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Tax reforms, sector specific labor supply and welfare effects

by

John K. Dagsvik, Marilena Locatelli and Steinar Strøm

Abstract:

This paper focuses in particular on the 1992 tax reform in Norway. In this reform the top marginal tax rates were cut considerably. We find that the impact on overall labor supply is rather modest, but these modest changes shadow for stronger sectoral changes. The tax reform stimulated the women to shift their labor from the public to the private sector and to work longer hours. A calculation of mean compensated variation, calculated within the framework of a random utility model, shows that the richest households benefited far more from the 1992 tax reform than did the poorest households.

Keywords: Labor supply, married females, structural model, sectoral choice, , evaluation of tax reforms

JEL classification: J22, C51

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I. Introduction

In the 1980s the keywords of tax reformers in the US and Europe were reduced tax rates and broadening of tax bases. The goal was to stimulate labor supply. In the 1990s OECD and the European Commison repeatedly argued that tax rates should be cut and that the tax systems should be changed towards proportional taxation. The tax reforms adopted by European countries introduced some changes in this direction, but the reforms have mainly implied streamlining of the existing tax systems, Bernardi and Profeta (2003). In the 1990s flat income tax has been proposed by many polticians as well as economists. Before 1990 it was only applied in a few countries like Hong Kong and the Channel Islands. In 1994 a flat tax system was introduced in Estonia and since then a number of countries have followed suit. By now there are altogether 22 countries worldwide with a flat tax system, of which half are in Eastern Europe, and proposals of introducing a flat income tax are discussed in several Western European countries, Paulus and Peichl (2008).

The Norwegian tax reform we analyze in this paper took place in 1992. The top marginal tax rate on wage income was reduced from 0.654 to 0.495, but also other tax rates were changed, and implied a sharp swing away from the existing progressive tax system. We also include an assessment of reforming the tax system further towards a flat income tax away from the existing progressive tax system. In this paper we use the labor supply model of Dagsvik and Strøm (2006) to evaluate the effects of the 1992 tax reform on labor supply of married females. We also evaluate the effects on household welfare. Furthermore, we assess the labor supply and welfare effects of a hypothetical fiuther tax reform where a flat tax is introduced. Whereas the emphasis in Dagsvik and Strøm (2006) was on model specification and estimation, this paper is concerned with assessing labor supply effects that follow from the tax reforms, and in particular the corresponding welfare effects, evaluated by the Compensating Variation (CV) measure. Because our model is a particular version of a random utility model that is nonlinear in income, the calculation of CV is a rather complicated matter. Among other things, the CV becomes a random variable in this case. Until recently, no analytic formulas have been available for calculating the distribution of CV. However, Dagsvik and Karlström (2005) have developed analytic formulas for this purpose, and we apply their methodology to calculate the distribution, mean CV and variances. Recently this methodology has been used to calculate welfare effects of family policies, Kornstad and Thoresen (2006), and to calculate the compensation that makes nurses indifferent between different types of jobs, Di Tommaso and Strøm (2008).To our knowledge our paper is the first where this methodology is used to assess the impact of tax reforms on household welfare. It is also the first paper that analyses the labor supply effects of the 1992 Norwegian tax reform and where sectoral choices are accounted for, see Dagsvik, Locatelli and Strøm (2006) for a pr evious and larger version.

The sector dimension of the model allows us to go beyond overall labor supply responses to changes in wages and tax rates. Our hypothesis is that although overall labor supply may be rather inelastic, these modest labor supply responses may shadow for stronger responses with respect to sectoral choice. Highly educated women are often found working in the public sector in the Scandinavian welfare states. Job security is higher than in the private sector, human capital seems to have a higher rate of return and the public sector may offer better opportunities to find subsidized childcare facilities. On the other hand, in the private sector, wages are more dispersed and hours are less regulated. We should thus expect that stronger incentives to work, like higher wages or lower marginal tax rates, may have an impact on the sectoral choice of working women. Higher wages, in particular in the private sector, or lower marginal tax rates, may give women an incentive to shift labor supply away from the public towards the private sector. A typical example is a part-time nurse or a medical doctor in a public hospital who shifts her labor supply to a private clinic with longer working hours. However, the income of the spouse may affect the choice of the wife and it also matters that matching in the marriage market is not random. Typically, a woman with a high potential wage in the market is married to a man with similar opportunities.

Our analysis shows that the sharp reductions in marginal tax rates in the 1992 tax reform stimulates overall labor supply to some extent, and it gives married women an incentive to move from the public to the private sector where hours are less constrained and wage dispersion is higher. Despite the fact that labor supply increases, which enlarges the tax base, tax revenues are reduced. The calculation of the mean value of the change in household welfare (CV) that follows from the 1992 tax reform shows that the rich gained far more than did the poor.

A central feature of our labor supply model is that in addition to leisure and disposable income, "job type" is an important decision variable. Type of job and other nonpecuniary job attributes may matter a great deal for the chosen labor market affiliation of the individuals. Some jobs may be more interesting and challenging than other jobs. To change working load within this setup, one has to change job; see Altonji and Paxson (1988) for findings that support this view. Type of job may matter for labor supply responses when tax systems are changed, as the more interesting and challenging a job is, the less important may be the net wage (above a certain level). Those who have these types of jobs are not randomly chosen in the population; they tend to be well educated, with high wage incomes, and their spouse may also fit the same characteristics. This kind of behavior may have strong implications for how tax rules should be changed to stimulate labor supply. Improved economic incentives should be targeted towards those who respond, not necessarily towards those with the highest education and income levels, who face the highest marginal tax rates. Although most job attributes are unobserved, this alternative point of departure has important implications for the empirical modeling framework, and accordingly for how the evaluation of tax reforms (the calculation of compensating variation) should be performed. A particularly important feature of this framework is that it allows for a new way of interpreting and dealing with quantity constraints in the labor market. Typically, data on hours of work show peaks at full-time and possibly part-time hours of work (typically 50 and 25 percent of a full-time job). Within our approach, this is explained as stemming from institutional regulations that yield more jobs with full-time or part-time hours of work than jobs with other hours of work.

The paper is organized as follows. In the next section, the model is explained briefly and in a more pedagogical way than in Dagsvik and Strøm (2006). Empirical specifications and discussion of estimates are given in Section 3. Section 4 reports labor supply elasticities. In Sections 5 and 6, the implications of two tax reforms are analyzed. Section 7 concludes.

II. The model

In this section we give a very brief outline of the modelling framework with reference to married/cohabiting women. For more detail and empirical analysis we refer to Dagsvik and Strøm (2006).

The labor supply and hence the wage income of the husband is assumed exogenously given. The household is assumed to derive utility from household consumption, here set equal to household disposable income, leisure and nonpecuniary attributes of jobs. Let z = 1, 2,…, be an indexation of the jobs and let z = 0 represent not working. The utility function is assumed to have the form $U(C,h,j,z) = v(C,h)\varepsilon_j(z)$, for z = 0, 1, 2,…, where $j = 1,2$, indexes the sectors and *j* = 0 if z = 0, and $v(\cdot)$ is a positive deterministic function. The terms $\{\varepsilon_j(z)\}$ are positive sector-and job-specific random taste shifters. The taste shifter accounts for unobserved individual characteristics and unobserved job-specific attributes. These taste shifters $\{\varepsilon_j(z)\}$, are assumed to be i.i.d. across jobs, sectors and agents, with c.d.f. $\exp(-1/x)$, for positive x. The reason why the index z enters the utility function is that job-specific attributes beyond wage and hours of work may affect the utility of the agents.

For given hours of work *h* and wage rate *w*, disposable household income is given by

$$C = f(hw, I), \tag{1}$$

where $f(\cdot)$ is a function that transforms pre-tax incomes into after-tax incomes. The pre-tax incomes are the wage income of the married female (*hw*) and three nonlabor income components included in the vector *I*. These three incomes are the wage income of the husband, the capital income of the household and child allowances, which vary with the number of children up to the age of 18. Child allowances are not taxed. All details of the tax structure are taken into account in the estimation and simulation of the model. The tax functions of wage income in 1994, as well as child allowances, are given in Appendix B. From there, we note that the tax functions differ depending on whether both spouses are working. Capital income is taxed at a flat rate of 0.28.

The agent is assumed to face two mean wage rates (mean across sector-specific jobs), w_1 and w_2, specific to each sector. For notational simplicity, let $w=(w_1,w_2)$. Furthermore, let $\varphi_j\left(h\mid w,I\right)$ be the probability of choosing sector *j* and hours of work *h* (for an utility maximizing agent), and let *D* be the set of feasible hours (assumed to be the same across sectors). In Dagsvik and Strøm (2006) it is demonstrated that

$$(2) \qquad \varphi_j\left(h\mid w,I\right)=\frac{v\big(f(hw_j,I),h\big)g_j(h)\theta_j}{v\big(f(0,I),0\big)+\sum_{k=1}^{2}\sum_{x>0,x\in D}v\big(f(xw_k,I),x\big)g_k(x)\theta_k},$$

for $h>0,\ \ j=1,2$, and

$$(3) \qquad \varphi_0\left(0\mid w,I\right)=\frac{v\big(f(0,I),0\big)}{v\big(f(0,I),0\big)+\sum_{k=1}^{2}\sum_{x>0,x\in D}v\big(f(xw_k,I),x\big)g_k(x)\theta_k},$$

for $h=0$, where $g_j(h)$ denotes the fraction of available jobs in sector *j* (available to the agent) with hours of work *h*. The term θ_j is a job opportunity index, representing the total amount of job opportunities available to the agent in sector *j*, *j* =1,2. The job opportunity index θ_j may also capture the effect of unobserved fixed cost of working. In the absence of fixed cost, unobserved preference effects for working versus not working, and no difference between job opportunities across sectors $\theta_j=1$. Otherwise, we expect θ_j to be less than one. The case with $\theta_j = 1$ and $g_k(h)$;k=1,2, being uniform, is the one that resembles the most conventional approach with no fixed cost and no restrictions on the set of available jobs. This is rather evident because this specification means that there are no systematic differences in the available jobs and with no fixed cost nor preferences effects for working versus not working are present.

A difficult issue is how the equilibrium opportunity densities $\{\theta_j g_j(h)\}$ are determined. However, since we in this context are only focused on the simulation of pure supply effects it makes sence to condition on the opportunity densities. In other words, this means that we condition on given wage rates and (distribution of) opportunity sets of jobs.

III. Empirical specification and estimation results

The choice set of offered hours is assumed to be represented by seven intervals. The medians of the intervals range from 315 annual hours to 2600 annual hours and are given by $D=\{0, 315, 780, 1040, 1560, 1976, 2340, 2600\}$. The midpoints in the intervals for part-time and full-time jobs are 1040 and 1976 annual hours, respectively. When estimating the model given in (3) and (4), we face two problems. First, sector *j* wage rates are observed only for those who work in sector *j*. Second, wage rates may be endogenous in the sense that they may be correlated with the taste shifters. To deal with these issues, sector-specific wage equations are estimated and used as instrument variables. In the wage equations, log wage rates are specified as a linear function of experience (defined as age minus years of education and minus six), experience squared and education level. For further discussion on the specification and estimation of the wage equations we refer to Dagsvik and Strøm (2006). Subsequently, the sector-specific wage rates in the model are replaced by the respective estimated wage equations, with the error terms added. As the wage equations contains these random error terms, we must take the expectation of the choice probabilities (2) and (3) with respect to these error terms. The aggregate wage elasticities and the expected value of compensating variation are all expected values with expectation taken with respect to the random parts of the wage equations. In practise, the random variables in the choice probabilities are integrated out through simulations.

The logarithm of the job opportunity index θ_j is assumed to be a linear function of length of schooling. The densities of offered hours $g_j(h), j=1,2,$ are assumed to be uniform, apart from peaks at typical full-time and part-time hours. This accounts for the fact that there are more jobs available in the labor market with part-time hours and full-time hours. The structure of the deterministic part of the utility function is assumed to be of a particular Box–Cox type, see Dagsvik and Strøm (2006). We assume a unitary labor supply model which implies “income pooling”.

The estimates of the structural model are reported in Dagsvik and Strøm (2006). We refer to this paper for a discussion of these results as well as extensions allowing for random effects, while in Table 1 report how the predicted choice probabilities vary with socioeconomic characteristics. The probability of *not working* decreases with age and education, and it sharply increases with the number of children. The older the woman and the lower her level of education is, the more likely it is that she works in the private sector.

The probability of working in the public sector is remarkably similar across varying numbers of children. In contrast, the probability of working in the private sector declines rather strongly with the number of children. These findings accord well with widely held conjectures that childcare facilities and leave with pay at the time of giving birth are more easily available in the public sector than in the private. Unfornuately, we do not observe variables at an individual level that may represent childcare facilities and parental pay.

Table 1. Choice probabilities and their variation with socioeconomic variables for married women, Norway, 1994. Per cent

Variables	Not working	Public sector	Private sector
Age range:			
25–34	10.45	47.32	42.33
35–44	7.75	49.05	43.20
43–64	6.80	44.71	48.49
Number of children:			
0	4.89	46.02	49.09
1	6.18	48.88	44.94
2	10.09	46.76	43.15
More than 2	16.79	47.03	36.18
Education:			
Less than 9 years	9.71	27.54	62.74
Intermediate	9.05	43.42	47.52
High, 15–17 years	4.42	73.27	22.31

Table 2 provides predictions of the conditional expectations of hours and their variation with socioeconomic characteristics. Expected hours, given working, are predicted to vary little across ages. They drop sharply in both sectors when the household has two or more children. Of particular interest is the prediction of how hours vary with education in the two sectors. In the public sector, hours increase slightly with years of education, whereas in the private sector, the highly educated women are predicted to work rather long hours. As mentioned above, highly educated women tend to prefer the public rather than the private sector, but those who do work in the private sector work long hours.

Although our estimates indicate that human capital has higher return in the public sector, we should keep in mind that hours are less regulated in the private sector and wage dispersion is higher. Examples of well-paid women working long hours in the private sector are women in leading management positions and female doctors working in private clinics rather than in public hospitals. The question is whether improvements in job opportunities like higher wages, lower taxes and less regulated hours will move more women with high education from the public sector to the private sector. These are some of the issues that we discuss in the next sections.

Table 2. Conditional expectations of annual hours and their variation with socioeconomic variables for married women, Norway, 1994

Variables	Public sector	Private sector
Age range:		
25–34	1530	1576
35–44	1571	1631
43–64	1598	1608
Number of children:		
0	1689	1694
1	1627	1662
2	1490	1530
More than 2	1310	1363
Education:		
Less than 9 years	1535	1531
Intermediate	1552	1604
High, 15–17 years	1607	1768

IV. Elasticities

In Tables 3–5, we report uncompensated wage elasticities in labor supply among married women when the hourly wage rates are increased. The choice probabilities related to sectors and hours are used to calculate these elasticities. We have used stochastic simulation to calculate the expectation of the choice probabilities with respect to the error terms in the wage equations. The marginal effects are calculated for each individual and thereafter aggregated, and subsequently the corresponding elasticities are calculated. We term them aggregate elasticities. They measure the elasticities of aggregate labor supply (participation, expected hours worked) with respect to the wage rates.

In practice, the choice probabilities are computed by stochastic simulation as follows. Let w_j^r be given by the wage equation of sector *j* as

(4) $$\log w_j^r = X\beta_j + \sigma_j \eta_j^r$$

where $\eta_j^r, r = 1,2,...,M,$ are independent draws from $N(0,1)$. If *M* is large

(5) $$\tilde{\varphi}_j(h \mid I) \cong \frac{1}{M}\sum_{r=1}^{M} \varphi_j\left(h \mid w^r, I\right); j = 0,1,2$$

where $w^r = \left(w_1^r, w_2^r\right)$.

An overall wage increase and overall labor supply

The first column of Table 3 defines the categories for which the elasticities are calculated. The second column gives the elasticities of the probabilities of working, working in the public sector and working in the private sector. For simplicity, we term these elasticities the working sector elasticities. The next column gives the elasticities of hours of work, given that the individual works either in the public sector or in the private sector. The last column gives the elasticities of the unconditional expectation of labor supply with respect to wage rate changes.[1]

From Table 3, we note that an overall wage increase implies an elasticity with respect to working (in any sector) of 0.27. The elasticity of hours supplied, conditional on working, is slightly higher, 0.35, which means that the aggregate elasticity of labor supply in the population of married

[1] The last column is approximately equal to the sum of the preceding columns. The equality is not exact due to aggregation.

females in Norway in 1994 sums up to around 0.64. The reason for the rather "low" participation elasticity relative to hours of work elasticity compared with the results from most other countries is due to the fact that labor market participation of married women was very high in 1994 and still is.

In the long run hours of work elasticities with respect to wage rates will also decrease as chosen hours of work increase towards 3640 hours annually (the upper bound of annual hours of work assumed in the estimation of the model).

An overall wage increase and sectoral responses

The sector dimension introduced here plays a novel role in how increased wage rates may affect behavior. From Table 3 we observe that, in the public sector, the wage elasticity related to participation is very low. The elasticity of conditional expected hours is considerably higher and similar to the elasticity in the private sector.

In the private sector the elasticity of the choice probability is much higher than in the public sector. A higher chance of finding jobs with longer working hours and higher wage levels may be the reason why women would like to shift their labor supply from the public to the private sector, and to find jobs with longer working hours, when there is an overall increase in wage rates.

We also report the elasticity of tax revenue with respect to an overall increase in wage rates. Tax revenues are increased for two reasons. A higher wage rate yields higher earnings, given labor supply. A higher wage rate stimulates labor supply. We observe that the elasticity is estimated to be 0.69, which is clearly less than 1.

A wage increase in the public sector only

In Table 4, we report the wage elasticities when only the wage rate in the public sector is increased. Comparing Tables 3 and 4, we observe that the effects on overall labor supply are considerably weaker when the wage rates in the public sector only are increased. The most important result is that the modest wage elasticities related to work in any sector (overall labor supply) shadow for much higher intersector wage elasticities. An increase in wage rates in the public sector gives women an incentive to move from the private to the public sector. Hours of work, given the sector, are only affected to a much minor extent.

A wage increase in the private sector only

The same pattern emerges when the wage rates in the private sector only are increased, as shown in Table 5.

Table 3. Aggregate elasticities of labor supply with respect to an overall wage increase in the public and the private sector. Married Norwegian females, 1994

	Mean Working Sector		***Mean conditional expected hours***		***Mean unconditional expected hours***	
	Probability	**Elasticities**	**Hours**	**Elasticities**	**Hours**	**Elasticities**
ALL (Private and Public)	92.10	0.274	1594	0.353	1468	0.637
PUBLIC	46.68	0.084	1574	0.365	735	0.453
PRIVATE	45.42	0.469	1616	0.335	734	0.821
Tax revenue						0.69

Table 4. Aggregate elasticities of labor supply with respect to a wage increase in the public sector. Married Norwegian females, 1994

	Mean Working Sector		***Mean conditional expected hours***		***Mean unconditional expected hours***	
	Probability	**Elasticities**	**Hours**	**Elasticities**	**Hours**	**Elasticities**
ALL (Private and Public)	92.10	0.15	1594	0.183	1468	0.34
PUBLIC	46.68	1.55	1574	0.329	735	1.93
PRIVATE	45.42	-1.29	1616	0.034	734	-1.26

Table 5. Aggregate elasticities of labor supply with respect to a wage increase in the private sector. Married Norwegian females, 1994

	Mean Working Sector		***Mean conditional expected hours***		***Mean unconditional expected hours***	
	Probability	**Elasticities**	**Hours**	**Elasticities**	**Hours**	**Elasticities**
ALL (Private and Public)	92.10	0.158	1594	0.210	1468	0.372
PUBLIC	46.68	-1.430	1574	0.036	735	-1.399
PRIVATE	45.42	1.790	1616	0.300	734	2.144

The elasticities given here must be interpreted as predictions of long term supply effects and do not say anything about the time needed for the full outcome of the wage change to be reached, conditional on constant sets of job opportunities. This will depend on the serial correlation in the random taste-shifters of the utility functions. For example, the present one period model is consistent with the two following extreme interpretations: in the first one the taste-shifters are serially uncorrelated, whereas in the second case they are time constant random effects. In the first case there will be a flow of persons that over time adjusts their labor supply responses due to new random draws of their taste-shifters. In the other case, the taste-shifters are fixed and consequently there will be no adjustments beyond the immediate response, due to changes in unobservables. With appropriate panel data one could model and estimate the corresponding transition probabilities. This issue is however far beyond the scope of this paper.

Income elasticities can easily be calculated, but they will be of no use in the calculation of the compensated Hicks elasticities. The reason is that with a random utility model the Slutsky equation in the traditional sense does not exist. Indifference curves are replaced by indifference bands and quantites by probabilities. The calculation of compensated elasticities will soon be available in another paper.

V. Labor-supply effects of tax reforms

In 1992, the Norwegian tax system was reformed, with a move towards lower and less progressive tax rates. In subsequent years, the tax structure remained virtually unchanged. Therefore, to assess the effects on labor supply we have chosen to focus on 1991, the year prior to the tax reform, and a post reform year, 1994.

The tax rates on labor incomes in these years are set out in Appendix B, and we observe that the 1992 reform considerably reduced the top marginal tax rate from 0.654 to 0.495, but also other tax rates were changed. To assess the labor supply responses to this reform, we have employed our model to simulate the labor supply among married women. Because the 1992 reform was a move towards less progressive taxes, we have also used the model to simulate the impact on labor supply of replacing the 1994 tax system with a flat and revenue-neutral tax system. The results are reported in Table 8. Note that when taxes are changed, this also implies a change in the taxation of the wage income of the spouse.

In our model, when the 1991 tax regime is replaced by the 1994 tax regime, we get an increase in labor market participation from 88.6 per cent to 92.1 per cent. There is a slight reduction in public sector participation, but there is a considerable increase in participation in the private sector. Thus, the labor supply effects of the tax reform of 1992 imply that married women are given a stronger incentive to find work outside home and to work in the private sector[2]. Given participation in any sector, the expected hours of work increase by around 127 hours per year (1594-1467). The increase in expected conditional working hours is higher for women working in the private sector than in the public sector. Despite the fact that labor supply is stimulated by the reform, tax revenue goes down. The reason is that lower tax rates have a negative effect on tax revenue, which outweighs the positive effect on tax revenue from the increase in labor supply. Thus the tax reform is under-financed.

In order to demonstrate the effects on labor supply when the 1992 tax reform is not under-financed we have multiplied the tax rates after the 1992 tax reform with a constant. The progressive tax structure of the 1992 reform is thus preserved. The constant is determined through simulations on the model so that the tax revenue is the same as in 1991. The constant is calculate to be 1.2, which means that all tax rates under the 1992 reform are raised by 20%.Table 8a shows the labor supply effects of this hypothetical tax structure. Comparing Tables 8 and 8a we observe that a tax revenue neutral version of the 1992 tax reform yields rather modest changes in overall labor supply. However, the shift of labor market participation towards the private sector and with longer working hours in the private is also now present. It should be emphasized that the 1992 tax reform that we analyze here *was* under-financed, which shift the tax burden towards future generations. To fully account for the inpact of future tax burdens on current labor supply is beyond the scope of this paper. It should be remembered that Norway is a petro-economy with huge funds, based on the cash-flow from the sale of

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[2] Data shows that participation among married and single women working in the private sector increased from 45.3 percent in 1993 to 49.1 percent in 1999.

oil and gas, invested abroad. This might have an impact on the willingness of the politicians to undertake reforms that are not fully financed.

The 1992 tax reform achieved what the government at the time wanted: labor supply was stimulated and in particular the incentives to encourage individuals to work in the private sector.

We also consider the hypotothetical effects of a flat tax. Based on the empirical model we find that a flat tax of 29 per cent on all incomes is found to yield the same tax revenue as the 1994 tax system. By introducing a hypothetical, but potential doable, flat tax system, the labor supply responses to the 1992 tax reform would be reinforced. There is a slight increase in overall participation, and there is a further shift in participation away from the public sector towards the private sector. Working hours are predicted to increase further, in particular in the private sector.

In Table 9 we report how choice probabilities vary with socioeconomic characteristics under the three tax strucures considered here. A striking result is that women with higher education, and hence with a stronger incentive to exploit the wage dispersion and wage level in the private sector when taxes are cut, increase their participation in the private sector at the expense of participating in the public sector. For the higher educated women public sector participation is predicted to go down from 76.41% to 73.27 % and the private sector participation is predicted to go up from 16.75% to 22.31%. We note that the flat tax system reinforces the labor supply effects of the 1992 tax reform. When grouped according to ages and number of children we predict a shift towards the private sector at the expense of participating in the public sector, with the exception for women with more than two children.

Table 10 reports the mean of expected hours, conditional on working in the public or the private sector, and grouped according to socioeconomic characteristics. The most notable result is the large increase in hours worked in the private sector by women with the highest education level in response to the 1992 tax reforms.

Table 8. Labor supply responses to the tax reform of 1992 and to a flat tax of 0.29

	Mean working probabilities, percent			Mean Conditional expected annual hours			Mean Unconditional expected annual hours		
	1991	1994	Flat tax	1991	1994	Flat tax	1991	1994	Flat tax
All sectors (Public and private)	88.58	92.10	93.15	1467	1594	1709	1299	1468	1592
Public sector	47.17	46.68	44.60	1479	1574	1652	697	735	737
Private sector	41.42	45.42	48.55	1453	1616	1762	602	734	855
Mean tax revenue Mill 1994 NOK							130	113	113

Table 8 A. Labor supply responses to the tax reform of 1992 with neutral revenue

(Tax revenue: 130 Mill 1994 NOK as in 1991 tax system)

	Mean working probabilities, percent	Mean Conditional expected annual hours	Mean Unconditional expected annual hours
All sectors			
(public and private)	89.08	1505	1340
Public sector	46.67	1496	698
Private sector	42.41	1514	642

Table 9. Choice probabilities and their variation with socioeconomic variables. Per cent

Variable	**1991 tax system**			**1994 tax system**			**Flat tax of 29%**		
	Not working	Public sector	Private sector	Not working	Public sector	Private sector	Not working	Public sector	Private sector
Age range									
25–34	14.43	47.56	38.01	10.45	47.32	42.23	10.12	45.06	44.82
35–44	11.19	49.71	39.10	7.75	49.05	43.20	7.24	46.32	46.43
43–64	9.90	45.27	44.83	6.80	44.71	48.49	7.44	41.79	50.77
Number of children									
0	7.31	47.27	45.42	4.89	46.02	49.09	5.55	42.92	51.53
1	9.11	50.03	40.86	6.18	48.88	44.94	5.39	46.42	48.20
2	14.39	46.62	38.99	10.09	46.76	43.15	9.71	44.39	45.90
more than 2	22.37	45.71	31.92	16.79	47.03	36.18	16.75	44.67	38.57
Woman's									

education									
low (≤9 years)	13.37	26.54	60.09	9.71	27.54	62.74	8.90	27.48	63.62
Intermediate (10–13 years)	12.82	43.46	43.72	9.05	43.42	47.52	9.24	41.19	49.57
High (15–17 years)	6.84	76.41	16.75	4.42	73.27	22.31	3.98	67.37	28.65

Table 10. Conditional expected annual hours under different tax rate systems by several variables and ranges

Variable	1991 tax system		1994 tax system		Flat tax of 29%	
	Public sector	Private sector	Public sector	Private sector	Public sector	Private sector
Age range						
25–34	1465	1434	1530	1576	1589	1706
35–44	1470	1462	1571	1631	1656	1785
43–64	1481	1438	1598	1608	1695	1764
Number of children						
0	1587	1528	1689	1694	1775	1843
1	1533	1496	1627	1662	1699	1806
2	1393	1369	1490	1530	1569	1677
more than 2	1215	1215	1310	1363	1399	1523
Woman's education						
low (≤9 years)	1455	1406	1535	1531	1605	1642
Intermediate (10–13 years)	1464	1446	1552	1604	1628	1747
High (15–17 years)	1494	1531	1607	1768	1702	1968

VI. Compensating variation

To further evaluate the 1992 tax reform, we calculate the change in household welfare. One way to do this is to apply the measure of Compensating Variation (CV). The calculation of CV is not straightforward in a random utility model when utility is not linear in household income. A random utility function implies that CV is also random. A general treatment of this issue was undertaken by Dagsvik and Karlstrom (2005). In order to bring out the essentials of their approach we shall first go through the argument in a somewhat simplified, but general, setting in the next subsection.

The Random Expenditure Function in Random Utility Models

Assume that the utility function has the structure $\mathrm{U_j(f,y)=\kappa_j(f,y)\varepsilon_j}$, where $\kappa_j(.)$ is a deterministic term, as a function of prices and tax system *f* and income *y*, and ε_j is a positive random term. The random terms $\{\varepsilon_j\}$ are supposed independent of the deterministic terms $\{\kappa_j\}$. The index j indicates discrete alternative j.

Now suppose that the prices and/or the tax system changes from regime f^0 (regime zero) to f, (regime 1). Let y^j, j= 0, 1, denote the income under regime f^0, f, respectively. Then the corresponding Compensating Variation, CV, is defined implicitly as the value that solves

(6) $$\max_k U_k(f^0, y^0) = \max_k U_k(f, y^1 - CV).$$

From this definition it follows that the CV measure becomes a random variable that may depend on all random terms $\{\varepsilon_j\}$. This is due to the fact that the maximum of the left hand side in (6) will not be attained at the same discrete alternative as the maximum of the right hand side of (6), except in special cases. Consequently, the random terms on each side will not cancel. We shall now proceed to review the main argument that yields the c.d.f. of the *CV*. To this end we first define the indirect utility function *V(f,y)* by

$$V(f,y) = \max_k U_k(f,y).$$

Moreover, define the expenditure function *Y(f, u)* in the usual way by $V(f, Y(f,u)) = u$, for given positive utility level *u*. Furthermore, define the choice index $J(f,y)$ as the index of the highest utility, that is, the utility of the chosen alternative, given *(f, y)*. For notational simplicity, let

$\mathrm{m_j(y)=max(\kappa_j(f^0,y^0),\kappa_j(f,y))}$, $V^0 = V(f_0, y_0)$, $V(y) = V(f,y)$, $U_j^0 = U_j(f^0, y^0)$, $U_j(y) = U_j(f,y)$, $\kappa_j^0 = \kappa_j(f^0,y^0), \kappa_j(y) = \kappa_j(f,y)$ and $J^0 = J(f_0, y_0)$. Consider the event $\{Y(f,V^0) \geq y\}$. This is the event that the regime 1 expenditure, given the initial utility level, is greater than *y*. Evidently, we have that $\{Y(f,V^0) \geq y\} \Leftrightarrow \{V(f,y) \leq V^0\}$. Moreover, notice that when alternative i is chosen initially and regime 1 expenditure at utility level V^0 is higher than y, then $U_i^0 \geq U_i(y)$, which is equivalent to $\kappa_i(y) > \kappa_i^0$. Hence, we get

(7) $$P(Y(f,V^0) \geq y, J^0 = i) = P(V(y) \leq V^0, J^0 = i)$$

$$= P(V^0 = U_i^0 \geq \max_k U_k(y), U_i^0 \geq \max_{k\neq i} U_k^0) = P(U_i^0 \geq \max(\max_k U_k(y), \max_{k\neq i} U_k^0))$$

$$= P(U_i^0 \geq \max(\max_{k\neq i} U_k(y), \max_{k\neq i} U_k^0), U_i^0 \geq U_i^0(y))$$

$$= \mathrm{P}(\kappa_i^0\varepsilon_i \geq \max_{k\neq i}(m_k(y)\varepsilon_k), \kappa_i^0 \geq \kappa_i(y))) = \mathrm{P}(\kappa_i^0\varepsilon_i \geq \max_{k\neq i}(m_k(y)\varepsilon_k).$$

Assume now that the random error terms are (type I) extreme value distributed with c.d.f. $\exp(-1/x)$, for positive x. Then it follows from (7) and well known results, that

(8) $$P(Y(f,V^0) \geq y, J^0 = i) = \mathrm{P}(\kappa_i^0\varepsilon_i \geq \max_{k\neq i}(m_k(y)\varepsilon_k)) = \frac{\kappa_i^0}{\kappa_i^0 + \sum_{k\neq i} m_k(y)}.$$

Let y_i be defined by $\kappa_i(y_i) = \kappa_i^0$. Then the agent will not switch from the initially chosen alternative, $J^0 = i$, if $Y(f, V^0) = y_i$, the reason being that utilities in regimes 0 and 1 are equal. Clearly, one must have that $Y(f, V^0) \leq y_i$, because otherwise the utility of alternative i will exceed U_i^0 ex post. Hence the relation in (8) is valid for $y \leq y_i$. Let $R_j(y) = 1$ if $\kappa_j(y) \leq \kappa_j^0$,

(that is, when $y \leq y_i$), and zero otherwise. Then from (8) it follows immediately that the c.d.f of the expenditure function $Y(f,V^0)$ is determined by

(9) $$P(Y(f,V^0) \geq y) = \sum_i P(Y(f,V^0) \geq y, J^0 = i) = \sum_i R_i(y) \frac{\kappa_i^0}{\kappa_i^0 + \sum_{k'i} m_k(y)}.$$

Note furthermore, that the two first moment of a random variable Y distributed on $[-a, \infty)$, with c.d.f. F(y) can be expressed as

(10) $$EY = \int_{-a}^{\infty} (1 - F(y))dy - a,$$

and

(11) $$EY^2 = 2\int_{-a}^{\infty} y(1 - F(y))dy + a^2.$$

The proof of (10) and (11) is straightforward. Hence, from (9) and (10) it follows that the mean expenditure is given by

(12) $$EY(f,V^0) = \int_{-a}^{\infty} \sum_i \frac{R_i(y)\kappa_i^0 dy}{\kappa_i^0 + \sum_{k'i} h_k(y)} - a = \sum_i \int_{-a}^{y_i} \frac{\kappa_i^0 dy}{\kappa_i^0 + \sum_{k'i} h_k(y)} - a,$$

provided the expenditure function $Y(f,V^0)$ is distributed on $[-a,\infty)$, for some positive *a*. Similarly, one can compute the second order moment and the variance of the expenditure function by using (11). Finally, from the definition in (6) we realize that $Y(f,V^0) = y^1 - CV$,

which yields

(13) $$ECV = y^1 - EY(f,V^0).$$

Calculation of the distribution of CV in our model

As we have seen in the previous section, the method of Dagsvik and Karlstrom (2005) provides convenient formulas for calculating mean and higher order moments of CV for observationally homogeneous populations. We shall now adapt this method to the more complicated case of our model. In our case we do not have an observational homogeneous population and we also need to consider aggregation across different population subgroups. Let E[*CV*|*X*] denotes the conditional mean CV, given individual characteristics *X*. Furthermore, let EVar(*CV*|*X*) and VarE(*CV*|*X*), denote two types of conditional variances of CV. The first variance measures the average variance of *CV* within observational identical population groups, whereas the second variance measures the variation in expected *CV* across observationally identical groups.

Let us next proceed with analysing *CV* in the context of this paper. With the notation introduced earlier, define

(14) $$\tilde{V}_j\left(h, w_j, I, f\right) = \max_{z \in B_j(h)} U\left(f\left(hw_j, I\right), h, z\right),$$

where $B_j(h)$ is the set of available jobs in sector *j* with hours of work *h*. The term $\tilde{V}_j\left(h, w_j, I, f\right)$ is the conditional indirect utility, given hours of work *h* in sector *j*, wage rate w_j, nonlabor income *I* and tax system *f*. Furthermore, the assumptions about the utility function imply that

(15) $$\tilde{V}_j\left(h, w_j, I, f\right) = \psi\left(h, w_j, I\right) \max_{z \in B_j(h)} \varepsilon_j(z).$$

where $\psi(h, w_j, I) = v(f(hw_j, I), h)$.

Owing to the fact that the random taste shifters are extreme value distributed, it follows that we can write

(16) $$\max_{z \in B_j(h)} \varepsilon_j(z) \overset{d}{=} \theta_j g_j(h) \tilde{\varepsilon}_j(h),$$

where $\overset{d}{=}$ denotes equality in distribution and $\tilde{\varepsilon}_j(h)$ has c.d.f. $\exp\left(-1/x\right), x > 0$. Moreover, $\tilde{\varepsilon}_j(h)$, $j = 0,1,2$, $h = 0,1,...$, are independent. (Recall that we use the convention that $h = 0$ implies $j = 0$.) As a result, we can express the conditional indirect utility as

(17) $$\tilde{V}_j\left(h, w_j, I, f\right) = \psi\left(h, w_j, I\right) \theta_j g_j(h) \tilde{\varepsilon}_j(h)$$

for $h > 0$, $j = 1,2$, and

(18) $$\tilde{V}_0\left(0, w_j, I, f\right) \equiv \tilde{V}_0\left(0, 0, I, f\right) = \psi\left(0, 0, I\right) \tilde{\varepsilon}_0(0)$$

for $h = 0$.

For notational simplicity, let $V_j\left(h, w_j, I\right) = \psi\left(h, w_j, I\right)\theta_j g_j(h)$ for $h > 0$ and $V_0\left(0, w_j, I, f\right) \equiv V_0\left(0,0,I,f\right) = \psi\left(0,0,I\right)$. Let $\tilde{V}\left(w, I, f\right)$ be the unconditional indirect utility, defined as

(19) $$\tilde{V}\left(w, I, f\right) = \max\left[\tilde{V}_0\left(0,0,I,f\right), \max_{j=1,2} \max_{h>0, h\in D} \tilde{V}_j\left(h, w_j, I, f\right)\right].$$

Analogously to (15) we realize that *CV* (for an individual), is defined implicitly through

(20) $$\tilde{V}\left(w, I, f^0\right) = \tilde{V}\left(w, I - CV, f\right),$$

where f^0 denotes the initial budget constraint and f denotes the budget constraint after the tax reform. In Dagsvik and Karlström (2005), it is demonstrated that the distribution of $Y \equiv I - CV$ is given by

(21) $$P\left(Y > y\right) = \frac{\sum_j \sum_{h\in D} R_j\left(h, y\right) V_j\left(h, w_j, I, f^0\right)}{K(y)},$$

where

$$R_j\left(h, y\right) = \begin{cases} 1 & \text{if } \; V_j\left(h, w_j, y, f\right) < V_j\left(h, w_j, I, f^0\right) \\ 0 & \text{otherwise}, \end{cases}$$

and

(22) $$K(y) = \max\left(\psi\left(0,0,I,f^0\right), \psi\left(0,0,y,f\right)\right) + \sum_{j=1}^{2} \sum_{h>0} \max\left(V_j\left(h, w_j, I, f^0\right), V_j\left(h, w_j, y, f\right)\right).$$

The difference between the case considered here and the treatment in Dagsvik and Karlström (2005) is that, in their case, *Y* is positive whereas in the present case, *Y* can attain negative values. However, the formulas in (10) and (11) can be applied. From (21), (22) and (10) it follows that the *individual* mean

CV, conditional on wage rates, nonlabor income and other characteristics (suppressed in the notation below) is given by

(23) $$E\left[CV \mid w,I\right] = I - EY = I + a - \sum_{j=1}^{2}\sum_{h>0} V_j\left(h, w_j, I, f^0\right)\int_{-a}^{y_j(h)}\frac{dy}{K(y)} - \psi\left(0,0,I,f\right)\int_{-a}^{y(0)}\frac{dy}{K(y)}$$

where $y_j(h)$ and $y(0)$ are defined by

(24) $$V_j\left(h, w_j, I, f^0\right) = V_j\left(h, w_j, y_j(h), f\right),$$

and

(25) $$V\left(0,0,I,f^0\right) = V\left(0,0,y(0),f\right).$$

Furthermore, (21), (22) and (11) yield

(26) $$Var\left[CV \mid w,I\right] = Var\left[Y \mid w,I\right] = a^2 + 2\sum_{j=1}^{2}\sum_{h>0} V_j\left(h, w_j, I, f^0\right)\int_{-a}^{y_j(h)}\frac{ydy}{K(y)}$$

$$+2\psi\left(0,0,I,f\right)\int_{-a}^{y(0)}\frac{ydy}{K(y)} - \left(E\left[Y \mid w,I\right]\right)^2.$$

It is important to emphasize that the formulas in (23) and (26) give the mean CV and variance of CV conditional on wage rates, nonlabor income and other individual (observed) characteristics. The next step is to compute the conditional mean and variance of CV given nonlabor income, education and the demographic variables that enter the model, i.e., the mean is taken with respect to the random wage rates. This is done by drawing independent error terms from the standard normal distribution and thereafter inserting these error terms into the wage equations. This yields a set of random wage rates for each woman. From these simulated wage rates, one can compute (simulate) the conditional mean, $E(CV \mid I)$ given nonlabor income and other individual characteristics, by taking the expectation with respect to the wage rates distribution for each woman. Below, we report the mean and spread in the population.

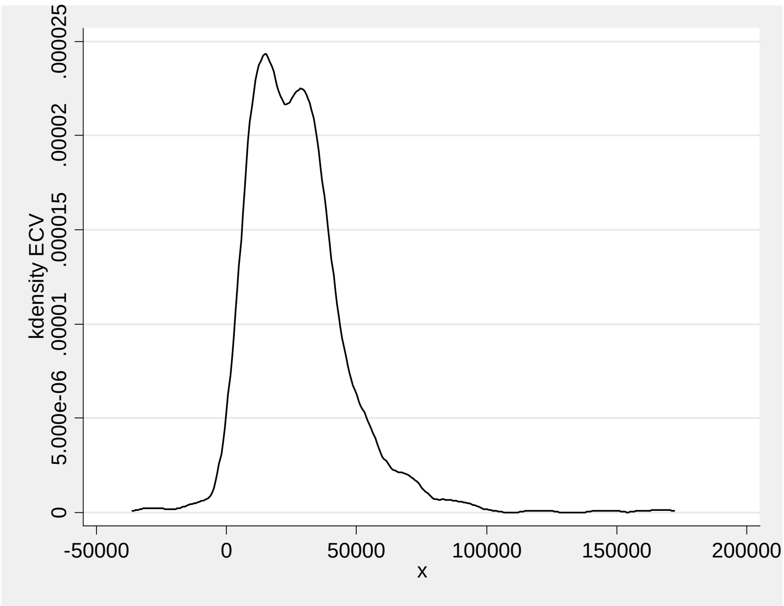
Table 11. Expected value of compensating variation, an estimate of the welfare changes for households from the 1992 tax reform. NOK 1994, with the 1991 tax system used as a reference against the 1994 tax system

	E(CV)	E(CV) in percent of observed disposable income*
All	27078	11.46
Deciles in the distribution of household disposable income*:		
1 (poor)	6761	4.32
2–9 (middle)	24896	11.11
10 (rich)	64150	16.66

* Decile(s) refers to the deciles in the distribution of disposable income, 1994

The standard deviations related to EVar($CV|X$) and VarE($CV|X$) are calculated to NOK 56000 and NOK 19429, respectively. Thus, the spread in the distribution of E[CV|X] is large, with the spread within groups exceeding the spread across groups.

Figure 1. Population density of expected Compensating Variation. Distribution of E(CV), comparing the 1991 tax regime against the 1994 tax regime



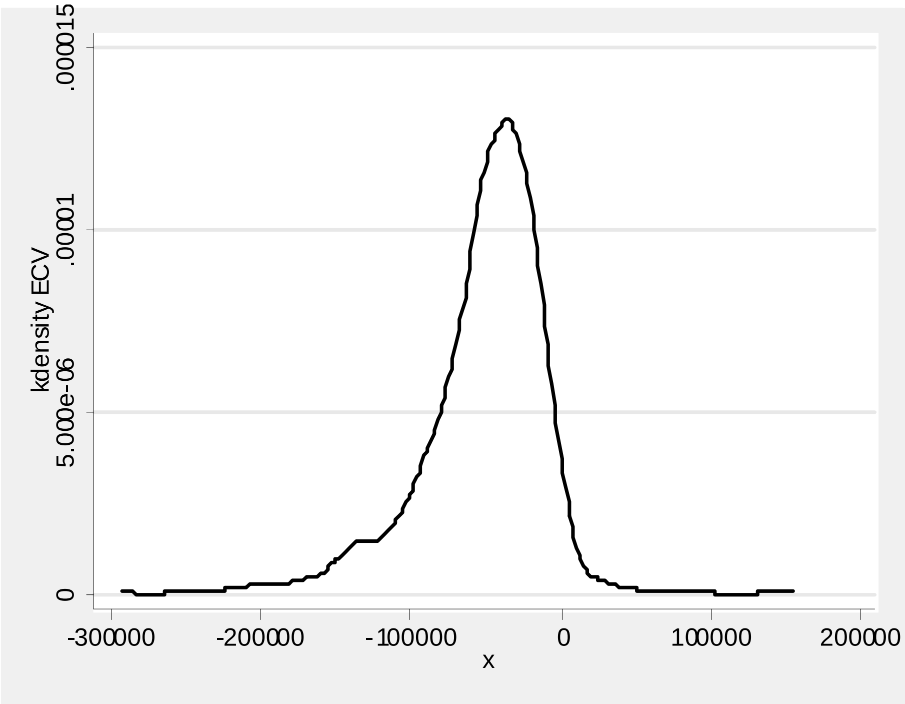
From Table 11, we observe that the mean household in the sample gained NOK 27078 from the 1992 tax reform. The richest household gained almost 10 times more than the poorest or 4 times more in relative income terms. The reason why is the sharp reduction in the tax rate at the top, from 65.4 percent in 1991 to 49.5 percent after the tax reform. Thus richest households thus got a considerable increase in disposable income, even with no change in their labor supply. The distribution of expected gain across households is given in Figure 1, and we observe that most of the households will benefit from the 1992 tax reform. Thus, such a reform would have attained support from a clear majority of households with married and cohabiting women at an election.

We have also calculated the expected value of compensating variation of a flat tax reform. In the calculations, the tax-revenue-neutral flat tax reform of 29% is used as a reference. Negative values mean that the numerical values have to be subtracted from household incomes under the flat tax regime in order to make the households indifferent in welfare terms between the 1994 regime and the flat tax regime. Table 12 then says that, on average, the households will gain NOK 51528 if there is a shift from the 1994 tax regime to a flat tax regime. The richest households gain around 8 times more than the poorest. Thus, in a distributional sense, the richest household benefited more from having the 1991 regime replaced with the 1994 tax regime than they would have in the case of a shift from the 1994 tax regime to a flat tax regime. In Figure 2, we show the population density of the individual mean CV. We observe that a vast majority will benefit from the replacement of the 1994 tax regime with a flat tax regime.

Table 9. Expected value of compensating variation, an estimate of the welfare changes for households from a flat tax reform. NOK 1994, with a flat tax regime used as a reference against the 1994 tax regime

	E(CV)
All	–51437
Deciles in the distribution of household disposable income, flat tax:	
1 (poor)	–17155
2–9 (middle)	–53093
10 (rich)	–146966

Figure 2. Population density of expected Compensating Variation. Distribution of E(CV), with the flat tax system of 29% used as a reference against the 1994 tax regime



VII. Conclusion

The labor supply model for married and cohabiting women, developed by Dagsvik and Strøm and estimated on Norwegian data from 1994, has been used in selected simulation experiments. Some of these experiments illustrate the effect of changes in wage rates and the distribution of offered hours, whereas others illustrate the effect of a tax reform. The overall elasticities are much smaller than elasticities related to sectoral responses.

The Norwegian tax reform of 1992 implied a considerable reduction in the top marginal tax rate, but the tax rates in lower brackets were also reduced. We find that the impact on overall labor supply is rather modest, but again these modest changes shadow for stronger sectoral changes. The tax reform stimulated the married women to shift their labor from the public to the private sector and to work longer hours. We have applied the methodology of Dagsvik and Karlstrøm (2005) to calculate the expected value of the compensating variation with the framework of a random utility model. This calculation of the expected value of changes in household welfare demonstrated that the richest households benefited far more from the tax reform than the poorest household. Thus there is a trade off between efficiency and equity as also found in Paulus and Peichl (2008). However, as shown above, most households gained from the reform.

A flat tax reform, with the same tax revenue as in 1994, would reinforce the labor supply responses of the 1992 reform. In relative terms, the richest households benefit more from the 1992 tax reform than from a having a further reform towards a flat tax regime.

It is beyond the scope of this paper to account for general equilibrium (GE) effects. However, we should expect that GE effects would have pushed down wages, in particular in the private sector ,and we should also expect that the average gain measured by CV would decrease.The estimated effects of tax reforms on labor supply should thus be considered as upper bounds.

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Appendix A. Data

Data on the labor supply of married women in Norway used in this study consist of a merged sample of the "Survey of Income and Wealth, 1994" and the "Level of living conditions, 1995" (Statistics Norway, 1994 and 1995, respectively). Data cover married couples as well as cohabiting couples with common children. The ages of the spouses range from 25 to 64. None of the spouses is self-employed and none of them is on disability or other type of benefits. A person is classified as a wageworker if their income from wage work is higher than their income from self-employment. All taxes paid are observed and in the assessment of disposable income, at hours not observed, all details of the tax system are accounted for. Hours of work are calculated as the sum of hours of the main job as well as those of any side jobs. A large majority of the women have only one job.

Wage rates above NOK 350 or below NOK 40[3] are not utilized when estimating the wage equations. The wage rates are computed as the ratio of annual wage income to hours worked. When computing annual wage income, we take into account the fact that some women have multiple jobs. The size of the sample used in estimating the labor supply model is 810. Descriptions of variables and summary statistics are given below.

[3] In May 2008, 1 USD≈NOK 5.00

Table A.1. Description of the variables used in the analysis (values in NOK, 1994)

Symbols	Description	
FNR	Identification number	
FAR	Woman Year of birth	
B02	Number of children 0-2	
B36	Number of children 3-6	
B717	Number of children 7-17	
B06	Number of children 0-6	
MALDER	Age in year (man)	
MUTD	Education in year (man)	
KALDER	Age in year (woman)	
KUTD	Education in year (woman)	
INR	Choice variable of working hours: 1-15	
ARBTID	Annual hours of work as follows:	
	INR =1 ARBTID = 0;	
	Public sector	**Private sector**
	INR =2 ARBTID = 315;	INR =9 ARBTID = 315;
	INR =3 ARBTID = 780;	INR =10 ARBTID = 780;
	INR =4 ARBTID = 1040;	INR =11 ARBTID = 1040;
	INR =5 ARBTID = 1560;	INR =12 ARBTID = 1560;
	INR =6 ARBTID = 1976;	INR =13 ARBTID = 1976;
	INR =7 ARBTID = 2340;	INR =14 ARBTID = 2340;
	INR =8 ARBTID = 2600;	INR =15 ARBTID = 2600;
KAPINNT	Household capital income	
MANNLONN	Men wage income per year	
Variable generated:		
KUTD_100	Woman Education in year (KUTD) /100	
SKILL	Work Experience = woman age–woman education in year (KUTD) – six (starting school age)	
SK_100	SKILL/100	
SK2_100	$(SKILL/100)^2$	
CAPINC	Net capital income (CAPINC)=KAPINNT–CHALL as KAPINNT includes CHALL. CHALL is child allowances, see Appendix B	
W_PU	Woman hourly wage in public sector	
W_PR	Woman hourly wage in private sector	

Table A.2. Descriptive statistics, number of observations = 810

Variable	Mean	Std. Dev.	Min	Max
FAR	53.92	9.04	30.00	69.00
B02	0.23	0.45	0.00	2.00
B36	0.30	0.56	0.00	3.00
B717	0.66	0.85	0.00	4.00
MALDER	42.80	9.17	25.00	66.00
MUTD	12.05	2.49	9.00	19.00
KALDER	40.07	9.04	25.00	64.00
LNKALDER	3.66	0.22	3.22	4.16
KUTD	11.61	2.15	9.00	17.00
INR	7.83	4.01	1.00	15.00
B06	0.54	0.77	0.00	3.00
ARBTID	1482.89	664.97	0.00	2600.00
SEKTOR	1.34	0.61	0.00	2.00
KUTD_100	0.11	0.02	0.09	0.17
SKILL	22.45	9.63	2.00	49.00
SK_100	0.22	0.09	0.02	0.49
SK2_100	0.05	0.04	0.0004	0.24
KAPINNT	32306.71	42378.48	0.00	568403.00
CHALL	13094.37	12154.01	0.00	60084.00
KVLONN	149751.97	83060.53	0.00	581693.00
MANNLONN	274372.89	106239.67	17312.00	1184861.00
W_PU	89.36	12.09	64.88	132.34
W_PR	109.77	13.68	80.14	156.44

Appendix B. Tax functions and child allowances

Table B.1. Tax function in 1994 for a married nonworking woman whose husband is working, OK 1994

Mannlonn, Y_{male}	Tax T
0–41907	0
41907–140500	$0.302Y_{male}$–12656
140500–252000	$0.358Y_{male}$–20524
252000–263000	$0.453Y_{male}$–44464
263000–	$0.495Y_{male}$–55510

Table B.2. Tax function in 1994 for a married working woman or man, NOK 1994

Wage income, Y	Tax T
0–20954	0
20954–140500	0.302Y–6328
140500–208000	0.358Y–14196
208000–236500	0.453Y–33956
236500–	0.495Y–43889

In 1994, the child allowances were:

- One child between 0 and 17 years: NOK 10416
- Two children between 0 and 17 years: NOK 21336
- Three children between 0 and 17 years: NOK 33696
- Four children between 0 and 17 years: NOK 46692
- Five children or more between 0 and 17 years: NOK 60084

Table B.3. Tax function in 1991 for a married nonworking woman, whose husband is working, NOK 1994

Mannlonn, Y_{male}	Tax T
0–38392	0
38392–70746	$0.303Y_{male}$–11642
70746–171915	$0.343Y_{male}$–14455
171915–200567	$0.418Y_{male}$–27348
200567–264239	$0.558Y_{male}$–55428
264239–	$0.654Y_{male}$–80509

Table B. 4. Tax function in 1991 for a married working woman, or working man. NOK 1994

Wage income Y	Tax T
0–19596	0
19596–22639	0.343Y–6722
22639–70746	0.303Y–5832
70746–137956	0.343Y–8634
137956–174037	0.418Y–18981
174037–219669	0.558Y–42964
219669–	0.654Y–64214