***	9.283	-	-
	(8.65)	(8.94)		
Observations	5,301	5,301	5,301	5,301
Non-zero observations	4,729	4,114	4,799	5,252

Notes: – Marginal effects, with robust standard errors in parenthesis.
*– Significant at ***: 1% level; **: 5% level; *: 10% level.*

Table A5: Structural form estimates - Tobit regression

	Paid work		**Unpaid work**	
	male	female	male	female
Male paid work		0.582**	−0.560***	−0.249**
		(0.25)	(0.05)	(0.10)
Female paid work	0.515***		0.022	−0.355***
	(0.14)		(0.10)	(0.08)
Male unpaid work	−0.115	0.792**		−0.540***
	(0.48)	(0.34)		(0.17)
Female unpaid work	0.553***	−0.914**	−0.235	
	(0.21)	(0.37)	(0.24)	
Observations	5,301	5,301	5,301	5,301
Non-zero observations	4,729	4,114	4,799	5,252

Notes: – *Robust standard errors in parenthesis.*
– *Significant at ***: 1% level; **: 5% level; *: 10% level.*
– *Control variables are same as in Table A4. Full estimation results are available from the author upon request.*