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Frederiksen, Anders; Graversen, Ebbe Krogh; Smith, Nina

Working Paper

Overtime Work Dual Job Holding and Taxation

IZA Discussion Papers, No. 323

Provided in Cooperation with:
IZA – Institute of Labor Economics

Suggested Citation: Frederiksen, Anders; Graversen, Ebbe Krogh; Smith, Nina (2001) : Overtime Work Dual Job Holding and Taxation, IZA Discussion Papers, No. 323, Institute for the Study of Labor (IZA), Bonn

This Version is available at:
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DISCUSSION PAPER SERIES

IZA DP No. 323

Overtime Work Dual Job Holding and Taxation

Anders Frederiksen
Ebbe Krogh Graversen
Nina Smith

July 2001

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

Overtime Work, Dual Job Holding and Taxation

Anders Frederiksen
CIM, CLS and Department of Economics, Aarhus School of Business

Ebbe Krogh Graversen
CIM, CLS and Danish Institute for Studies in Research and Research Policy

Nina Smith
CIM, CLS and Department of Economics, Aarhus School of Business and IZA, Bonn

Discussion Paper No. 323
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IZA

P.O. Box 7240
D-53072 Bonn
Germany

Tel.: +49-228-3894-0
Fax: +49-228-3894-210
Email: iza@iza.org

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IZA Discussion Paper No. 323
July 2001

ABSTRACT

Overtime Work, Dual Job Holding and Taxation*

Traditionally, labour supply data do not include much information on hours and wages in secondary job or overtime work. In this paper, we estimate labour supply models based on survey information on hours and wages in overtime work and second job which is merged to detailed register information on income taxes, deductions, taxable income etc. We also allow for the effect of observed fixed costs in main occupation and unobserved fixed costs in second job, and a 'stigmatization effect' from unemployment. The estimated models follow a 'Hausman-approach'. The results indicate that the labour supply elasticities are highly sensitive to the inclusion of information on overtime work and secondary job and to the handling of fixed costs of work. The estimated elasticities are numerically larger when explicit information on overtime and second job work is taken into account compared to traditional labour supply models without explicit information on overtime pay and second job wages. However, when the model allows for stigmatization effects and unobserved fixed costs of work in second job, the resulting elasticities reduce considerably.

JEL Codes: C13, C21, C24, H24, J22

Keywords: Labour supply, dual job holding, overtime work, piecewise linear budget constraints

Nina Smith
Aarhus School of Business
Department of Economics
Fuglesangs Alle 20
DK-8210 Aarhus V
Tel.: +45 8948 6413
Fax: +45 8615 5175
Email: nina@asb.dk

* Financial support from the Danish Social Science Foundation is gratefully acknowledged. The creation of the data set used in the study has been supported financially by the Rockwool Foundation, and the construction of the data set is joint work with the Rockwool Research Unit. The presented analysis is solely the authors' responsibility.

1. Introduction

A major criticism of many labour supply models is that hours cannot be varied freely within jobs and that the decision to work overtime or to enter a second job is very different compared to the decision on hours in main occupation. The wages in overtime job typically exceed the wages in main occupation although empirical evidence show that this is not always the case, and sometimes there is even no compensation for overtime work, see for instance Trejo (1993) and Bauer and Zimmermann (1999). Further, the decision to work in a second job may reflect restrictions on hours in main occupation due to employers' preferences or due to regulations caused by for instance unions, see Oswald and Walker (1995). This may induce individuals who are underemployed in their main occupation to enter into a second job. However, a second (or third) job may also reflect that some jobs are complements, i.e. professors with complementary consultancy jobs, see Paxson and Sicherman (1996). Second jobs will typically imply new fixed costs of work additional to the costs of work in main occupation contrary to overtime work which by definition occurs at the main occupation employer.

The explicit modelling of costs of work, overtime payments and wages in second jobs is expected to be extremely important when analysing potential tax reforms. If the tax reforms change the marginal income tax rates, we also expect the conditions 'at the margin' of the budget constraint to be especially important. A potential tax reform with tax cuts may change the individual's optimal budget segment, i.e. induce the individual to take overtime work or a second job and therefore, it is important that the estimated model takes these non-linearities of the budget constraint into account.

The main purpose of this paper is to analyse the sensitivity of labour supply elasticities to the inclusion of explicit information on overtime pay and wages in second job and to analyse the potential supply effects of different tax reforms. Typically, there is a relatively small variation in the measured number of weekly working hours, especially for men, around the standard number of hours. This fact may indicate that the information on overtime work or second job is not very precisely registered. Further, if the hours exceed the standard hours, a number of persons receive overtime wages which may exceed the standard wages by large amounts. On the other hand, the option of overtime is not open in many jobs. For these individuals, the only way of varying their

labour supply in an upward direction is to get a second job which is sometimes implying a lower hourly wage rate than the standard wage in the main occupation. However, the second job may imply extra time and costs because of transportation etc., and these - typically fixed - costs may affect the labour supply decision.

Based on a discrete-continuous variable technique, we estimate a number of alternative models of labour supply where we successively add more information on wages in overtime work and second job and allow for a more flexible specification of the model with respect to inclusion of unobserved fixed costs of work in second job and potential stigmatization effects of individuals who are observed as unemployed. The estimated model is a Hausman model in line with Flood and MaCurdy (1992). Like in Arrufat and Zabalza (1986), we account for the joint participation and hours decision. It is especially important when we look at female labour supply where a significant non-zero part of the women are nonparticipants.[1] We take into account measurement errors in the labour supply as well as unobserved heterogeneity in preferences.

The paper estimates the labour supply in Denmark based on a representative survey collected in 1996. The survey information on weekly hours and wages, fixed costs of work and other information relevant for the labour supply decision is merged with information from administrative registers on incomes and taxes for the individuals (and households) included in the sample. Thus, we are able in a rather precise way to construct individual budget constraints which take into account fixed costs of work, individual variation in tax deductions, non-labour income, local tax rates and overtime payments or wages in a second job.

The results indicate that the labour supply elasticities are highly sensitive to the inclusion of information on overtime work and secondary job and to the handling of fixed costs of work. The estimated elasticities are numerically larger when explicit information on overtime and second job work is taken into account compared to traditional labour supply models without explicit information on overtime pay and second job wages. However, when the model allows for stigmatization effects and unobserved fixed costs of work in second job, the resulting elasticities

[1] Contrary to papers like Blomquist (1983) and Flood and MaCurdy (1992), our male sample is not restricted to workers with positive hours solely, but we allow the small group of non-working men to influence the results.

reduce considerably. The simulations of alternative tax reforms which reduce the marginal tax rates indicate that despite the relatively small estimated wage elasticities, there are considerable labour supply effects mainly in the upper end of the income distribution which reduce the financial burden from un-financed tax cuts. But the design of a tax reform is very important.

In Section 2 the theoretical framework is outlined, and in Section 3 the choice of empirical specification and the likelihood to maximize are presented. Section 4 describes the data used and gives some descriptive statistics on Danish labour supply, wages and taxes. In Section 5, a more detailed description of the budget constraints in each of the estimated models is given. The results from the estimations are presented in Section 6, and in Section 7, we use the estimation results to analyse labour supply effects of a hypothetical tax reform. Section 8 concludes the paper.

2. The theoretical model

Despite the very vast literature on labour supply models, there are relatively few studies on overtime work and dual job holding. One of the first studies which explicitly models these aspects of the supply decision is the study by Ashworth and Ulph (1981) who find that the explicit modelling of overtime and second job in the budget constraint is important, especially for women, when estimating income and substitution effects of for instance tax changes. They find that the elasticities are numerically larger when overtime and second job wages are explicitly modelled compared to a model where the budget constraint is linearized around the point of observation. In the present study, we follow the ideas of Ashworth and Ulph and include explicitly information on hours and wages in second job and overtime work when modelling the individual budget constraints.

Another complication when analysing tax reforms is that many individuals are not able to vary their labour supply freely. Some individuals may not have the option of overtime work at their present employer, either due to constraints on overtime work arising from collective agreements or due to constraints imposed by the employer.[2] However, some individuals may have the option

[2]According to Altonji and Paxson (1991), the restrictions on hours may be a major explanation of job mobility. Since we do not have information on job mobility, we are not able to model this dynamic aspect of the labour supply decision.

of taking a second job as discussed above. For other individuals, this option does not exist. The standard number of working hours may also be higher than the desired hours, and it may be impossible for the individual to reduce labour supply downwards, see Stewart and Swaffield (1997), who find that more than one third of British male manual workers would prefer to work fewer hours at the prevailing wage than they actually do. For the US, 35-45% of the male heads of households are dissatisfied with their actual number of working hours and the majority prefers to work more hours, see the survey by Dickens and Lundberg (1993). The same seems to be the case for Canada. Kahn and Lang (1991) find in a study based on Canadien data that about half of the observed individuals would prefer to work a different number of hours at their present wages and the majority of the dissatisfied Canadian workers would prefer to work more hours than they actually do.

The sample of Danish workers used in this study includes limited information on desired hours versus observed hours. The respondents are asked whether they would prefer to work fewer or more hours if they were able to change their weekly hours. The answers indicate that - in line with the UK results - the majority of Danes, especially women, work more hours than they desire, see Smith (1998). However, the survey question does not specify anything about wage rates relating to the potential changes in working hours and thus, we prefer not to use this information explicitly in the estimated model. Instead, the empirical model applied allows for differences between observed and desired hours by the choice of stochastic specification.

The observed labour supply may also be influenced by restrictions due to involuntary as well as voluntary unemployment. Individuals hit by involuntary unemployment should in principle be treated as if they were having a positive labour supply even though their observed labour supply is zero. Part of the measured unemployment may be voluntary. Since Denmark has experienced a high level of unemployment during two decades, it has been difficult effectively to apply the rules in the unemployment insurance (UI) schemes that the unemployed shall be available for a job. With the relatively generous compensation schemes (high compensation for low-wage groups and long duration) in case of unemployment and until recently, a liberal way of interpreting and administering the availability rules, it is expected that a significant part of the unemployed in some demographic groups is not having a positive desired labour supply. One way of handling the

demand side conditions and voluntary or involuntary unemployment is to estimate a 'double-hurdle model', see for instance Dickens and Lundberg (1993) and Euwals and van Soest (1999) which are studies with explicit modelling of the number of job offers faced by the individual. Since the focus of this paper is to model overtime work and analyse how sensitive the estimated supply responses are to the specification of budget constraints with overtime work, we do not extend our model along these lines. Instead, we try directly to identify the desired hours of the unemployed persons by using information on their search activity.

The theoretical model is based on the piecewise linear approach in which it is assumed that individuals know their entire budget constraint. It is determined as

$$C = (w^m h^m - FC^m) + w^o h^o + (w^s h^s - FC^s) + Y + V - t(I) \qquad (1)$$

where C is annual consumption, w^m, w^o and w^s are the hourly wage rates in main occupation, overtime work and second job, respectively, h^m, h^o and h^s are annual labour supply in main occupation, overtime work and second job, respectively, Y is annual taxable non-labour income, V is annual non-taxable non-labour income, incl. spouse's after tax income if married or cohabiting. t(I) is the tax function, where I is annual assessed income, $I = \Sigma wh + Y - D$, and D is annual deduction. FC^m and FC^s are the fixed money costs of work (for instance transportation and childcare costs) associated with main job and second job, respectively. We assume that there is no fixed cost associated with overtime work. In a static one period model, the individuals are assumed to choose bunches of (C,h), which maximizes their utility function U(C,h), given the piecewise linear budget constraint. The labour supply variable h in the utility function is the total labour supply, $h = h^m + h^o + h^s$. For simplicity, we assume that all three components of labour supply enter additively in the utility function. Thus, we do not expect that overtime work or work in second job imply a higher (or lower) disutility per hour of work compared to work in main occupation. Utility maximization, given the budget constraint, implies a labour supply function which depends on the after tax wage rate and after tax income which again depends on the labour supply function through the tax function t(.).

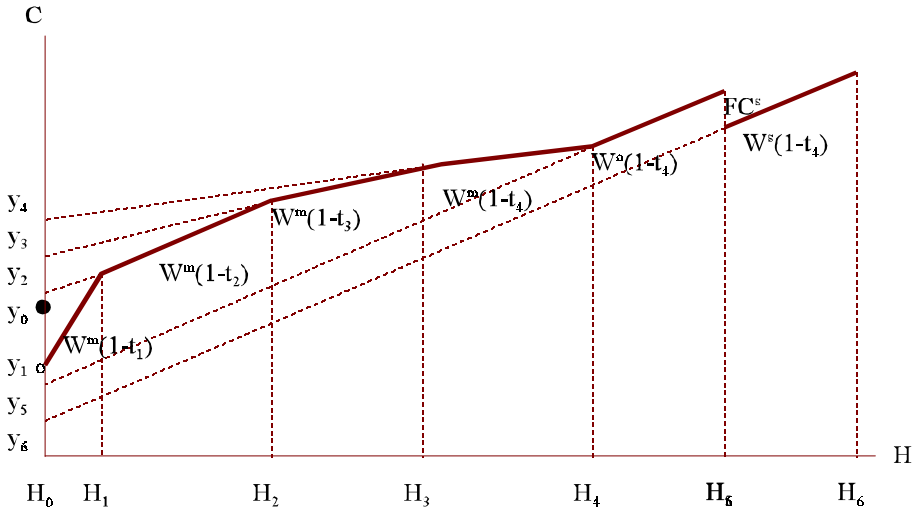
In the piecewise linear case, all kinks, the after tax wage rates and virtual incomes on the linear segments can be found using a simple iterative procedure as long as the nonlabour income, the gross wage rate, the labour supply and the tax system are known. Figure 1 illustrates a budget constraint for a hypothetical person who has both overtime work and a second job besides the main occupation. The person was subject to the Danish tax system in 1996 which had four tax segments and three kink points. The marginal tax rates on the four segments were 7%, 47.2%, 51.8%, and 65.8.[3] Labour supply up to H_4 represents work in main occupation, excluding overtime work, with an hourly gross wage rate, w^m. (If H_4 is interpreted as standard number of weekly hours in a full-time job in 1996, it is equal to 37 hours). The person is assumed to have an income in main occupation, excluding overtime work, which passes the 3 thresholds or kinks of the progressive income tax scheme. If the person works more than standard hours, he is assumed to get overtime compensation which exceeds the standard wage in main occupation in many jobs. This is represented by the hours range from H_4 to H_5. Further, the person may have a second job. In Figure 1, it is assumed that the net wage in the second job equals the hourly overtime compensation and that the individual faces fixed costs related to the second job of the size FC^s.

A different budget constraint appears if the person has a relatively low hourly wage rate in main occupation - or he has a very large tax deduction - which implies that kink points from the tax schedule lie in the hour ranges for overtime work or second job. There are of course a number of possible combinations of hypothetical budget constraints, depending on the size of Y, V, D, w^i, and the job opportunities faced by the individual. We return to this in Section 5. The order of the three types of labour supply, h^m, h^o and h^s, may also be varied. Although it is natural to consider labour supply in main occupation as the 'first' labour supply, it is not always obvious which type of labour supply is 'second' and 'third'. Here we assume that the individual considers

[3] These marginal tax rates for 1996 are sample averages because the local tax rates vary considerably. In 1996, the majority (46%) of the individuals in the sample faced a marginal tax rate of 51.8%, while 29% of the individuals had a marginal tax rate of 65.8% and 24% of the individuals had a marginal tax rate of 47.2%. Only about 1% of the individuals had the lowest marginal tax rate of 7%. In Figure 2, the sample distributions of weekly hours and marginal tax rates in 1996 are shown.

overtime work as the second option and a second job as the third option.[4]

Figure 1. The piecewise linear budget constraint with fixed costs of work and six linear segments due to non-linear income taxes and different wages in main occupation, overtime work and second job.



Note: The difference between y_1 and y_0 in Figure 1 is the sum of fixed costs of work and reductions in unemployment or social welfare benefit.

The after tax wage rate on segment j is given as $w^i_j = w^i (1-t_j)$ where t_j is the marginal tax rate on segment j, and w^i is the hourly wage rate in either main occupation, overtime work or second job (i = m, s, o). To simplify notation, we drop the subscript i in the following description. The virtual income on the first budget segment is given as $y_1 = V+Y-t(Y-D)-FC^m$. The virtual income corresponding to segment j can be found iteratively as $y_j = y_{j-1}+(w_{j-1}-w_j)H_{j-1}$, $\forall\ j \geq 2$.[5]

[4] Alternatively, the labour supply decision might be treated as three separate processes. One for standard hours, one for overtime hours and one for second job hours, where the overtime option only exists for individuals with positive standard hours. Since the three processes are highly correlated through the marginal tax rates on labour income, which depends on the ordering of the three types of labour supply, we prefer to put the described structure on the data. However, only a minority of the individuals in the data causes a full ordering. The major share has only one or two of the three kinds of work.

[5]Further, for the budget segment relating to second job, the fixed costs of second job, FC^s, are deducted from virtual income, y_j. Thus, in Figure 1, $y_6 = y_5 + (w_5-w_6)H_5 - FC^s$.

Given the definition of y_j, w_j and H_j above, the individual's optimization problem becomes the following, where k is the maximum number of segments (k=6 in Figure 1):

$$\begin{aligned} &\text{Max } U(C,h) \\ &\quad \text{s.t.} \\ C = &\begin{cases} y_1 & \text{if } h = H_0 \\ w_j h + y_j & \text{if } H_{j-1} < h < H_j \qquad j=1,\ldots,k \\ w_k H_k + y_k & \text{if } h = H_k \end{cases} \end{aligned} \tag{2}$$

H_k corresponds to the total time allocation. The solution to the maximisation problem can be found by an algorithm that compares all local optima for the complete budget constraint and returns the global optimum as the maximum of all local optimal utilities. The first step of the algorithm is to identify the locally optimal choice of labour supply from the desired hours function, $f(w_j,y_j)$, for each linear segment of the budget constraint. If the locally optimal solution is calculated to be within the range of hours over which the linear segment is defined, it is said to be "feasible". If we have a 'convex' kink and the locally optimal solution on a segment lies above the feasible range and if the locally optimal solution on the following segment lies below the feasible range, we have a kink between two segments as a feasible solution. An interior 'non-convex' kink can never be a feasible solution (while the corner solution at h=0 may be both optimal and feasible). Hence, this first step yields a vector, I, of information about the segments and kinks, where I=1 if the segment or kink is feasible, and zero otherwise. Second, after all feasible local optima have been identified, the algorithm finds the global optimum by calculating which of the feasible local optima that generates the maximum utility.

When the direct utility function is only implicitly available, the maximum must be calculated using the indirect utility function. It is easily done for all the feasible segments, but no definitive wage rate exists at the kink points. However, we can evaluate the inverse demand function, w=w(h,y), at the hours corresponding to the kink point and find a 'support' wage rate. By duality, the substitution of the 'support' wage rate into the indirect utility function at the kink point hours is sufficient to evaluate the level of direct utility at the kink point, cf. Duncan (1990).

3. The empirical specification

In order to specify the empirical model, we have to select a functional form of the labour supply function and a stochastic structure. In this study, we select a flexible non-linear specification which allows for backward bending labour supply as in Duncan (1990). The specification is non-linear in the wage rates but linear in the non-labour income. However, the direct utility function does not exist in a closed form, so instead we use the indirect utility function in the algorithm described above to find the desired labour supply.[6]

Consider the following empirical specification, which is linear in all the parameters to be estimated, θ.

$$h = f(w_j,y_j) = x_j\theta + \nu \equiv \hat{h}_j + \nu, \qquad j = 1,...,k \tag{3}$$

The error component, ν, represents heterogeneity in preferences with $\nu \sim N(\mu_\nu,\sigma^2_\nu)$. x_j is the explanatory variable and includes, besides the wage and income variables, a constant term and other observable characteristics. The after tax wage rate and virtual income enter the labour supply function by the non-linear term $\beta\ln(w_j) + \gamma(y_j/w_j)$. This specification allows a backward bending supply curve for some or all individuals if $\beta<0$ and $\gamma<0$. The model is well specified in a utility maximising sense as long as the Slutsky condition holds, i.e. $(\beta - \gamma(y_j/w_j))/h - \gamma > 0$, cf. MaCurdy et al. (1990).

Heterogeneity of preferences, represented by ν, tends to generate clusters of observations around the convex kink points and to disperse observations away from non-convex kink points, see Moffitt (1986). The empirical data normally show no bunching or dispersion of individuals at or around the kink points, but usually there is a large concentration of observations at h=0 and at the standard number of hours in a full time job which may reflect different constraints on labour

[6] As an alternative, we have used the linear labour supply specification which was also used in Blomquist (1983) and Flood and MaCurdy (1992). It is linear in both wage rates and non-labour income, and the direct utility function has an explicit closed form. In our study, we do not find, contrary to the results found in other studies, that the results measured by average elasticities for different demographic groups are very sensitive to choice of specification, see Sacklén (1996) for a recent discussion of this problem. Since the non-linear specification is the more flexible and since it performs statistically slightly better, we present the results from the non-linear specification.

supply, as discussed in Section 2. Figure 2 in Section 4 confirms this picture. In Denmark, the standard number of hours in a full-time job in 1996 was 37 hours weekly in most occupations and sectors. Figure 2 indicates a large concentration of observations at 37 hours and, mainly for women, at 0 hours. In order to capture optimization errors due to hours constraints etc. or measurement errors, we add an additive random error term to the model. Let the observed labour supply, h^*, be a function of actual hours, h, and an error component, ϵ, so $h^* = h + \epsilon$, where $\epsilon \sim N(0,\sigma^2_\epsilon)$ and $E(\nu,\epsilon) = 0$. Now the problem is, that the observed h^* is neither sufficient to allocate individuals to their correct budget segment nor sufficient to identify their marginal tax rate, except at zero hours of work. Only the information on the actual hours, h, reveals this. Since the individuals' actual segment choice is not directly observable, one has a discrete-data version of an errors-in-variables problem. Hence, the resulting stochastic model specification becomes the following.

$$h^* = \begin{cases} H_0 + \epsilon & \text{if } \hat{h}_1 + \nu \le H_0 & \text{Lower limit} \\ \hat{h}_j + \nu + \epsilon & \text{if } H_{j-1} < \hat{h}_j + \nu \le H_j & \text{Segment j, j=1,...,k} \\ H_j + \epsilon & \text{if } \hat{h}_{j+1} + \nu < H_j < \hat{h}_j + \nu & \text{Kink j, j=1,...,k-1} \\ H_k + \epsilon & \text{if } \hat{h}_k + \nu \ge H_k & \text{Upper limit} \end{cases} \qquad \textbf{(4)}$$

This combines the discrete and continuous parts of the choice in an estimable econometric model. The likelihood function becomes

$$\mathcal{L} = \prod_{i=I} G(h_i^* = 0) \prod_{i=J} g(h_i^*) \prod_{i=K} G(h_i^* = H_k) \qquad \textbf{(5)}$$

where G(.) is the cumulative density function, and g(.) is the derivative of G(.) wrt. x, $\delta G(.)/\delta x$. I is the index set for the nonparticipants ($h^*=0$), J is the index set for the individuals with a positive labour supply less than H_k ($0<h^*<H_k$), and K measures the individuals who work H_k hours or more ($h^* \ge H_k$). The exact expression of the density $g(h_i^*)$ and the probability $G(h_i^*=0)$ is given in Graversen and Smith (1998). Maximisation of the likelihood, $\mathcal{L}$, provides the coefficients of the

labour supply function.[7]

4. Data

The data used in this study are based on a survey which originally included 4000 individuals and which was collected by Statistics Denmark in the spring of 1996 for the Rockwool Research Foundation. In the present study, the sample is restricted to individuals aged 18-59 years in order to avoid the results to be influenced by the availability of early retirement schemes which for certain groups typically start at the age of 60.[8] We also exclude individuals with long-term illness, students, self-employed persons and assisting wives. The two latter groups because we are not able to calculate their income taxes and construct budget constraints for these individuals. These exclusions result in a sample of 2441 individuals.

The measured labour supply of unemployed individuals is determined by questions on their search behaviour. Unemployed individuals who are on unemployment insurance benefits or social welfare are asked the conventional questions from labour force surveys on search behaviour. Based on the answers to these questions, we divide the unemployed into two groups, those who satisfy the ILO conditions of being unemployed (involuntarily unemployed) and those who do not (voluntarily unemployed). The ILO criteria for being categorized as (involuntarily) unemployed are that the person actively has been seeking for a job within the latest month and that he or she is able and willing to start in a new job within the next two weeks. If the person satisfies these conditions, he or she is assumed to have a measured labour supply of 37 hours weekly if full-time insured against unemployment and 20 hours weekly if part-time insured against unemployment. If the person does not satisfy the ILO criteria, we categorize the person as voluntarily unemployed with a measured labour supply of 0 hours.[9]

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[7] The sample used is a non-representative sample where unemployed persons are over-sampled. Therefore, the likelihood function in (5) is weighted by the appropriate weights.

[8] In 1994-1995 an early retirement scheme was introduced which allowed early retirement from the age of 50 *(overgangsydelsen)*. New entrance into the scheme was stopped in the beginning of 1996 but during this two-year period, a relatively large number of long-term unemployed individuals entered the scheme (in our sample about 90 individuals are observed to be on this retirement scheme). We do not control for the potential selectivity effects which may exist for the individuals aged more than 50 in our study.

[9] The same grouping into involuntary and voluntary unemployment in labour supply models is used in Euwals and van Soest (1999) and Bingley and Walker (1997).

The sample includes survey information on weekly normal hours in main occupation, the normal working hours in second job, if the person holds a second job, and the number of hours in overtime work in the week prior to the survey week.[10] Figure 2 shows the distribution of total weekly hours of work for the 1150 men and 1291 women who are included in the sample used in this study. There is a very strong clustering of observations at 37 hours, for men as well as for women. Very few participating men work less than 37 hours weekly. If men do not work the standard hours, they tend to work overtime or have a second job, see Tables 1 and 2. The opposite is the case for women where part-time work is more widespread, and fewer women than men work more than 37 hours weekly.

Figure 2. Total number of weekly hours of labour supply, including overtime work and second job, and marginal tax rates. 1996.

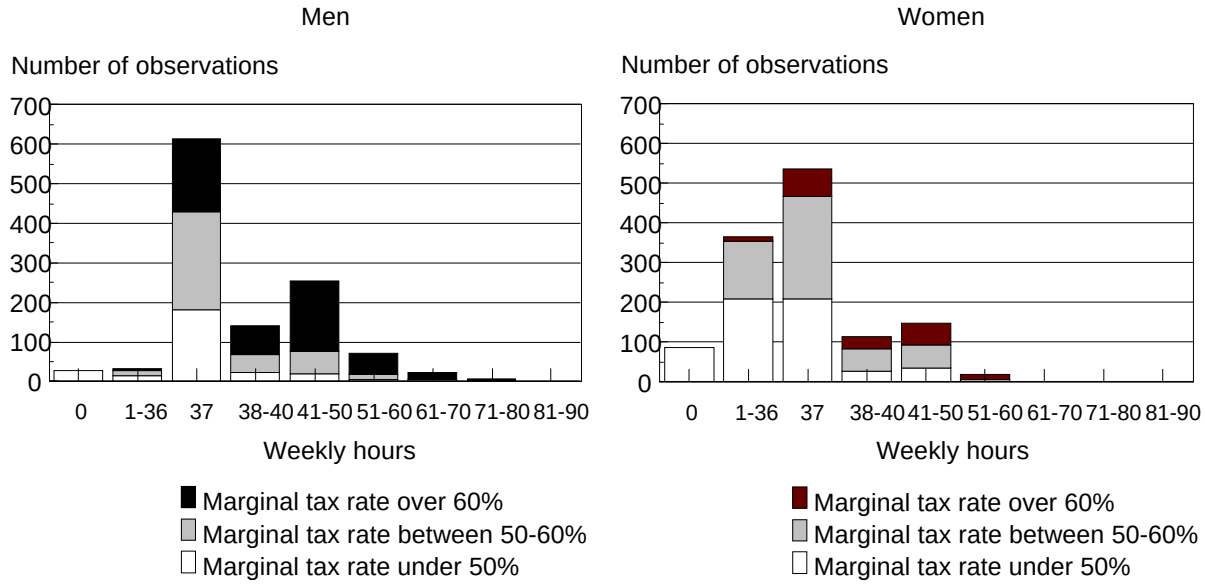


Figure 2 also shows the marginal tax rates faced by the individuals in the sample. In general, the marginal tax rates in Denmark are high compared to other OECD countries, see for instance OECD (1996), and the marginal tax rates are considerably higher for men than for women. This reflects of course the higher level of earnings and non-wage income of men, but it also reflects

[10] It may be criticised that the time dimension is not the same for overtime work, second job and work in main occupation. We prefer to use 'the normal work hours' to measure the labour supply since it gives a smoothed measure of the desired labour supply. Unfortunately, this information for overtime hours is not available in our data set. Instead, we use the 'best' approximation, namely overtime work referring to the week of the interview.

the Danish tax system which is dominated by separate taxation of spouses, see Callan et al. (1999).

Tables 1 and 2 show the sample distribution on different labour supply states and the average hours of labour supply in main occupation, overtime work and second job. 12% of the sample is either unemployed or observed as non-participants, 64% have only one job and no overtime, and 24% have a second job or work overtime beside their main occupation. Out of these 24%, 18% work overtime, 5% have a second job, and 1% work overtime and have a second job.[11]

Table 1. Distribution of men and women in non-participation, unemployment and employment in main, overtime and second job occupation.

	Non-partici-pants	Unem-ployed	Main occupation only	Main & overtime[1)] occupation	Main & second job occupation	Main, overtime[1)] & second job occupation	Total
Men	0.03 (36)	0.06 (72)	0.60 (694)	0.22 (254)	0.06 (72)	0.02 (22)	0.99 (1150)
Women	0.08 (101)	0.07 (86)	0.67 (864)	0.14 (187)	0.03 (45)	0.01 (8)	1.00 (1291)
All	0.06 (137)	0.06 (158)	0.64 (1558)	0.18 (441)	0.05 (117)	0.01 (30)	1.00 (2441)

Note: 1) 130 men and 81 women with observed overtime (main hours exceeding 37 per week) did not get any compensation for their overtime work.

The weekly number of working hours is relatively low in Denmark compared to other European countries, see Smith (1998).[12] On average, an employed man works 41 hours weekly, and an employed woman works 36 hours. On average, weekly overtime work amounts to 2 hours and weekly second job work to 1 hour for an employed man. For employed women overtime work is 1 hour weekly on average and only 0.4 hours weekly in a second job.

[11] The incidence of overtime in Denmark seems to be considerably lower than in the UK where overtime incidence (for males) is found to be about 40%, see Kalwij and Gregory (2000). For the US, Trejo (1993) finds that the dual job-holding rate is about 6% for both men and women in the 1991 CPS sample which is based on observations in a given survey week. When using annual data, the dual job-holding rate is considerably higher, 21% for men and 12% for women. Since our data are based on a question on 'normal weekly hours in second job', the larger figures in the study by Trejo are probably the relevant figures to compare.

[12] The relatively low weekly hours for Danish labour force participants partly reflect that the participation rate for women is relatively high. Thus, the total weekly hours of market work in an average Danish household is not much lower than in other countries. See Smith (1998).

Table 2. Average weekly hours in main occupation, overtime and second job, conditional on participation. Shares in parentheses.

	Main occupation	Overtime work	Second job	Total
Men	37.9 hours (0.92)	2.1 hours (0.05)	1.0 hours (0.03)	41.0 hours (1.00)
Women	34.5 hours (0.96)	1.0 hours (0.03)	0.4 hours (0.01)	35.9 hours (1.00)
All	36.1 hours (0.94)	1.5 hours (0.04)	0.7 hours (0.02)	38.3 hours (1.00)

The average observed wage rates in main occupation, overtime work and second job and the distribution of the individuals according to normal weekly hours in main occupations are shown in Table 3. Overtime payments exceed the payments for standard hours in main occupation with a considerable amount for both men and women, while the picture for second jobs is more mixed. Individuals with low hours in main occupation tend to have relatively low hourly wages in second job while individuals with a full-time job have higher wages in a second job. This may reflect that individuals with few hours in main occupation have to supplement their income with a second job in order to work the preferred hours, i.e. they are restricted from having a full-time job in their main occupation, see Trejo (1993).

Table 3. Average hourly wages in main occupation, overtime work and second job, distributed according to hours in main occupation.

Normal weekly hours in main occupation	Main occupation		Overtime work		Second job	
Men	N	Wage, DKK	N	Wage, DKK	N	Wage, DKK
0	36	-	0	-	0	-
1-36	56	144.5	16	171.1	12	77.8
37	914	130.4	246	169.2	66	146.2
38-	144	148.1	14	180.4	16	159.2
all	1150	133.7	276	170.1	94	140.5
Women	N	Wage, DKK	N	Wage, DKK	N	Wage, DKK
0	101	-	0	-	0	-
1-36	407	105.7	65	134.5	26	101.4
37	700	108.6	128	162.4	24	169.5
38-	83	100.1	2	159	3	141.1
all	1291	107	195	148.6	53	135.9

Note: N is number of observations. Note that the same individual may enter up to three times in the table.

The survey data contains information on childcare costs and costs of transportation for individuals who are employed. Childcare is fairly cheap in Denmark because the coverage of publicly provided and highly subsidized childcare is high. On average, childcare and transportation costs amounted to about DKK 700 monthly (about USD100).

5. Budget constraints and alternative model specifications

In order to construct individual budget constraints which reflect the income tax scheme, information on capital income, other non-labour income sources and tax deductions originating from administrative tax and income registers has been merged with the survey information. However, despite the very detailed information from the administrative tax and income registers there still exist a number of problems when constructing individual budget constraints including information on overtime and second job.

One problem is that a number of individuals who have a positive labour supply in main occupation, overtime work or in a second job have missing information on the wage rates related to these types of labour supply. For these individuals, we predict their hourly wage rates based on estimations of selectivity-corrected wage functions in the three states. The three wage functions and probit estimations of the probability of having an observed wage (the latter is used for the calculation of the self-selection correction term) are shown in the Appendix.

However, this does not give an answer to all questions concerning individual budget constraints with overtime and second job hours. First, it is important to note that the observed labour supply in main occupation, overtime and second job may not reflect the optimal point on the budget constraint for the individual if the labour supply is restricted by the employer, due to regulations by unions or due to demand constraints (involuntary unemployment). Therefore, we have to make a number of assumptions in order to be able to construct individual budget constraints. In order to evaluate whether these assumptions are critical for the estimations, we have estimated a number of models where we successively add more survey information and allow the model to be successively more flexible.

One question relates to overtime work. Individuals who are not observed with a positive number of overtime hours may have the option to work overtime. These individuals may have preferred not to do so because it was not optimal for them to work overtime, given the overtime wage rates at the actual employer. Or the individual may be restricted from overtime work at his present employer. For individuals who have the option to work overtime, but who have not done so, we do not know whether there is a separate overtime rate exceeding the wage rate in main occupation. Our basic assumption (which is relaxed in some of the estimated models) is that budget constraint can be extended linearly from the point of observation, i.e. the individual is able to work more hours at the wage rate on the observed budget segment. For some individuals, typically monthly paid salaried workers, the monthly payment is fixed irrespective of the weekly or monthly number of hours actually worked. Thus, they do not get overtime compensation for extra hours exceeding full-time hours. For this group, we assume that the budget constraint is horizontal to the right of the observation point, except for individuals who are also observed to have a second job.

A second question concerns how to model the second job option. If a person is not observed having a second job, we assume that the person maximizes utility on the budget segments relating to main job (including overtime) either because the wage rate in second job is too low or because there are fixed costs of work related to a second job which makes it unattractive. We do not have survey information on fixed costs of work related to second job but in some of the estimated models, we allow for unobserved fixed costs of work related to a second job.

For individuals insured against unemployment, we include potential unemployment benefits in the budget constraint at 0 hours. Unemployed individuals who are insured in an UI fund receive an hourly compensation of 90% of prior hourly wages up until a flat rate. The UI compensation in Denmark is independent of other sources of income and independent of the income of a spouse. It is not straightforward to model the reduction of UI benefits in the budget constraint when labour supply exceeds 0 hours. In this study, it is chosen to ignore UI benefits if labour supply is positive, and we do not make a gradual reduction. The argument is that because of the way UI is administered, it is in practice not possible for the individual in a given week freely to choose a given combination of hours of unemployment and employment. If an unemployed person is not

insured against unemployment, he will be eligible for social welfare which is means-tested at a rate of 100% against all sources of income, including income of a spouse if the person is legally married. However, due to the same reasons as for UI benefits, we ignore social welfare if labour supply exceeds 0 hours.

The way of treating UI benefits creates a large non-convexity in the budget constraint for the majority of individuals. In Figure 1, this is partly reflected by the distance between y_0 and y_1. Another source adding to the size of $y_0 - y_1$ is fixed costs of work. Thus, the state as non-participant may be economically very attractive or even preferable for a number of individuals with low human capital and low wages for whom the replacement rate of the UI benefits is high. Some individuals (6% of the sample) are actually observed to prefer the non-participation state or to be voluntarily unemployed. However, the state as non-participant/voluntarily unemployed may imply a stigmatization effect for those individuals who receive social welfare or UI-benefits. The stigmatization may reflect that there is a negative effect on individual utility from being on public income support because of 'reputation among neighbours' etc. Or it may reflect that the individual is aware that being on public income support is a negative signal for a future potential employer. The stigmatization effect may explain that a number of individuals with very flat budget constraints and large non-convexities at zero hours are actually observed to work a positive number of hours.[13] In some of the estimated models presented below, we extend the flexibility of the estimated model by including an unobserved stigmatization effect, i.e. we add an indicator variable on the right hand side of (3) which assumes the value of 1 if the individual works, and 0 else.

In order to show the sensitivity of the estimated coefficients and resulting elasticities, we show the results from estimating 5 models which successively include more information on overtime pay and second job wage rates and successively add more flexibility with respect to allowing for unobserved stigmatization effects and unobserved fixed costs of work in second job. In all models, the observed working hours are the total of main, overtime and second job hours. In the first model (I), we ignore the information on overtime and second job wage rates and assume that the

[13] The stigmatization effect may also capture effects from administrative rules concerning availability for the labour market etc.

individual gets an hourly compensation equal to the hourly wage rate in main occupation, i.e. we assume that the budget constraint is linear, except for kinks due to the tax and transfer schemes. This 'baseline model' corresponds to the definitions of wage rates and working hours in Blomquist (1983). The second model (II) includes information on overtime wage rates and wage rates in second jobs. In models I and II, we do not allow for a stigmatization effect. Thus, these models include a large non-convexity at zero hours. In models III-V, we allow for a stigmatization effect. Except for the stigmatization effect, model III is analogue to model I, i.e. no information on overtime pay and second job wage rates is included. In model IV, this wage information is added. In model V, which is the preferred model, we further allow for unobserved fixed costs of work in second job.[14]

All the models are estimated for men and women, separately. Beside the wage and income variables, we include a number of demographic variables as controls: Civil state, age, children in different age categories, education, ownership of house and urbanization.[15]

6. Empirical results

The estimations in Tables 4 and 5 confirm that the definition of labour supply and hourly wage rates and the flexibility of the Hausman model specification are important for the estimated wage and income coefficients and respective elasticities. In general, the numerical size of the estimated coefficients and elasticities is higher for women than men, and the variation across models is also larger for women than men. The estimated wage effect is significantly positive in all models while the income effect is negative, but often insignificant. In the baseline model, model I, the estimated wage elasticity (uncompensated elasticity of substitution) is 0.277 for men and 0.360 for women,

[14] In alternative estimations not presented here, we have experimented with various specifications where additional information on constraints on labour supply is used. The survey includes a question on whether the individual is able to vary his labour supply freely or he is constrained due to employer preferences or regulations due to unions. If the individual answers that he is not able change his labour supply, we assume that the budget constraint is horizontal to the right of the point of observation. Thus, we still ignore rigidities in a downward direction and assume that optimization errors due to restrictions which prevent lower hours are captured in the optimization/measurement error term. The results from this estimation were extremely close to the results presented in model V. In another alternative model, we assume that individuals who answer positively on the question concerning labour supply constraints only have the choice between two points on the budget constraint: Either their observed hours or 0 hours. However, this model did not converge for neither men nor women.

[15] In the models which do not allow for a stigmatization effect, we do not include age and educational variables because these variables implied that the estimations were extremely unstable.

while the income elasticity for men is estimated to be -0.078 and for women -0.040. Including information on overtime pay and second job wage rates increases the numerical size of the coefficients and elasticities dramatically for men as well as women, see model II.

Models I and II do not allow for a potential unobserved stigmatization effect. This means that the budget constraint contains an extremely large non-convexity at zero hours, especially for individuals who are eligible for UI benefits or social welfare, see Figure 1 where the difference between y_0 and y_1 indicates the size of this non-convexity. Model III introduces a 'stigmatization' effect from being unemployed and receiving public income transfers, i.e. it allows for an individual downgrading of the utility of non-wage income if non-employed. For women this non-convexity seems to be extremely important, and the more flexible model III gives much lower substitution effects for women than model II. The estimated stigmatization effect is significantly positive for women, indicating that there is a negative utility effect from being non-employed. For men, the effect is insignificant. The difference between men and women with respect to changes between results from models II and III may reflect that a much larger fraction of women is observed with very small or even negative incentives to work because of the high replacement rate for low-wage groups of the Danish UI-benefits and social welfare system, as documented in Pedersen and Smith (2001).

Model IV combines models II and III and includes both a stigmatization effect and information on overtime pay and second job wage rates. For both men and women, the inclusion of detailed information on the budget constraint with separate wage rates for main occupation, overtime work and second job reduces the estimated wage and income effect in a model which also allows for stigmatization effects. Thus, the estimated coefficients are very sensitive to the inclusion of a stigmatization effect. There is a large increase from model I to model II in the estimated coefficients when information on wage rates in overtime work and second job is included in a model which does not allow for the flexibility related to the stigmatization effect. But in a model which includes a stigmatization effect, we do not find a large increase in estimated coefficients when including information on overtime pay and second job wage rates.

Table 4. Estimation of labour supply functions for men. 1996. (Standard deviations in parentheses).

	I Baseline	**II** I + information on w^o and w^s	**III** I + stigmati-zation effect	**IV** III + information on w^o and w^s	**V** IV + fixed costs in second job
$\ln(w_{net})/10$	0.736 (0.143)	1.281 (0.142)	1.581 (0.251)	0.333 (0.08)	0.169 (0.039)
$(y/w_{net})/100$	-0.079 (0.029)	-0.097 (0.015)	-0.062 (0.027)	-0.016 (0.003)	-0.001 (0.001)
Controls for demographic variables	yes	yes	yes	yes	yes
Stigmatization effect	-	-	0.766 (0.725)	0.329 (0.009)	0.341 (0.008)
Fixed costs of second job	-	-	-	-	0.071 (0.011)
σ_ϵ(measurement, optimization)	0.090 (0.002)	0.097 (0.001)	0.072 (0.002)	0.046 (0.002)	0.024 (0.001)
σ_υ(heterogeneity)	0.055 (0.003)	0.059 (0.003)	0.064 (0.003)	0.079 (0.003)	0.083 (0.002
Mean log(ℒ)	0.786	0.763	0.801	0.899	1.039
No. of obs.	1150	1150	1150	1150	1150
Elasticities[1]					
ϵ_{ucw_net}	0.277 (0.009)	0.413 (0.022)	0.413 (0.175)	0.103 (0.065)	0.052 (0.034)
ϵ_{cw_net}	0.358 (0.010)	0.496 (0.022)	0.469 (0.188)	0.119 (0.063)	0.053 (0.034)
ϵ_y	-0.078 (0.002)	-0.143 (0.021)	-0.023 (0.141)	-0.018 (0.060)	-0.006 (0.023)

Note 1: The elasticities are calculated from the following expressions and evaluated at average sample values:

$$\epsilon_{ucw} = \Phi\left(\frac{x\theta}{\sqrt{\sigma_\epsilon^2+\sigma_v^2}}\right) * \left(\beta - \gamma * \frac{y}{w}\right) * \frac{1}{h},\ \epsilon_y = \Phi\left(\frac{x\theta}{\sqrt{\sigma_\epsilon^2+\sigma_v^2}}\right) * \gamma * \frac{y}{w*h},\ \text{and}\ \epsilon_{cw} = \epsilon_{ucw} - \frac{w*h}{y} * \epsilon_y$$

Finally in model V, unobserved fixed costs of work in second job are introduced in the model, i.e. a new type of flexibility is added into the Hausman model. This has minor effects on the estimated substitution effect, but reduces further the estimated income effect. The estimated fixed costs effect is significant for men but for women the inclusion of unobserved fixed costs of work does

not seem to matter much. The estimated fixed costs of second job are insignificant for women. The estimated wage elasticities are 0.052 and 0.148 for men and women, respectively. The average income elasticity is almost identical for men and women, -0.006 and - 0.007, respectively.

Table 5. Estimation of labour supply functions for women. 1996. (Standard deviations in parentheses).

	I Baseline	**II** I + information on w^o and w^s	**III** I + stigmati-zation effect	**IV** III + information on w^o and w^s	**V** IV + fixed costs in second job
$\ln(w_{net})/10$	1.111 (0.245)	3.326 (0.175)	0.813 (0.200)	0.363 (0.130)	0.488 (0.093)
$(y/w_{net})/100$	-0.022 (0.014)	-0.220 (0.041)	-0.081 (0.018)	-0.032 (0.022)	-0.004 (0.002)
Controls for demographic variables	yes	yes	yes	yes	yes
Stigmatization effect	-	-	0.225 (0.004)	0.071 (0.006)	0.074 (0.002)
Fixed costs of second job	-	-	-	-	0.003 (0.025)
σ_ϵ(measurement, optimization)	0.115 (0.002)	0.065 (0.001)	0.046 (0.001)	0.032 (0.022)	0.030 (0.001)
σ_υ(heterogeneity)	0.059 (0.005)	0.209 (0.007)	0.111 (0.003)	0.115 (0.003)	0.117 (0.003)
Mean log(ℒ)	0.441	0.345	0.190	0.966	0.966
No. of obs.	1291	1291	1291	1291	1291
Elasticities[1]					
ϵ_{ucw_net}	0.360 (0.005)	0.760 (0.019)	0.396 (0.221)	0.137 (0.034)	0.148 (0.038)
ϵ_{cw_net}	0.381 (0.005)	0.907 (0.022)	0.473 (0.217)	0.169 (0.034)	0.152 (0.038)
ϵ_y	-0.040 (0.001)	-0.137 (0.005)	-0.099 (0.123)	-0.030 (0.025)	-0.007 (0.053)

Note 1: See Table 4.

The size of the average elasticities found in the preferred model V is lower than the results found in previous Danish studies using a Hausman approach, see Graversen (1998). For Sweden, in a recent study Blomquist et al. (2001) have found, using a non-parametric approach, wage

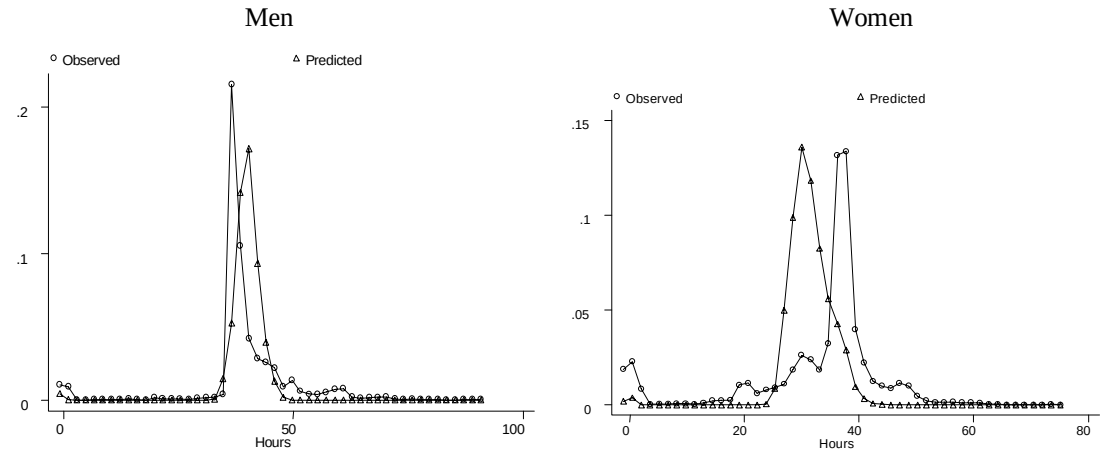
elasticities for Swedish men of about 0.075 which is lower than earlier studies based on Hausman models, see Blomquist and Hansson-Brusewitz (1990).

The variance of both the measurement error and the heterogeneity error is highly significant in all specifications for both men and women. Hence, the inclusion of the two error terms seems to be of importance. The size of the variance of the measurement and optimization error is approximately the double of the heterogeneity error variance in model I but it reduces the more information on overtime work and second job is included and the more flexibility is allowed in the estimated model. The heterogeneity error variation increases across model specification.

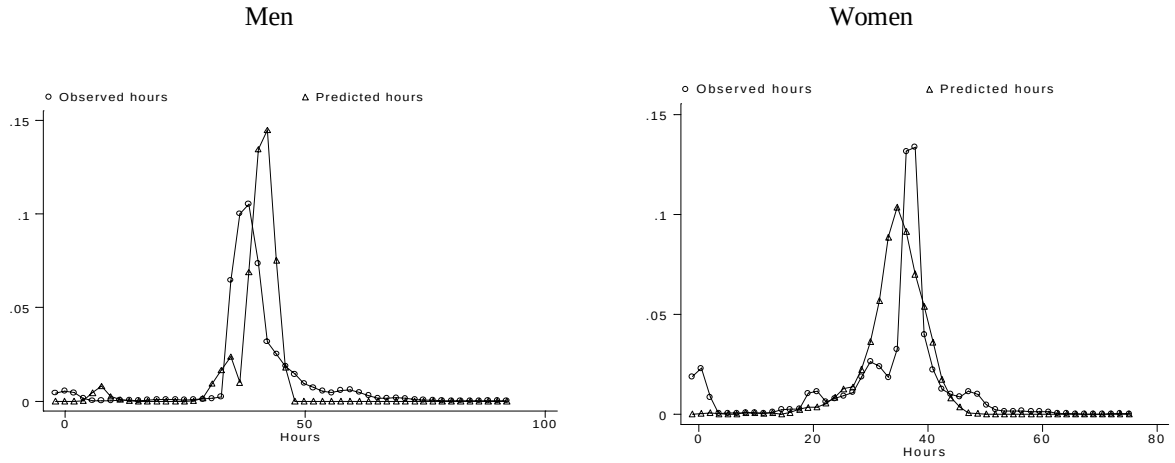
The Hausman approach is known to have a small predictive power. In Figure 3, we have predicted the distribution of weekly hours labour supply based on a baseline model (model I) and the preferred model V. For women, model V is considerably better than model I in predicting the modes of the observed hours' distributions. Both models predict fewer women to work 0 or 37 hours than is observed. For men, both models over-predict the full-time frequency. Both models seem to predict a smoother distribution of labour supply compared to the observed hours distribution. The existence of individual heterogeneity and measurement errors is the main reason for this evidence. Thus, the inclusion of improved information on hours and wages and a more flexible specification of the Hausman model do not improve much the predictive power of the model. This means that we have to compare the initial predicted labour supply in the simulation study in Section 6 with the predicted labour supply after a reform.

Figure 3. Observed and predicted weekly hours. Model I and model V.

Model I



Model V



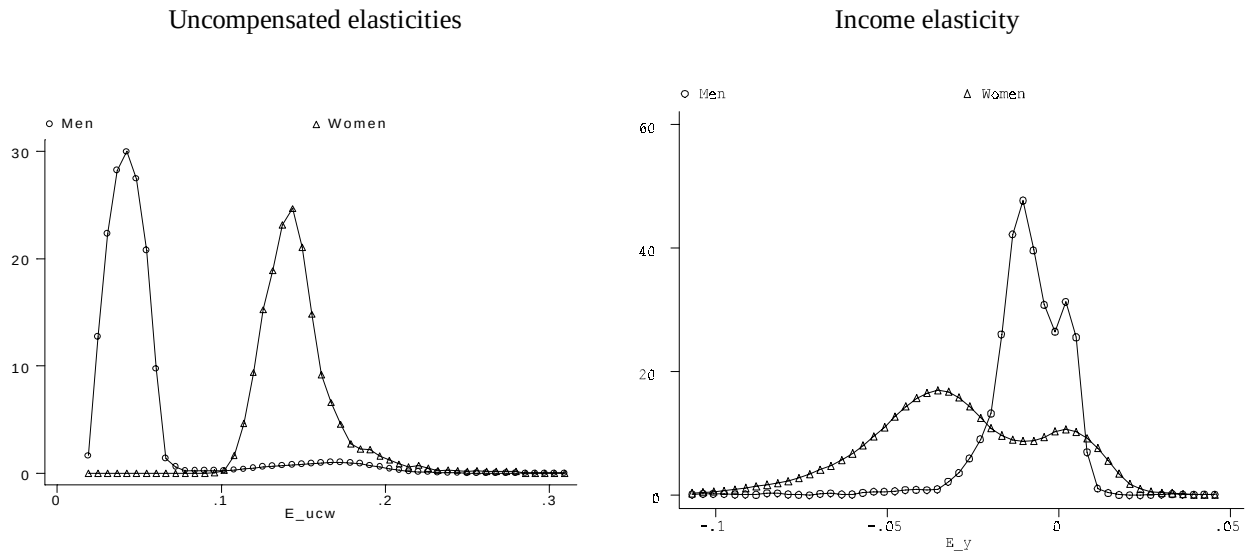
7. Labour supply reactions to tax reforms

In many countries, one of the main ambitions in tax reforms has been to reduce marginal tax rates on labour income. Since the Danish marginal tax rates on labour income are high in an international setting, this has also been on the political agenda in Denmark for years. However, unfinanced tax cuts which are introduced because of structural policy goals may be very problematic. This is partly because of short-run business cycle considerations relating to the tightness of the fiscal policy and partly because of long-run problems of financing the welfare state due to ageing population problems within the next decades which will increase the financial burden of the public sector because of a number of tax-financed social welfare systems which are highly sensitive to demographic changes. Therefore, the supply reactions to tax cuts which may reduce the financial burden of tax reforms are extremely important. Since the focus in this paper has been to improve the traditional labour supply model by including information on overtime pay and second job wage rates, we study hypothetical tax reforms which reduce the marginal tax rates in the medium and upper income ranges.[16]

When analysing tax reform reactions in a regime with very complex budget constraints with many kink points and non-convexities, it is important to know the distribution of elasticities across income deciles. The sample distribution of wage and income elasticities for the preferred model V is shown in Figure 4. The distributions of wage (i.e. uncompensated substitution) elasticities are unimodal and fairly symmetric around the mean for both men and women, but with long tails. The distribution of income elasticities is more compressed (note that the scales on the axes are different for the distributions of income and substitution effects), except for a few outliers which are not included in Figure 4.

[16] In Graversen and Smith (1998), the potential labour supply effects of a tax reform reducing taxes on labour income for low-wage groups are analysed.

Figure 4. Simulated income and substitution elasticities.



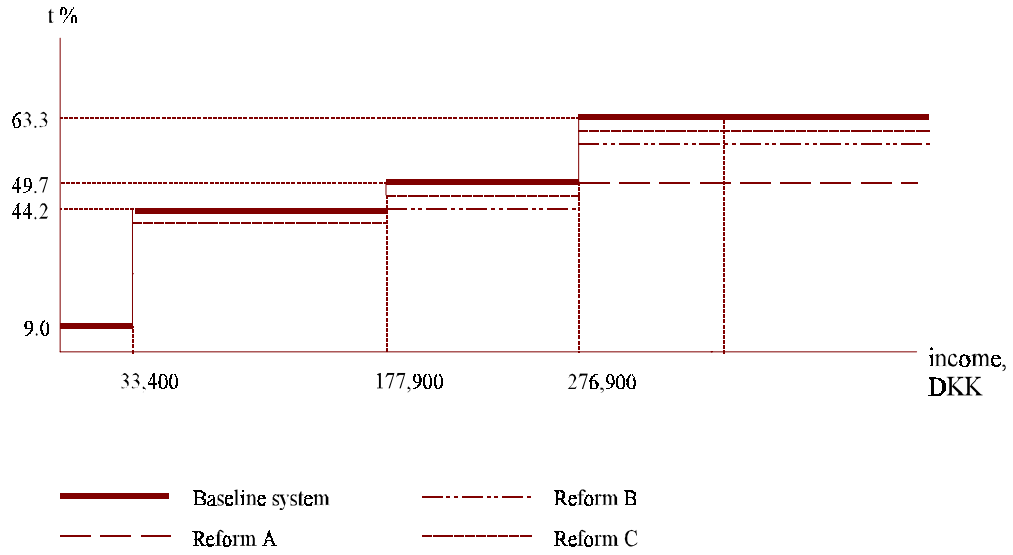
Note: Simulations are based on model V.

The overall estimated elasticities vary systematically with disposable income. The higher the disposable income, the lower the substitution elasticity, ranging from 0.14 in the first income decile to 0.08 in the highest income decile. The income elasticity increases (numerically) with disposable income, ranging from -0.003 in the lowest income decile to -0.010 in the highest decile. However, this variation partly reflects compositional effects across income deciles: The higher the income decile, the fewer women. Men have lower substitution elasticities and since they dominate the higher income deciles, the overall substitution elasticities decrease with income. For the income elasticity, the difference between men and women is less pronounced. The wage and income elasticities across income groups are shown in Table A5 in the Appendix.

We study alternative tax reforms which reduce the tax burden on wage income in the medium and upper income ranges. We compare the supply effect of hypothetical tax reforms with the predicted labour supply given no changes in the actual tax structure and use the year 2002 as the base year for the comparisons. 2002 is the year when the latest tax reform which was introduced in 1999 is fully in force, and it is the base year which is most often used for the political discussions on new tax reforms. This means that we predict the labour supply for all individuals in the sample given the tax rules in 2002 and compare with the predicted labour supply given alternative tax

reforms.[17] Figure 5 shows the marginal tax rates and the tax brackets for the year 2002. These are slightly different from the marginal tax rates in 1996, see Sections 4 and 5.

Figure 5. The Danish income tax system in 2002 ('Baseline' system and alternative tax reforms).



Note: It is assumed that the person lives in a municipality with 'average' tax rates, and that he does not have any positive or negative capital income or other income and no allowances beside the zero-rated allowance for local and state taxes.

In the first reform (A) we remove the third tax kink, implying that the highest marginal tax rate on the fourth tax segment would be (on average) 49.7%. The second reform (B) reduces the marginal tax rates on the third and fourth tax segments by 5.4%. In the third reform (C), we reduce the marginal tax rates in the three upper tax brackets by 1.8%.[18] This will imply a (small) tax reduction for 99% of the individuals in the sample. The fourth reform (not shown in Figure

[17] Since our sample is based on observations for the year 1996, we have to inflate all wage and income variables to 2002 level. We use the observed increase in wage inflation for the years 1997-2000 and use the forecasts of wage inflation from the Danish Economic Council (2000) for the year 2000. In the Danish tax system, the marginal income tax rate in a given income bracket is calculated as g% + (1- g%)*(t^{local} + t^{state}) where g is called the 'gross tax rate', t^{local} is the average local tax rate in Danish municipalities and counties and t^{state} is the progressive state tax rate. The gross tax is 9% in 2002, the average of t^{local} is assumed to be 33.2% and the three tax rates to the state are 5.5%, 6% and 15% in 2002.

[18] Reform B reflects that the state tax is reduced by 6% in the third and fourth income brackets. Reform C implies a reduction of the lowest state tax rate from 5.5% to 3.5%.

5) increases the third tax bracket from DKK 276,900 to DKK 350,000, thus implying that a large number of individuals with incomes in the fourth tax bracket get a reduction of their marginal tax rates. It is estimated that the first, second and third reforms have initial effects, i.e. ignoring supply reactions, on public-sector revenues of about 1% of GDP while the initial revenue effect of the fourth reform is about half because fewer individuals will benefit from the lower marginal tax rates. The predicted effects of the alternative reforms are illustrated in Table 6.

Table 6. Predicted labour supply effects compared to predicted labour supply in 'baseline tax system' and effects on public-sector revenue of alternative tax reforms.

	Reform A	Reform B	Reform C	Reform D
Public-sector revenue, rate of self-financing	0.207	0.260	0.119	0.580
Labour supply effects (relative change of weekly hours):		----------%----------		
Men	0.660	0.442	0.140	0.804
Women	0.724	0.835	0.445	0.758
Income decile 1	0.335	0.468	0.385	0.766
Income decile 2	0.367	0.538	0.364	0.993
Income decile 3	0.467	0.679	0.341	0.531
Income decile 4	0.519	0.682	0.321	0.533
Income decile 5	0.619	0.659	0.275	0.527
Income decile 6	0.996	0.764	0.296	0.427
Income decile 7	0.831	0.71	0.279	-0.039
Income decile 8	0.995	0.692	0.25	1
Income decile 9	0.733	0.578	0.213	0.623

Note: Predicted labour supply effects are based on model V. 'Income' is disposable income. Income decile 1 is defined as the observations in percentile 5-14, income decile 2 is the observations in percentile 15-24 etc. Thus, we exclude outlier-observations in both ends of the distribution in the decile figures, but not in the figures for the total supply effects.

The four reforms have very different effects on the public-sector revenue and labour supply. Reform A increases the weekly labour supply of both men and women with about 0.7% and the rate of self-financing is only about 20%. As expected, mainly the higher income groups will increase their labour supply. For these groups, the positive substitution effects from lower

marginal tax rates dominate the negative income effects. Fewer women will benefit from the lower marginal tax rates but since they have lower income elasticities, the total supply effect is more positive for women relative to men. Reform B implies a smaller reduction in marginal tax rates but more individuals, i.e. a number of medium income earners will also benefit from this reform, which has larger supply effects on women (more women will face reduced tax rates) but smaller effects on men compared to Reform A. Reform C reduces the marginal tax rates for virtually all tax payers by about 1.8 %-points. This reform is the most expensive for the public- sector revenues and the self-financing rate amounts to only 11%. The explanation is that for higher income groups, which tend to have higher income elasticities, there is a large negative income effect on labour supply from reducing the tax rates in all income brackets, but the positive substitution effects are more marginal. Thus the labour supply effects of the high income groups are smaller than in the other reforms. Finally, reform D has a self-financing rate of 58% and the largest effects on labour supply. The weekly labour supply in this reform is predicted to increase by about 0.8%.

The results above indicate that the total revenue effect, including labour supply effects, from alternative tax reforms is highly depending on the design of the reform which implies a given initial loss of tax revenue. However, it is worth mentioning that the analysis presented above is partial in the sense that we have not included potential effects on consumption and indirect tax revenues. If these effects are included, the rate of self-financing of the tax reforms analysed above will increase, since disposable income will increase for all income groups. Another effect not included in this study is the potential effects of taxation on the wage formation process. If the average income tax and the tax progression is changed, this may have different effects on wage inflation for different groups and thus, on the demand side of the economy, see Pedersen et. al (1999).

Another reservation concerning the results presented in Table 6 is that the predicted labour supply effects and the effects on public-sector revenues are highly sensitive to the choice of model specification. This is illustrated in Table 7 which shows the predicted labour supply and revenue effects for tax reform A (third tax kink is removed and the highest marginal tax rates reduced to 49.7%) based on all the five models estimated in Tables 4 and 5.

Table 7. Predicted labour supply and public-sector revenue effects based on alternative models specifications: Tax reform A (highest marginal tax rates reduced to 49.7% on average).

	I Baseline	**II** I + information on w^o and w^s	**III** I + stigmati-zation effect	**IV** III + information on w^o and w^s	**V** IV + fixed costs in second job
Public-sector revenue, rate of self-financing	0.650	1.932	0.881	0.461	0.207
Labour supply effects (relative change of weekly hours):		----------%----------			
Men	2.22	7.02	4.67	2.18	0.66
Women	3.55	6.31	2.63	0.93	0.72

Table 7 shows that the size of the predicted labour supply and public-sector revenues effect is highly sensitive to the specification of the labour supply model. In the preferred model V which exploits the survey information on wage rates and allows for the largest degree of flexibility, the degree of self-financing in a tax reform reducing the progression of the tax system by removing the third tax kink is about 21%. In model II where information on overtime hours and second job is included the degree is 193%, but the Hausman-model specification is fairly inflexible. Mainly the inclusion of the stigmatization effects seems to be important when estimating a Hausman-model which includes individuals observed at 0 hours. This is due to a large non-convexity at 0 hours caused by the Danish public income transfer system and fixed costs of work.[19] Thus, one of the main lessons from this study is that when analysing the effects of tax reforms based on a Hausman-model approach, it is important to choose a model which allows for sufficient flexibility at the non-convex part of the budget constraints. In the Danish case, mainly the non-convexity at 0 hours seems to be important while the non-convexity caused by second job seems to have minor influence on the estimated labour supply effects.

[19] Alternatively, the construction of the budget constraint might have been based on the assumption that UI-benefits and social welfare are reduced hour by hour if labour supply exceeds 0 hours. However, this assumption may also be criticized because individuals on UI-benefits and social welfare are not allowed by the authorities to choose the number of hours they want to work weekly and then get supplementary UI-benefits or social welfare on an hourly basis up to full-time (37) hours weekly.

8. Conclusion

In this paper, we have estimated labour supply functions for men and women in Denmark using a piecewise linear Hausman model to account for non-linear taxes. Traditionally, labour supply data do not include explicit information on hours of work and hourly wages in second job or overtime work. In this paper, we compare the estimated labour supply responses based on budget constraints reflecting detailed information on overtime work and second job with the estimates based on budget constraints which do not include information on overtime work or second jobs. The model allows for individuals with a labour supply of zero hours (housewives or voluntarily unemployed persons who do dot satisfy the ILO criteria of being unemployed because they are not actively seeking a job). Further, we introduce different elements of flexibility into the Hausman model. The results turn out to be extremely sensitive to the specification of labour supply and the flexibility of the model specification. The estimated wage elasticities for men vary from 0.41 to 0.05 depending on specification and for women variation is even larger, between 0.76 and 0.15. The variation in estimated income elasticities is also considerable. The preferred model includes detailed information on overtime pay and wages in second job and allow for unobserved stigmatization effects from non-employment and unobserved fixed costs of work in second job. This model gives the numerically lowest estimates of income and substitution effects. The estimated model is used for analysing alternative tax reforms which have very different effects on different budget segments. The results show that due to the variation across income deciles in the estimated wage and income elasticities, the design of tax reforms which reduce the highest marginal tax rates substantially has large effects on the rate of self-financing of the tax reform.

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Appendix

Table A1. Descriptive statistics

	Men		Women	
Variable	Mean	Std. dev.	Mean	Std. dev.
Weekly labour supply, given participation				
- main occupation	37.9	5	34.5	6.5
- overtime work	2.1	5.1	1	2.8
- second job	1	4.3	0.4	2.2
Hourly gross wage rate, DKK				
- main occupation	133.7	53.8	107	26.9
- overtime work	170.1	53.3	148.6	66.1
- second job	141.1	110.6	135.9	126.9
Weekly nonlabour income, DKK	2725.4	1401.3	3170.3	1439.9
Marginal tax rate, %	54.7	13.1	48	15.2
Age	39.1	11.1	39.1	10.4
Owner of house (0/1)	0.64	0.49	0.69	0.46
Region				
- Copenhagen	0.3	0.46	0.32	0.46
- major cities	0.34	0.48	0.32	0.46
- country	0.36	0.49	0.36	0.47
Children 0 - 2 years (0/1)	0.13	0.34	0.15	0.35
Children 3 - 6 years (0/1)	0.11	0.33	0.11	0.32
No. of children	0.75	0.96	0.85	0.95
Civil state				
- Single	24	0.42	0.22	0.41
- Married	0.58	0.5	0.62	0.48
- Cohabiting	0.18	0.39	0.16	0.37
No. of observations	1150		1291	

Table A2. Log main occupation gross wage rate estimates (conditional OLS) and probit estimations of probability of having non-missing wage rate in main occupation. Men and women.

Parameter	Men				Women			
	Wage rates		Non-missing		Wage rates		Non-missing	
	Estim.	Std.dev.	Estim.	Std.dev.	Estim.	Std.dev.	Estim.	Std.dev.
Constant	4.8835	0.7909	-2.0794	13.0020	3.8055	1.2251	-1.3570	15.7746
Age	0.0066	0.0251	0.6034	0.4957	0.0178	0.0403	0.2156	0.6231
Age^2	-0.0002	0.0002	-0.0143	0.0077	-0.0002	0.0003	0.0005	0.0089
Age^3			0.0001	0.0001			-0.0000	0.0001
Education	-0.0695	0.0825	-1.6145	2.1311	0.0231	0.1164	-1.1498	2.4434
$Education^2$	0.0020	0.0019	0.1436	0.1238	-0.0003	0.0025	0.1412	0.1294
$Education^3$			-0.0039	0.0029			-0.0041	0.0029
Age*education	0.0011	0.0017	0.0040	0.0391	0.0001	0.0025	-0.0059	0.0515
$(Age*education)^2$	-0.0000	0.0000	-8.8994	0.0000	-6.2253	0.0000	-7.8858	0.0001
$(Age*education)^3$			5.8329	1.6260			8.2951	2.2930
Married			0.4913	0.1630			0.0051	0.1342
Cohabiting			0.1872	0.1630			-0.0527	0.1505
# 0-2 years child			0.0299	0.2037			-0.1866	0.1329
# 3-6 years child			0.1098	0.1823			-0.2557	0.1062
# 7-14 years ch.			-0.0637	0.1180			-0.2450	0.0809
# 15-17 years ch.	-0.0142		-0.3372	0.1628			-0.2713	0.1283
# of children		0.0096			0.0047	0.0122		
House ownership			0.2736	0.1316			0.1207	0.1133
Holiday house	0.0045		0.0124	0.2341			0.3520	0.1926
Tenure	-0.0001	0.0031			-0.0006	0.0025		
$Tenure^2$	0.0088	0.0001			0.0002	0.0001		
Experience	-0.0003	0.0031			0.0071	0.0026		
$Experience^2$	0.2669	0.0001			-0.0002	0.0001		
Salaried workers	0.0940							
- high level	-0.0340	0.0449			0.2967	0.0380		
- medium level	0.0027	0.0434			0.1585	0.0310		
- low level	-0.0745-	0.0427			0.1313	0.0269		
- skilled	0.0632	0.0418			0.1745	0.0538		
- unskilled	-0.0001	0.0421			0.0260	0.0282		
- others	-0.0001	0.0555			0.0706	0.0401		
Unemploym.95	0.0218	0.0001			-0.0001	0.0001		
Unemploym.94	0.2158	0.0001			-0.0000	0.0000		
Copenhagen	0.1193	0.0432			0.1609	0.0306		
Frederiksberg	0.0640	0.0746			0.1422	0.0515		
Copenh. County	0.0960	0.0363			0.0855	0.0268		
Fredborg	-0.0112-	0.0419			0.1282	0.0315		
Roskilde	0.0126	0.0492			0.0424	0.0346		
Western Sealand	-0.1044-	0.0430			0.0527	0.0332		
Storstroem	0.0188	0.0460			0.0385	0.0345		
Bornholm	-0.0580	0.0864			0.0172	0.0680		
Fyn	0.0672	0.0378			0.0615	0.0280		
Southern Jutland	0.0202	0.0409			0.0209	0.0322		
Ribe	0.0156	0.0447			-0.0253	0.0373		
Vejle	-0.0283	0.0406			0.0645	0.0299		
Western Jutland	-0.0336	0.0399			0.0074	0.0332		
Aarhus	-0.2839	0.0348			0.0392	0.0263		
Viborg		0.0427			0.0429	0.0347		
Lambda		0.0870			-0.0331	0.1126		
Diagnostics test:	0.560							
P-values:	0.002							
Skewness	0.4326		0.300		0.480		0.470	
Kurtosis			0.180		0.003		0.250	
$R^2_{adj.}$					0.3810			

Table A3. Log overtime occupation gross wage rate estimates (conditional OLS) and probit estimations of probability of having non-missing wage rate in overtime occupation.

Parameter	Men				Women			
	Wage rates		Non-missing		Wage rates		Non-missing	
	Estim.	Std.dev.	Estim.	Std.dev.	Estim.	Std.dev.	Estim.	Std.dev.
Constant	1.4580	3.3170	-28.0296	16.6038	7.7729	3.4269	0.6583	19.6947
Main wage rate	0.0021	0.0008			0.0045	0.0027		
Age	0.1069	0.1115	1.0766	0.7175	-0.01970	0.1228	-0.1070	0.8230
Age^2	-0.0010	0.0009	-0.0128	0.0108	.0001	0.0009	0.0049	0.0126
Age^3			0.0001	0.0001			-0.0000	0.0001
Education	0.2618	0.3207	3.6706	2.4074	-0.54470	0.4316	0.4436	3.0411
$Education^2$	-0.0057	0.0071	-0.1642	0.1226	.0229	0.0112	-0.0237	0.1620
$Education^3$			0.0033	0.0027			0.0006	0.0037
Age*education	-0.0038	0.0081	-0.0848	0.0553	0.0045	0.0097	-0.0255	0.0667
$(Age*education)^2$	-0.0000	0.0000	0.0001	0.0001	-0.0000	0.0000	0.0000	0.0001
$(Age*education)^3$			-3.1830	2.4780			-1.9000	3.1650
Married			0.2554	0.1626			-0.0117	0.1946
Cohabiting			0.1964	0.1656			0.0469	0.2088
# 0-2 years child			-0.1978	0.1547			0.0179	0.1976
# 3-6 years child			-0.1895	0.1330			-0.0692	0.1627
# 7-14 years ch.			-0.1029	0.0985			0.0692	0.1179
# 15-17 years ch.			-0.2616	0.1802			0.0588	0.1839
# of children	-0.0419	0.0429			0.0035	0.0521		
House ownership			0.0741	0.1300			-0.1002	0.1607
Holiday house			-0.5377	0.3058			0.3495	0.2236
Tenure	0.0113 -	0.0154			0.0067	0.0252		
$Tenure^2$	0.0004	0.0006			0.0002 -	0.0010		
Experience	-0.0086	0.0123			0.0018	0.0263		
$Experience^2$	0.0003	0.0004			-0.0002	0.0009		
Salaried workers								
- high level	0.2009	0.2172			0.0870	0.4034		
- medium level	0.1924	0.2039			0.3409	0.2204		
- low level	0.1159	0.1939			0.4383	0.1896		
- skilled	0.1553	0.1954			0.7146	0.2669		
- unskilled	0.0745	0.1873			0.2421	0.1691		
- others	0.0452	0.1941			0.0568	0.1982		
Unemploym.95	0.0001	0.0004			-0.0011	0.0004		
Unemploym.94	-0.0001-	0.0002			0.0007	0.0003		
Lambda	0.1524	0.2554			-0.5468	0.3500		
Diagnostics test:								
P-values:								
Skewness	0.755		0.265		0.855		0.325	
Kurtosis	0.075		0.009		0.105		0.015	
$R^2_{adj.}$	0.2578				0.6300			

Table A4. Log second job gross wage rate estimates (conditional OLS) and probit estimations of probability of having non-missing wage rate in second job. Men and women.

Parameter	Men				Women			
	Wage rates		Non-missing		Wage rates		Non-missing	
	Estim.	Std.dev.	Estim.	Std.dev.	Estim.	Std.dev.	Estim.	Std.dev.
Constant	9.4001	6.8503	-13.6165	14.4981	-0.7613	27.3744	-77.0737	37.6651
Main wage rate	-0.0004	0.0019			-0.0041	0.0059		
Age	0.0058	0.2251	0.3907	0.5549	0.5769	1.0449	2.2583	1.5403
Age^2	-0.0012	0.0019	- 0.0044	0.0088	-0.0079	0.0071	-0.0211	0.0220
Age^3			0.0000	0.0001			0.0000	0.0001
Education	-0.6968	0.7166	1.7556	2.2347	-0.2813	3.0341	13.6745	5.9206
$Education^2$	0.0175	0.0166	-0.0927	0.1230	0.0109	0.0690	-0.7442	0.3212
$Education^3$			0.0019	0.0028			0.0153	0.0070
Age*education	0.0098	0.0163	-0.0254	0.0414	-0.0057	0.0855	-0.2475	0.1296
$(Age*education)^2$	-0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0001
$(Age*education)^3$			-5.7359	1.5410			-1.3131	6.5440
Married			0.1071	0.1767			-0.1550	0.2134
Cohabiting			0.0352	0.1801			-0.1088	0.2355
# 0-2 years child			0.1003	0.1500			0.2459	0.2037
# 3-6 years child			-0.0866	0.1344			-0.2608	0.2158
# 7-14 years ch.			0.1077	0.0983			-0.0421	0.1351
# 15-17 years ch.			-0.4467	0.2115			0.0705	0.1912
# of children	0.1978	0.0968		0.1344	-0.1012	0.1678		
House ownership			-0.2172	0.2325			-0.1566	0.1827
Holiday house			0.0890				0.0627	0.2939
Tenure	-0.0774	0.0371			-0.1348	0.1167		
$Tenure^2$	0.0026	0.0014			0.0077	0.0062		
Experience	0.0292	0.0266			0.0401 -	0.0955		
$Experience^2$	0.0001	0.0010			0.0015	0.0032		
Salaried workers								
- high level	0.4069	0.3656			-4.9494	1.1981		
- medium level	-0.0471	0.3238			-2.1503 -	0.6426		
- low level	0.2434	0.2847			1.4029	0.5174		
- skilled	0.0479	0.3271			.	.		
- unskilled	0.2363	0.2658			-0.8185	0.5514		
- others	-0.0657	0.4058			-0.2269	0.5397		
Unemploym.95	0.0009	0.0011			0.0041 -	0.0019		
Unemploym.94	-0.0006	0.0010			0.0147	0.0044		
Lambda	-0.6987	0.5267			-0.1283	0.6038		
Diagnostics test:								
P-values:								
Skewness	0.835		0.275		0.650		0.150	
Kurtosis	0.950		0.030		0.825		0.025	
$R^2_{adj.}$	0.1568				0.2663			

Table A5. Variation of elasticities across income deciles (Standard deviations in italics).

	ϵ_{ucw_net}				ϵ_{cw_net}				ϵ_{y}			
	Men		Women		Men		Women		Men		Women	
Decile 1	0.060	*0.047*	0.161	*0.032*	0.064	*0.047*	0.164	*0.032*	0.000	*0.002*	-0.004	*0.003*
Decile 2	0.060	*0.047*	0.150	*0.021*	0.061	*0.047*	0.153	*0.021*	-0.002	*0.008*	-0.004	*0.003*
Decile 3	0.050	*0.021*	0.150	*0.018*	0.047	*0.021*	0.154	*0.018*	-0.002	*0.016*	-0.003	*0.002*
Decile 4	0.050	*0.031*	0.153	*0.026*	0.051	*0.031*	0.157	*0.026*	-0.004	*0.019*	-0.003	*0.003*
Decile 5	0.044	*0.012*	0.148	*0.024*	0.045	*0.012*	0.151	*0.024*	-0.002	*0.011*	-0.003	*0.003*
Decile 6	0.046	*0.019*	0.148	*0.021*	0.047	*0.019*	0.151	*0.021*	-0.004	*0.017*	-0.003	*0.003*
Decile 7	0.053	*0.034*	0.141	*0.015*	0.054	*0.034*	0.145	*0.015*	-0.011	*0.031*	-0.003	*0.003*
Decile 8	0.053	*0.034*	0.147	*0.074*	0.054	*0.034*	0.150	*0.074*	-0.010	*0.031*	-0.008	*0.055*
Decile 9	0.051	*0.032*	0.142	*0.036*	0.052	*0.032*	0.145	*0.036*	-0.010	*0.029*	-0.005	*0.021*
Decile 10	0.053	*0.039*	0.146	*0.061*	0.054	*0.039*	0.149	*0.061*	-0.012	*0.036*	-0.008	*0.037*
All	0.052	*0.034*	0.149	*0.038*	0.053	*0.034*	0.152	*0.038*	-0.006	*0.023*	-0.004	*0.022*

Note: Elasticities are based on model V.

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