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

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Current draft: March 2011

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 analyzes 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. When including both weekdays and weekend days in the analysis, a complementary relationship between the partner's time allocations is found. The more time the men spends with market (non-market) work, the more time the women spends with market (non-market) work and vice versa. When restricting the analysis to weekdays, however, men's time dedicated to paid and unpaid work is unaffected by their wives' time use decisions, while women adjust their time allocation to the time allocation of their partner.

JEL-Classification: J16, J22, C34

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

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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 (German Federal Statistical Office, 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, while 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 may suffer from a disadvantage 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 specialization 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, 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 how partners within one household share their work between each other. Whereas most 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. Restricting the sample to employed partners, it is analyzed how one spouse's time spend on paid and unpaid work, respectively is affected by his partner's times spend on 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 on 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 consistent 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 adressed 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 on 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. First, the analysis is conducted including both weekdays and weekend days, while in the second step weekend days are excluded. When all days of the week are included, a complementary relationship between the partner's time allocations is found, i.e. male time dedicated to market (non-market) work increases female time dedicated to market (non-market) work and vice versa. When excluding weekend days, however, men's time spend with paid and unpaid work is unaffected by their wives' time use decisions, while women adjust their time allocation to the time allocation of their partner.

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. Most of the empirical time use research focuses on wage effects, i.e. it is

analyzed whether ones own and the spouse's wage do have an impact on the partners' time allocation (cf. Hersch and Stratton, 1994; Bloemen and Stancanelli, 2008; Kalenkoski *et al.*, 2009). Following modern economic theories that model intra-household time allocation as the outcome of a bargaining process between the partners, the partners' wages serve as a proxy for the individuals' relative bargaining power within the household.

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 (2009), 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 on caregiving when their wife works more hours in the market. Accordingly, fathers engaging in childcare can relieve their wife 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.

In a similar analysis for Italian parents, Bloemen *et al.* (2010) find a positive correlation between fathers' and mothers' time dedicated to paid work as well as between their times

dedicated to childcare. For household work, however, the results differ between weekdays and weekend days. While the unobservable factors influencing the spouse's times dedicated to housework are positively correlated on weekends, they are negatively correlated on weekdays.

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 by 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 on market work. At least in case of female time allocation, this assumption is debatable.

3 Empirical Specification

The question of main interest is, how one partner's time in one activity is affected by changes in his own time in another activity (where 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 on one activity is highly correlated with his time spent on 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). 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 on the respective activities

[2]The percentage of individuals not spending any time on market work or non-market work on the survey

are truncated at a value of zero. Taking these features into account results in a system of four linear time-use equations characterized as:

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

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

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} are error terms.

The coefficients of main interest are α_{jk1}, α_{jk2}, α_{jk3} and α_{jk4}. They represent how an individuals time spent on 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). In the following analysis, 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.

day is displayed in Table A1 in the Appendix.

In the first step, the reduced form representation of 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.*, 2009; Kimmel and Connelly, 2007). 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 is not 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 on 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 on an activity and the amount of time spend on 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 unpaid work. [3]

The assumptions made regarding the exclusion restrictions on the structural equations are as follows: In order to identify the paid work equations, it is 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, 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 does not hold true for female employment hours. Likewise, in order to identify the unpaid work equations, I assume that some job characteristics such as the individuals' working time regulation, i.e. whether they are doing shift work or have fixed work schedules, 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.

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 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

[3] 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 is estimated instead.

problem, a heteroscedasticity-robust variant of the Hausman test (cf. Wooldridge, 2002) is applied.

4 Data and Descriptive Statistics

4.1 German Time Use Data

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. A detailed comparison of the GTUS 1991/91 and the GTUS 2001/02 is shown in Table A2 in the Appendix. 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.[4] Moreover, the information is very detailed. Every household member had to fill in at least two time diaries – one on a working day and one on a Saturday or Sunday – in order to describe the routine of the day in short intervals (5- and 10-minute, respectively). By means of these diaries, about 200 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 at shedding 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 relevant 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. I 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 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.

[4] It should be noted that – given the estimation strategy in this paper – it is not necessary to have data on both the husband and the wife, since predicted instead of actual time use is included in the structural equations.

[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.

4.2 Sample

The sample considered in the following analysis consists of married and cohabiting couples living within one household. Households containing adult persons in need of care were excluded. Since interest is directed towards the partner's time allocation to paid (and unpaid) work, the sample is restricted to dual-earner couples, i.e. couples in which both partners are employed and of working age. Obviously, excluding one-earner couples or couples in which both partners are not employed from the analysis means that the sample is not representative for all couples in Germany. This holds true for West Germany in particular, where a high fraction of married women does not participate in the labor market.[6] On the one hand, excluding non-employed partners might result in underestimating the real extent of spousal interaction in regard to time allocation. For example, a husband who increases his time in unpaid work might induce his non-employed wife to participate in the labour market. On the other hand, one can assume that the interaction between individual and spousal time allocation is the strongest under time pressure and therefore more pronounced for dual-earner couples. Under this assumption, the results would serve as a lower bound estimate for the time allocation decisions of all couples. Irrespective of these considerations, the main interest of this paper is directed towards the time allocation decisons of partners who actually have to reconcile market and non-market work. For these couples, i.e. those who already decided to participate in the labour market, the results are representative anyway.

Regarding time diary information, the sample was restricted to spouses who had filled in the time diary on the same day and this day had to be a normal day.[7] Intuitively, one would argue that investigating spousal labor supply necessitates that the analysis is restricted to working days. However, in many industries (e.g. in the retail industry, the media industry, the hospital sector, etc.) working on the weekend is quite usual. Moreover, the definition of market work in this analysis – and time use analysis in general – goes beyond the consideration of contractual working hours, but incorporates every activity in connection with employment. Besides overtime work in general, this includes time spent for e.g. attending business dinners, answering job-related e-mails/phone calls, or taking a computer course. Since many of these activities might be done at weekends as well, ignoring weekend days would be inappropriate.[8] Moreover, excluding weekend days might result in underestimating male non-market work, since men tend to do relatively more household and childcare tasks on weekends. Finally, as Frazis and Stewart (2010) point out, it is unclear how to interpret separate regression coefficients for weekends and

[6] In the sample drawn from the GTUS, 52% of the West German and 35% of the East German women living with a partner are not employed.

[7] 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 did not change significantly, thus they are not presented here.

[8] In the sample considered, 31% of the men and 21% of the women spend time on employment on a weekend day.

weekdays without knowing the effect of these covariates on overall time use. The effect of a covariate on weekday time use can be thought of as the combined effect of the effects of the covariate on overall time use and on the weekday-weekend distribution of time spent in the activity.

To address this issue, at first all diary days (i.e. both weekdays and weekend days) are included in the analysis. Then, the same analysis is conducted excluding weekend days. The motivation for excluding weekend days in the second step of the analysis is that on weekdays time pressure is much higher than on weekends, 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. Concentrating on weekdays thus delivers some further insight into spousal time allocation under time constraints. Excluding individuals with missing information on at least one of the variables used in the empirical analysis leads to a sample of 3,200 couples and 7,448 diary days, of which 5,301 are weekdays.

4.3 Variables

In the empirical analysis several household and individual characteristics are controlled for.[9] Since there are no theoretical arguments to suggest that some factors 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. To allow for differences in the time allocation of East and West German couples and changes over time, 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 both are included. On the household level, the household income, the couples' marital status (cohabiting or married), the number of children, and the age of the youngest child are additionally controlled for. In the analysis including all diary days, indicators on whether the day is a Saturday or a Sunday are included. On the individual level, the age of the partners, their schooling and vocational education (4 and 6 dummies, respectively), their occupation (4 dummies) and their net hourly wages are controlled for.

Concerning the income information, some remarks are necessary. Firstly, information on household income and the individual's monthly net earnings was collected both as a continuous variable and in intervals, for respondents who did not provide continuous income information. For them, income is set equal to the mid-point of each interval, and to the lower bound of the top interval. Secondly, income and 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

[9]Descriptive statistics of these variables are given in Table A3 in the Appendix.

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 income and earnings variables with the dummy for the sample period. Thirdly, 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 labor market experience of the individuals is missing), predicting the partner's wages was not possible. However, since 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' time spent on 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, craftsman, 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.[10] To identify the paid work equations, indicators for the spouses' working time regulations (indicating whether they have fixed work schedules or shift work), their commuting time to the workplace as well as an indicator for whether the diary refers to a Friday, are included as instruments. The latter variable accounts for the fact that in Germany, many firms have lower working hours on Fridays.

Of course, using individual or household characteristics as instruments for the partners' time allocation decisions is debatable, since these characteristics are not exogenously determined, but themselves choice variables. First, it can be argued that individuals having a high preference for market work and therefore higher working hours are able to afford a domestic help that reduces their time spend on housework. However, correlations that can be attributed to higher working hours generating the possibility to substitute spending time on household

[10]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.

tasks by spending money on engaging a domestic help or purchasing a dishwasher/dryer should be captured by controlling for the individual's wage and the household income, respectively. Second, one can assume that individuals having a high preference for non-market work will choose a job that is characterized by working time regulations that comply with their needs for spending time on housework and child-rearing, respectively. However, the results of the first-stage estimations for the unpaid work equations reveal that during weekdays the individuals' working time regulations are totally uncorrelated with the partners' time spend on non-market work. This result does not lend support to the hypothesis that the individual's working time regulation is a consequence of his preferences for non market work. Lastly, one can argue that the amount of time spend on non-market work will be higher on Fridays compared to other weekdays and will therefore not be uncorrelated with the day of the week. However, it is plausible to assume that this correlation is not attributed to the characteristics of the day itself, but is entirely driven by the variation in working hours between Fridays and other weekdays. Stated differently, given that an individual works equal hours from Monday till Friday, why should he spend more time on household work on a Friday than on any another day of the week?

4.4 Couples' Time Allocation

Figure 1 shows the daily minutes German 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 on the respective activity are included only. For an overview of the percentage of individuals who do not spend any time on market or non-market work on the survey day and the amount of time dedicated to these activities, unconditional on participation, see Table A1 in the Appendix.

Regarding the spouse's time allocation to paid work, employed men spend almost 9 and a half hours and employed women about 7 and a half hours on paid work on an average working day. As expected, the amount of time spend on employment is much smaller on the weekend, with almost 5 hours for men and almost 4 and a half hour for women. Hence, for those who actually spend time on employment on the weekend, the gender difference in time allocated to employment is very small. Averaged over the whole week, this results in men working just under 9 hours and women working about 7 hours in the market.

< Figure 1 about here >

Regarding the partners' time in unpaid work, it becomes obvious that with an average workload of 4 and a half hours per day, women do the bulk of the couples' household work on weekdays, while men spend less than 2 and a half hours on unpaid work. On weekend

days, the difference between the sexes becomes smaller, since men spend relatively more time on household and childcare tasks on weekends (3 and a half hours on average), while women increase their amount of time dedicated to non-market work only sightly on weekends.

The results up to now clearly indicate the existence of a gender division of labor between the partners, with men specializing in market work and women specializing in non-market work. However, although men and women differ in their allocation of time to market and non-market work, the total workload of the household is shared equally between the partners. While men's total workload is slightly higher on weekdays, women's total workload is higher on the weekend. Averaged over the whole week, both men and women spend about 9 and a half hours on either market or non-market work. This goes against the widely held belief that women's total workload exceeds that of men's if both partners are employed.[11] However, this finding is in line with Burda *et al.* (2007), who find hardly any differences in total working hours between men and women in Germany, the Netherlands and the U.S.

5 Empirical Results

5.1 Reduced form estimates

In the following, the main results of the reduced form estimations are discussed. The results for the partners' times spend on paid work are shown in Table 1. The probit regressions in the first part of the dubble-hurdle model reveal that for women the probability of spending any time on market work on the survey day depends on both individual and household characteristics. In contrast, hardly any of the variables show a significant impact on men's employment probability, independent of whether the analysis includes all diary days or is restricted to weekdays. This indicates that the reason for not spending any time on employment on the survey day differs by gender. Since for women the determinants of the probability of working on the survey day are similar to those associated with female labor supply (vocational education, number/age of the children), being part-time employed seems to be the main reason for spending zero minutes on market-work on the survey day. For men, a clear-cut reason for not working on the survey day – except for the day being a weekend 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 on employment and the minutes of time spend on employment conditional on participation to be determined by different factors.

[11] 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 on market work confirm those expected by theoretical consideration and found in previous studies regarding individual labor supply. The instruments used in the paid work equations are highly correlated with both male and female time spend on market work and joint significance of the instruments can be confirmed by the corresponding F-tests. For both men and women, time spend on paid work is increasing with the distance to the workplace and significantly lower on Fridays compared to other weekdays. With respect to the individual's working time regulation, some differences between the results based on all diary days and those based on weekdays become obvious. When considering all diary days, doing shift work is found to be positively associated with both partners' time dedicated to market work, while it is negatively correlated with men's working hours on weekdays.

The results of the reduced form equations for male and female time spend on unpaid work are shown in Table 2. Since the proportion of women not spending any time on 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 on 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, the truncated regressions for the partners' minutes spend on unpaid work, it becomes obvious that male non-market work is hardly affected by individual characteristics. From the instruments, the presence of young children, the house ownership as well as the distance to the nearest grocery store are the main determinants of male time dedicated to unpaid work. For women, the presence of additional persons in the household as well as the existence of a dishwasher/dryer is further correlated with their time spend on non-market work, while the distance to the grocery store is uncorrelated with female time in unpaid work. Regarding the results of the F-tests for joint significance of the instruments, instrument weakness can be ruled out for all but one equation. When restricting the sample to weekdays, the value of 8.9 for the male equation is slightly below $F = 10$, which is considered to be the critical threshold for rejecting the hypothesis of week instruments.

5.2 Structural form estimates

Full structural form estimates for the partners' times allocated to paid and unpaid work are shown in Table A4 in the Appendix. 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 presented in Table 3.

< Table 3 about here >

In regard to the results for the analysis including both weekdays and weekend days, a positive correlation between the partner's time allocated to market work is found. The more time the men dedicates to market work, the more time the women dedicates to market work as well and vice versa. 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. While male time in market work is unaffected by the couples' non-market time allocation, female time in paid work is highly affected by the partner's time spend on unpaid work: The more (less) time the men (women) spends with non-market work, the more time the women dedicates to market 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.

Regarding the couples' time allocation to unpaid work, the results show that for both partners their time in market work has a negative impact on their time in non-market work, which is merely a consequence of the time budget constraint. Furthermore, a positive correlation between the partner's minutes allocated to unpaid work is found. Again, this could be an indicator for assortative mating in regard to high preferences for market or non-market work of both spouses. Moreover, it is likely that the partners carry out some household or childcare tasks jointly, as for example preparing dinner, going shopping or playing with the children. A striking finding appears regarding the effect of male time in paid work on female time in unpaid work: While the positive effect of female market work on male non-market work is quite reasonable, the negative effect of male non-market work on female non-market work is somewhat surprising and contrary to the findings of Deding and Lausten (2006). Why do women whose husbands have higher working hours spend less time in non-market work? One explanation might be that men generate the need for more hours of unpaid work by their presence at home. This might be the case if they hold their wife to a higher standard or if the women want to appear busy in front of their husbands. On the other hand, it might simply reflect that men produce more mess with their presence at home.

With respect to the analysis excluding weekend days, some interesting results appear. First, men's time allocation is absolutely unaffected by their wife's time allocation on weekdays. Neither men's time dedicated to market work nor their time dedicated to non-market work is significantly affected by their wife's time allocation. This implies that with an increase in their wife's working hours, men are willing to increase their engagement in non-market work on weekends, but not on weekdays. However, since many non-working tasks cannot be postponed until the weekend (e.g. taking the children to school, preparing meals, etc.), women's decision in regard to their working hours will mainly be affected by her time constraints during the week. This 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) have to be done at fixed times of the day. Dividing non-market work into housework and childcare and analyzing both tasks separately may deliver 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 was not possible here.

Second, the former positive effect of male time in non-market work on female time in non-market work turns negative when excluding weekend days. On the weekend, the partner's times in non-market work constitute complements, probably because partners spend more time on non-market work jointly. During the week, however, the times constitute supplements, in a way that men who engage in household and childcare tasks can lower their wives non-market workload, who on her part is able to increase her employment hours. This finding is consistent with Bloemen *et al.* (2010), who find that the unobservable factors influencing the spouse's times dedicated to housework are positively correlated on weekends, but negatively correlated on weekdays. 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 0.19 to 0.92. Hence, for all equations the null-hypothesis of valid exclusion restrictions cannot be rejected.[12]

< Table 4 about here >

For comparison, the model was additionally estimated by applying a Tobit model instead of the double-hurdle model. Table 4 shows the estimation results for the interdependencies between the time uses of the partners. In most instances, the Tobit results are similar to those of the dubble-hurdle model. However, regarding the results for the analysis including all diary days, men's time spend on market work is now significantly affected by their wife's time

[12]Moreover – as a sensitivity check – different specifications of the model were estimated in which some of the instruments were excluded from the equations. These models yielded similar results, proving that the findings are not driven by a single instrument.

allocation to market and non-market work. Moreover, the former positive effect of male time dedicated to unpaid work on female time dedicated to paid work is not significant any more. These distinct differences between the Tobit and the dubble-hurdle model are probably due to large number of zero observations associated with these equations. This is consistent with the results of Stewart (2009), who uses simulated time use data to compare the bias associated with alternative estimation procedures and finds that the bias associated with the Tobit estimation increases as the fraction of zero observations increases. As he states, the main reasons for this poor performance is that the Tobit model rests on the assumption that that the process that determines whether an individual engages in an activity is the same one that governs how much time is spent in that activity. This explanation is consistent with the findings of Daunfeldt and Hellström (2007) who, in their study of time spent in household production activities, reject the Tobit model in favor of the two-part model.

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 on an activity and the amount of time spend on this activity, conditional on participation to be determined by separate processes and therefore relaxes the strong assumptions of the Tobit model.

The results of the analysis differ by the observation period investigated. When including both weekdays and weekend days, a complementary relationship between the partner's time allocations is found. The more time the men spends with market (non-market) work, the more time the women spends with market (non-market) work and vice versa. When restricting the analysis to weekend days, however, men's time dedicated to paid and unpaid work is unaffected by their wives' time use decisions, while women adjust their time allocation to the time allocation of their partner. These results help us getting an idea of the couples' decision making process regarding the division of labor between the partners. It seems 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. Although men whose wife works more hours in the market dedicate more time to non-market work on the weekend, they do not increase their non-market workload on weekdays.

Although the division of labor between men and women has become much more equal in (West) Germany within the last decade, 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 at 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.

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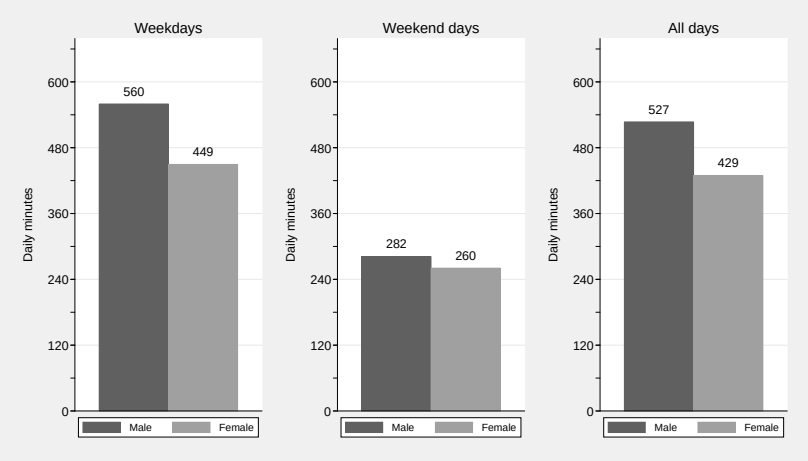
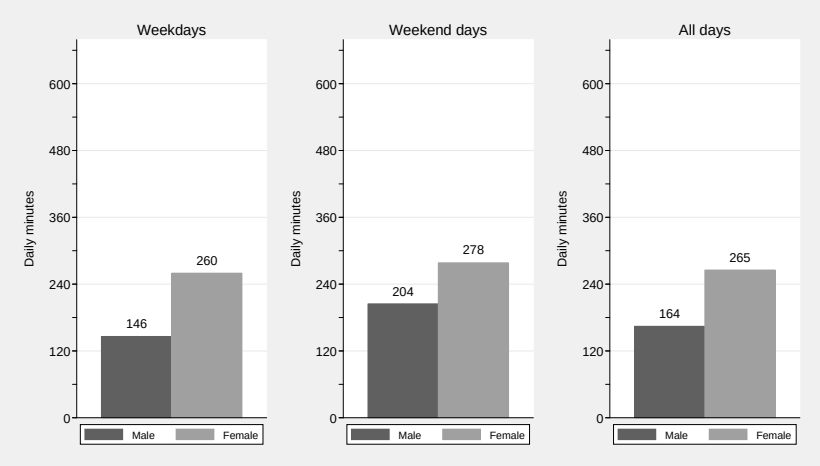
Figures and Tables

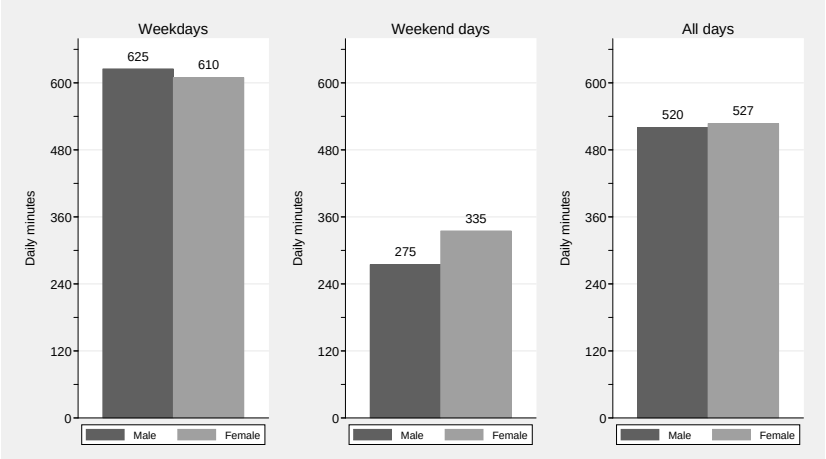
Figure 1: Partners' Daily Workload



(a) Paid work



(b) Unpaid work



(c) Total work

Table 1: Reduced Form Estimates – Paid Work

	All days				Weekdays			
	Male		Female		Male		Female	
	P(t>0)	E(t|t>0)	P(t>0)	E(t|t>0)	P(t>0)	E(t|t>0)	P(t>0)	E(t|t>0)
Exogenous regressors:								
Saturday	−0.523***	−233.894***	−0.590***	−132.228***	-	-	-	-
	(0.02)	(13.00)	(0.02)	(15.42)				
Sunday	−0.567***	−374.509***	−0.650***	−199.113***	-	-	-	-
	(0.02)	(16.80)	(0.02)	(21.40)				
East Germany	0.023	11.875	0.009	72.779***	0.031	19.329**	0.031	81.784***
	(0.02)	(10.14)	(0.03)	(11.04)	(0.02)	(9.84)	(0.03)	(10.81)
Wave 1991/92	0.160***	22.371	−0.036	−11.587	0.107***	37.895*	−0.061	−7.419
	(0.05)	(19.58)	(0.05)	(23.67)	(0.04)	(19.65)	(0.05)	(23.03)
East Germany*Wave 1991/92	−0.044	−1.660	0.122***	40.337***	−0.041	−1.582	0.119***	46.362***
	(0.03)	(12.53)	(0.04)	(14.27)	(0.03)	(12.17)	(0.04)	(14.40)
Cohabiting	0.028	−3.213	0.070**	42.715***	0.019	0.369	0.045	37.317***
	(0.03)	(12.45)	(0.04)	(11.66)	(0.02)	(11.74)	(0.04)	(11.77)
Household net income (in 1,000€)	0.011	4.601	−0.005	12.372**	0.004	10.900**	−0.005	15.490***
	(0.01)	(4.92)	(0.01)	(5.60)	(0.01)	(4.98)	(0.01)	(5.42)
Household net income (in 1,000€)*Wave 1991/92	0.004	17.696***	0.030*	19.278***	0.003	15.230**	0.028*	16.556**
	(0.02)	(6.35)	(0.02)	(7.45)	(0.01)	(6.48)	(0.02)	(7.43)
Age	−0.000	−0.732*	−0.003***	−1.582***	−0.001	−1.098***	−0.004***	−1.922***
	(0.00)	(0.38)	(0.00)	(0.46)	(0.00)	(0.35)	(0.00)	(0.47)
Net hourly wages (in €)	0.000	0.017	0.000	0.120**	0.000	−0.050	0.001**	0.101*
	(0.00)	(0.04)	(0.00)	(0.05)	(0.00)	(0.06)	(0.00)	(0.06)
Net hourly wages (in €)*Wave 1991/92	−0.007***	−5.640***	−0.006**	−8.046***	−0.003**	−5.598***	−0.005**	−7.173***
	(0.00)	(1.23)	(0.00)	(1.50)	(0.00)	(1.14)	(0.00)	(1.50)
Schooling (ref.: lower school degree)								
No degree/other degree	0.010	1.111	−0.013	6.658	0.000	3.835	−0.021	1.488
	(0.02)	(6.39)	(0.02)	(8.37)	(0.01)	(6.01)	(0.02)	(8.40)
Degree for professional college	−0.004	−16.745	−0.034	5.351	0.007	−14.965	−0.034	12.659
	(0.03)	(11.03)	(0.03)	(13.56)	(0.02)	(10.80)	(0.03)	(13.68)
High school degree	−0.013	−12.705	−0.029	−11.258	−0.002	−10.069	−0.042*	−9.020
	(0.03)	(10.33)	(0.03)	(10.50)	(0.02)	(10.25)	(0.02)	(10.52)
Vocational education (ref.: apprenticeship)								
No education	−0.010	6.785	−0.015	−5.663	−0.040	−9.476	−0.010	−10.302
	(0.04)	(17.34)	(0.03)	(15.27)	(0.03)	(15.77)	(0.03)	(15.43)
Master school	−0.038*	14.709**	0.058	15.649	−0.040***	17.810**	0.033	13.389
	(0.02)	(7.23)	(0.04)	(17.40)	(0.01)	(7.05)	(0.04)	(18.57)
University of applied science degree	0.013	10.093	0.088***	25.620**	0.003	20.702*	0.085**	18.744
	(0.03)	(11.12)	(0.03)	(12.11)	(0.02)	(10.85)	(0.03)	(11.96)
University degree	0.034	−3.820	0.174***	14.621	0.012	2.672	0.131***	15.068
	(0.03)	(12.43)	(0.04)	(13.99)	(0.02)	(12.22)	(0.03)	(13.69)
Other educational degree	−0.000	17.388	0.027	19.189**	−0.026	24.045**	0.036	13.945
	(0.04)	(11.94)	(0.03)	(9.72)	(0.03)	(11.10)	(0.03)	(9.76)
Occupation (ref.: white collar worker)								
Self-employed	0.219***	15.705*	0.081***	−26.996**	0.072***	19.444**	0.009	−30.344**
	(0.02)	(8.49)	(0.03)	(12.66)	(0.02)	(8.37)	(0.03)	(13.26)
Civil servant	−0.025	−35.353***	−0.015	−10.795	−0.023	−36.559***	−0.019	−3.027
	(0.02)	(6.99)	(0.03)	(10.99)	(0.01)	(6.73)	(0.03)	(11.15)
Blue collar worker	−0.043**	−4.429	−0.037	−24.443**	−0.016	1.203	−0.049**	−22.572**
	(0.02)	(7.07)	(0.03)	(10.60)	(0.01)	(6.61)	(0.02)	(10.44)

To be continued on next page

Table 1: Reduced Form Estimates – Paid Work (continued)

	All days				Weekdays			
	Male		Female		Male		Female	
	P(t>0)	E(t|t>0)	P(t>0)	E(t|t>0)	P(t>0)	E(t|t>0)	P(t>0)	E(t|t>0)
Instruments:								
No. of children	0.004	2.538	−0.026***	−25.700***	−0.000	2.006	−0.027***	−30.271***
	(0.01)	(2.74)	(0.01)	(3.54)	(0.01)	(2.65)	(0.01)	(3.53)
Youngest child < 3 years	−0.029	−6.454	−0.258***	−72.319***	−0.027	−4.591	−0.239***	−77.499***
	(0.03)	(10.59)	(0.03)	(16.61)	(0.02)	(10.04)	(0.03)	(16.85)
Youngest child >= 3 and < 6 years	0.000	−11.400	−0.074***	−41.466***	0.019	−13.273*	−0.066***	−49.492***
	(0.02)	(7.93)	(0.03)	(9.66)	(0.02)	(7.71)	(0.02)	(9.58)
Additional persons living in the household	0.005	−26.490**	0.006	−47.431***	0.032	−24.892**	0.027	−49.354***
	(0.04)	(12.49)	(0.04)	(16.58)	(0.03)	(11.74)	(0.04)	(16.05)
External help	0.031**	−4.586	0.021	3.267	0.021*	−4.832	0.013	3.895
	(0.01)	(5.32)	(0.02)	(6.41)	(0.01)	(5.14)	(0.02)	(6.42)
House owner	0.006	11.437**	0.008	−16.442**	−0.002	13.181**	0.010	−16.491**
	(0.02)	(5.52)	(0.02)	(6.64)	(0.01)	(5.29)	(0.02)	(6.72)
Dishwasher	0.007	−5.362	−0.058***	−15.016*	0.012	−6.466	−0.042**	−15.540*
	(0.02)	(6.27)	(0.02)	(8.04)	(0.01)	(6.00)	(0.02)	(7.97)
Dryer	−0.007	−5.569	0.028*	7.649	0.014	−6.260	0.023	4.519
	(0.01)	(5.53)	(0.02)	(6.74)	(0.01)	(5.32)	(0.02)	(6.66)
Distance grocery store (in minutes)	0.000	0.048	0.000	0.148	−0.000	−0.058	0.000	0.109
	(0.00)	(0.16)	(0.00)	(0.17)	(0.00)	(0.14)	(0.00)	(0.17)
Fixed working hours	−0.017	−9.874*	0.028*	7.495	−0.016	−3.358	0.017	8.276*
	(0.01)	(5.32)	(0.02)	(6.10)	(0.01)	(5.17)	(0.01)	(4.40)
Shift work	0.020	15.543**	0.051*	37.898***	−0.040***	−3.471*	−0.025	19.518**
	(0.02)	(7.28)	(0.03)	(9.75)	(0.01)	(1.98)	(0.02)	(9.72)
Distance workplace (in minutes)	−0.000	0.530***	−0.001***	1.029***	−0.000	0.645***	−0.001***	1.041***
	(0.00)	(0.07)	(0.00)	(0.12)	(0.00)	(0.06)	(0.00)	(0.13)
Friday	−0.045***	−58.735***	−0.070***	−34.186***	−0.027***	−59.448***	−0.055***	−34.859***
	(0.02)	(5.11)	(0.02)	(5.98)	(0.01)	(5.12)	(0.01)	(6.03)
F-statistic for joint significance of instruments	-	100.91	-	36.50	-	59.59	-	27.24
Observations	7,448	5,389	7,448	4,570	5,301	4,729	5,301	4,114
Predicted values: E(t)		378.80		239.35		496.77		314.36
Predicted values: E(t|t>0)		477.72		357.29		555.72		397.08

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

Table 2: Reduced Form Estimates – Unpaid Work

	All days				Weekdays			
	Male		Female		Male		Female	
	P(t>0)	E(t|t>0)	P(t>0)	E(t|t>0)	P(t>0)	E(t|t>0)	P(t>0)	E(t|t>0)
Exogenous regressors:								
Saturday	0.039***	86.350***	-	44.482***	-	-	-	-
	(0.01)	(3.74)		(5.19)				
Sunday	0.037***	31.547***	-	−42.797***	-	-	-	-
	(0.01)	(4.36)		(5.49)				
East Germany	0.001	9.160	-	−21.144**	−0.018	6.988	-	−54.913***
	(0.01)	(6.77)		(8.94)	(0.02)	(8.15)		(11.14)
Wave 1991/92	−0.014	16.337	-	63.261***	−0.027	4.248	-	38.939**
	(0.02)	(15.21)		(15.07)	(0.03)	(16.94)		(18.16)
East Germany*Wave 1991/92	0.014	1.069	-	−34.364***	0.027	4.964	-	−26.311*
	(0.02)	(9.03)		(11.25)	(0.02)	(10.43)		(13.97)
Cohabiting	−0.008	−17.561*	-	−54.991***	−0.007	−17.615	-	−61.835***
	(0.02)	(9.08)		(11.47)	(0.02)	(11.08)		(14.65)
Household net income (in 1,000€)	−0.003	2.405	-	−6.679*	−0.006	−1.415	-	−14.646***
	(0.01)	(3.83)		(3.80)	(0.01)	(4.38)		(4.58)
Household net income (in 1,000€)*Wave 1991/92	−0.007	−11.346**	-	−13.464***	−0.005	−9.571*	-	−5.910
	(0.01)	(4.49)		(4.78)	(0.01)	(5.31)		(5.84)
Age	−0.001**	0.321	-	1.652***	−0.001*	0.449	-	1.660***
	(0.00)	(0.28)		(0.34)	(0.00)	(0.31)		(0.41)
Net hourly wages (in €)	−0.000**	−0.139*	-	−0.063	−0.000**	0.075	-	−0.091
	(0.00)	(0.08)		(0.07)	(0.00)	(0.14)		(0.10)
Net hourly wages (in €)*Wave 1991/92	0.004***	0.811***	-	2.076***	0.004**	0.476**	-	1.695**
	(0.00)	(0.20)		(0.67)	(0.00)	(0.19)		(0.81)
Schooling (ref.: lower school degree)								
No degree/other degree	0.008	7.232	-	4.132	−0.021*	9.730*	-	−1.228
	(0.01)	(7.56)		(9.97)	(0.01)	(5.56)		(6.85)
Degree for professional college	0.025*	6.186	-	−5.708	0.009	11.928	-	1.116
	(0.01)	(7.10)		(7.25)	(0.02)	(8.47)		(11.38)
High school degree	−0.024	−0.883	-	−7.224	0.031*	15.535*	-	−0.653
	(0.02)	(11.06)		(8.94)	(0.02)	(8.33)		(8.75)
Vocational education (ref.: apprenticeship)								
No education	−0.024	−0.883	-	−7.224	−0.018	−2.141	-	−9.820
	(0.02)	(11.06)		(8.94)	(0.03)	(11.23)		(10.81)
Master school	−0.016*	1.866	-	−21.033*	−0.008	7.530	-	−29.676**
	(0.01)	(6.14)		(10.91)	(0.01)	(6.41)		(13.07)
University of applied science degree	−0.024*	−9.488	-	−22.450**	−0.030	−15.150*	-	−32.391***
	(0.01)	(7.57)		(9.40)	(0.02)	(8.66)		(11.36)
University degree	0.005	2.589	-	−20.565**	0.008	−8.599	-	−27.162**
	(0.02)	(8.37)		(10.18)	(0.02)	(9.65)		(12.23)
Other educational degree	−0.018	2.436	-	−9.779	−0.015	−3.677	-	−9.698
	(0.02)	(8.00)		(7.64)	(0.02)	(10.28)		(8.99)
Occupation (ref.: white collar worker)								
Self-employed	−0.062***	−37.760***	-	11.383	−0.069***	−37.114***	-	19.717**
	(0.01)	(6.74)		(7.89)	(0.01)	(7.86)		(9.40)
Civil servant	0.014	12.876**	-	12.957	0.020	15.418***	-	7.485
	(0.01)	(5.20)		(8.34)	(0.01)	(5.86)		(9.98)
Blue collar worker	0.008	5.183	-	6.975	0.006	3.395	-	10.438
	(0.01)	(5.23)		(7.08)	(0.01)	(5.64)		(8.23)

To be continued on next page

Table 2: Reduced Form Estimates – Unpaid Work (continued)

	All days				Weekdays			
	Male		Female		Male		Female	
	P(t>0)	E(t|t>0)	P(t>0)	E(t|t>0)	P(t>0)	E(t|t>0)	P(t>0)	E(t|t>0)
Instruments:								
No. of children	−0.005	4.584**	-	31.414***	−0.004	5.062**	-	38.368***
	(0.00)	(1.99)		(2.34)	(0.00)	(2.25)		(2.85)
Youngest child < 3 years	0.060***	44.372***	-	135.505***	0.060***	36.112***	-	142.836***
	(0.02)	(6.48)		(9.28)	(0.02)	(7.19)		(11.28)
Youngest child >= 3 and < 6 years	0.041***	19.721***	-	58.693***	0.042***	16.204***	-	61.961***
	(0.01)	(5.62)		(6.58)	(0.02)	(6.07)		(7.73)
Additional persons living in the household	−0.002	7.087	-	34.176***	−0.010	14.172	-	42.869***
	(0.02)	(10.03)		(10.80)	(0.02)	(10.75)		(12.56)
External help	0.017**	3.683	-	1.772	0.018*	0.709	-	0.320
	(0.01)	(4.07)		(4.76)	(0.01)	(4.62)		(5.62)
House owner	0.005	11.116***	-	22.330***	0.004	7.492**	-	21.189***
	(0.01)	(4.03)		(4.81)	(0.01)	(3.31)		(5.74)
Dishwasher	−0.009	−7.085**	-	1.998*	−0.010	−4.786*	-	4.152*
	(0.01)	(2.95)		(1.19)	(0.01)	(2.62)		(2.32)
Dryer	−0.003	−5.597	-	−2.831**	−0.007	−3.627	-	−2.200*
	(0.01)	(4.10)		(1.31)	(0.01)	(4.72)		(1.31)
Distance grocery store (in minutes)	−0.000	0.223**	-	0.113	−0.000**	0.230**	-	0.046
	(0.00)	(0.11)		(0.13)	(0.00)	(0.11)		(0.16)
Fixed working hours	0.015*	4.319	-	−5.804	0.012	2.370	-	−5.541
	(0.01)	(4.15)		(4.38)	(0.01)	(4.66)		(5.29)
Shift work	0.005	15.023***	-	−14.057**	0.020	23.701	-	0.108
	(0.01)	(5.13)		(6.87)	(0.01)	(15.29)		(8.18)
Distance workplace (in minutes)	−0.000	−0.108**	-	−0.167**	−0.000	−0.231***	-	−0.242**
	(0.00)	(0.05)		(0.07)	(0.00)	(0.06)		(0.09)
Friday	0.004	29.670***	-	20.538***	0.004	25.669***	-	20.821***
	(0.01)	(4.61)		(5.08)	(0.01)	(3.87)		(5.13)
F-statistic for joint significance of instruments	-	15.76	-	15.88	-	8.92	-	13.13
Observations	7,448	6,813	-	7,377	5,301	4,799	-	5,252
Predicted values: E(t)		150.78		292.89		132.22		294.15
Predicted values: E(t|t>0)		163.36		295.33		145.16		296.49

*Notes: – Marginal effects, with robust standard errors in parenthesis. – Significant at ***: 1% level; **: 5% level; *: 10% level. – Since the proportion of women not spending any time on non-market work on the survey day amounts to less than 1%, the first-step probit model could only be estimated for men.*

Table 3: Structural Form Estimates - Truncated Regression

	All days			
	Paid work		Unpaid work	
	Male	Female	Male	Female
Prediction: Paid work male		0.662***	−0.220***	−0.314***
		(0.10)	(0.03)	(0.05)
Prediction: Paid work female	0.212**		0.118***	−0.468***
	(0.08)		(0.05)	(0.06)
Prediction: Unpaid work male	−0.141	1.168***		0.268**
	(0.29)	(0.21)		(0.12)
Prediction: Unpaid work female	0.183	−1.259***	0.266**	
	(0.13)	(0.24)	(0.12)	
Observations	5,389	4,570	6,813	7,377
Overidentification-test (p-value)	0.72	0.37	0.27	0.19
	Weekdays			
	Paid work		Unpaid work	
	Male	Female	Male	Female
Prediction: Paid work male		0.834***	−0.438***	−0.284***
		(0.11)	(0.04)	(0.10)
Prediction: Paid work female	0.153*		0.030	−0.423***
	(0.09)		(0.08)	(0.09)
Prediction: Unpaid work male	−0.312	1.493***		−0.513***
	(0.26)	(0.21)		(0.18)
Prediction: Unpaid work female	0.184	−1.371***	−0.057	
	(0.12)	(0.22)	(0.15)	
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. – The predicted values of the reduced form equations are the expected values of t, conditional on $t > 0$, i.e. $E(t|t > 0)$. – Full estimation results are shown in Table A4 in the Appendix.*

Table 4: Structural Form Estimates - Tobit Results

	All days			
	Paid work		Unpaid work	
	Male	Female	Male	Female
Prediction: Paid work male		0.467***	−0.377***	−0.387***
		(0.16)	(0.04)	(0.06)
Prediction: Paid work female	0.515***		0.301***	−0.198***
	(0.14)		(0.05)	(0.05)
Prediction: Unpaid work male	0.084	0.391		0.243**
	(0.40)	(0.29)		(0.12)
Prediction: Unpaid work female	0.553***	−1.169***	0.647***	
	(0.21)	(0.12)	(0.15)	
Observations	7,448	7,448	7,448	7,448
	Weekdays			
	Paid work		Unpaid work	
	Male	Female	Male	Female
Prediction: Paid work male		0.582**	−0.560***	−0.249**
		(0.25)	(0.05)	(0.10)
Prediction: Paid work female	0.316**		0.022	−0.355***
	(0.12)		(0.10)	(0.08)
Prediction: Unpaid work male	−0.115	0.792**		−0.540***
	(0.48)	(0.34)		(0.17)
Prediction: Unpaid work female	0.278	−0.914**	−0.235	
	(0.21)	(0.37)	(0.24)	
Observations	5,301	5,301	5,301	5,301

*Notes: – Coefficient estimates, with robust standard errors in parenthesis. – Significant at ***: 1% level; **: 5% level; *: 10% level. – The predicted values of the reduced form equations are the expected values of t, conditional on $t > 0$, i.e. $E(t|t > 0)$. – Since $var(\epsilon_{ijk})$ is not identified for the Tobit model, neither marginal effects nor the test for over-identification restrictions could be calculated. – Control variables are the same as in Table A4. Full estimation results are available from the author upon request.*

Appendix

Table A1: Partners' Time Allocation

	Average minutes	Percentage of zeros	Average minutes if t>0
		All days	
Paid work male	362.87	0.31	517.51
	(284.89)	(0.46)	(173.29)
Paid work female	263.20	0.39	426.11
	(255.02)	(0.49)	(185.01)
Unpaid work male	150.91	0.08	124.23
	(141.22)	(0.27)	(94.87)
Unpaid work female	261.70	0.01	221.04
	(162.65)	(0.12)	(135.63)
		Weekdays	
Paid work male	489.04	0.13	550.67
	(227.52)	(0.33)	(136.51)
Paid work female	352.07	0.22	446.83
	(240.01)	(0.41)	(170.99)
Unpaid work male	132.86	0.09	121.60
	(129.66)	(0.29)	(91.94)
Unpaid work female	255.94	0.01	221.45
	(166.41)	(0.12)	(134.97)

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
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	0.26	(0.44)
Wave 1991/92	0.67	(0.47)
East Germany*Wave 1991/92	0.18	(0.39)
Household net income (in 1,000€)	2.73	(1.10)
Household net income (in 1,000€)*Wave 1991/92	1.61	(1.42)
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	(0.34)
Additional persons living in the household	0.04	(0.20)
House owner	0.62	(0.49)
External help	0.38	(0.48)
Dishwasher	0.64	(0.48)
Dryer	0.42	(0.49)
Distance grocery store (in minutes)	12.51	(17.29)
Friday	14.00	(0.35)
Saturday	14.62	(0.35)
Sunday	14.53	(0.35)

	Male		**Female**	
Individual level:	mean	sd	mean	sd
Age	43.41	(8.50)	40.67	(8.26)
Net hourly wages (in €)	10.26	(16.27)	7.70	(22.29)
Net hourly wages (in €)*Wave 1991/92	5.80	(6.71)	4.10	(4.41)
Schooling				
Lower school degree/other degree	0.36	(0.48)	0.27	(0.44)
Intermediary school degree	0.30	(0.46)	0.44	(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	(0.26)
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	(0.31)
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	(0.39)	0.10	(0.30)
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)	0.48	(0.50)
Shift work	0.17	(0.38)	0.11	(0.31)
Distance workplace (in minutes)	42.01	(38.14)	36.81	(33.40)
Observations	**3,200**			

Table A4: Structural Form Estimates – Truncated Regression (Table 3 Continued)

	All days				Weekdays			
	Paid work		Unpaid work		Paid work		Unpaid work	
	Male	Female	Male	Female	Male	Female	Male	Female
Exogenous regressors:								
Saturday	−178.200***	165.192***	−29.560	−143.979***	-	-	-	-
	(36.71)	(50.49)	(21.10)	(20.48)				
Sunday	−309.920***	93.126*	−60.558***	−112.589***	-	-	-	-
	(35.04)	(52.29)	(11.92)	(14.69)				
East Germany	4.157	27.311**	12.378*	−10.000	18.508*	−16.653	18.475**	−10.393
	(11.22)	(12.54)	(7.21)	(9.06)	(10.85)	(16.00)	(9.36)	(12.67)
Wave 1991/92	20.916	24.611	12.190	40.188**	40.186**	−0.458	45.454**	46.390**
	(19.39)	(27.69)	(17.81)	(15.65)	(19.47)	(24.78)	(18.47)	(19.82)
East Germany*Wave 1991/92	−9.924	−11.827	0.867	−4.885	−6.063	−2.591	−7.114	8.764
	(13.55)	(17.24)	(10.63)	(12.09)	(13.56)	(16.08)	(12.08)	(16.19)
Cohabiting	−11.227	10.070	−12.228	−31.234***	−4.732	−3.297	−17.684	−44.139***
	(13.19)	(15.45)	(10.34)	(12.05)	(12.29)	(15.39)	(12.12)	(15.53)
Household net income (in 1,000€)	4.915	−3.438	4.408	−6.662*	11.843**	−11.254*	2.718	−8.200*
	(4.89)	(5.89)	(3.77)	(3.77)	(4.89)	(6.28)	(4.59)	(4.67)
Household net income (in 1,000€)*Wave 1991/92	13.750**	9.279	−8.281*	−3.711	9.458	15.191**	−8.035	−0.245
	(6.47)	(7.75)	(4.67)	(4.99)	(6.47)	(7.28)	(5.45)	(6.29)
Age	−0.449	0.813	−0.078	0.955***	−0.695**	1.293**	−0.279	0.019
	(0.33)	(0.63)	(0.31)	(0.36)	(0.32)	(0.62)	(0.34)	(0.50)
Net hourly wages (in €)	−0.003	0.054	−0.080	0.003	−0.082	0.007	0.086	−0.007
	(0.06)	(0.06)	(0.09)	(0.07)	(0.06)	(0.07)	(0.14)	(0.10)
Net hourly wages (in €)*Wave 1991/92	−5.072***	−5.282***	0.130	−0.270	−5.051***	−4.876***	−0.940**	−0.858
	(1.22)	(1.50)	(0.20)	(0.73)	(1.11)	(1.45)	(0.44)	(0.96)
Schooling (ref.: lower school degree)								
No degree/other degree	−0.434	4.861	3.517	−4.003	3.885	0.032	12.205**	−3.987
	(6.48)	(8.32)	(4.97)	(5.66)	(5.95)	(8.25)	(5.42)	(6.85)
Degree for professional college	−17.265	12.843	1.123	2.099	−12.588	15.967	5.866	−0.003
	(11.27)	(13.68)	(7.62)	(9.86)	(11.26)	(13.64)	(8.54)	(11.31)
High school degree	−13.019	−19.137*	3.683	−12.171*	−5.859	−14.626	9.756	−9.690
	(10.61)	(10.40)	(7.10)	(7.27)	(11.12)	(10.39)	(8.35)	(8.90)
Vocational education (ref.: apprenticeship)								
No education	1.536	−17.080	−2.847	−10.593	−14.740	−26.719*	−17.629	−14.198
	(17.29)	(15.23)	(11.18)	(8.87)	(15.79)	(15.29)	(11.41)	(10.83)
Master school	14.837**	−11.492	−4.516	−9.361	20.176***	−29.688	−0.300	−19.459
	(7.20)	(19.55)	(6.28)	(10.94)	(7.20)	(21.61)	(6.43)	(13.20)
University of applied science degree	9.555	−2.441	−8.909	−0.709	16.432	−18.560	−9.790	−12.892
	(11.64)	(13.32)	(7.45)	(9.41)	(11.79)	(13.27)	(8.44)	(11.65)
University degree	−4.331	−16.060	−1.054	5.682	0.796	−20.740	−9.833	−0.773
	(12.45)	(15.24)	(8.25)	(10.16)	(12.26)	(14.91)	(9.57)	(12.68)
Other educational degree	16.018	5.189	4.735	0.292	21.488*	0.759	−2.799	1.135
	(11.96)	(9.80)	(8.02)	(7.70)	(11.30)	(9.62)	(10.28)	(9.11)
Occupation (ref.: white collar worker)								
Self-employed	10.993	−11.027	−22.931***	−6.423	7.712	2.078	−17.710**	17.360*
	(13.67)	(13.17)	(6.93)	(7.56)	(13.16)	(14.28)	(7.81)	(9.28)
Civil servant	−32.456***	9.743	8.305	6.929	−30.502***	10.510	−2.249	0.817
	(8.00)	(11.52)	(5.29)	(6.85)	(8.04)	(11.38)	(6.60)	(8.41)
Blue collar worker	−1.190	−16.518	6.200	0.331	4.923	−9.464	1.171	−7.691
	(7.50)	(10.57)	(5.12)	(5.50)	(6.83)	(10.41)	(5.74)	(6.73)

To be continued on next page

Table A4: Structural Form Estimates – Truncated Regression (Table 3 Continued)

	All days				Weekdays			
	Paid work		Unpaid work		Paid work		Unpaid work	
	Male	Female	Male	Female	Male	Female	Male	Female
Instruments:								
No. of children	-	7.121	−0.829	19.660***	-	0.989	57.191**	39.169***
		(7.70)	(4.31)	(2.80)		(8.58)	(25.86)	(6.44)
Youngest child < 3 years	-	64.989*	10.853	74.132***	-	63.430*	228.061**	136.117***
		(36.97)	(18.14)	(13.61)		(36.90)	(95.40)	(26.52)
Youngest child >= 3 and < 6 years	-	17.121	6.148	33.462***	-	3.667	120.152**	72.576***
		(16.44)	(8.86)	(7.97)		(17.95)	(52.00)	(14.93)
Additional persons living in the household	-	-	−3.011	23.813**	-	-	112.139	58.480***
			(11.27)	(10.87)			(74.44)	(21.01)
External help	-	-	3.825	1.114	-	-	25.442	8.174
			(4.11)	(4.81)			(26.33)	(8.45)
House owner	-	-	6.509	13.417***	-	-	81.891**	33.687***
			(4.97)	(5.20)			(35.07)	(8.94)
Dishwasher	-	-	−5.685	−5.738	-	-	−25.715	−3.963
			(4.94)	(5.83)			(29.02)	(10.10)
Dryer	-	-	−7.476*	5.278	-	-	−1.365	8.691
			(4.17)	(4.93)			(28.27)	(8.29)
Distance grocery store (in minutes)	-	-	0.167	0.152	-	-	1.148*	0.305
			(0.11)	(0.13)			(0.50)	(0.24)
Fixed working hours	−9.109	−0.050	-	-	−2.117	−0.367	-	-
	(5.66)	(6.06)			(5.30)	(6.07)		
Shift work	15.971**	12.255	-	-	4.638	13.387	-	-
	(7.95)	(10.58)			(9.83)	(9.55)		
Distance workplace (in minutes)	0.502***	0.812***	-	-	0.564***	0.699***	-	-
	(0.07)	(0.13)			(0.08)	(0.14)		
Friday	−48.617***	4.327	-	-	−47.593***	9.283	-	-
	(9.13)	(8.97)			(8.65)	(8.94)		
Observations	5,389	4,570	6,813	7,377	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.*