Asymmetric Effects of Changes in Labor Supply on Labor Demand

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Abstract

We propose and test a model in which longer working hours and higher labor force participation lead to a fall in unemployment. Longer working hours and higher labor force participation both have two direct effects: People have higher incomes and less (leisure) time. This has implications for the composition of consumption demand. People spend less time on "home production" and "outsource" domestic tasks to the market. Consumption demand shifts toward unskill-intensive goods. The relative demand for unskilled labor rises and unemployment falls. We study the relation between labor market participation, home production and the demand for household services using Germany time use data. The empirical results corroborate the predictions from the theoretical model.

Keywords: Labor Market Participation, Home Production, Low Skill Employment
JEL Classification: J22, J23, E21, E24

1 Introduction

In this paper, we present and test a model in which increases in labor market participation[1] trigger an increase in the relative demand for unskilled labor and therefore improve the labor market prospects of unskilled workers. This feedback effect works through changes in the composition of consumption demand respectively changes in home production.

Debates on increasing versus cutting down on weekly working time, prolonging working life by changing the official retirement age and increasing labor force participation particularly among women resurface periodically in the political discussion.[2] The arguments

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[1]In the remainder of the paper, we will use the term *labor market participation* as encompassing (weekly) working time, working life, and labor force participation.

[2]A rise in the official retirement age is currently discussed in order to finance pay-as-you-go funded social security systems in times of population aging. An increasing number of firms in Europe is currently returning to longer working hours in the face of increasing global competition.

against or in favor of these policy measures are well known. Opponents of increased labor market participation think that—for want of jobs—it does not make much sense to have people work longer (hours or years) or have more people enter the labor force in times of high unemployment. This view is based on what has become known as the "lump of labor fallacy". It does not take into account that changes in labor *supply* entail changes in income and consumption demand and thus ultimately in labor *demand*. In other words: The amount of work to be done is not a fixed lump. This idea that the economy adjusts to changes in labor supply—at least in the long run—is well established among economists. Earlier empirical studies of employment effects of working time reduction summarized by Calmfors and Hoel (1988) and (1989) were inconclusive but generally sceptical that this could reduce unemployment. More recent studies, mainly from the economy wide working time reductions in the late 1990s in France, tend to be somewhat more optimistic that working time reduction could have had positive employment effects.[3] Hunt (1999) examines the employment effects of the reduction in working hours in Germany from the mid-1980s to the mid-1990s and finds that "work-sharing" has reduced employment in this period.[4] These studies generally suffer from the fact that changes in labor market participation usually involve changes in unit wage costs (eg, working time reduction with compensatory wage increases) and the effects of the two are hard to separate.[5]

This paper presents and tests a new argument in this old debate. It studies the effects of changes in labor market participation in the absence of compensatory wage changes or any other change in unit labor costs. Hence, our argument is independent of potential union or policy-induced wage-setting schemes. While a voluminous empirical and theoretical literature on the employment effects especially of working reduction already exists, very few studies look at how different types of workers are affected by these measures.[6] In our paper, we show that changes in labor market participation (henceforth LMP) effectuate changes not only in the *level* but also—and more importantly—in the *composition* of the demand for goods and services. In particular, we show that increases in labor market participation lead to a rise in the relative demand for those goods whose production is intensive in the use of unskilled labor. As a consequence, the relative demand for unskilled labor rises and unemployment falls. Thus, measures geared at changing labor market participation do not only result in level effects on employment, but also affect workers with different skill levels differently.

[3] See, eg, Logeay and Schreiber (2003) who conclude that the reduction in standard working hours in combination with wage subsidies led to an increase in employment.

[4] A thorough review of the literature can be found in OECD (1998), pp. 117-148.

[5] Calmfors and Hoel (1989) give five reasons of why working time reduction might actually lead to a reduction in labor demand: (i) Wage rates per unit of time may rise. (ii) Even if wage rates remain constant, wage costs per unit of time may rise due to the existence of fixed costs per employee. (iii) Labor productivity per hour may fall because the proportion of "non-productive" time devoted to starting up and finishing work may rise. (iv) The factor cost of employing new workers rises relative to the cost of increasing overtime when standard hours are cut. (v) Capital utilization will decrease to the extent that the operating time of the capital stock is reduced pari passu with working time.

[6] Corneo (1995) is a notable exception.

In the model economy considered in this paper, individuals maximize their utility over consumption and leisure and allocate their time over three types of activities: market work, producing goods and services at home, and leisure. Consumption is not equal to expenditures in our model, but consists of goods and services purchased on the market as well as self-produced goods.[7]

A rise in LMP has two direct effects in our model: Workers have higher incomes and less (leisure) time. This change in the endowment of people is likely to have effects on the composition of consumption demand. People with higher incomes can consume more. At the same time, they have less time at their disposal. Due to these endowment changes, people raise expenditures on those goods or services, that they have "produced" on their own so far.[8] Examples of this home production are house cleaning, preparing food (making pizza rather than having it delivered,...), car washing, fixing bicycles, ironing shirts, walking dogs, repairs at home, do-it-yourself, child care, etc. The goods that everyone can make on their own are—almost by definition—exactly those that can be "produced" by unskilled workers. So, as a consequence of growing LMP, consumption demand shifts towards goods and services that are supplied mostly by unskilled workers and the relative demand for unskilled labor rises.

Unemployment in this model emerges because wages are downwardly rigid.[9] The adverse effects of this rigidity of wages are (obviously) especially strong at the lower end of the skill distribution. Given this concentration of unemployment at unskilled labor, comparative statics of unemployment depend on changes in the composition of labor demand. Exogenous changes that increase the demand for products that are intensive in the use of unskilled labor have significant employment effects. Substitution away from these products is likely to reduce employment. The employment effects are shown to be more severe, the more complementary are the consumption goods and leisure.

In the second part of the paper, we test the basic mechanism of our model, i.e. we analyze the empirical link between labor force participation and the demand for goods and services that could be produced by the household itself. That changes in the *structure* of consumption demand do affect the *level* of employment has already been found in a series of empirical studies surveyed in Schettkat and Salverda (2004). The focus in these studies is on international differences in the structure of consumption demand while we look at how changes in labor market participation result in changes in the composition of consumption demand. Brück, Haisken-DeNew, and Zimmermann (2003) showed already that the demand for household services is very income-elastic, and that there is a potentially large market for such services. We show additionally, that not only an increasing

[7]The argument that consumption is more than expenditures goes back to Becker (1965) and Gronau (1977).

[8]This argument has been analyzed as an explanatory factor for the drop in household expenditures at retirement in recent studies (Aguiar and Hurst 2004, Hurd and Rohwedder 2003, Heathcote 2002).

[9]Labor market frictions that entail downward rigidity of wages include unemployment benefits, minimum wages, welfare aid, wage-compression due to strong unions, etc.

income, but also the decrease in disposable time raises the demand for household services and other substitutes for home production. Taken together, this evidence implies that increased labor market participation can create jobs for the unskilled—via changes in demand.

We use data on West German households, since there is still quite some scope for increasing working time and labor force participation, especially of females. A quick comparison with the U.S. makes clear that there is considerable scope for reallocation between market work and household production in Germany where a considerable portion of a household's consumption bundle is produced at home. A sizable 50% of total working time (including market work and home production) of Germans takes place at home while in the U.S. the corresponding number is only 39% (Freeman and Schettkat 2002).

We proceed in two steps: First, we use the German time use survey from 1991/92 and investigate whether the time spent on home production activities differs by labor market participation. We find evidence of decreasing time spent on home production upon higher labor market participation. However, it is not clear whether home production is simply reduced without any compensatory outsourcing.[10] Furthermore, working individuals might simply be more efficient in home production so that no additional outsourcing takes place. Thus, we secondly look at a well-defined subset of services substituting for home production, for which we have additional information in the data, and analyze whether outsourcing increases upon higher labor market participation. Again, we find evidence supporting our hypothesis, that outsourcing increases when labor market participation rises. The existing literature on home production and outsourcing of domestic tasks focusses mainly on the intra-household division of labor between, eg, husbands and wives.[11]

The remainder of the paper is organized as follows: In Section 2, we develop the theoretical model. The empirical evidence of the link between labor market participation, home production, and outsourcing is presented in Section 3. Conclusions are drawn in Section 4.

2 The Theoretical Model

The economy is populated by a continuum of measure 1 of heterogeneous households indexed by skill level j. For simplicity, we assume that the entire age distribution is represented in each household. Within each household, all members have the same skill level. At age ρ, members of the household drop out of the labor force. We do not model the retirement decision of the household explicitly, but take the retirement age ρ as endogenously given. For a worker's labor market prospects, only the skill level plays a role while age (as long as it is below ρ) is irrelevant. So, at each skill level, the labor force

[10] In the following, we will use the term "outsourcing" to describe the act of buying household services and other home-producible goods and services instead of producing them in the household.

[11] See, eg, Van der Lippe, Tijdens, and De Ruijter (2004).

consists of a continuum of measure ρ of homogeneous workers.

Labor force participation of households is λ. In the model, λ is exogenous and equal across cohorts and households. Working time per worker is fixed exogenously by the government at ω units of labor per period. Labor supply of each household ξ is equal to the individual working time ω times the integral over all cohorts from 0 to ρ and over those workers who actually participate in the labor force:

$$\xi = \rho \cdot \lambda \cdot \omega.$$

Households have preferences over two consumption goods and leisure. One good can be produced at home or purchased on the market, while the other one can only be purchased at the market and is the numéraire. Unemployment arises because of a minimum wage which depends on the average income level.

2.1 Production in Firms

2.1.1 Technology

Both goods are produced by a continuum of measure 1 of homogenous firms using all types of labor. Good 1 is the self-producible good and good 2 is the market good. The technology for good i is

$$y_i = \int_0^i e^{j\cdot(1+\chi_i)} \cdot n_{i,j} \cdot dj \tag{1}$$

where $n_{i,j}$ is labor input of skill type j for the production of good i. Marginal productivity $\frac{\partial y_i}{\partial n_{i,j}} = e^j$ is increasing with skill level j for both goods.[12] χ is a productivity parameter reflecting differential comparative advantage of skills. $\chi_2 > \chi_1$ implies that the production of good 1 is intensive in the use of unskilled labor. For simplicity, we set $\chi_1 = 0$ and $\chi_2 = \chi$. Firms act as price-takers on input and output markets. Maximizing profits

$$\pi_i = p_i \cdot \int_0^1 e^{j\cdot(1+\chi_i)} \cdot n_{i,j} \cdot dj - \int_0^1 w_j \cdot n_{i,j} \cdot dj \tag{2}$$

leads to demands for type j labor in sectors i:

$$n^d_{i,j} = \begin{cases} \infty & \Leftrightarrow \quad w_j < p_i \cdot e^{(1+\chi_i)\cdot j} \\ [0,\infty) & \Leftrightarrow \quad w_j = p_i \cdot e^{(1+\chi_i)\cdot j} \\ 0 & \Leftrightarrow \quad w_j > p_i \cdot e^{(1+\chi_i)\cdot j} \end{cases} \tag{3}$$

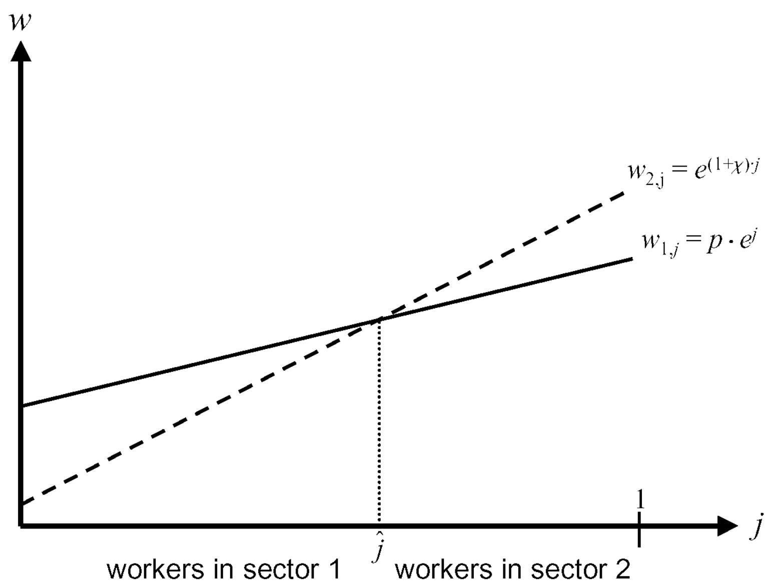
where w_j is the wage for type j labor and p_i is the price of good i.

2.1.2 Allocation of Workers to Sectors

Figure 1 illustrates the allocation of types to sectors. On the horizontal axis is the space of types. On the vertical axis are the wages in the two sectors as functions of the type j.

[12] The exponential specification implies that the distribution of labor income is skewed to the right.

Figure 1: Allocation of Types j to Sectors



Workers supply labor to the firm that offers the highest wage. In equilibrium, firms in sector 1 pay $w_j = p \cdot e^j$ while firms in sector 2 pay $w_j = e^{(1+\chi)\cdot j}$.[13] This difference in wages determines the allocation of types to sectors. Type $\hat{j} = \ln p^{\frac{1}{\chi}}$ is indifferent between working in sector 1 and working in sector 2. All lower types prefer working in sector 1 while all higher types prefer working in sector 2. The higher is the relative price of good 1, the more skill types prefer to work in sector 1. The productivity advantage χ of sector 2 has a negative direct effect on $\hat{j}$ but an indirect effect through p which might counteract the direct effect. For a discussion of the interaction between these two effects, see Weiss (2004).

Equilibrium wages for different types of workers are thus

$$w_j = \begin{cases} p \cdot e^j & \Leftrightarrow \quad j < \ln p^{\frac{1}{\chi}} \\ e^{(1+\chi)\cdot j} & \Leftrightarrow \quad j \geq \ln p^{\frac{1}{\chi}} \end{cases} \tag{4}$$

2.1.3 Goods Supply

Retirement age $\rho < 1$, labor force participation $\lambda < 1$, and fixed working time $\omega < 1$ restrict labor supply of households at each skill level j to $\xi < 1$. Labor supply in the two sectors is thus given by

$$n^s_{1,j} = \begin{cases} \xi & \Leftrightarrow \quad j < \ln p^{\frac{1}{\chi}} \\ \in [0, \xi] & \Leftrightarrow \quad j = \ln p^{\frac{1}{\chi}} \\ 0 & \Leftrightarrow \quad j > \ln p^{\frac{1}{\chi}} \end{cases} \qquad n^s_{2,j} = \begin{cases} 0 & \Leftrightarrow \quad j < \ln p^{\frac{1}{\chi}} \\ \xi - n^s_{1,j} & \Leftrightarrow \quad j = \ln p^{\frac{1}{\chi}} \\ \xi & \Leftrightarrow \quad j > \ln p^{\frac{1}{\chi}} \end{cases} \tag{5}$$

[13] The price of the numéraire, good 2 is normalized to 1. We assume that parameter constellations are such that production is positive in both sectors. This implies that the relative goods price p is larger than 1.

Goods supply is given by

$$y_1 = \int_0^{\ln p^{\frac{1}{\chi}}} e^j \cdot \xi \cdot dj = \xi \cdot \left(p^{\frac{1}{\chi}} - 1\right) \qquad y_2 = \int_{\ln p^{\frac{1}{\chi}}}^1 e^{(1+\chi)\cdot j} \cdot \xi \cdot dj = \xi \cdot \frac{e^{1+\chi} - p^{\frac{1+\chi}{\chi}}}{1+\chi} \tag{6}$$

2.1.4 Wage Rigidity

Unemployment in this model is due to a downward rigidity of the wages. We assume that the wage cannot fall below a minimum $\tilde{w}$ which is indexed to the average income level in the economy.[14] This assumption introduces a rigidity that keeps relative wages from adjusting perfectly to changes in relative labor demand. Therefore, changes in relative labor demand affect employment. This sort of rigidity in the relative wage arises if strong unions ensure a compressed wage structure, if a legal minimum wage exists that is indexed to the average wage, or if welfare aid or unemployment benefits depend on the average income. Another source of such a rigidity in the relative wage could be considerations of fairness as, eg, put forward in the "fair wage-effort hypothesis" by Akerlof and Yellen (1988) and (1990) and recently confirmed in a series of experimental studies surveyed by Fehr and Gächter (2000).[15] In this model, the $\tilde{w}$ should be seen as a simple means to capture all these phenomena leading to a rigidity in the relative wage.[16]

We assume that the "minimum wage" $\tilde{w}$ is a constant fraction θ of the average wage:

$$\tilde{w} = \theta \cdot \int_{\tilde{j}}^1 w_j \cdot dj = \theta \cdot \left(\frac{\chi \cdot p^{\frac{1+\chi}{\chi}} + e^{1+\chi}}{1+\chi} - p \cdot e^{\tilde{j}} \right) \tag{7}$$

where $\tilde{j}$ is the type whose market wage is equal to the minimum wage. All higher types receive higher wages while all lower types are unemployed. So, $\tilde{j}$ also represents the fraction of unemployed workers.

[14] In France, Japan, Spain (among others), the legal minimum wage is explicitly indexed to the average wage (see Cahuc and Zylberberg (2004), page 715). In other countries, this link might not be as explicit, but by and large, wages at the lower end of the distribution are usually somehow tied to the evolution of average wages over time. This assumption is not crucial for the results. On the contrary, the endogeneity of the minimum wage is moderating the employment effect of changes in LMP. If the wage minimum is exogenous, the effect is even stronger.

[15] The fair wage-effort hypothesis is motivated by equity theory in social psychology and social exchange theory in sociology. According to this hypothesis, workers withdraw effort as their actual wage falls short of what they consider their "fair wage". Such behavior causes unemployment by introducing a downward rigidity in wages. Kahnemann, Knetsch, and Thaler (1986) have shown that individual conceptions of fair wages often diverge substantially from the levels that would clear competitive labor markets. See Weiss (2000) for a detailed discussion of causes and effects of rigidities in the relative wage.

[16] In a system of union wages classified by skill levels, $\tilde{w}$ can be seen as the lowest wage level in this classification. For ease of labelling, we will in the remainder of the paper refer to $\tilde{w}$ as the minimum wage.

2.1.5 Unemployment

The unemployment rate $\tilde{j}$ is determined by the equality of the minimum wage $\tilde{w}$ and the market wage of a type $\tilde{j}$ worker, $w_{\tilde{j}}$:

$$\theta \cdot \left(\frac{\chi \cdot p^{\frac{1+\chi}{\chi}} + e^{1+\chi}}{1+\chi} - p \cdot e^{\tilde{j}} \right) \stackrel{!}{=} p \cdot e^{\tilde{j}}$$

Solving for $\tilde{j}$ yields the following lemma.

Lemma 1 *The rate of unemployment $\tilde{j}$ is given by*

$$\tilde{j} = \ln \left(\frac{\theta}{1+\theta} \cdot \frac{\chi \cdot p^{\frac{1+\chi}{\chi}} + e^{1+\chi}}{p \cdot (1+\chi)} \right) \tag{8}$$

It is increasing in θ and decreasing in p.

Not surprisingly, the more generous is the minimum wage (the higher θ), the higher is the rate of unemployment.

The effect of the relative goods price p corresponds to the so-called Stolper-Samuelson-Effect in trade theory. An increase in the relative price of good 1 leads to an increase in the relative demand for lower types of labor (in which the production of good 1 is intensive). This change in relative labor does not fully translate into respective changes in the relative wage so that employment increases.[17]

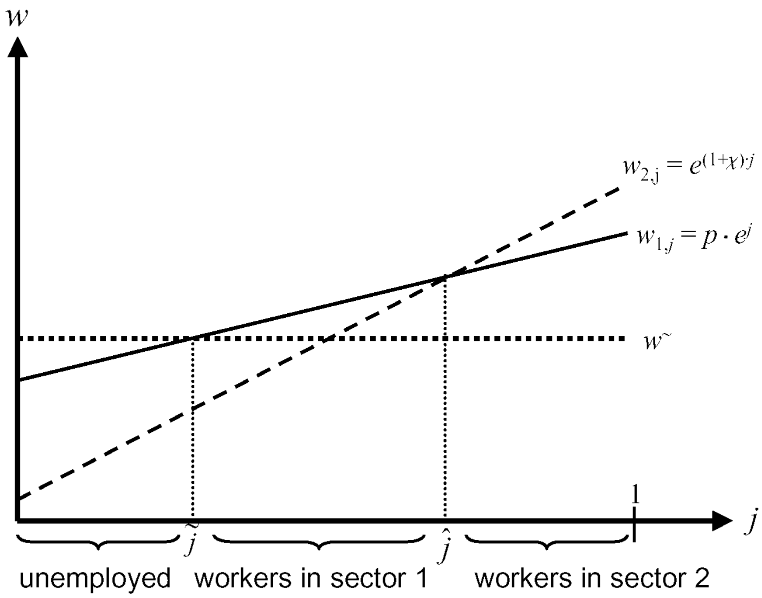
Note that fixed working life ρ, fixed working time ω, and labor force participation λ do not have any direct effect on unemployment $\tilde{j}$ in the model. It is shown in the next section that they affect employment through their effect on the relative goods price p.

Figure 2 illustrates the effect of the minimum wage on employment. For the high types, the wage they can earn in sector 2 exceeds the wage they would receive in sector 1. Therefore, they work in sector 2. The medium range types earn a higher wage in sector 1 than in sector 2. These types work in sector 1. The low types, whose market value in both sectors falls short of the minimum wage, cannot find a job.

An increase in the relative price of good 1, p, exerts an upward pressure on the wage in sector 1. In terms of Figure 2, an increase in p implies an upward shift of the solid line.

[17] χ is a parameter representing the technological advantage of sector 2 relative to sector 1 . As sector 2 employs the high types, an increase in χ can be seen as skill-biased technological change. (To be exact, an increase in χ represents sector-biased technological change with a skill-biased effect on labor demand.) An increase in χ has a positive direct effect on unemployment. Since the relative wage cannot fully adjust to changes in relative labor demand in this setting, skill-biased technical change leads to higher unemployment. For a discussion of this result, see Weiss (2000). But an increase in χ also has an indirect negative effect on unemployment via an increase in the relative price of good 1, p. Whether an increase in χ leads to a fall in the relative demand for lower skill workers is not clear. It depends on the elasticity of substitution in consumption demand. For a discussion of this result, see Weiss (2004).

Figure 2: Allocation of Types j to Sectors and Unemployment



For the highest unemployed types, the wage is pushed above the minimum wage. They find employment, so that total unemployment decreases.[18]

The effect of the fixed working lifetime on the relative goods price p depends on consumption demand which is analyzed in the next subsection.

2.2 Consumption and Home Production

All households share the same preferences over consumption and leisure

$$U_j\left(c_{1,j}, c_{2,j}, l_j\right) = \left(c_{1,j}^{\gamma} + c_{2,j}^{\gamma} + l_j^{\gamma}\right)^{\frac{1}{\gamma}} \tag{9}$$

where l_j is leisure time of a type j household, $c_{i,j}$ is consumption of good i, and $\sigma = \frac{1}{1-\gamma}$ is the elasticity of substitution between consumption of good 1, consumption of good 2, and leisure.[19]

Good 1 is either bought on the market at price p or produced at home with technology

$$y_{1,j}^{h} = \alpha \cdot n_j^{h} \tag{10}$$

where n_j^h is the time that a type j household devotes to home production and α is a productivity parameter. We assume that at home, skill types do not differ in productivity.

[18]The intersection between the solid line (wage in sector 1) and the dotted line (minimum wage) moves to the left. In fact, the dotted line (the minimum wage) shifts upward as well, but this shift is less pronounced because the minimum wage is indexed to both, the wage in sector 1 (which increases) and the wage in sector 2 (which remains unchanged).

[19]For simplicity, we assume, that within a household, consumption and leisure of all household members are just aggregated before they enter the joint utility function.

This assumption is made for simplicity. It has no qualitative effect on the results as long as lower types have a comparative advantage in the production of the good that can be produced at home. Good 2 is bought on the market at price 1.

For employed households, the budget and time constraints are respectively

$$p \cdot \left(c_{1,j} - y_{1,j}^h\right) + c_{2,j} = w_j \cdot \xi \quad \text{and} \quad l_j + n_j^h + \xi = 1 \tag{11}$$

For unemployed households, the budget and time constraints are respectively[20]

$$p \cdot \left(c_{1,j} - y_{1,j}^h\right) + c_{2,j} = 0 \quad \text{and} \quad l_j + n_j^h = 1 \tag{12}$$

Maximizing utility (9) subject to the constraints (10) through (12) yields

$$c_{1,j} = \begin{cases} \frac{\alpha^{\frac{1}{1-\gamma}}}{1+\alpha^{\frac{\gamma}{1-\gamma}} \cdot \left(1+p^{\frac{\gamma}{1-\gamma}}\right)} & \Leftrightarrow \quad j < \tilde{j} \\ \frac{\alpha^{\frac{1}{1-\gamma}} \cdot \left(\frac{w_j \cdot \xi}{\alpha \cdot p} + (1-\xi)\right)}{1+\alpha^{\frac{\gamma}{1-\gamma}} \cdot \left(1+p^{\frac{\gamma}{1-\gamma}}\right)} & \Leftrightarrow \quad j \geq \tilde{j} \end{cases} \qquad c_{2,j} = \begin{cases} \frac{(\alpha \cdot p)^{\frac{1}{1-\gamma}}}{1+\alpha^{\frac{\gamma}{1-\gamma}} \cdot \left(1+p^{\frac{\gamma}{1-\gamma}}\right)} & \Leftrightarrow \quad j < \tilde{j} \\ \frac{(\alpha \cdot p)^{\frac{1}{1-\gamma}} \cdot \left(\frac{w_j \cdot \xi}{p \cdot \alpha} + 1 - \xi\right)}{1+\alpha^{\frac{\gamma}{1-\gamma}} \cdot \left(1+p^{\frac{\gamma}{1-\gamma}}\right)} & \Leftrightarrow \quad j \geq \tilde{j} \end{cases} \tag{13}$$

$$l_j = \begin{cases} \frac{1}{1+\left(1+p^{\frac{\gamma}{1-\gamma}}\right) \cdot \alpha^{\frac{\gamma}{1-\gamma}}} & \Leftrightarrow \quad j < \tilde{j} \\ \frac{\frac{w_j \cdot \xi}{\alpha \cdot p} + 1 - \xi}{1+\left(1+p^{\frac{\gamma}{1-\gamma}}\right) \cdot \alpha^{\frac{\gamma}{1-\gamma}}} & \Leftrightarrow \quad j \geq \tilde{j} \end{cases} \qquad n_j^h = \begin{cases} \frac{\left(1+p^{\frac{\gamma}{1-\gamma}}\right) \cdot \alpha^{\frac{\gamma}{1-\gamma}}}{1+\left(1+p^{\frac{\gamma}{1-\gamma}}\right) \cdot \alpha^{\frac{\gamma}{1-\gamma}}} & \Leftrightarrow \quad j < \tilde{j} \\ \frac{(1-\xi) \cdot \left(1+p^{\frac{\gamma}{1-\gamma}}\right) \cdot \alpha^{\frac{\gamma}{1-\gamma}} - \frac{w_j \cdot \xi}{\alpha \cdot p}}{1+\left(1+p^{\frac{\gamma}{1-\gamma}}\right) \cdot \alpha^{\frac{\gamma}{1-\gamma}}} & \Leftrightarrow \quad j \geq \tilde{j} \end{cases} \tag{14}$$

2.3 General Equilibrium

We restrict the analysis to interior solutions. In particular, we assume that the parameter constellation is such that (i) production in both sectors is strictly positive, (ii) unemployment is strictly positive and strictly below 100%, and (iii) all types of households spend some strictly positive amount of time on home production.

Definition 1 *An equilibrium corresponds to a price system* $\left\{\{w_j\}_{j\in[0,1]}, \{p_i\}_{i=1,2}\right\}$ *and an allocation* $\left\{\{c_{ij}\}_{j\in[0,1],i=1,2}, \{l_j\}_{j\in[0,1]}, \left\{n_j^h\right\}_{j\in[0,1]}, \{y_i\}_{i=1,2}, \left\{y_{1,j}^h\right\}_{j\in[0,1]}\right\}$ *that satisfy the following conditions:*

- ***(Utility Maximization):*** *Given the price system* $\left\{\{w_j\}_{j\in[0,1]}, \{p_i\}_{i=1,2}\right\}$*, the strategy* $\left\{\{c_{ij}\}_{i=1,2}, l_j, n_j^h\right\}$ *maximizes the utility (9) of each household of type* $j \in [0,1]$ *under the technological constraint (10), and the respective budget and time constraints (11) or (12).*

[20] To keep things simple, we assume that there are no unemployment benefits. Unemployed households live on their home production.

- ***(Profit Maximization):*** *Given the price system* $\left\{\{w_j\}_{j\in[0,1]},\{p_i\}_{i=1,2}\right\}$*, the production plan* $\left\{\{n_{i,j}\}_{j\in[0,1]},y_i\right\}$ *maximizes profits (2) of each firm in sector* i*.*
- ***(Market Clearing):***

  For each consumption good $i=1,2:\quad \int_0^1 c_{i,j}\cdot dj = y_i.$

  For each production factor $j\in[0,1]:\quad \sum_{i=1}^2 n_{i,j}=\xi.$

Proposition 1 *An equilibrium exists and is unique. The relative goods price* p *as a function of technology parameters* α*,* χ*, preference parameter* γ*, institutional parameter* θ*, labor force participation* λ*, retirement age* ρ*, and working time* ω *is given implicitly by*

$$(\alpha\cdot p)^{\frac{\gamma}{1-\gamma}}\cdot\frac{\alpha\cdot p\cdot\ln\left(\frac{\theta}{1+\theta}\cdot\frac{\chi\cdot p^{\frac{1+\chi}{\chi}}+e^{1+\chi}}{p\cdot(1+\chi)}\right)+\frac{\chi\cdot p^{\frac{1+\chi}{\chi}}+e^{1+\chi}}{(1+\theta)\cdot(1+\chi)}+\frac{1-\xi}{\xi}\cdot\alpha\cdot p}{1+\left(1+p^{\frac{\gamma}{1-\gamma}}\right)\cdot\alpha^{\frac{\gamma}{1-\gamma}}}=\frac{e^{1+\chi}-p^{\frac{1+\chi}{\chi}}}{1+\chi}\tag{15}$$

where $\xi=\rho\cdot\lambda\cdot\omega$*.*

Proof. See Appendix A. ■

Proposition 2 *An increase in retirement age* ρ*, labor force participation* λ*, or working time* ω *leads to an increase in the relative goods price* p*.*

Proof. See Appendix B. ■

Increases in retirement age, labor force participation and working time all imply a rise in market work. An increase in market work makes households reduce home production and demand more of good 1 from the market. As a consequence, the relative price of good 1 rises.

2.4 Employment Effects of Increasing Labor Market Participation

From Lemma 1 we know that unemployment $\tilde{j}$ depends on the relative goods price p. This is the channel through which market work ξ affects unemployment.

Proposition 3 *An increase in retirement age* ρ*, labor force participation* λ*, or working time* ω *leads to a decrease in the unemployment rate* $\tilde{j}$*. This effect—in terms of* $\frac{\partial\tilde{j}}{\partial\xi}\cdot\frac{\xi}{\tilde{j}}$*—is stronger the smaller is the elasticity of substitution between consumption and leisure* $\sigma=\frac{1}{1-\gamma}$*.*

Proof. See Appendix C. ■

As stated in Proposition 2, an increase in market work leads to an increase in the relative price of good 1. This shifts relative demand for lower types (in which the production of good 1 is intensive) upward. This lifts the wages of some hitherto unemployed types above the minimum wage. They find employment and unemployment falls.

What is the role of the substitution elasticity in this effect? If substitutability is high, an increase in market work can easily be offset by a respective decrease in home production without the need for drastic changes in goods and factor prices. In this case, the wage rigidity does only little harm. (In the extreme case of perfect substitutes, the relative goods price is equal to 1 and the unemployment rate is $\tilde{j} = \ln\left(\frac{\theta}{1+\theta} \cdot \frac{\chi+e^{1+\chi}}{1+\chi}\right)$ independently of market work ξ.) If on the other hand, substitutability is low, substantial changes in relative goods and factor prices are required to induce changes in consumption and leisure following an increase in market work. In this case, the wage rigidity has larger effects.

Now, what is wrong with the arguments that (i) if working life is prolonged, the old take away the jobs from the young, (ii) if more women work, they take away the jobs from the men, (iii) if the employed work longer work hours, the employment prospects of the unemployed are corroded? It is true, of course, that an extension of market work implies an increase in labor supply. At given labor demand, this would entail a rise in unemployment. But—unless the economy is in a recession—the total amount of work to be done is not fixed. Higher labor supply leads to more production, higher incomes and thereby higher demand for goods and labor. But why does unemployment fall if labor supply and demand both increase? The increase in market work leads to an increase in labor supply which is symmetric across all skill levels while the induced increase in labor demand is biased towards unskilled labor. Given the concentration of unemployment at unskilled labor, this shift in relative labor demand has positive employment effects.

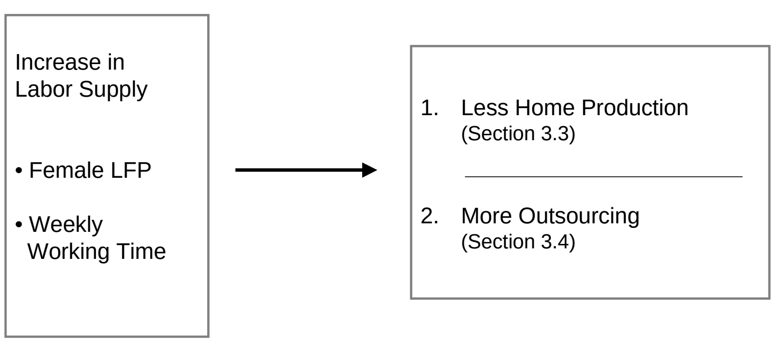
3 Labor Market Participation, Home Production and the Demand for Goods & Services - An Empirical Analysis

In this section, we present evidence supporting our view that increased labor market participation leads to a decrease in home production and to outsourcing of household work and other self-producible goods. The more time is spent in market work, the less time is available for home production and leisure. Some activities in home production like cleaning the house, maintaining the garden and partly child care can be outsourced. Hence, households with a higher labor market participation are more likely to outsource some home production activities.

In the empirical part, we investigate only two aspects of labor market participation, namely changes in (weekly) working time and changes in labor force participation, particularly of women. Changes in the duration of a work life induced by an increased official retirement age are not analyzed. There are some recent papers trying to explain the significant drop in consumption expenditures upon retirement which also investigate whether these households substitute home production for some goods and services formerly purchased at the market (Hamermesh (1984), Banks, Blundell, and Tanner (1998), Hurd and Rohwedder (2003), Aguiar and Hurst (2004), and Heathcote (2002)). Given the particular circumstances and needs of older (retired) people, the link between the length of working life and home production will be studied in a separate paper.

Our empirical evidence is twofold and summarized in Figure 3: Firstly, we investigate the allocation of time by household members conditional on their working time (Section 3.3). We acknowledge differences in the labor market decisions of men and women, and present direct evidence that the time spent on home production activities is reduced the more time the household members spend in market work. This evidence does not necessarily imply more outsourcing of these activities among those who work more. It might just indicate that increased labor force participation leads to a reduction in the consumption of those goods and services that were formerly produced by the household. In order to see whether home production is substituted by respective goods and services purchased at the market, we secondly use the additional information in the time use data about help received by the household (Section 3.4). This help comprises household services, child care, care for elderly persons and technical help. This approach yields empirical evidence supporting our hypothesis that outsourcing takes place, when labor market participation of household members is increased. Hence, we will summarize the empirical evidence as supporting the view, that (a) households with a higher labor market participation reduce their time spent on home production, and (b) that they substitute these tasks by outsourcing, i.e., demanding services and products that fulfill these tasks.

Figure 3: Overview over the empirical analysis

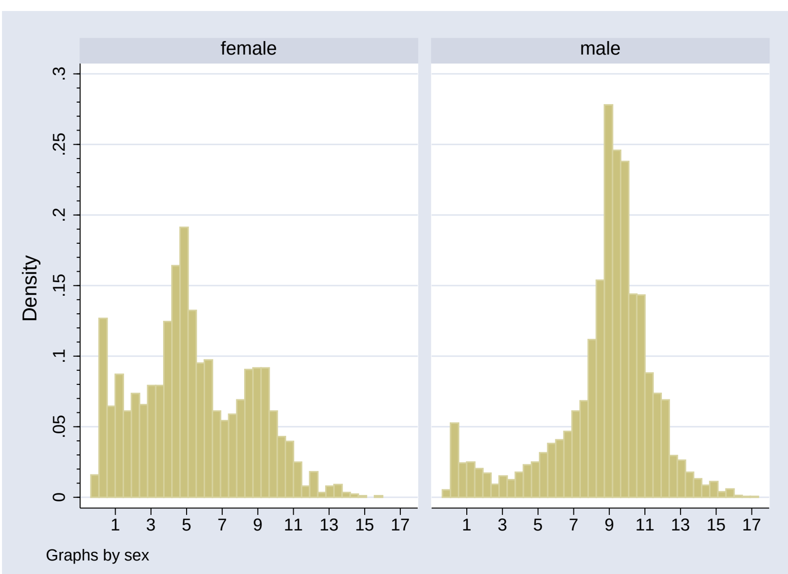


3.1 The Data

For both parts of the analysis, we use a 95% sample of the German time budget survey (Zeitbudgeterhebung) from 1991/92 by the Statistisches Bundesamt. We restrict the sample to West German households headed by married or cohabiting couples in the prime working age group 20-60. Furthermore, the sampling weights supplied by the Statistisches Bundesamt are used in order to render the data representative. Since only one wave of the data is available, we conduct a cross sectional analysis. This implies that we cannot account for unobserved heterogeneity. However, the survey contains a detailed set of household and personal characteristics as well as additional regional variables, which allow us to filter many dimensions of inter-personal heterogeneity.

The time use of respondents is surveyed for two days using a time diary filled out by the respondents, and then summarized over the day by type of activity. We follow the standard classification scheme to group activities into home production, working time and leisure time. The dependent variable home production, HP, is characterized as time spent for food preparation and cleanup, cleaning inside or outside the home, caring for clothes, plants and animals, time spent for shopping, home and car repair, and all children-related activities or caring for other people. Our working time variable, denoted H, is time spent working, commuting to work, taking breaks while at work, and searching for work.[21] The distribution of working hours among the working by sex is shown in Figure 4. For men, it is distinctly single-peaked around 9-10 hours per day. On contrary, we see a very different distribution of female working time with two peaks. The first and highest peak is around 5 hours a day which accords with a part time job plus the time needed for travelling to work and taking breaks at work. The second and lower peak is again around 9-10 hours per day, which corresponds to a full time job plus travel time etc.

Figure 4: Distribution of mean work hours per day by sex among the working



In order to measure labor force participation, P, we have two variables at our disposal. The one based on the diary data does not give us a good idea of the labor force participation

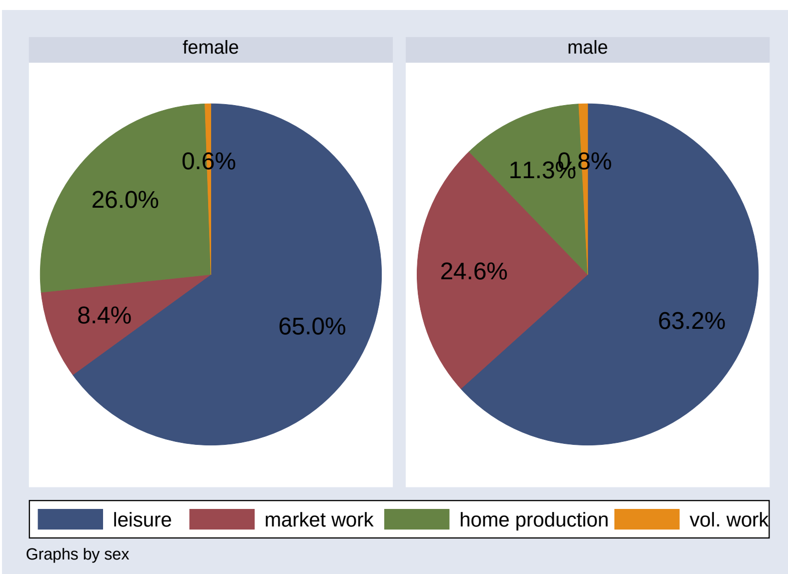
[21]The last category, leisure, comprises time spent for sleeping and napping, washing, dressing, eating, receiving medical care, and time spent for everything else.

of the respondents since the diary day may be a weekend, the person might be sick or on holidays, or the person is part-time employed and only works three days a week etc. Thus, the labor force participation variable is taken from the interview part where respondents are asked whether they are employed. For a description of the other variables used in the analysis, see Appendix D.

3.2 A Descriptive Look at the Relation between Labor Force Participation, Home Production and Outsourcing

We first start with an overview of the general time allocation of working and not working men and women in order to understand the dynamics of the time allocation and the differences in home production between those who are working and those who are not. We distinguish between women and men for two reasons: First, it is widely documented in the literature (Beblo 1999, Van der Lippe, Tijdens, and De Ruijter 2004), that men and women differ in their engagement in home production activities. Second, female labor market participation exhibits a large heterogeneity and policies aimed at increasing labor force participation are often targeted at women.

Figure 5: Time use by (a) sex and (b) sex and employment status (in % of total time)



General time use is split into three broad categories: Both, men and women, spent about two thirds of their day on leisure activities as defined in Section 3.1. However, they differ substantially in how they spent the remaining time. While men spent 22.8 percent of their total time on work-related activities and 11.6 percent on home production activities on average, women allocate their time the other way round: They spent on average roughly one quarter of their time on home production and only 8.4 percent on work-related activities (Figure 5).[22]

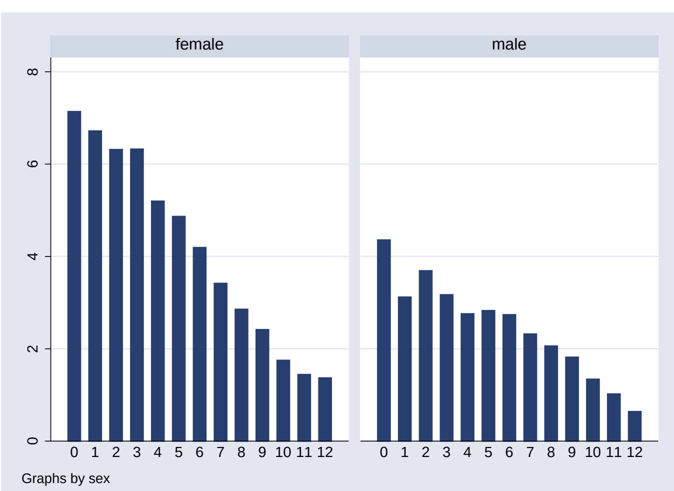
Next, we decompose time use by employment status. Two things are worth noting from Table 1: (1) Working men and women spent only about half as much time on home production activities than their not working counterparts. (2) Differential work status does not explain the gender differences in home production time.

Table 1: Average home production by sex and employment status (hrs/day resp. percent of total time)

	all	not working	working		
			all	part time	fulltime
men(w)	2.77	4.24	1.70	3.28	1.36
women(w)	6.18	7.01	4.39	5.83	1.55
in percent of total time per day					
men(w)	11.5	17.7	7.1	13.7	5.7
women(w)	25.7	29.2	11.1	24.3	6.5

Decomposing time use by working time shows that women with a part time job spend about an hour and 10 minutes less time on home production per day than not working women, while full time employed women reduce the home production by 5 and a half hours per day (Table 1). Figure 6 illustrates this strong and continuous reduction of home production in the increase in working time which is stronger for women. Even among men, the differences in home production by work status and hours are sizeable: Not working men take care of the household about 4 hours and a quarter each day and full time employed men reduce their engagement in the household to about an hour an 22 minutes.

Figure 6: Home production by sex and hours of work



[22]Brines (1994) and Greenstein (2000) put forward sociological factors in order to explain these gender differences. Beblo (1999) analyzes strategic behavior in intra-family time allocation.

Next, we look directly at the relation between labor force participation and outsourcing. In the time use data, we have information on whether (and if, by how much) a household receives help from outside the household. The respective question in the survey reads:

> "Have members of your household received help from persons not belonging to the household within the last three months in the following categories?
>
> - help in the household (cleaning, shopping, laundry)
> - child care
> - care for elderly persons
> - technical help"

18.2% of all households under consideration answered that they receive help from outside the household. 7.6% of all households received help that was paid for. Table 2 displays the percentages of households that received help stratified by employment status.

Table 2: Share of Households Receiving Help, by employment status

Type of help received	all households	Households whose members have the following employment status: both not employed	one employed	both employed
unpaid	11.6%	0.0%	7.1%	14.6%
paid	7.6%	2.3%	3.9%	10.0%
unpaid and paid	18.2%	2.3%	10.5%	23.3%

The higher is a household's labor market participation, the higher is the chance that this household receives (unpaid and paid) help from outside. Using the German Socio-Economic Panel, Hank (2001) presents similar numbers and states that "dual career households use professional help the most." The fraction of households purchasing domestic services is highest among households in which women spend many hours in market work.

3.3 Does Increased Labor Market Participation Lead to a Reduction of Home Production?

The goal of this section is to analyze the relationship between labor force participation and home production activities in a multivariate setting. Households maximize their utility from consumption and leisure as specified in equation (9). Producing goods and services at home saves money, but consumes time resources that could be spent on market labor or leisure activities. Hence, households will have to weigh the marginal cost of purchasing certain goods or services against the marginal cost of producing these goods and services themselves.

We model the decision how much time per day a household spends on home production as a function of household characteristics Z, the labor force participation and hours worked by husband and wife P and H, monthly household net income and interactions INC, and individual characteristics of the spouses X. Furthermore, we control for seasonal and weekly patterns T and regional differences R. We recognize that labor force participation might not be exogenous, and will comment on that later on. For the beginning, we assume labor force participation to be exogenous. The empirical specification is the following:

$$\begin{aligned} HP_h = \alpha + \sum_i \left(\gamma_i \cdot P_{i,h} + \delta_i \cdot H_{i,h} + \eta_i \cdot X_{i,h}\right) \\ + \beta \cdot Z_h + \zeta \cdot INC_h + \rho \cdot T_h + \tau \cdot R_h + \epsilon_h \end{aligned} \tag{16}$$

where HP denotes total time per day spent on home production at day t in minutes, averaged over husband and wife. The subscripts stand for household h, diary day t and household member i where i can be the husband m or the wife f.

The labor market participation of husband and wife can be split up into a participation dummy P and the hours worked on the diary day H. Our argument is that the higher the labor market participation, the less time will be spent on home production. We include labor force participation dummies in order to capture potential fixed effects that might be associated with market work. Furthermore, we differentiate by husband and wife, because we want to analyze whether male and female market work are perfect substitutes - which we do not suppose given the descriptive evidence from Section 3.2. On contrary, we suspect that increasing female labor force participation has stronger negative effects on the home production of households.

Table 3 shows a significant effect of male and female work hours, H, on the total time spent on home production in the household. As expected, the more the household members work, the less time is spent on home production. For example, if the wife works one hour more, the home production time of the household is reduced by 14 minutes, roughly the ratio is 4:1. The magnitude of the effect is almost twice as high compared to male working hours, and a t-test reveals that they are statistically significantly different.

However, it can also be seen that the effects of male and female labor market participation are significantly positive and counteract the effect of working hours. It is unlikely that the participation dummies capture non-linearities in the relationship between home production and work hours, given that we use the interview question for labor force participation which is only weakly correlated with work hours on the diary day. Therefore, this result is counterintuitive at the first look. However, in the following we will see that there are other confounding factors.

Participation appears in the regression again in interaction with household income and income squared. We account thus for the possibility, that the partners work *and* do the housework themselves, because they can not make ends meet with a single income. Financially distressed households might not substitute market goods and services for home production, but just consume more in general. The empirical results support this idea.

Table 3: Regression results / dependent variable: total household home production per day

participation and hours of work, husband and wife					
P_f	61.48818	(2.87)***	H_f	-0.22844	(-24.00)***
P_m	128.99936	(3.37)***	H_m	-0.12692	(-15.90)***
household and individual characteristics					
$K0-5$	63.05641	(5.18)***	$K6-18$	26.84121	(2.89)***
$Hauptschule_f$	24.33286	(0.69)	$Hauptschule_m$	47.0674	(1.46)
$Realschule_f$	25.09171	(0.72)	$Realschule_m$	42.52376	(1.31)
$FH-Reife_f$	17.49983	(0.49)	$FH-Reife_m$	34.56131	(1.06)
$Abitur_f$	5.42856	(0.15)	$Abitur_m$	41.38174	(1.28)
household income					
INC	0.13324	(5.35)***	INC^2	-0.00002	(4.63)***
$INC \cdot K0-5$	-0.00043	(-0.10)	$INC^2 \cdot K0-5$	-2.95E-10	(-0.61)
$INC \cdot K6-18$	-0.00368	(-1.18)	$INC^2 \cdot K6-18$	2.74E-10	(0.85)
$INC \cdot P_f$	-0.02631	(-2.77)***	$INC^2 \cdot P_f$	3.03E-09	(2.20)**
$INC \cdot P_m$	-0.10342	(-4.10)***	$INC^2 \cdot P_m$	2.23E-08	(3.99)***
female age dummies					
$AGE_f 25-29$	21.70375	(1.93)*	$AGE_f 45-49$	44.92787	(3.80)***
$AGE_f 30-34$	29.79413	(2.71)***	$AGE_f 50-54$	19.49411	(1.71)*
$AGE_f 35-39$	19.45376	(1.72)*	$AGE_f 55-59$	24.65495	(2.04)**
$AGE_f 40-44$	25.86447	(2.26)**	$AGE_f 60$	5.79854	(0.26)
seasonal and weekday regional dummies					
FEB	18.06117	(2.75)***	TUE	-0.58056	(-0.10)
MAR	12.08427	(1.64)	WED	-5.03724	(-0.85)
APR	14.01139	(2.13)**	THU	5.62325	(0.96)
JUN	27.31624	(4.39)***	FRI	8.31817	(1.41)
JUL	27.6077	(3.69)***	SAT	-14.47212	(-2.17)**
OCT	8.40214	(1.42)	SUN	-138.02328	(-20.23)***
NOV	-13.69205	(-0.91)			
regional dummies and constant term					
MID	-1.85767	(0.42)	Constant	22.73144	(0.38)
$SOUTH$	1.71524	(0.40)			
Observations	3956		Adjusted R-squared	0.42	

t statistics in parentheses; * significant at 10% (*), 5% (**), and 1% (***)

The reference category are the 20-24 year old without a completed school degree, who do not have a job and are surveyed in January on a Monday in the North.

The richer the household, the more it reduces home production when the female (and/or the male) is working. This holds for male and female participation. This effect counteracts the initially positive effect of participation on home production time. Taken together, the magnitude of the participation effects is negligible: If the woman works and the household net income exceeds 2338 DM per month, the total net effect of working is larger than zero from the first minute that she spends in market work. The share of households in the sample with an income equal or lower than 2338 DM amounts to only about 3 percent.

The net effect of female labor fore participation on a household's home production for different income groups is shown in Table 4. The table calculates the change in household home production time when the woman switches from not working to working, and tests its significance. The first column contains the reduction in home production time under the assumption that the woman works average hours. In the second column, we assume that she switches to working part time and the third, that she takes up a full time job. The table shows that under all these assumptions, female labor market participation results in a statistically significant reduction in home production time. The reduction is larger, the more hours the woman works and the richer the household. The quantitative effect is large: When the woman switches to working full time, home production decreases by more than 2 hours per day. And even when she starts working part time only, the household reduces its home production time by more than one hour per day. Thus, married households with a working woman differ substantially from households where only the man works - and male and female labor market participation are obviously not perfect substitutes.

Table 4: Net effect of female labor force participation on household home production time by income group

	Net effect on household home production time when the women switches from not working to working...					
household income	...average hours[a]		...part time[b]		...full time	
mean income	-0.989	(-12.63)***	-1.367	(-16.97)***	-2.395	(-23.98)***
median income	-0.947	(-12.97)***	-1.325	(-17.55)***	-2.353	(-24.52)***
10th percentile	-0.634	(- 7.47)***	-1.012	(-11.58)***	-2.040	(-19.20)***
90th percentile	-1.029	(- 6.98)***	-1.407	(- 9.47)***	-2.435	(-15.25)***

Note: t-values in parentheses. *** denotes significance at the 1% level.

[a] Average female working time is calculated for those women who are working and amounts to roughly 3.35 hours.

[b] We determine working time in a part- or full-time job from the distribution of female working hours. Part-time is roughly defined as the lower peak value at 5 hours per day, full-time hours as the higher peak value at 9.5 hours. Both numbers accord well with the approximate regular working time of about 4 resp. 8 hours per day plus time for commuting and breaks.

Hence, our findings suggest that: (1) The more the spouses work, the less time they spend on home production. (2) This effect is almost double as large for women than for men, and it is sizeable: One additional hour in market work crowds out about a quarter of an hour of female home production time.

We will only briefly comment on the results for the other household and personal characteristics, since they are not in the center of our attention. We cannot find evidence of a direct effect of education on home production time, which could have been due to education-specific attitudes and tastes etc. We also do not find a strong relation between age and home production. We additionally include month and weekday dummies into our estimation to capture seasonal effects in home production. For example, the positive significant coefficients for June and July indicate that households might save some outdoor home production tasks for the summer, e.g., repairing the house or doing some gardening. Furthermore, significantly more home production is done on weekends than during the week, if we simply look at average home production time per weekday. This intertemporal substitution of home production can be explained by weekend shopping and weekend do-it-yourself activities. This effect is filtered by the weekday dummies SAT and SUN which have - however - significantly negative estimated coefficients, so that the intertemporal substitution seem to work the opposite way. The weekend seems to be mainly reserved for leisure activities.

3.4 Does a Higher Labor Market Participation Result in a Higher Demand for Household Services?

In the preceding chapter, we analyzed the link between labor market participation and the amount of time spent on home production. We found that higher labor market participation is associated with less time spent on home production. In this section, we use the data on "help received by the household" described in Section 3.2[23] to study the link between the demand for these services and labor market participation of household members. The idea is that at least parts of a household's home production can in principle be outsourced. An increase in market work should—at the same time—lead to a reduction in home production and an increase in outsourcing.

We estimate the effect of households' labor market participation on their demand for paid services that substitute for home production. We use a two-step Heckman selection specification because only 7.6% of the households in our sample actually receive paid help and we suspect that this selection is not random, eg, older households are more likely to purchase such services. In the first step, a probit model is estimated to determine the effect of labor market participation and covariates on the probability to actually purchase help. In the second step, the amount of outsourcing of those households that do outsource is regressed on the labor market participation variables and covariates. Regression results are shown in Table 5.

[23]Throughout this section, we aggregate the four categories of received help to "total outsourcing". We also have information on the number of hours of received help and whether or not it was paid.

Table 5: The Effects of LMP on Outsourcing

	Selection		Outsourcing of domestic tasks (in hours)	
P_f	0.063834	(4.40)***		
P_m	0.2506921	(0.83)		
H_f	0.0009434	(1.69)*	0.1981811	(2.31)**
${H_f}^2$	-2.33e-06	(-2.46)**	-0.0003048	(-2.05)**
H_m	0.0005271	(1.14)	0.1157112	(1.47)
${H_m}^2$	-4.66e-07	(-0.75)	-0.000141	(-1.45)
$K0-5$	0.4008895	(6.72)***	21.48912	(2.41)**
AGE_{Avg}	0.0140226	(2.43)**	-2.136373	(-2.34)**
AGE_{Diff}	-0.0094918	(-0.95)	-3.627174	(-2.08)**
INC_f	0.0005712	(7.02)***		
INC_f^2	-4.79e-08	(-3.59)***		
INC_m	0.0002383	(2.08)**		
INC_m^2	-7.13e-09	(-0.62)		
$SchoolYrs_{Avg}$	0.0590687	(3.97)***		
$SchoolYrs_{Diff}$	-0.0294776	(-1.26)		
$Urban$	0.1262087	(2.08)**		
GNP	-0.0000114	(-2.58)***		
$TertSec$	0.0115513	(2.11)**		
$Weekend$			15.75794	(0.89)
$Constant$	-5.563136	(-9.69)	175.0173	(3.19)***
Mill's λ			-23.276	(-1.87)*
Observations	3174 (of which 288 uncensored, 2886 censored)			

Note: t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Mills λ denotes the coefficient on the inverted Mills ratio computed from the probit model.

The first column reports the results from the selection equation. A woman's labor force participation has a strongly significant effect on the household's probability to have a paid help. Working time of women (in minutes per day) also has a significantly positive effect. The effect of men's working time is insignificant. This finding corresponds to the findings in Section 3.3 showing that housework is considered to a large extent the woman's job. If she has the time to do it. If not, it is outsourced. Whether and how much the man works does not make much of a difference. Income and the number of children aged 0 to 5 positively affect the likelihood of receiving paid help. Other significant control variables are age, education, urbanization of the place of residence, and GNP per capita and the size of the tertiary sector in the region.

The second column of the table reports the results from the OLS regression of outsourcing in hours on labor market participation variables and covariates. Daily working time of women has a significant, positive effect on the amount of a household's outsourcing: the more the woman works, the more household work is outsourced. Again, the man's working time does not have a significant effect.

In order to get an idea of the magnitude of these effects, we simulated changes in female labor force participation and working time. Table 6 reports the effects of these changes on purchased hours of outsourcing. For details on how we computed these effects, see Appendix F.

Table 6: The Effects of Changes in Labor Market Participation on Help received

	Woman enters labor market		Woman works 1 hour more	
Relative change in...	w/ constant income	w/ income adjustment	w/ constant income	w/ income adjustment
household income:	±0%	+19.6%	±0%	+1.7%
selection probability:	+140.6%	+215.4%	+10.7%	+13.4%
outsourcing, conditional:	+115.8%	+124.3%	+17.2%	+17.5%
aggregate outsourcing:	+306.8%	+437.5%	+26.7%	+29.8%

Notes: 2nd row: Relative change in a household's probability of sourcing out.

3rd row: Relative change in outsourcing, given positive outsourcing. All entries: Sample averages.

The first column displays the effect on the outsourcing of housework when the woman enters the labor market.[24] The probability of a household to demand any substitutive market services at all increases by 141%. The amount of outsourcing of those households that actually do source out rises by 115%. This implies that the aggregate amount of outsourcing grows by 307%. These estimates are calculated holding household income constant. As has been argued in Section 2 though, taking up a job is usually accompanied by an increase in income. This is taken into account in the second column.[25] On average,

[24]The effect of male labor force participation is not considered here because it is already quite high and is insignificant in our regression.

[25]For details, see Appendix F.

a woman's entering the labor market implies an increase in household income by 20%. This further boosts market demand for household and similar services. The third and fourth columns display the effects of an increase in weekly working time by one hour. Only households in which the woman works are considered here.[26] When she increases her work hours by one hour, the household's outsourcing rises by a sizeable 30%.

These results strongly corroborate the theoretical predictions from Section 2. An increase in labor market participation implies that households have less time and more money. The increase in income can be expected to entail a proportional increase in total expenditures. But this increase is not proportional across different goods. Household income (and thus total consumption expenditures) increases by roughly 20%, when the woman enters the labor market. At the same time, the demand for household services and other types of paid help rises by more than 400%. But not only increases in female labor force participation, also rises in female working hours result in large increases in the amount of outsourcing. As these services are mostly rendered by unskilled workers, it can be expected, that the relative demand for unskilled labor increases in the wake of increases in working time or labor force participation.

4 Summary and Conclusion

`To be written.`

Appendix

A Proof of Proposition 1

At $p = 0$, the right hand side (RHS) of equation (15) is larger than the left hand side (LHS):

$$\frac{e^{1+\chi}}{1+\chi} \cdot \xi = RHS\,(0) \qquad \geq \qquad LHS\,(0) = \begin{cases} 0 & \Leftrightarrow \quad \rho > 0 \\ \frac{1}{3} \cdot \frac{e^{1+\chi}}{(1+\theta)\cdot(1+\chi)} \cdot \xi & \Leftrightarrow \quad \rho = 0 \\ \frac{e^{1+\chi}}{(1+\theta)\cdot(1+\chi)} \cdot \xi & \Leftrightarrow \quad \rho < 0 \end{cases}$$

The limit of the right hand side for $p \to \infty$ is smaller than the limit of the left hand side:

$$-\infty = \lim_{p\to\infty} RHS\,(p) \qquad < \qquad \lim_{p\to\infty} LHS\,(p) = \infty$$

Both sides of the equation are continuous in p. Therefore, at least one p must exist that makes both sides equal. This establishes the existence of the general equilibrium.

[26] An increase in men's working time is not considered here because it does not have a significant effect on a household's outsourcing.

As stated in Section 2.3, we only consider parameter constellations for which production in both sectors is strictly positive. This requires for the relative goods price:

$$p \in [1, e^X]$$

Within these limits, aggregate demand for good 2 is increasing in the relative price of good 1, p, while aggregate supply of good 2 is decreasing in p. Thus, if an equilibrium price p exists, it must be unique.

B Proof of Proposition 2

The equilibrium condition is

$$C_2\left(p\left(\xi\right),\xi\right) = Y_2\left(p\left(\xi\right),\xi\right)$$

Comparative statics with respect to ξ yields:

$$\frac{\partial p}{\partial \xi}\cdot\frac{\xi}{p} = -\frac{\frac{\partial Y_2}{\partial \xi}\cdot\frac{\xi}{Y_2}-\frac{\partial C_2}{\partial \xi}\cdot\frac{\xi}{C_2}}{\frac{\partial Y_2}{\partial p}\cdot\frac{p}{Y_2}-\frac{\partial C_2}{\partial p}\cdot\frac{p}{C_2}}$$

The denominator is negative (see the proof of uniqueness in Appendix A). How about the numerator?

$$\frac{\partial Y_2}{\partial \xi}\cdot\frac{\xi}{Y_2} = 1 \quad \text{and} \quad \frac{\partial C_2}{\partial \xi}\cdot\frac{\xi}{C_2} = 1 - \frac{\frac{(p\cdot\alpha)^{\frac{1}{1-\rho}}}{1+\left(1+p^{\frac{\rho}{1-\rho}}\right)\cdot\alpha^{\frac{\rho}{1-\rho}}}}{C_2}$$

so that

$$\frac{\partial Y_2}{\partial \xi}\cdot\frac{\xi}{Y_2}-\frac{\partial C_2}{\partial \xi}\cdot\frac{\xi}{C_2} = \frac{\frac{(p\cdot\alpha)^{\frac{1}{1-\rho}}}{1+\left(1+p^{\frac{\rho}{1-\rho}}\right)\cdot\alpha^{\frac{\rho}{1-\rho}}}}{C_2} > 0$$

which implies that

$$\frac{\partial p}{\partial \xi}\cdot\frac{\xi}{p} = -\frac{\overbrace{\frac{\partial Y_2}{\partial \xi}\cdot\frac{\xi}{Y_2}-\frac{\partial C_2}{\partial \xi}\cdot\frac{\xi}{C_2}}^{>0}}{\underbrace{\frac{\partial Y_2}{\partial p}\cdot\frac{p}{Y_2}-\frac{\partial C_2}{\partial p}\cdot\frac{p}{C_2}}_{<0}} > 0$$

C Proof of Proposition 3

From Lemma 1 we know that unemployment is decreasing with the relative goods price p. Together with Proposition 2 this implies that a reduction in market work ξ leads to an increase in unemployment $\tilde{j}$.

Next, we have to show that the effect of market work ξ on unemployment $\tilde{j}$ is stronger, the smaller is the elasticity of substitution between consumption and leisure σ :

$$\frac{\partial\left|\frac{\partial\tilde{j}}{\partial\xi}\cdot\frac{\xi}{\tilde{j}}\right|}{\partial\sigma}<0 \quad\Leftrightarrow\quad \frac{\partial\left(\frac{\partial\tilde{j}}{\partial\xi}\cdot\frac{\xi}{\tilde{j}}\right)}{\partial\sigma}>0$$

Market work ξ affects unemployment only through the relative goods price p (see equation 8):

$$\frac{\partial\tilde{j}}{\partial\xi}\cdot\frac{\xi}{\tilde{j}}=\frac{\partial\tilde{j}}{\partial p}\cdot\frac{p}{\tilde{j}}\;\cdot\;\frac{\partial p}{\partial\xi}\cdot\frac{\xi}{p}$$

The effect of the relative goods price p on unemployment $\tilde{j}$ does not depend on the substitution elasticity σ (see Lemma 1):

$$\frac{\partial\left(\frac{\partial\tilde{j}}{\partial\xi}\cdot\frac{\xi}{\tilde{j}}\right)}{\partial\sigma}=\underbrace{\frac{\partial\left(\frac{\partial\tilde{j}}{\partial p}\cdot\frac{p}{\tilde{j}}\right)}{\partial\sigma}}_{=0}\cdot\underbrace{\frac{\partial p}{\partial\xi}\cdot\frac{\xi}{p}}_{<0}+\underbrace{\frac{\partial\tilde{j}}{\partial p}\cdot\frac{p}{\tilde{j}}}_{<0}\cdot\frac{\partial\left(\frac{\partial p}{\partial\xi}\cdot\frac{\xi}{p}\right)}{\partial\sigma}\overset{?}{>}0$$

It suffices thus to show that $\frac{\partial\left(\frac{\partial p}{\partial\xi}\cdot\frac{\xi}{p}\right)}{\partial\sigma}<0$.

$$\frac{\partial\left(\frac{\partial p}{\partial\xi}\frac{\xi}{p}\right)}{\partial\sigma}=-\frac{\frac{\partial\left(\frac{\partial Y_2}{\partial\xi}\frac{\xi}{Y_2}-\frac{\partial C_2}{\partial\xi}\frac{\xi}{C_2}\right)}{\partial\sigma}\cdot\left(\frac{\partial Y_2}{\partial p}\frac{p}{Y_2}-\frac{\partial C_2}{\partial p}\frac{p}{C_2}\right)-\left(\frac{\partial Y_2}{\partial\xi}\frac{\xi}{Y_2}-\frac{\partial C_2}{\partial\xi}\frac{\xi}{C_2}\right)\cdot\frac{\partial\left(\frac{\partial Y_2}{\partial p}\frac{p}{Y_2}-\frac{\partial C_2}{\partial p}\frac{p}{C_2}\right)}{\partial\sigma}}{\left(\frac{\partial Y_2}{\partial p}\frac{p}{Y_2}-\frac{\partial C_2}{\partial p}\frac{p}{C_2}\right)^2}\overset{?}{<}0$$

From Appendix B we know that $\frac{\partial Y_2}{\partial p}\frac{p}{Y_2}-\frac{\partial C_2}{\partial p}\frac{p}{C_2}<0$, $\frac{\partial Y_2}{\partial\xi}\frac{\xi}{Y_2}-\frac{\partial C_2}{\partial\xi}\frac{\xi}{C_2}>0$ and that

$$\frac{\partial Y_2}{\partial\xi}\frac{\xi}{Y_2}-\frac{\partial C_2}{\partial\xi}\frac{\xi}{C_2}=\frac{\frac{(p\alpha)^{\frac{1}{1-\rho}}}{1+\left(1+p^{\frac{\rho}{1-\rho}}\right)\alpha^{\frac{\rho}{1-\rho}}}}{C_2}=\frac{p\alpha}{\xi p\alpha\ln\left(\frac{\theta}{1+\theta}\frac{\chi p^{\frac{1+\chi}{\chi}}+e^{1+\chi}}{p(1+\chi)}\right)+\frac{\chi p^{\frac{1+\chi}{\chi}}+e^{1+\chi}}{(1+\theta)(1+\chi)}\xi+(1-\xi)\,p\alpha}$$

independent of $\sigma=\frac{1}{1-\rho}$. Therefore $\frac{\partial\left(\frac{\partial Y_2}{\partial\xi}\frac{\xi}{Y_2}-\frac{\partial C_2}{\partial\xi}\frac{\xi}{C_2}\right)}{\partial\sigma}=0$.

All that remains to be shown is that $\frac{\partial\left(\frac{\partial Y_2}{\partial p}\frac{p}{Y_2}-\frac{\partial C_2}{\partial p}\frac{p}{C_2}\right)}{\partial\sigma}<0$. From equation 6 follows that $\frac{\partial\left(\frac{\partial Y_2}{\partial p}\frac{p}{Y_2}\right)}{\partial\sigma}=0$.

$$\frac{\partial C_2}{\partial p}\frac{p}{C_2}=\frac{\partial\left(\frac{(p\cdot\alpha)^{\frac{\rho}{1-\rho}}}{1+\left(1+p^{\frac{\rho}{1-\rho}}\right)\cdot\alpha^{\frac{\rho}{1-\rho}}}\right)}{\partial p}\frac{p}{\frac{(p\cdot\alpha)^{\frac{\rho}{1-\rho}}}{1+\left(1+p^{\frac{\rho}{1-\rho}}\right)\cdot\alpha^{\frac{\rho}{1-\rho}}}}+\frac{\partial\Lambda}{\partial p}\frac{p}{\Lambda}$$

where $\Lambda=\left(\xi\cdot p\cdot\alpha\cdot\ln\left(\frac{\theta}{1+\theta}\cdot\frac{\chi\cdot p^{\frac{1+\chi}{\chi}}+e^{1+\chi}}{p\cdot(1+\chi)}\right)+\frac{\chi\cdot p^{\frac{1+\chi}{\chi}}+e^{1+\chi}}{(1+\theta)\cdot(1+\chi)}\cdot\xi+(1-\xi)\cdot p\cdot\alpha\right)$ does not depend on ρ.

$$\frac{\partial\left(\frac{(p\cdot\alpha)^{\frac{\rho}{1-\rho}}}{1+\left(1+p^{\frac{\rho}{1-\rho}}\right)\cdot\alpha^{\frac{\rho}{1-\rho}}}\right)}{\partial p}\frac{p}{\frac{(p\cdot\alpha)^{\frac{\rho}{1-\rho}}}{1+\left(1+p^{\frac{\rho}{1-\rho}}\right)\cdot\alpha^{\frac{\rho}{1-\rho}}}}=\frac{\rho}{1-\rho}\cdot\frac{1+\alpha^{\frac{\rho}{1-\rho}}}{1+\left(1+p^{\frac{\rho}{1-\rho}}\right)\cdot\alpha^{\frac{\rho}{1-\rho}}}$$

It suffices to show that

$$\frac{\partial\left(\frac{\partial C_2}{\partial p}\frac{p}{C_2}\right)}{\partial\sigma}=\frac{\partial\left(\frac{\rho}{1-\rho}\cdot\frac{1+\alpha^{\frac{\rho}{1-\rho}}}{1+\left(1+p^{\frac{\rho}{1-\rho}}\right)\cdot\alpha^{\frac{\rho}{1-\rho}}}\right)}{\partial\sigma}>0$$

With $\frac{\rho}{1-\rho}=\sigma-1$:

$$\frac{\partial\left(\frac{\partial C_2}{\partial p}\frac{p}{C_2}\right)}{\partial\sigma}=\frac{1+\alpha^{\sigma-1}}{1+(1+p^{\sigma-1})\cdot\alpha^{\sigma-1}}-(\sigma-1)\frac{\left(\ln\alpha+\left(1+\alpha^{\sigma-1}\right)\cdot\ln p\right)\cdot(\alpha\cdot p)^{\sigma-1}}{\left(1+(1+p^{\sigma-1})\cdot\alpha^{\sigma-1}\right)^2}$$

For $\sigma\leq 1$ (with $\alpha>1$), the right hand side is unambiguously positive:

$$\frac{\partial\left(\frac{\partial C_2}{\partial p}\frac{p}{C_2}\right)}{\partial\sigma}>0$$

For $\sigma>1$, this inequality can only be established numerically because the relative goods price p is endogenous and cannot be expressed as an explicit function of the exogenous parameters.

Numerical simulations for $\alpha\in[1,10]$, $\chi\in[0,10]$, $\mu\in[0,1]$, $\rho\in[0,1)$ (implying $\sigma\in[1,\infty)$), and $\xi\in[0,1]$ confirm that the inequality also holds for $\sigma>1$.

This completes the proof:

$$\frac{\partial\left(\frac{\partial p}{\partial\xi}\frac{\xi}{p}\right)}{\partial\sigma}=-\frac{\overbrace{\frac{\partial\left(\frac{\partial Y_2}{\partial\xi}\frac{\xi}{Y_2}-\frac{\partial C_2}{\partial\xi}\frac{\xi}{C_2}\right)}{\partial\sigma}}^{=0}\cdot\overbrace{\left(\frac{\partial Y_2}{\partial p}\frac{p}{Y_2}-\frac{\partial C_2}{\partial p}\frac{p}{C_2}\right)}^{<0}}{\left(\frac{\partial Y_2}{\partial p}\frac{p}{Y_2}-\frac{\partial C_2}{\partial p}\frac{p}{C_2}\right)^2}+\frac{\overbrace{\left(\frac{\partial Y_2}{\partial\xi}\frac{\xi}{Y_2}-\frac{\partial C_2}{\partial\xi}\frac{\xi}{C_2}\right)}^{>0}\cdot\overbrace{\frac{\partial\left(\frac{\partial Y_2}{\partial p}\frac{p}{Y_2}-\frac{\partial C_2}{\partial p}\frac{p}{C_2}\right)}{\partial\sigma}}^{<0}}{\left(\frac{\partial Y_2}{\partial p}\frac{p}{Y_2}-\frac{\partial C_2}{\partial p}\frac{p}{C_2}\right)^2}<0$$

and therefore:

$$\frac{\partial\left(\frac{\partial\tilde{j}}{\partial\xi}\cdot\frac{\xi}{\tilde{j}}\right)}{\partial\sigma}=\underbrace{\frac{\partial\left(\frac{\partial\tilde{j}}{\partial p}\cdot\frac{p}{\tilde{j}}\right)}{\partial\sigma}}_{=0}\cdot\underbrace{\frac{\partial p}{\partial\xi}\cdot\frac{\xi}{p}}_{<0}+\underbrace{\frac{\partial\tilde{j}}{\partial p}\cdot\frac{p}{\tilde{j}}}_{<0}\cdot\underbrace{\frac{\partial\left(\frac{\partial p}{\partial\xi}\cdot\frac{\xi}{p}\right)}{\partial\sigma}}_{<0}>0$$

D Description of Variables

Variable Name	Description
HP	home production in minutes per day averaged over the spouses
P	employment status (= 0 if not employed, = 1 if employed)
H	time spent on gainful employment (in minutes per day)
$K0-5$	number of children in the household aged $0-5$ years
$K6-18$	number of children in the household aged $6-18$ years
$Hauptschule$	dummy for 9 years of schooling
Realschule	dummy for 10 years of schooling
FH-Reife	dummy for 11 years of schooling
Abitur	dummy for 13 years of schooling
$SchoolYrs_{Avg}$	average years of schooling of wife and husband
$SchoolYrs_{Diff}$	difference in schooling years between husband and wife
$TrainYears$	years of vocational training
INC	household income
INC^2	household income squared
$AGE\ a_1 - a_2$	dummy for age between a_1 and a_2
AGE_{Avg}	average age of wife and husband
AGE_{Diff}	difference between the husband's and the wife's age
MID	region dummy (North Rhine-Westphalia, Hesse)
$SOUTH$	region dummy (Rhineland-Palatinate, Baden-Wuerttemberg, Bavaria)
$Urban$	degree of urbanization of the region
GNP	per capita gross national product in the region
$TertSec$	employment share of the tertiary sector
$Weekend$	weekend dummy (= 1 if the interview was on a weekend)
$Unemp_R$	unemployment rate in the region

Source: Zeitbudgeterhebung 1991/92

E Income

In the dataset, income is recorded in the form of a range card question, where the respondents are given income intervals and asked to specify the income group they belong to. This is often done in surveys in order to get a higher response rate(Juster and Smith 1997, Winter 2002). Thus, we only have information on the interval, in which the household's income falls. In order to assign the household a continuous income, we combine the information about the lower and upper limits corresponding to the respective income intervals with additional information that we have on household and personal characteristics. Interval-coded data can then be treated like an ordered response, where the cut-points are already known. We define a latent variable income $INC^* = x\beta + e$ where $e|x \sim N(0,1)$.

This latent variable is our continuous income variable. If $\alpha_1 < INC^* \leq \alpha_2$, the observed income class is for example $INC = 2$ with the limits α_1 and α_2, and so forth. The parameters α and β can be estimated by maximum likelihood. In the case of interval-coded data, the cut-points α are already known, so that only the parameters β have to be estimated. The standard normal assumption made above is changed to $INC^*|x \sim N(x\beta, \sigma^2)$ where $\sigma^2 = Var(INC^*|x)$ is assumed not to depend on x. The parameters β and σ^2 can then be estimated by maximum likelihood (Wooldridge 2002).

Table 7: Regression results for household income, ordered probit with known cut-points

P_f	565.32309	(52.80698)	***	P_m	1,304.05	(119.15418)	***
H_f	0.87113	(0.12996)	***	H_m	0.34168	(0.10822)	***
AGE_f	114.69679	(34.91534)	***	AGE_m	177.46037	(37.88280)	***
${AGE_f}^2$	-1.15126	(0.41982)	***	${AGE_m}^2$	-1.86947	(0.43777)	***
$SchoolYrs_f$	996.89685	(313.24823)	***	$SchoolYrs_m$	1,142.46	(309.03682)	***
${SchoolYrs_f}^2$	-40.97947	(14.23473)	***	${SchoolYrs_m}^2$	-41.78632	(14.11550)	***
$TrainYrs_f$	-31.17941	(53.09139)		$TrainYrs_m$	-0.35652	(77.95081)	
${TrainYrs_f}^2$	34.39915	(11.17286)	***	${TrainYrs_m}^2$	38.85876	(14.11582)	***
$Urban$	99.68285	(40.64260)	**				
GNP	0.00636	(0.00354)	*	$Unemp_R$	-70.60562	(13.51361)	***
$Weekend$	371.06141	(67.71278)	***	$Constant$	-17,519.30831	(2,274.15671)	***
Observations	3956						

Standard deviations in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 8: Regression results for (a) women's and (b) men's income, ordered probit with known cut-points

(a) women's income				(b) men's income			
P_f	875.2491	(31.03887)	***	P_m	1556.869	(98.04013)	***
H_f	0.3683918	(0.2104273)	*	H_m	-0.4184731	(0.2429606)	*
${H_f}^2$	0.0022576	(0.0003458)	***	${H_m}^2$	0.001157	(0.0003117)	***
AGE_f	7.46488	(13.03019)		AGE_m	190.3022	(20.91862)	***
${AGE_f}^2$	0.0264209	(0.1572435)		${AGE_m}^2$	-1.864858	(0.2408324)	***
$SchoolYrs_f$	358.8041	(173.6036)	*	$SchoolYrs_m$	1611.079	(247.4928)	***
${SchoolYrs_f}^2$	-12.46794	(7.897955)		${SchoolYrs_m}^2$	-63.22272	(11.30448)	***
$TrainYrs_f$	-38.19013	(29.22008)		$TrainYrs_m$	62.36355	(61.74953)	
${TrainYrs_f}^2$	32.3933	(6.074545)	***	${TrainYrs_m}^2$	38.92703	(11.15009)	***
$Urban$	7.497551	(23.01425)		$Urban$	162.3689	(33.42403)	***
GNP	0.006536	(0.0019818)	***	GNP	-0.0021455	(0.0028505)	
$Unemp_R$	6.404296	(7.638079)		$Unemp_R$	-40.27372	(10.95677)	***
$Weekend$	276.2312	(30.48817)	***	$Weekend$	122.3447	(55.51534)	*
$Constant$	-3070.687	(981.374)	***	$Constant$	-12639.47	(1395.906)	***
Observations	4200			Observations	4368		

Standard deviations in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

Tables 7, 8 (a) and (b) report the results from these regressions for household income, women's income, and respectively men's income. We use these results to obtain a continuous measure of income which we then use in the regressions. In our case, the method of choosing the midpoints as the income measure is quantitatively similar to the more sophisticated method using ordered probit estimation.

F Computation of the Effects of Changes in Labor Market Participation on Households' Outsourcing

F.1 The Effect of a Woman Taking Up a Job

In Sections 3.3 and respectively 3.4, we presented the effects of a woman taking up a job on the time spent on home production and respectively on the demand for household services. In this appendix, we explain how we calculated these effects from the regression results. For every household in the sample we calculated the predicted value of time spent on home production (respectively outsourcing of household services) given household characteristics and supposing that the woman does not work ($P_f = 0$, $H_f = 0$). Then we redid the same calculations supposing that the woman works ($P_f = 1$, $H_f > 0$). The woman's working time was set to the average working time of all working women in the sample.

From these values we calculated the percentage respectively level change in time spent on home production (respectively outsourcing) implied by the woman taking up a job (see Tables 4 and 6):

$$\frac{\partial Y_h}{\partial P_{f,h}} = \frac{E\left(Y_h|X_h, P_{f,h}=1, H_{f,h}=\overline{H_{f,h}}\right)}{E\left(Y_h|X_h, P_{f,h}=0, H_{f,h}=0\right)} - 1$$

where Y_h is the respective dependent variable, and X_h are household characteristics. $E(Y_h|\bullet)$ is the predicted value of Y_h from the corresponding regressions of Y_h on labor market participation and covariates in Sections 3.3 and 3.4. $\overline{H_{f,h}}$ is the number of working hours of all working women in the sample.

In a second step we also took into account that changes in women's labor market participation involve changes in her income. So, we let income vary endogenously with labor market participation:

$$\frac{\partial Y_h}{\partial P_{f,h}} = \frac{E\left(Y_h|X_h, P_{f,h}=1, H_{f,h}=\overline{H_{f,h}}, Inc_{f,h}=Inc_{f,h}\_high\right)}{E\left(Y_h|X_h, P_{f,h}=0, H_{f,h}=0, Inc_{f,h}=Inc_{f,h}\_low\right)} - 1$$

where $Inc_{f,h}\_high = E\left(Inc_{f,h}|X_h, P_{f,h}=1, H_{f,h}=\overline{H_{f,h}}\right)$
and $Inc_{f,h}\_low = E\left(Inc_{f,h}|X_h, P_{f,h}=0, H_{f,h}=0\right)$.
$E\left(Inc_{f,h}|\bullet\right)$ is the predicted value from the regression reported in Table 8 in Appendix E.

F.2 The Effect of a Increasing a Woman's Working Time by 1 Hour

The effects of an increase in women's working time by 1 hour are calculated accordingly. The effect holding income constant is given by:

$$\frac{\partial Y_h}{\partial P_{f,h}} = \frac{E\left(Y_h|X_h, H_{f,h}+1\right)}{E\left(Y_h|X_h, H_{f,h}\right)} - 1$$

The total effect comprising the income effect is given by:

$$\frac{\partial Y_h}{\partial P_{f,h}} = \frac{E\left(Y_h|X_h, H_{f,h}+1, Inc_{f,h}\_Plus1\right)}{E\left(Y_h|X_h, H_{f,h}, Inc_{f,h}\right)} - 1$$

where $Inc_{f,h}\_Plus1 = E\left(Inc_{f,h}|X_h, H_{f,h}+1\right)$.

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