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A nested discrete choice model with nonlinear income

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Abstract
Shift work has a documented negative impact on workers' health and social life, effects which are compensated for with higher wages and shorter working hours. Many countries face a 'nursing shortage', and increasing wages is argued to lead to an increase in the short-term labor supply in health care. Omitting shift work in the evaluation of such policies may lead to biased estimates of the wage elasticities. Focusing on registered nurses (RN) employed in the public health sector, this paper presents an econometric analysis that allows the nurses to compose their 'job package' in three steps by choosing: a) hospital or primary care, b) daytime or shift work and c) one of four categories of hours. The utility maximization problem is solved by discretizing the budget set and choosing the optimal job package from a finite set of alternatives. The nested structure is estimated on Norwegian micro data. There is some variation in the responsiveness to wage between shift and day workers and by care level. The job-specific elasticities are small but positive. However, the simulation of a wage increase in all job types, when conditioning the analysis to those already participating in the sector, indicates a slight reduction in hours. Thus, the income effect seems to dominate in the labor supply of nurses.

1. Introduction

Shift work, in particular night work, is known to have a negative impact on the health and well-being of workers. Yet it is impossible to deliver inpatient health services without shift work. One segment of the literature addressing shortages of health personnel focuses on the wage impact on labor supply. Intuitively there is reason to believe that shift workers respond differently to a wage increase than those working daytime hours. For instance it probably causes more health strain to extend the working hours, from part-time to full-time, if you have to work the additional hours during nighttime.

In addition, there is reason to believe that an increase in wages for both shift and daytime jobs might lead some workers to turn down the shift work compensation, as the daytime job pays 'sufficiently'. This may increase the hours of work, as daytime hours are slightly longer, but at the expense of the willingness to work shift hours. A change in the relative wages of shift work and daytime hours will presumably have stronger effects. A very small number of existing studies take these differences between shift labor and regular daytime labor into account. This paper is an attempt to explicitly include the choice between shift work and daytime hours in a labor supply model of registered nurses (RNs), focusing on wage as a policy instrument. The nurses maximize utility given a nonlinear budget set that incorporates taxes in a static neo-classical structural labor supply model. The approach is inspired by Aaberge, Dagsvik and Strøm (1995) and van Soest (1995).

The physical strain of shift work is well documented. An overview by Costa (1996) reports that shift work, particularly night work, can disturb cardiac rhythms, interfere with work performance and efficiency over 24 hrs, strain family and social relationships and impair sleeping and eating habits. Costa especially stresses that "Shift and night work may have specific adverse effects on women's health in relation to family roles and hormonal and reproductive functions." Ohida et.al (2001), in a study of young female nurses in Japan, observe a significant association between working night shifts and using alcohol to help induce sleep, and between shift work and daytime drowsiness.

To compensate for the extra strain, shift workers often work shorter hours than those with a regular schedule. Partly because the agreed weekly hours are lower for shift workers, and partly because shift workers often prefer less than a full-time job to be able to look after their children and maintain their social life. This leads us to the positive aspects of shift work. Many workers prefer shift work in order to better cope with challenges outside the workplace, without leaving the work force. Many shift workers know that they will return to daytime hours later in life, but given their current situation shift work is preferred.

In the literature review by Antonazzo et.al. (2003) of nurses' labor supply, they emphasize the need to address the relative importance of pecuniary and non-pecuniary job characteristics. "E.g. compensation for shift work is crucial for the nurses' income, but shift work is reported as demanding, especially if you are in a full-time job." However, the existing literature does not identify separate wage responses on working hours for personnel working shift hours and daytime hours respectively. The result might be an omitted variables bias in the estimated wage elasticities. One exception is a recent paper by Askildsen *et al.* (2003) who corrects for this effect.

They stress the fact that several studies may be alleged to suffer from an omitted variables problem as they do not control for crucial differences in contractual arrangements between jobs. Shift hours are compensated for with an hourly wage premium, and with shorter mandated weekly working hours. Rosen (1986) gives an introduction to the literature on compensating variations. Applications on shift work include Kostiuk (1990) and Lanfranchi et al. (2002).

Shift work is, however, only one important factor when choosing a nursing job. In this paper the nurses first have to choose the preferred care level. There are many differences between a hospital and a primary care job, supporting the nested structure of the choice model, such as patient characteristics, types of nursing tasks, preventive versus curative focus, teamwork opportunities, stress levels, leadership, travel distance and centrality (hospitals are located in higher populated areas). Most of these characteristics are, however, unobservable to the researcher. International studies of the nursing labor market have noted large earnings differences between similar hospital and non-hospital RNs. Schumacher and Hirsch (1997) explain half of the hospital wage advantage in their study to be unmeasured worker ability. The remainder is likely to reflect compensating differentials for hospital disamenities. Due to the centralized wage bargaining for public employees, wage differences between care levels are more moderate in Norway.

In their review of nursing labor supply, Antonazzo et.al. (2003), find a huge variation in results, particularly on the effect of wages, depending on the methodological framework applied. The impact of own wage on labor force participation is not significantly different from zero in most of the studies, whereas there are a few studies with elasticities greater than one. The impact on hours worked is estimated with elasticities from –0.94 to +2.8 depending on sample, time period and gender. The impact of an increase in household non-labor income is estimated with elasticities that are slightly negative in relation to the participation rate, and insignificant or negative for hours worked. An exception is Phillips (1995), which finds participation to be highly responsive to wage. The abovementioned study by Askildsen *et al.* (2003) estimates a wage elasticity from –0.05 to 0.46 depending on the econometric specification when regressing hours against the log wage. They argue that the alternative with an elasticity of 0.21 seems most reasonable due to their correction for sample selection and wage endogeneity. They find that individual and institutional features are statistically significant and important for working hours.

Askildsen *et al.* is a natural reference point as their analysis uses some of the data registers used in my study. The approaches are, however, significantly different in some respects, making similar results less likely. Their sample includes both married and single females. They do not include non-work income, including spouse’s income. The taxes on labor income is also not included. In my study I focus on the single individuals who are expected to be more flexible in their response to wage changes. Taxes and non-work income like asset income and child allowance are included in this analysis. Askildsen *et al.* includes shift work in their analysis, but only as a measure to correct for the differences in wage rates for those working shifts. In my study, the alternatives of shift work or regular daytime work are presented as separate job packages with different hourly wages. The impact of other non-pecuniary aspects of shift work, like night work, on individual welfare is captured by the error term. Thus while Askildsen *et.al.* only focus on how wages should be corrected for the fact that wages in shift work are higher than in non-shift work, I account explicitly for the same fact, but also for the fact that changes in wages may have an effect on job choices. Other variables than wages may also affect the choices of shift work versus non-shift work.

Sæther (2004) focuses on the prospects of attracting nurses to the public health sector from non-health jobs. That paper also applies a discrete choice framework and identifies a wage elasticity for hospital jobs of 0.17, and of 0.39 in primary care. Here, in the present paper I attempt to explicitly include the shift dimension into the model. The cost of this approach is the need to focus only on the subsamples of nurses working in the public sector. On the other hand, when we no longer need to identify the wages in non-health jobs, we can utilize the richness of the high quality register data for health personnel containing wages and hours in addition to the shift information.

In this paper the nurses face three subsequent choices. First, the choice of care level, a hospital job or a primary care job like in a nursing home, home nursing or a health center. Secondly the choice of working shifts or regular daytime, and finally the choice of working hours. The motivation for this modeling is to better inform policymakers of the possible impact of wage as an instrument, focusing on making the predicted effect on all public health hours more accurate and on possible differences between personnel working shifts and regular hours.

A comparison of the predictions of the model to the observed choices is encouraging. Both with regards to the choices between a hospital or a primary care job, and the choice between shift work and a regular daytime job. The predicted distribution of hours seems less accurate. The main difficulty is for the model to predict the high share working full-time without extra hours.

The prediction of choices is repeated for policy simulations where the wages in some or all of the job alternatives are increased. Conditioning on participation in the public health care sector, I first present the effects of job type-specific wage increases. A 10% increase in hospital pre-tax wages increases the predicted share choosing a hospital job with 3.4%. The short-term labor supply, measured in hours, is estimated to have an elasticity of 0.20 in the hospital jobs, but the high level of uncertainty makes it not significant from zero at a 10% level. The wage elasticity for primary care hours is higher, and significant at a 10% level. A simulation of a 10% increase in wages in all shift jobs, both hospital and primary care jobs, predicts an increase in the share preferring shift work with 2.9%. The wage elasticity for shift hours is 0.153. The wage elasticity for daytime hours is higher, but with great uncertainty in the predictions.

A simulation of a wage increase in all job types predicts a somewhat different response. A 10% increase in the pre-tax hourly wages for those already employed in the public health sector is predicted to lead to a 1.43% decrease in hours worked. The predicted reduction is mainly an effect of more nurses preferring part-time and extended part-time work. There is little predicted change from daytime to shift work with shorter contracted hours, nor any systematic change between the care levels. When wages in all jobs are increased, the model predicts a slight reduction in hospital hours, and even more for primary care hours. The response in primary care hours is however not significantly different from zero. In response to a wage increase in all job types the shift hours are slightly reduced but the effect is not significantly different from zero. There is no significant difference in the response between shift and non-shift hours.

The complicated structure of the choices and the many factors in addition to wage influencing the choice of job type and hours are among the factors causing a relatively high level of uncertainty in the predictions. Keeping in mind that the analysis is restricted to the short-term impact on working hours of those already participating in the public health care sector, the lesson is that changes in wage has a limited impact on the working hours. A job-specific wage increase attracts nurses from other jobs and thus increases the hours produced in that job. The costs seem to be a slight reduction in the average hours of work for those enrolled prior to the wage increase.

An overall wage increase for all public employees seems to reduce the hours of work slightly for those already employed. On the other hand we know from other studies, like Sæther (2004), that such wage increases will attract nurses from other sectors in the economy leading to a modest increase in the hours worked.

The next section introduces the data and context, before a formal model is presented in Section 3. After a description of findings in Section 4, Section 5 concludes.

2. Data

The public health care providers are the dominant employers for Norwegian registered nurses. In 2002, 91.4 percent of those working within health and social services were public employees. This paper is based on data from the Norwegian Association of Local and Regional Authorities (NALRA), organizing employers in municipalities and counties. The employers organized in NALRA employed almost all public staff, with the exception of some national hospitals. Being prior to the hospital ownership reform, the counties demanded RNs for their hospitals, and the municipalities needed personnel for their health centers, nursing homes and home nursing.

In 2002, there were 77,819 registered nurses, of which 90% participated in the labor market. Those not participating were undertaking further education or enrolled in one of the social security programs, such as disability pension, medical and vocational rehabilitation and early retirement. For a general overview of the Norwegian health care system, see van den Noord et.al. (1998) and European Observatory on Health Care Systems (2000).

The attractiveness of limiting the analysis to the NALRA employees is the superiority of the data quality. Each individual has a record of monthly working hours and pay in October. The income is separable into the basic salary and a fixed monthly benefit component including compensation for shift work. In addition, there is a separate component for overtime pay. Shift work is regulated by law and through agreements between NALRA and the nursing union. A registered nurse works 37.5 hours per week in a full-time position with daytime hours. Selecting a job that includes shift work will reduce this to 35.5 hours per week. Part-time work is common and expressed as a percentage of full-time. The character of the shift work varies, from a combination of daytime and evenings, to a combination of days, evenings and nights. Weekend work every third or fourth week is also common. Due to aggregation of the different compensation payments, I am unable to separate between the different shift forms. Each shift type has characteristics, however, that may be difficult to rank. As summarized by ICN (2000), evening and night shifts are frequently less staffed, and nurses have difficult access to safe transport and basic comforts such as hot meals. Rotating shifts have been associated with more sleep disturbance, digestive problems, fatigue and alcohol intake, as well as impaired psychological health and work performance. Kostiuk (1990) and Lanfranchi et al. (2002) apply a similar shift measure.

The sample is restricted to single females including cohabitants without joint children. The number of observations is 4042 in 1995 and 8124 in 2000. The most preferred alternative by far is a hospital job with shift work, followed by a primary care job with shift work. The general tendency is that RNs prefer shift work earlier in life, switching to daytime work as they get older.

The data set is based on the NALRA data matched with other administrative data registers delivered by Statistics Norway. The set includes information about demography, income and employment relations and the age of children. Appendix 1 provides details on the variable construction, trimming procedure and summary statistics for key individual level variables by job category.

Hourly wage is the applied earnings measure, calculated by dividing monthly earnings by reported monthly hours. These observed hourly wages are used when assigning predicted hourly wages for all nurses in all possible job alternatives in the model, and not only the alternative actually chosen. The alternatives available for NALRA workers are hospital jobs with shift work, hospital jobs with daytime hours, primary care jobs with shift work and primary care jobs with daytime hours. I exploit the richness of the register data in this procedure, including residency and observed experience. When estimating the wage equation I control for the selection effect applying a Heckman two-step procedure, as there is reason to believe that there is a selection process driving the decision of where to work. See Appendix 2 for the wages, and Appendix 3 for the taxes.

3. Model

This paper presents a static neo-classical structural labor supply model with single decision-makers. The individual's utility depends on income, leisure and other characteristics of the jobs. The utility maximization problem is solved by discretizing the budget set and choosing the optimal care level, shift type, leisure and income combination from a finite set of alternatives.

Conditioning on their participation in the public health care sector, nurses are facing a chain of choices in the composition of their "job package". Firstly a choice between a hospital or primary care job ($i = A, B$), secondly whether to work shifts or regular daytime ($j = 1, 2$), and finally the choice of category of hours h_{ijk} $(k=1,\ldots,4)$. Nurses working shifts face different contractual arrangements than those working daytime. Hours are shorter and the hourly wage is higher. The feasible working hours are grouped into the following categories: part-time, extended part-time, full-time, and extended full-time. Extended full-time is a nurse in full-time position working overtime, but also includes nurses working at more than one hospital where the total workload totals more than 100%. The hours per week in the categories are h_{i1k} ={18.4, 27.5, 35.5, 38.8} if the nurse works shifts, and h_{i2k} ={19.6, 29.6, 37.5, 40.8} if the nurse works non-shift. Each 'job package' has a pre-tax wage rate per hour $w_{ij}(h_{ijk})$ defined by the level of care *i* and shift type *j.* The offered wage is a piecewise linear relation of hours capturing the agreed terms in overtime compensation. In addition there are other job characteristics *(i, j)* that may affect preferences and hence choices. As an example we may think of specific skills involved in the job, patient mix and responsibility.

Let C_{ijk} be disposable household income after tax per year when the nurse works h_{ijk} hours in the main job *i* with shift category *j* with a wage per hour of $w_{ij}(h_{ijk})$. Hourly wage being dependent on hours worked is relevant only for those working extended overtime when they are compensated for overtime work.

The pre-tax labor income r_{ijk} with job specific hours h_{ijk} is given by

$$r_{ijk} = w_{ij}(h_{ijk})h_{ijk} \tag{1}$$

Disposable income corresponding to the job package *i,j,k* is given by the budget constraint

$$C_{ijk} = r_{ijk} - T(r_{ijk}) + I \tag{2}$$

The net-of-tax income C_{ijk} is the sum of the after tax earnings in the job, $r_{ijk} - T(r_{ijk})$, and other income, *I*, summarizing capital income after tax, transfers and savings. The tax, $T(r_{ijk})$, is progressive with the tax brackets in the Norwegian tax system.

I assume that the nurses make their choices by maximizing utility, given the job-packages available in the market. Thus,

$$\max_{(i,j,h_{ijk})} U\left[C_{\text{ijk}}, h_{ijk}, i, j\right] \tag{3}$$

s.t.

$$(h_{ijk}, w_{ijk}, i, j) \in D. \tag{4}$$

The first element in the utility function represents the net-of-tax income. The second element is the leisure time represented with the sum of hours worked. The last elements are representations of other characteristics of the job packages *i,j.*

The set *D* is the opportunity set, i.e. it contains all the opportunities available to the individual. I do not include non-market opportunities in *D*, and I have also excluded jobs not covered by the NALRA register. Note that for the same nurse, wage rates may differ across jobs and whether they work regular hours or not. In traditional labor supply offered wages are determined by human capital characteristics, and offered hours are uniformly distributed. However, in real life wages may vary across sectors for observationally identically workers, and jobs with a specific number of hours may be more available in the market than other, say "full-time", jobs. Thus, when the nurses make their choice with respect to labor supply, they choose between job-packages with different wage and hours profiles. See Aaberge, Colombino and Strøm (1999) for the modeling of labor supply along these lines.

The preferences are unknown to the analyst, neither does he observe all details of the job-packages available in the market. I will therefore assume a random utility model

$$U_{ijk}=u_{ijk}+\varepsilon_{ijk}, \tag{5}$$

where U_{ijk} is the utility when the nurse works h_{ijk} hours for employer i with shift j. u_{ijk} is the deterministic element in the utility function and ε_{ijk} is a stochastic term with an iid extreme value distribution with an expected mean of 0 and a variance of $\mu_2^2\pi^2/6$. The random term ε_{ijk} captures the unobserved attributes of the 'job packages'.

Let $P_{ijk}(h_{ijk})$ be the unconditional probability that h_{ijk} hours are worked in job i with shift type j.

$$P_{ijk}(h_{ijk}) = \Pr(U_{ijk} = \max_{\{q,s,r\}\in D} U_{qsr}) \tag{6}$$

However, to explain the choice structure, I will start with the two last elements in the choice chain and work backwards. The choice of shifts or daytime and the choice of working hours, can be integrated into one expression. Let h_{Ajk} be the number of working hours k ($k=1,2,3,4$), in shift type j ($j=1,2$), when the nurse works at care level A (hospital). Then,

$$P(h_{Ajk} \mid A) = P(h_{Ajk} \mid A_j)P(A_j \mid A) = \frac{e^{u(h_{Ajk})/\mu_2}\eta_j(s_j)}{\sum_{q=1}^{2}\sum_{r=1}^{4} e^{u(h_{Aqr})/\mu_2}\eta_q(s_q)}, \; j=1,2,\; k=1,2,3,4 \tag{7}$$

where the η-function is an opportunity index as the employers have a higher supply of shift jobs than they have of regular daytime jobs.

$$\eta_j(s_j) = e^{\tau s_j/\mu_2} \tag{8}$$

where $s_j = 1$ if the job is based on shift work and $s_j = 0$ if not. τ is a parameter.

The expected consumer surplus is given by (Ben-Akviva and Lerman, 1985). For those preferring a hospital job we have

$$N(A) = \mu_2 \ln\left[\sum_{k\in A1} e^{u(h_{A1k})/\mu_2}\eta_1(s_1) + \sum_{k\in A2} e^{u(h_{A2k})/\mu_2}\eta_2(s_2)\right] \tag{9}$$

where A1 represents shift work at the hospital and A2 represents daytime work. The parallel expression for primary care as the first choice is

$$N(B) = \mu_2 \ln\left[\sum_{k\in B1} e^{u(h_{B1k})/\mu_2} \eta_1(s_1) + \sum_{k\in B2} e^{u(h_{B2k})/\mu_2} \eta_2(s_2) \right] \qquad (10)$$

μ_2 is not identified and is thus absorbed in the utility function. Following Ben-Akiva and Lerman (1985) it can be shown that in this case we get the following expression for the probability of a hospital (*A*) job choice

$$P(A) = \frac{\delta(d) N_A^{\mu}}{\delta(d) N_A^{\mu} + N_B^{\mu}} \qquad (11)$$

where $\mu = \mu_2 / \mu_1$ is possible to identify. μ_1 takes care of the uncertainty in the choice between a hospital and a primary care job. μ is a measure of degree of dependence in unobserved utility among the alternatives in the upper nest. The statistic 1-μ^2 is a measure used as an indication of correlation, in the sense that as μ rises, indicating less correlation, this statistics drops. (McFadden, 1978). A value of μ=1 indicates complete independence within the nests, i.e. no correlation. When μ=1, representing independence among the alternatives, the GEV distribution becomes the product of independent extreme value terms. In this case the nested logit model reduces to the standard logit model. The value of μ must be within a particular range for the model to be consistent with the utility-maximizing behavior. If μ is between zero and one, the model is consistent with utility maximization for all possible values of the explanatory variables. (Train, 2003).

I have also introduce an opportunity index related to location $\delta(d)$. While there are primary care jobs for nurses in all municipalities in the country, the availability of hospital jobs is scarce in less urban areas. To correct for these differences in the opportunity sets, an indicator of centrality is applied. *d=1* if the nurse lives in an urban area, and zero otherwise. The opportunity index is expressed as

$$\delta(d) = e^{\theta D} \qquad (12)$$

with θ as an unknown parameter.

The probability of choosing a primary care job is *P(B)=1-P(A).* The unconditioned probabilities are thus

$$P(h_{Ajk}, A) = P(h_{Ajk} \mid A) P(A)\,;\; j=1,2\,,\; k=1,2,3,4 \qquad (13)$$

$$P(h_{Bjk}, B) = P(h_{Bjk} \mid B) P(B)\,;\; j=1,2\,,\; k=1,2,3,4 \qquad (14)$$

The likelihood function is then

$$L = \prod_{s \in A} P_s(h_{ijk}, A) \prod_{s \in B} P_s(h_{ijk}, B) \qquad (15)$$

Economic theory does not impose the functional form of the utility function. Van Soest (1995) prefers a polynominal representation of the utility function. Aaberge et.al. prefer the 'Box-Cox' function. This structural form of the utility function gives an opportunity to interpret the parameters as opposed to a polynomial representation of the utility function. An implication of the MaCurdy et al. (1990) critique is that seemingly flexible functional forms may not be flexible anymore once quasi-concavity or monotonicity is imposed. Even though we do not impose these conditions explicitly, it might still be the case that the structure of the model implicitly will force the estimates to satisfy quasi-concavity. For example, a wrongly shaped utility function would lead to high probabilities of choosing the corners of the budget frontier. The focus on single females reduces the numbers of unobserved complicating factors in the behavioral responses, making facing such complications less likely. The alternative of applying a polynomial to estimate the utility function non-parametrically may give a better fit but is less grounded in economic theory.

The deterministic part of the preferences in this paper is thus represented by a variation of a "Box-Cox" utility function. Quasi-concavity is not imposed, but checked ex post to confirm that the estimated preferences are quasi-concave. I let $v_{Ajk} = u_{Ajk} / \mu_2$, and $v_{Bjk} = u_{Bjk} / \mu_2$.

$$v_{ijk} = \alpha \frac{(C_{ijk} / 3 \cdot 10^6)^{\lambda} - 1}{\lambda} + \beta_j(X)\left[8760 - (8 \cdot 365) - h_{ijk}) / 8760\right] \qquad (16)$$

where

$$\beta_j(X) = \beta_0 + \beta_1 X_1 + \beta_{2j} X_2 \qquad (17)$$

8760 is the number of total annual hours, while α, λ, and the $\beta's$ are unknown parameters. For the utility function to be quasi-concave, we require λ <1. Note that if $\lambda \to 0$ the utility function converges to a log-linear function. The characteristics are: X_1= age of the nurse, X_2=1, if shift work, = 0 if daytime work. The parameters *(α, λ, β_{0j}, β_1, β_{2j}, τ , μ , θ)* are estimated using a maximum-likelihood procedure. Note that μ_2 is not identified, and is absorbed in α and β_j.

4. Results

Before focusing on the policy simulation making it possible to calculate wage elasticities, the parameters estimated are presented and a comparison is made of the choices predicted with those observed.

From Table 1 we observe that all parameters are sharply determined and that λ is estimated to yield a quasi-concave utility function. Parameters attached to the income term in the utility function *(16)* are estimated with a λ of –1.68 and an α - the constant in the consumption term - of 0.84, meaning that the nurses prefer the job that pays best if otherwise similar. In the leisure component, the constant β_0 in the leisure term is positive and significant, which means that more hours of leisure increases the utility. Somewhat surprisingly β_1 is negative, as one might expect that the nurses would prefer jobs with less working hours when they get older. This may be caused by the fact that some of the young nurses have small children and therefore choose part-time jobs. As expected personnel working shifts prefers jobs with shorter working hours. Their additional hour of work is much more likely to be at nighttime, making it more demanding than extending the working hours during daytime. The effect seems to be slightly stronger for hospital personnel, with a β_{2A} of 10.20 and a β_{2B} of 7.93. μ, the degree of independence in unobserved utility among the upper nests, is estimated to 0.71. Remember however, that this parameter is weighted by the centrality of residency, τ . The parameter θ in the opportunity index, taking into account the dominating offer of shift jobs, is also significant with a value of 1.27. McFadden's Rho is reported to 0.175.

Table 1 Estimation of parameters of the utility function and opportunity densities.

		Estimate	Std.error	P-value
	Utility function			
β_0	Constant - 'leisure element'	5.651	1.358	[.000]
β_1	Age	-0.118	0.031	[.000]
β_{2A}	Shift Work in hospitals	10.200	0.890	[.000]
β_{2B}	Shift Work in primary care	7.926	0.941	[.000]
α	Constant - 'consumption element'	0.836	0.212	[.000]
λ	Exponent - 'consumption element'	-1.677	0.231	[.000]
μ	Degree of independence in unobserved utility among the alternatives	0.709	0.266	[.008]
	Opportunity density*			
τ	1 if living in a central area, 0 otherwise	1.150	0.067	[.000]
θ	1 if the job is shift work, 0 otherwise	1.274	0.046	[.000]
Number of observations		4042		
Log likelihood		-9243.97		
McFadden's Rho		0.175		

For the wage equation see appendix 2.

How well does the model predict?

A comparison of the predictions of the model with the observed choices is encouraging, both with regard to the choice between a hospital and a primary care job and the choice of shift type. As reported in Table 2, 71.7% are predicted to choose a hospital job, while 73.1% are observed working at a hospital. 81.9% are predicted to work shifts, while 82.1% are observed with such arrangements. The predicted distribution of hours seems less accurate. The main difficulty is for the model to predict the high share working full-time without extra hours. Aggregating the probabilities for part-time and full-time jobs respectively gives a prediction of 45%

(35% observed) working part-time and 65% (55% observed) working full-time. A common approach is to introduce an opportunity index to model the fact that the availability of jobs is peaked around certain categories of hours. This is not a feasible strategy here as the number of alternative hours is limited to four in this model due to the complicated nested structure leading to 16 possible alternatives of choice combinations.

58.7% are predicted to work in a hospital job with shift work (61.3% observed), 13% in a hospital job without shift work (11.8% observed), 23.3% in a primary care job with shift work (20.8% observed) and 5.0% in primary care without shift work (6.1% observed). The predicted average of total weekly hours is 31.9 (32.1 hours per week observed). If we let the "average nurse" represent the distribution of total working hours, that is 31.9 hours per week, 18.7 hours (19.9 hours observed) will be worked in a hospital job with shift work and 4.1 hours (3.9 hours observed) with regular daytime. 7.5 hours (6.2 hours observed) will be worked in a primary care job with shifts and 1.6 hours (2.1 hours observed) with regular daytime work.

Out-of-sample prediction

From a policy perspective an important feature of structural modeling is the ability to present relevant out-of-sample predictions. To evaluate the model I use the parameters estimated from the 1995 data and predict the choices in 2000. The sample is now all the 8124 single females in 2000, still including cohabitants without joint children. The hourly wages are predicted from the observed data in 2000. There were changes in the average relative wages after 1995 making shift work better compensated in 2000. In addition, the wage growth was higher in the hospital sector making the average hourly wage identical between the care levels in 2000. Daytime work wages were, however, 12% lower in the hospital sector and 18% lower in the primary care sector. In a situation with excess demand for nursing labor there is reason to expect that nurses respond to the relative wage changes with a higher share preferring jobs in the hospital sector, and jobs with shift work.

There were, however, extensive changes during this 6-year period both in institutional features, like the introduction of a new financing system for hospitals, and a significant increase in the number of nurses employed in the public sector. This increase was matched by a rise in production levels, though not proportionally with the increase in personnel. In specialist health services, the psychiatric and somatic institutions increased the number of full-time nursing positions by 23% to 27,415 in 2000 (Statistics Norway, 2001). The number of full-time positions increased in primary care too; 30% for all professions. In the samples included here the share working in primary care was 27% in 1995 and 38% in 2000. These changes in sample shares can partly be due to an increase in the number of primary care institutions reporting to the NALRA register. With such extensive changes in the health sector, it is probably to push our luck to expect accurate predictions of a model based on cross section parameters in 1995.

In the right column in Table 3, the observed and predicted choices are presented for the nurses observed in 2000. The average age is 34.5, the same as for the sample from 1995 presented in Table 2. We see that 73.3% are predicted to chose a hospital job (61.7% observed). The model is thus responding to the relative increase in the hospital wages since 1995 and predicts an increase in this share. 82.4% are predicted to work shifts, which also is an expected increase due to the relative increase in shift wages. The observed choices indicate, however, a slight reduction in the share to 80.7%.

As above the model has difficulties in predicting the high share working full-time. The model predicts a reduction in the full-time hours from 55% to 50%. While the level is too low, the direction of change is correct with an observed share of 60% working full-time in 2000 compared to 65% in 1995.

Table 2. Observed and predicted choices in 1995.

	Observed		Predicted	
N=4042	**Means**	***Std.dev.***	**Means**	***Std.dev.***
	Job-type shares		*Job-type probabilities*	
Hospital	0.731		0.717	*0.116*
Primary	0.269		0.283	*0.116*
	1.000		1.000	
Shift	0.821		0.819	*0.034*
Daytime	0.179		0.181	*0.034*
	1.000		1.000	
Hours of work	*Category shares*		*Predicted probabilities*	
Part-time	0.157		0.169	0.124
Extended part-time	0.189		0.277	0.035
Full-time	0.508		0.295	0.056
Extended full-time	0.147		0.259	0.087
	1.000		1.000	
	Job-type shares		*Job-type probabilities*	
Shift – hospital	0.613		0.587	*0.102*
Daytime – hospital	0.118		0.130	*0.032*
Shift – primary	0.208		0.233	*0.094*
Daytime –primary	0.061		0.050	*0.026*
	1.000		1.000	
	*Job-type shares * Mean hours*		*Expected hours*	
Hours – hospital shift	19.9	*16.6*	18.7	*3.5*
Hours – hospital daytime	3.9	*11.1*	4.1	*1.3*
Hours – primary shift	6.2	*12.5*	7.5	*3.1*
Hours - primary daytime	2.1	*8.5*	1.6	*1.0*
	32.1	6.9	31.9	2.6
Age	34.5	*8.6*		

Table 3. Out-of-sample predictions. Observed and predicted choices in 2000.

	Observed in 1995 and 2000				Observed in 2000			
	Observed		**Predicted**		**Observed**		**Predicted**	
	Means	***Std.dev.***	**Means**	***Std.dev.***	**Means**	***Std.dev.***	**Means**	***Std.dev.***
	Job-type shares		*Job-type probabilities*		*Job-type shares*		*Job-type probabilities*	
Hospital	0.579		0.731	0.118	0.617		0.733	0.114
Primary	0.421		0.269	0.118	0.383		0.267	0.114
	1.000		1.000		1.000		1.000	
Shift	0.752		0.820	0.030	0.807		0.824	0.026
Daytime	0.248		0.180	0.030	0.193		0.176	0.026
	1.000		1.000		1.000		1.000	
Hours of work	*Category shares*		*Predicted probabilities*		*Category shares*		*Predicted probabilities*	
Part-time	0.178		0.213	*0.110*	0.175		0.193	*0.100*
Extended part-time	0.261		0.277	*0.033*	0.228		0.285	*0.031*
Full-time	0.458		0.271	*0.047*	0.503		0.281	*0.044*
Extended full-time	0.102		0.239	*0.084*	0.093		0.241	*0.072*
	1.000		1.000		1.000		1.000	
	Job-type shares		*Job-type probabilities*		*Job-type shares*		*Job-type probabilities*	
Shift – hospital	0.453		0.599	*0.103*	0.515		0.603	*0.099*
Daytime – hospital	0.126		0.132	*0.026*	0.102		0.131	*0.025*
Shift – primary	0.299		0.221	*0.094*	0.292		0.222	*0.093*
Daytime –primary	0.122		0.048	*0.026*	0.091		0.045	*0.023*
	1.000		1.000		1.000		1.000	
	*Job-type shares * Mean hours*		Expected hours		*Job-type shares * Mean hours*		Expected hours	
Shift – hospital	14.0	*16.1*	18.3	*3.1*	16.2	*16.4*	18.6	*3.0*
Daytime – hospital	4.4	*11.9*	4.0	*1.1*	3.6	*10.8*	4.0	*1.0*
Shift – primary	8.5	*13.6*	6.9	*3.0*	8.5	*13.8*	7.0	*3.0*
Daytime -primary	4.2	*11.5*	1.5	*0.9*	3.1	*10.0*	1.4	*0.8*
	31.2	*7.1*	30.8	*2.3*	31.4	*7.0*	31.0	*2.0*
Age	39.1	*7.1*			34.5	*7.8*		
Sample size	2605				8124			

Table 4. A policy experiment to identify changes in hours with an increase in wages.

Predicted choices	With 'observed' wages		With a 10% simulated wage increase in all jobs		With a 10% simulated wage increase in hospital jobs		With a 10% simulated wage increase in primary care jobs		With a 10% simulated wage increase in shift jobs		With a 10% simulated wage increase in daytime jobs	
	Means	***Std.dev.***	**Means**	***Std.dev.***	**Means**	***Std.dev.***	**Means**	***Std.dev.***	**Means**	***Std.dev.***	**Means**	***Std.dev.***
Probabilities												
Hospital	0.717	*0.116*	0.719	0.116	0.741	0.113	0.694	0.121	0.717	0.117	0.719	0.116
Primary	0.283	*0.116*	0.281	0.116	0.259	0.113	0.306	0.121	0.283	0.117	0.281	0.116
	1.000		1.000		1.000		1.000		1.000		1.000	
Shift	0.819	*0.034*	0.82	0.032	0.819	0.034	0.82	0.036	0.843	0.038	0.792	0.035
Daytime	0.181	*0.034*	0.18	0.032	0.181	0.034	0.18	0.036	0.157	0.038	0.208	0.035
	1.000		1.000		1.000		1.000		1.000		1.000	
Part-time	0.169	0.124	0.173	0.123	0.169	0.124	0.159	0.128	0.169	0.124	0.16	0.128
Extended part-time	0.277	0.035	0.279	0.034	0.277	0.035	0.273	0.035	0.276	0.034	0.274	0.035
Full-time	0.295	0.056	0.293	0.055	0.295	0.056	0.3	0.058	0.293	0.055	0.301	0.059
Extended full-time	0.259	0.087	0.254	0.084	0.259	0.087	0.268	0.09	0.262	0.087	0.264	0.089
	1.000		1.000		1.000		1.000		1.000		1.000	
Hours												
Hospital	22.8	4.1	22.5	4.0	23.2	4.0	22.0	4.1	22.5	4.0	22.8	4.0
Primary care	9.1	3.9	9.0	3.8	8.4	3.7	9.8	4.0	9.0	3.8	9.0	3.9
Shift jobs	26.2	2.2	25.8	2.0	25.9	2.0	26.1	2.2	26.6	2.3	25.3	1.8
Daytime jobs	5.8	1.7	5.7	1.5	5.7	1.6	5.7	1.7	5.0	1.6	6.6	1.7
Hours total	31.9	2.6	31.5	2.4	31.6	2.5	31.8	2.6	31.6	2.5	31.8	2.6

Table 5. Effects of policy simulations

	A job specific simulated 10% wage increase in									
	All Jobs		**Hospital jobs**		**Primary care jobs**		**Shift jobs**		**Daytime jobs**	
Wage elasticities	**Means**	***Std.dev.***	**Means**	***Std.dev.***	**Means**	***Std.dev.***	**Means**	***Std.dev.***	**Means**	***Std.dev.***
All hours	-0.1427(**)	0.0740	-0.111(*)	0.061	-0.040	0.027	-0.1154(*)	0.0604	-0.0374	0.0206
Hospital hours	-0.1218(**)	0.0659	0.200	0.182	-0.346	0.214	-0.1167	0.0619	-0.0110	0.0158
Primary hours	-0.2047	0.1433	-0.903	0.462	0.748(*)	0.382	-0.1192	0.0983	-0.1072	0.0682
Shift hours	-0.1310	0.1249	-0.105	0.099	-0.034	0.040	0.1530(*)	0.0981	-0.3330	0.1618
Daytime hours	-0.1178	0.2362	-0.082	0.167	-0.042	0.091	-1.3662	0.6369	1.4387	0.8171
Hospital shift hours	-0.1089	0.0958	0.214	0.206	-0.346	0.214	0.1587(*)	0.0859	-0.3146(*)	0.1523
Hospital daytime hours	-0.0990	0.2733	0.223	0.330	-0.346	0.214	-1.3844	0.6429	1.4889	0.8560
Primary shift hours	-0.1955	0.2066	-0.903	0.462	0.757	0.379	0.1303	0.1459	-0.3804	0.1902
Primary daytime hours	-0.1704	0.1720	-0.903	0.462	0.791	0.524	-1.3209	0.6206	1.3055	0.7187
Part–time hours	2.5051	1.6572	1.931	1.305	0.721	0.618	1.8497	1.2364	0.8670	0.5932
Extended part-time hours	0.3685	0.3120	0.277	0.231	0.113	0.122	0.2162	0.2119	0.1908	0.1305
Full-time hours	-0.2675	0.2107	-0.218	0.173	-0.064	0.062	-0.2780	0.1852	0.0003	0.0558
Extended full-time hours	-0.6514	0.3202	-0.499	0.261	-0.189	0.125	-0.3848	0.2044	-0.3336	0.1621

* indicates a result that is significantly different from zero at a 10% level, while ** is significant at a 5% level.

A policy experiment
In order to identify the wage elasticities, a policy experiment is introduced. We now look at desired hours only and not actual hours. The predictions presented above are repeated while increasing pre-tax wage rates and leaving the tax system unaffected. Table 4 presents the predicted choices before and after a job–specific wage increase or an increase in all wages simultaneously. Table 5 presents the matching elasticities, or sum of elasticities for wage increases in all job types. The elasticities are calculated by $(h_{w1} - h_{w0}) / h_{w0} * (100/10)$, where h_{w0} is predicted average weekly hours prior to the policy reform and h_{w1} is the same expression afterwards. The elasticity is divided by 10, as the policy simulation introduced a 10% wage increase.

Job specific wage increases
When targeting the simulated wage increases to the hospital jobs, the probability of selecting a hospital job is increased from 71.7% to 74.1%. The hospital hours are increased with an elasticity of 0.200, although not significantly at a 10% level. At the same time the sum of hours for both care levels is reduced. The predicted reduction in total hours is 1.1% for a 10% wage increase in the hospital jobs. An increase in primary care wages mirrors the changes predicted from an increase in hospital wages, but the magnitude is larger at 0.75. The next policy simulation is an increase in shift wages only. The wage elasticity for the shift hours is found to be 0.153. The elasticities were 0.158 for hospital shift hours and 0.130 for primary care shift jobs.

General wage increases
The second column in Table 4 shows a 10% increase in all wages. In a policy perspective this may be more realistic in a scenario with centralized wage bargaining like in Norway. The predicted change is a reduction in average hours worked per week to 31.5, a reduction of 1.5%. Annually this adds up to more than three working days lost per nurse due to the income effect of a wage increase. Of course the sensitivity of labor supply to the wage rate varies over the sample, but for the policy analysis we focus on the aggregated elasticities. As reported in Table 5 a 10% wage increase in all public sector jobs leads to a reduction of hours with 1.4%. The predicted reduction is mainly an effect of more nurses preferring part-time and extended part-time. There is little predicted change between the care levels nor any systematic change from daytime to shift work with shorter contracted hours. The job-specific changes due to a general pre-tax hourly wage increase is a reduction of 1.2% for hospital hours and a reduction of 2% for primary care hours. The corresponding reductions for shift hours are 1.3% and 1.1% for the daytime hours. Most of these predicted changes are not significantly different from zero, with the exception of all hours and the hospital hours (at a 5% level). This result is somewhat surprising as the sample consists of single females who are traditionally more responsive to changes in wages than married females.

5. Conclusions

A discrete choice labor supply model incorporating self-selection and choice of shift work was developed and estimated on single female Norwegian registered nurses. Conditioning on their participation in the public health care sector, the nurses are facing a chain of choices in the composition of their "job package". Firstly a choice between a hospital and a primary care job, secondly whether to work shifts or regular daytime and finally the choice of one of four categories of hours. A high share of the RNs work shifts, and thus face different contractual arrangements than those working daytime. The hours are shorter and the hourly wage is higher, but the health strain related to shift work is also well documented. The choices are predicted with the existing contractual arrangements and then repeated for policy simulations where the pre-tax wage rates in all or some of the job alternatives are altered.

First, I increase wages for only one of the care levels or one of the shift types. A simulated increase in hospital wages predicts a wage elasticity of 0.20 for the hospital hours, however not significantly different from zero. This result is mirrored for a wage increase in the primary care sector, however with a larger and significant effect. A simulated wage increase for shift jobs predicts a wage elasticity of 0.15. This is mirrored by the daytime hours, but with a higher degree of uncertainty. One reason for the high level of uncertainty for the primary care and regular daytime hours is probably the fact that there are relatively few single nurses observed in these categories. The complicated structure of the choices and the large number of factors in addition to wage influencing the choice of job type and hours, are other reasons for the relatively high level of uncertainty in the predictions.

The simulation of a 10% wage increase in all "job packages" predicts no or a slightly negative response in hours worked in the public health care sector. The predicted reduction is mainly an effect of more nurses preferring part-time and extended part–time work. There is little predicted change between care levels, nor any systematic change from daytime to shift work, with shorter contracted hours. The response is somewhat stronger for primary care hours than for hospital hours, but the primary care response is also predicted with higher uncertainty. The shift hours respond to a simulated increase in wages in all job types with a slight reduction in hours offered, while the response in regular hours is somewhat lower. Neither of these responses in hours are significantly different from zero.

It seems reasonable to assume that the increase in wage rates for all nurses might lead some people to renounce the shift work compensation, as the daytime job pays 'sufficiently'. The simulation of a wage increase in all jobs predicts no such reallocation. The reduction in hours is due to a change from full-time to part–time, but with a stable allocation of hours between care levels and shift types.

Bearing in mind that the analysis is restricted to the short-term impact on working hours of those already participating in the public health care sector, the lesson is that changes in wage has a limited impact on working hours. To the extent that such changes are found, the effect seems to be slightly negative when measuring total hours offered. One way to interpret this result is that conditioned on the decision to participate in the work force there are other factors that are as least as important for the hours worked as wage. Intuitively there is reason to believe that shift workers respond differently to a wage increase than those working daytime hours. The predictions from the model presented in this paper weakly support such beliefs, but due to the high level of uncertainty in the model, the differences in wage elasticities are not significant.

As an instrument to reallocate hours between job packages, job-specific wage increases are effective, but incur a loss as the total number of hours worked is predicted to be reduced.

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Appendix 1. Variable construction and trimming procedure.

The data used is based on several of the administrative data registers delivered by Statistics Norway, with the register of authorized health personnel as an identifier. Our trimming procedure excludes personnel above 66 years of age, as many retire at 67. Some personnel categories have access to early retirement, but it was not common practice for registered nurses in 1995.

Authorized foreign RNs are excluded when they do not have a permanent residency in Norway (only temporary residency code/social security number, F-number), or if they have a permanent residency code, but no income or address in Norway. The data includes information about annual earnings prior to and after taxation, employment status, and demographic variables. All employers are coded by the NACE Standard Industrial Classification, which gives us detailed information about their sector and type of activity.

Table A1 Sample trimming

	N
RNs registered in 1995 (permanent residence code only)	63 527
Subtracting	
Foreigners with no income in Norway	3 934
RNs with higher education (Not nursing related)	658
67 years or older	2 387
Registered during 1995	2 722
Temporary licenses	40
Missing in some variables	2 335
Not employed by NALRA (Or working in a NALRA institution not reporting)	27 280
NALRA employees	24 171
Of which single females (Including cohabitants without children)	*4 042*

Table A2 Key variables by sector

1995	All		Hospital				Primary care			
			Shift		Daytime		Shift		Daytime	
Variable	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.
Sector share	100%		0.613	*0.487*	0.118	*0.323*	0.208	*0.406*	0.061	*0.239*
N	4042		2477		477		842		246	
Age	34.5	*8.6*	33.4	*7.6*	40.7	*10.7*	33.5	*8.3*	37.3	*8.9*
Born in Norway=1	0.93	*0.25*	0.93	*0.25*			0.94	*0.24*	0.94	*0.23*
Gave birth in 1994 or 1995	0.15	*0.36*	0.14	*0.35*	0.09	*0.28*	0.25	*0.43*	0.09	*0.29*
Live in a central area (Cat. 6&7 out of 7)	0.66		0.71		0.74		0.48		0.56	
Income from work, NOK	205660	*39756*	207113	*38088*	210962	*42531*	195368	*40218*	215981	*42358*
Social security benefits, NOK	12 756	*21181*	10303	*19109*	15011	*25677*	18039	*22470*	15001	*22880*
Total income, NOK	221050	*41868*	219789	*38433*	229691	*48778*	215466	*40048*	236102	*57974*
Hours per year										
Part-time	0.16	*0.36*	0.12	*0.33*	0.22	*0.41*	0.24	*0.43*	0.08	*0.27*
Extended part-time	0.19	*0.39*	0.19	*0.40*	0.09	*0.29*	0.24	*0.43*	0.12	*0.33*
Full-time	0.51	0.50	0.49	0.50	0.55	0.50	0.46	0.50	0.74	0.44
Extended full-time	0.15	0.35	0.19	0.39	0.14	0.35	0.05	0.22	0.06	0.23
*Predicted mean wage per hour, NOK Prior to shifts and other compensation payments**										
Hospital – daytime	104.1	5.90	103.7	6.0	106.5	5.0	103.4	5.8	105.5	5.1
Hospital – shift work	96.1	5.52	95.6	5.6	98.9	4.7	95.6	5.2	98.2	4.7
Primary care – daytime	105.5	3.31	105.3	3.3	107.4	2.8	105.0	3.1	106.7	2.9
Primary care – shift work	103.7	3.58	103.4	3.6	105.5	3.1	103.2	3.4	105.1	3.1

*** The average hourly compensation is NOK 11.7 for hospital nurses working shifts and NOK 3.73 for daytime workers. For primary care nurses the compensation pay is NOK 16.4 per hour for those working shifts and NOK 5.9 for daytime workers.**

Appendix 2. Hourly wages by care level and shift type

Job specific hourly wages are constructed for all the alternatives, including ‘job packages’ with a different care level and shift type than for their actual job. The first step is to sort the jobs by the NACE standard industrial classification and aggregate into two care levels. The job types are then categorized by shift type into two alternatives: Regular daytime or shift work compounding all other shift combinations. Only public positions within institutions organized by NALRA are included: A) Hospitals with and without shift work and B) primary care jobs with and without shift work.

The earnings measure used is hourly wage. I have calculated hourly wages for the job in which they were observed. This is possible due to detailed data of monthly income and working hours for the NALRA employees. Intuitively there is reason to believe that there is a selection into the different job types driven by unobserved factors such as preferences and productivity. I take this selection into consideration when predicting hourly wages for each individual, also in the job categories where they do not work. A Heckman two-step procedure is applied when estimating the wage equations as presented in Table A3, with a significant selection effect. I repeat this procedure for each job category. Table A3 only reports the wage equation for hospital jobs with regular daytime work. Only the basic salary is included in this regression. Compensation for management tasks and strenuous work is not included. I exclude the equations for the other job alternatives, as they are parallel. The wage prediction is undertaken for all NALRA employees, not only single ones. The wage rates are quite homogenous due to the centralized wage bargaining. The wage rate is mostly driven by work experience. I have used number of years with an income qualifying for pension entitlement during the last 20 years as a measure of experience. The measure is constructed on earnings histories available from the Norwegian National Insurance Scheme. A management position or additional specialization in a subdiscipline of nursing are possible ways to increase earnings. Some institutions in severe need of personnel offer a higher additional compensation and wage rates beyond the level agreed upon in the central bargaining for their number of years of work experience. The nurses' age is important with regard to their choice of job type. A representative "work life cycle" is to start of with a full-time job with shift work. After the first maternity leave a part-time job is preferred. As the children grow older the hours of work are increased again. As the nurses grow older, there will gradually be a higher share that prefers daytime work only. The first job is normally in a central area where the colleges and hospitals are located, but with age many relocate to less central areas. Due to our subsample of single nurses the average age is only 34.5 years, and on average it is 9 years since they were licensed.

Table A3. Wage equation

	Heckman selection model Dependent variable: Wage per hour in the hospital sector	Coef.	Std. Err	z
Female	Female=1	-0.0430	0.0058	-7.35
Regiona	Oslo/Akershus	0.0053	0.0112	0.47
Regionc	West	-0.0019	0.0050	-0.38
Regiond	Middle	0.0038	0.0057	0.67
Regione	North	0.0929	0.0056	16.49
Age	Age	0.0691	0.0555	1.25
age2	Age^2/10	-0.1711	0.1899	-0.90
age3	Age^3/1000	0.1686	0.2834	0.60
age4	Age^4/100000	-0.0529	0.1557	-0.34
erf95	Years of work experience last 20 years	-0.0067	0.0144	-0.46
erf952	Experience^2/10	0.2275	0.2237	1.02
erf953	Experience^3/1000	-1.7856	1.3783	-1.30
erf954	Experience^4/100000	4.4604	2.9214	1.53
Cnordic	From Nordic country except Norway=1	-0.0026	0.0084	-0.31
coecd_no	From OECD area except the Nordic countries=1	0.0105	0.0109	0.96
Cglobal	Non-OECD background=1	-0.0303	0.0162	-1.87
kommsen1	Municipal centrality index 1 =1 – Least central	-0.0172	0.0077	-2.23
kommsen2	Municipal centrality index 2 =1	-0.0172	0.0070	-2.47
kommsen3	Municipal centrality index 3 =1	-0.0552	0.0052	-10.71
kommsen4	Municipal centrality index 4 =1	-0.0195	0.0150	-1.30
kommsen5	Municipal centrality index 5 =1	0.0085	0.0090	0.94
kommsen6	Municipal centrality index 6 =1 (7= Most central)	-0.0075	0.0049	-1.52
Constant		3.6941	0.5941	6.22

	select			
Female	Female=1	-0.2191	0.0380	-5.77
Regiona	Oslo/Akershus	-0.6368	0.0422	-15.09
Regionc	West	0.0867	0.0359	2.42
Regiond	Middle	0.0577	0.0405	1.43
Regione	North	0.1038	0.0386	2.69
Cnordic	From Nordic country except Norway=1	-0.0218	0.0565	-0.39
coecd_no	From OECD area except the Nordic countries=1	-0.0932	0.0752	-1.24
Cglobal	Non-OECD background=1	-0.2286	0.0995	-2.30
Age	Age	0.7607	0.3577	2.13
age2	Age^2/10	-2.5423	1.2481	-2.04
age3	Age^3/1000	3.9098	1.8884	2.07
age4	Age^4/100000	-2.2747	1.0473	-2.17
erf95	Years of work experience last 20 years	-0.1937	0.0823	-2.35
erf952	Experience^2/10	3.3933	1.3208	2.57
erf953	Experience^3/1000	-21.3902	8.3671	-2.56
erf954	Experience^4/100000	47.4317	18.1047	2.62
married	Married=1	0.0392	0.0233	1.68
b950_5	No. of children aged 0-5	-0.0596	0.0188	-3.17
kommsen1	Municipal centrality index 1 =1 – Least central	0.1356	0.0566	2.40
kommsen2	Municipal centrality index 2 =1	-0.0244	0.0507	-0.48
kommsen3	Municipal centrality index 3 =1	-0.0127	0.0377	-0.34
kommsen4	Municipal centrality index 4 =1	0.3051	0.1147	2.66
kommsen5	Municipal centrality index 5 =1	-0.0849	0.0639	-1.33
kommsen6	Municipal centrality index 6 =1 (7= Most central)	0.0802	0.0348	2.31
Constant		-9.6467	3.7106	-2.60

	Coef.	Std. Err	z
/athrho	0.085	0.202	0.42
/lnsigma	-2.440	.0177335	-137.60
rho	0.085	0.200	
sigma	0.087	0.002	
lambda	0.007	0.018	

Log likelihood	**-5471.45**
Number of obs	24171
Censored obs	20553
Uncensored obs	3618
Wald chi2(22)	865.6
Prob >chi2	0

Appendix 3. Taxes

Income tax

Table A4 Tax rules applied

Income = Y	Tax
0 – 20 954	0
20 954 – 143 500	0.302Y – 6 328
143 500 – 212 000	0.358Y – 14 364
212 000 – 239 000	0.453Y – 34 504
239 000 -	0.495Y – 44 542

Capital tax

Capital income is taxed at a rate of 28 percent.