# UNIVERSITY OF OSLO

HEALTH ECONOMICS
RESEARCH PROGRAMME

## Wage Policies for Health Personnel

Essays on the Wage Impact on Hours of Work and Practice Choice

**Erik Magnus Sæther**

*Ragnar Frisch Centre for Economic Research, and Health Economics Research programme at the University of Oslo*

**Working Paper 2005: 1**

# Wage Policies for Health Personnel

## Essays on the Wage Impact on Hours of Work and Practice Choice

Dissertation for the Dr. Polit Degree
Department of Economics,
University of Oslo

Erik Magnus Sæther*

Health Economics Research programme at the University of Oslo
HERO 2005

**JEL Classification:** C25, I10, J22.
**Keywords:** Physicians, registered nurses, discrete choice, non-convex budget sets, labor supply, sector-specific wages.

* Author's address: Ragnar Frisch Centre for Economic Research, Gaustadalléen 21, N-0349 Oslo, Norway. Health Economics Research programme at the University of Oslo (HERO) E-mail: e.m.sather@frisch.uio.no.

Current employer: PricewaterhouseCoopers, Karenslyst allé 12, N-0245 Oslo. E-mail: erik.magnus.saether@no.pwc.com


Health Economics Research programme at the University of Oslo
Financial support from The Research Council of Norway is acknowledged.
ISSN 1501-9071, ISBN 82-7756-137-4

## Contents

# Preface

This work has been financed by the Health Economics Research Programme at the University of Oslo (HERO), by the means of grants from the Norwegian Research Council. I am sincerely grateful for their financial support, and for the academic fellowship HERO has catered for.

I am grateful to the Ragnar Frisch Centre for Economic Research where I have been provided with excellent working conditions and a superb group of researchers who have been supportive throughout the project. I would particularly like to thank Research Director Erik Hernæs, Sverre A.C. Kittelsen and Rolf Golombek for their advice and assistance. I would also like to thank my fellow doctoral students for their willingness to help and many enjoyable conversations by the espresso machine. Tao Zhang and Jia Zhiyang have been particularly helpful in the computer programming.

Thanks to the Department of Economics, University of Oslo, for accepting me into their doctoral programme and offering challenging courses and research seminars.

Thanks also to the Fulbright foundation for funding my stay as a Visiting Scholar to the University of California, Berkeley. Thanks to the Center for Health Management Studies, School of Public Health, which welcomed me for the academic year 2000-2001. This visit was of great value and inspiration. I would especially like to thank Professor Ray Catalano and Professor Paul Gertler for their hospitality. The Frisch Centre also co-financed my stay at UC Berkeley.

Professor Michael Hoel has been my main advisor and provided me with valuable comments and advice on the craft of research. When I ventured into empirical research, Professor Steinar Strøm came in as my second advisor. He has provided me with generous advice and support for which I am sincerely grateful. Many thanks to both of you!

Thanks to Professor Tor Iversen at the Institute of Health Management and Health Economics and John Dagsvik at Statistics Norway, who have both been generous with support and advice. Pål Jørgen Bakke has read through the manuscript and improved the presentation. I would also like to thank Torbjørn Hægeland for encouraging me to take up Ph.D. studies. He has also provided good advice.

Thanks to PricewaterhouseCoopers and Harald Noddeland for giving me time to finish my thesis as their employee. This has been of great help.

Discussions following presentations at the 4th International Health Economics Association (iHEA) World Congress in San Francisco, the Nordic Health Economics Study Group Meeting in Bergen and seminars at the University of Oslo have also been valuable in writing this thesis.

Finally, I would like to thank my family and friends for their interest in my research and maybe even more for making me focus on other facets of life. My wife Ingelin has been invaluable through her positive attitude and tireless support. I am also grateful to my children Andreas, Håvard and Vilja for enriching my life. My parents have also provided precious support.

Apart from the introductory chapter, the thesis consists of four self-contained essays. For the sake of coherence, some repetitions occur. Note that subtitles, footnotes, figures and tables are numbered separately (starting from 1) in each chapter.

Needless to say, the shortcomings are my responsibility alone.

Oslo, 19 May 2004

# Chapter 1
# Introduction and Summary

**Abstract**
This thesis aims to explore the short-term impact of increased wages on the working hours of health personnel and their practice choice. An additional objective is to identify existing compensating differentials in the job market for health personnel.

## 1. Why study the labor supply of health personnel?

The excess demand for nursing labor in the national health service (NHS) persists in many developed countries in spite of systematic increases in the education capacity in order to meet the demand. Many registered nurses (RNs) work part-time, or in non-health jobs. Some are also temporarily out of the workforce. Nurses' trade unions claim that a wage increase will increase not only recruitment into the nursing profession, but also the *short-term* labor supply of those already qualified. Higher wages are claimed to increase hours worked by personnel employed in the health sector, and attract nurses from non-health activities.

RNs is not the only health profession facing a demand surplus in Norway. For many years there has also been i.a. an insufficient number of physicians. In most OECD countries health personnel is partially or fully publicly funded while practicing, either directly by wages or indirectly by reimbursements and fees. The health authorities motivate the funding by their responsibility to ensure the population access to health services. Yet, many countries suffer from personnel shortages in general or have an uneven distribution of personnel with shortages in the public sector, in certain medical specialties or in some geographical areas.

Wages and other fees are considered to be important means for motivating health personnel to seek work in areas with special needs and to accept jobs with disamenities like night work. In most countries the health authorities try to influence the health personnel's choice of specialization, practice type and working hours. Regulation through quotas has been widely used in countries with a national health service (NHS). With the deregulation of health markets, incentives such as the physician's pay and practice income play a relatively more important role in the implementation of health policies.

The purpose of this thesis is to provide a contribution to the understanding of wage reforms and their consequences. Wages are the dominating costs in the health sector, i.e. catering for more than 70% of hospital operational expenses (SINTEF 2002). Needless to say, wage increases incur significant strains on public budgets. It thus seems relevant to carefully assess the consequences of wage reforms on job choice and hours of work.

From a research perspective, the best alternative is to introduce a natural experiment, randomly assigning wage increases, and comparing the behavioral responses of those receiving a wage increase with those who do not. Knowing that such experiments are unacceptable, economists have looked for alternative strategies. The use of structural labor supply models have been widespread both because of their strong connection between economic modeling and empirical analysis, and for the possibility of undertaking policy simulations. In this thesis I have used a sub-category of structural labor supply models, discretizing the budget constraint. The framework is well suited for the analysis of the labor supply of individuals facing a nonlinear budget set, such as health personnel who face a complicated pay scheme combined with step-wise tax brackets. The possibility to include sector-specific wages and a system for modeling other attributes of the jobs, like shift work and hospital strain, also improves the relevance of the framework. I also hope to provide a contribution to the method by adapting the models through detailed alternatives of hours, the possibility to combine jobs, a nested structuring of care level and shift choice and through the calculation of compensating variation for shift work.

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. The non-pecuniary attributes of jobs like travel distance, shift work, patient mix, care level, combining them with family life and workload, are important to the physicians and nurses in their decision process. Yet wages remain the most central policy variable in the implementation of a human resource policy in the NHS. Perhaps this thesis can be seen as one possible response to the challenge by Antonazzo et al. (2003), and hopefully increase the accumulated scientific knowledge on the topic.

The impact of changes in wages on working hours and job type is a highly relevant policy question, which involves complicated behavioral mechanisms. The purpose of this study is to better inform the policymaking in a sector where the health personnel caters for a high share of the total expenses. Some studies on these topics exist but mostly in a US or UK context. To my knowledge there are no other studies of the labor supply of health personnel that apply the type of modeling applied in this thesis.

An additional goal is thus to apply and further develop the framework of discrete choice modeling in the analysis of labor supply and compensating variations. During the last decades researchers at the University of Oslo and Statistics Norway, as well as other international researchers, have developed a framework for the analysis of labor supply for individuals facing a nonlinear budget set. The framework is thus suitable for the analysis of health personnel facing a combination of the complicated regulations of payment in the health sector and step-wise tax brackets. The possibility to include sector-specific wages and a system for modeling other attributes of jobs, like shift work and hospital strain, also improves the relevance of the framework.

## 2. Labor supply analyses for health personnel

The analysis of individuals' labor supply often focuses on two dimensions. The decision whether to work or not and the number of hours preferred if participating in the labor market. This definition might be enhanced to specify the types of jobs or sectors where the labor is supplied and to focus on the supply over a lifetime. E.g. in some periods of life it is preferable to reduce the hours worked, for instance in a situation with small children. The essays in this thesis focus on the hours of work for those already participating in the labor market, specified by sector or practice type.

As this thesis focuses on the supply side in the market for health personnel, important aspects of the demand for labor are disregarded. The obvious reason for this is the need to simplify the analyses. The empirical argument is the amount of vacant positions, which should support the assumption that there were few restrictions on the demand side and ample opportunities for physicians and RNs to find their preferred combination of jobs and working hours.

In the overview of the Norwegian labor supply research, Dagsvik (2003) discusses the many difficulties the researchers face. There is a striking lack of robust estimates on the impact of wage changes and tax reforms on the decision to work and the number of hours as illustrated by the following quote from Blundell et al. (1998) p. 827:

"Labor supply effects have been notoriously difficult to estimate in a robust and generally accepted way. The difficulties that researchers typically face relate to the treatment of (nonlinear) tax schedules, the fact that individuals have different tastes over nonmarket time and consumption for reasons that cannot be controlled for using observable information, and the fact that individuals' observed decisions represent intertemporal allocations as well as within period allocations".

The reviews of the empirical literature, i.a. Killingsworth (1983), Killingsworth and Heckman (1986), Blundell and MaCurdy (1999) confirms the large variation of the effects in labor supply models like the wage elasticity. Among others, a study by Mroz (1987) shows that different statistical and empirical approaches to the same data sample lead to large differences in the estimated supply elasticities.

As most registered nurses are women, the literature on female labor supply provides an important background to this discussion. Killingsworth and Heckman (1986) provide a comprehensive review of the research, indicating that women's workforce participation is responsive to changes in the wage rate, unearned income, spouse's wage and marital status, as well as having children, particularly of preschool age. The survey indicates that labor supply elasticities for females are positive, i.e. the positive substitution effect outweighs the negative income effect.

In relation to the nursing profession itself, a survey by Link (1992) summarizes the literature and finds that wage levels, and having children, influence labor force participation, although the responsiveness to wage changes has declined considerably over time. The latter finding reflects the fact that most RNs are now working in the US, as well as in other industrialized countries. In a recent review of the labor supply literature for nurses, Antonazzo et al. (2003) present the huge variation in results depending on the economic models and samples.

Still, most physicians are men and at least the current working pattern was developed at a time when almost all physicians were men. The physicians generally work more hours than the RNs. Pencavel (1986) summarizes the labor supply literature for men. Much of the literature has focused on low and middle income individuals and families. Work by Feenberg and Poterba (1993) and Feldstein (1995) on high-income individuals suggests that these individuals are responsive to incentives. However, a number of other studies have found no such effect for the high-income group, as presented in the survey by Røed and Strøm (2002). Showalter and Thurston (1997) present their analysis of US physicians as a continuation of the research on white-collar professions, and focus on tax effects on labor supply. In spite of the vast economic literature on physician behavior, labor supply studies are few and far between. Those that do exist show the wage elasticities of physicians who are not self-employed to be modest. Examples are Sloan (1975) and Noether (1986). Rizzo and Blumenthal (1994) focus on the impact on labor supply of wage and non-wage income for a sample of self-employed US physicians.

For a general overview of the labor supply literature see Killingsworth (1983), Killingsworth and Heckman (1986), Blundell and MaCurdy (1999), and Blundell (2001).

Rosen (1986) gives an introduction to the literature on compensating variations. "The theory of equalizing differences refers to observed wage differentials required to equalize the total monetary and non-monetary advantages or disadvantages among work activities and among workers themselves." These ideas go back to the writings of Adam Smith. As presented by Rosen, the evidence of compensating variations related to a broad scope of working conditions, is mixed.

When entering the job market, registered nurses (RNs) face job alternatives with differences in wages and other job attributes. Previous studies of the nursing labor market have shown large earnings differences between similar hospital and non-hospital RNs. Corresponding differences are found in some of the analyses of shift and regular daytime workers. One example is a paper by Hirsch and Schumacher (1997) who focus on the wage differentials for US RNs and find significant shift premiums and hospital premiums. Lanfranchi et al. (2002) demonstrate how the estimation of a shift premium and shift choice fits well into the framework of switching regression models with endogenous switching.

## 3. The application of discrete choice modeling in labor supply analyses

Discrete choice models describe decision makers' choices among alternatives. In this section I will give a presentation of some basic features of the methodology following Train (2003).

To fit within a discrete choice framework, the set of alternatives, called the choice set, needs to exhibit three characteristics:

i) The choice set must be mutually exclusive. Choosing one alternative necessarily implies not choosing any of the other alternatives.
ii) The choice set must be exhaustive, in that all possibilities are included.
iii) The number of alternatives must be finite.

Discrete choice models are usually derived under an assumption of utility-maximizing behavior by the decision maker. Thurstone (1927) originally developed the concepts in terms of psychological stimuli, leading to a binary probit model of whether respondents can differentiate the level of stimulus. Marschak (1960) interpreted the stimuli as utility and provided a derivation of utility maximization. Following Marschak, models that can be derived in this way are called random utility models (RUM). It is important to note, however, that models derived from utility maximization can also be used to represent decision making that does not entail utility maximization. Utility, as a constructed measure of well-being, has no natural scale or level, and only differences in utility matter.

Random utility models are derived as follows: A decision maker, labeled *n*, faces a choice among *J* alternatives. The decision maker would obtain a certain level of utility from each alternative. The utility that decision maker *n* obtains from alternative *j* is $U_{nj}$, $j$=1,…,J. This utility is usually assumed known to the decision maker but not the researcher. The decision maker chooses the alternative that provides the greatest utility. The behavioral model is therefore: choose alternative *i* if and only if $U_{ni} > U_{nj} \forall j \neq i$.

The researcher does not observe the decision maker's utility. The researcher observes some attributes of the alternatives as faced by the decision maker, labeled $x_{nj} \forall j$, and some attributes of the decision maker, labeled $s_n$, and can specify a function which relates these observed factors to the decision maker's utility. The function is denoted $V_{nj} = V\left(x_{nj}, s_{nj}\right) \forall j$ and is often called representative utility. Usually, V depends on parameters that are unknown to the researcher and therefore estimated statistically.

Since there are aspects of utility that the researcher does not or cannot observe, $V_{nj} \neq U_{nj}$. Utility is decomposed as $U_{nj} = V_{nj} + \varepsilon_{nj}$, where $\varepsilon_{nj}$ captures the factors that affect utility but are not included in $V_{nj}$. Given its definition, the characteristics of $\varepsilon_{nj}$, such as its distribution, depend critically on the researcher's representation of the choice situation.

The researcher does not know $\varepsilon_{nj} \forall j$ and therefore treats these terms as random. The joint density of the random vector $\varepsilon_n = \left\langle \varepsilon_{n1}, \ldots, \varepsilon_{nJ} \right\rangle$ is denoted $f\left(\varepsilon_n\right)$. With this density, the researcher is able to make probabilistic statements about the decision maker's choice. The probability of decision maker *n* choosing alternative *i* is

$$
\begin{aligned}
P_{ni} &= \text{Prob}\left(U_{ni} > U_{nj} \forall j \neq i\right) \\
&= \text{Prob}\left(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj} \forall j \neq i\right) \\
&= \text{Prob}\left(\varepsilon_{nj} - \varepsilon_{ni} < V_{ni} - V_{nj} \forall j \neq i\right)
\end{aligned}
$$

This probability is a cumulative distribution, namely, the probability that each random term $\varepsilon_{nj} - \varepsilon_{ni}$ is below the observed quantity $V_{ni} - V_{nj}$. Different discrete choice models are obtained from different specifications of this density, that is, from different assumptions about the distribution of the unobserved portion of utility. Logit and nested logit have closed-form expressions for this integral and are derived under the assumption that the unobserved portion of utility is a distributed iid extreme value and a type of generalized extreme value respectively. Probit is derived under the assumption that $f(.)$ is a multivariate normal, and mixed logit is based on the assumption that the unobserved portion of utility consists of a part that follows any distribution specified by the researcher, plus a part that is an iid extreme value. With probit and mixed-logit the resulting integral does not have a closed form, and is evaluated numerically through simulation.

In this thesis the decision makers are the registered nurses or physicians choosing between job alternatives. A job alternative not only specifies the practice type but also includes a specific number of hours. For the physicians I also allow for job-packages with a main job and an extra job, with specified hours in both. This creates a large set of alternative job-packages which the individuals must choose from. In the modeling of RNs, the job-packages are specified also with information about shift type. The models applied are multinomial logits and nested logit, with some adoptions.

A more general issue is whether there should be a direct empirical application of the economic model presented, or if this approach is too difficult as there are many other aspects influencing peoples choices observed in markets that are not observable to economists. One alternative and less stringent approach is to use economic modeling to motivate the empirical analysis, but restrict the analysis to reduced form estimates and natural experiments. The downside of that approach is the lack of generality in the application of the results.

## 4. The Norwegian Health Care System

In Norway the health services are mainly publicly financed and provided by the government. Norway spends about 8% of its GDP on health. This is approximately 2,400 USD PPP (purchasing power parities) annually (OECD 2002), of which 85% is publicly financed. The private share is mainly outpatient co-payments as inpatient services are offered free of charge.

The primary care services are today mainly provided by private practitioners on public contracts, but in my thesis I use data from the years prior to the 2001 family physician reform. At that time there was a mix of 50% private providers with contract, 40% ‘municipal health officers’, and the rest were private providers with no or a part refund from the National Insurance Scheme, and interns in their final practice year before qualifying. The municipalities provide and finance mother and child health centers, nursing homes and home nursing.

The provision of outpatient services is split between special wards at the hospitals and specialists in private practices. Inpatient services are catered for by government providers or nongovernmental organizations (NGOs) with a public contract. There is a waiting time for almost all non-acute health services that are publicly provided, normally weeks or months but in some low-priority cases, also years. In Norway it is prohibited to supply privately financed inpatient services, with the exemption of some hospitals with a national capacity of less than 100 beds. However, there is ample supply of private outpatient services offering the same services as hospital outpatient clinics for those who have sufficient willingness to pay. After public procurement to reduce NHS waiting lists, most private surgical procedures are paid out of pocket, as private health insurance schemes cover only a negligible share of the population.

In the period of focus there have been a series of reforms influencing the demand and supply of health personnel. Activity-based funding was introduced at the hospitals in 1997 and has since been a major reason for the increase in hospital activities. In specialist services, the number of discharges increased by 11% from 1995 to 2000. Outpatient consultations were increased by 13%. There was a 14% increase from 1995 to 2000 in the number of employees at psychiatric and somatic institutions in the specialist health services. According to Statistics Norway (2001) the number of full-time nursing positions increased by 23% to 27,415 in 2000. The number of full-time positions for auxiliary nurses was reduced by 4% to 8,386 in 2000, continuing the trend of registered nurses replacing this personnel category. The number of full-time positions for physicians was increased by 23% to 8,288 in 2000. But the financing reform was not the sole reason for the activity increase. All the usual factors like demographic change, technological development and wealth increase fuelled this development. In primary care the number of full-time positions for all professions increased by 30% in the primary care sector to 89,670 in 2000, reducing the ratio of full-time positions per patient to 0.44.

In 1998 the public financing of private specialist practices was enhanced to include most private specialists, reducing patient co-payment and increasing the demand for private treatment. A public waiting time guarantee has also increased the focus on the need for increased capacity. The introduction of the patients' right to choose their preferred hospital for elective treatment may also have promoted the hospitals attention to waiting time and treatment capacity. Recent reforms, taking place after my data time window, include the family physician reform (partly capitation based) in 2001 and the transferrals of hospital ownership to five regional authorities in 2002.

When analyzing the labor supply of physicians and RNs we face some additional difficulties which we are only partly able to deal with. The market for health personnel consists of a few large buyers in the public sector and a dominant public insurance scheme for the private practices. This implies that we have elements of a monopsonistic labor market where the buyers face an upward sloping supply curve. When considering a wage increase to attract the marginal worker, the hospital must take into account that they also must increase the wage for all personnel already employed at the hospital. In the public sector the wage bargaining is centralized, and seniority, formal qualifications and working hours seem to determine earnings together with the amount of overtime. In private practice the importance of unobserved heterogeneity is probably a more important determinant for earnings than for the other sectors.

## 5. Characteristics of the Physician Labor Market

After 6 years at university, medical students continue in internships with 1 year of hospital practice and 6 months of primary care practice. To become a licensed specialist you must undertake a training program while practicing as a jr. physician at a hospital or in a similar arrangement for primary care providers (PCPs). The median number of years from authorization to licensing as a specialist in my sample is 10 years. A central committee has traditionally regulated the distribution of junior physicians and hospitals consultants. During the nineties there seemed to be an increased tendency of local initiatives where hospitals strengthened their physician staff without committee permits. In accordance with an increased market orientation in the health care sector, there seems to be a tendency that wage and other job characteristics will be more important for the distribution of physicians and as a way for the health authorities to attract personnel.

There is almost full workforce participation among physicians, with few people working part-time and an insignificant group working in non-health sectors. A normal pattern is to work extra hours in the main job, but many physicians also work in a second position or evening practice. According to the Norwegian Medical Association (2002) there were 15,300 physicians in Norway below 67 years at the end of 1999. The rapidly increasing share of women had reached 31% that year. 59% of the workforce were qualified specialists.

From 1994 to 1999 there were 1,900 Norwegians who completed their training and were licensed as physicians. During the same period a striking number of 6,000 physicians of other nationalities received a permanent or a temporary license valid for six months of practice. The high number of licensed foreign physicians was due to active recruitment in the other Scandinavian countries and Germany. Many never arrived in Norway after all, whereas others returned after a period of practice. Approximately 2,300 physicians of other nationalities were active in 1999/2000, of whom 1,500 had permanent residencies and 800 temporary residencies. 35% of the foreign physicians had a licensed specialty.

In 1999, 8,000 physicians worked mainly in public hospitals and 3,800 worked in primary care as municipal employees or in private practice with public funding. 800 specialists worked in private practice with public funding as their main practice. 300 physicians worked in companies, 600 in research and development and 400 in health administration. Private-for-profit hospitals where manned by a small number of full-time employees, supplemented by public hospital physicians working part-time. There are some earnings differentials by sector as presented in Figure 1. Physicians mainly working in private practice have a higher mean income than those in other sectors. Hospital physicians follow in second place, with physicians working with administrative tasks earning considerably less.

Approximately 800 vacant public positions were reported in 1997, the period this analysis focuses on. These vacancies existed in spite of campaigns to recruit foreign personnel, and at a time when the increases in educational capacity were beginning to take effect. Even though the institutional set-up and physician coverage rate varies a lot between countries, it is easy to find similar challenges in guiding personnel to serve the population with the highest needs in the other Scandinavian countries and the UK.

As this thesis focuses on the supply side of the physician market, important aspects of the demand for physician labor are disregarded. The obvious reason is the need to simplify the model. The empirical argument is the many vacant positions that should support the assumption that there were few restrictions from the demand side and ample opportunities for the physicians to find their preferred combination of jobs and working hours. On the other hand, public providers faced block grants until July 1997 when an activity based funding was introduced. This budget restriction may have forced the hospital administration to reduce hours of planned overtime in order to keep the budget. But even with restrictions on public hours, physicians are free to combine their hospital position with private practice or other jobs. Another motivation for public hospital physicians to have a second job in a private practice is the possibility to deduct practice related expenses from their earnings prior to taxation. These expenses include rents for an office in their own home, computers, books and journals. The register data used in this thesis only reports income after these expenses have been deducted.

There is a selection process driving the choice of specialty, sector, participation and working hours. As almost all physicians work full-time the variation in working hours consists of extended hours in the main job and/or extra private practice. The wage differentials between specialties and sectors are significantly compressed compared to in the US, and the matching process seems less driven by expected income than in many other countries. E.g. the acceptability of shift-work seems to be important for the sector choice. Figure 2 present the annual median earnings (labor income, capital income, pension benefits, and social security payments) by specialty in 1997. The relative earnings have, however, been changing over the years in response to the various health sector reforms. The recent family physician reform has for instance dramatically increased the income of most PCPs. A similar wage reform took place in the hospital sector in 1996, and I have used this as a “natural experiment” to evaluate the predictions in my physician paper.

There are also differences in specialty status, as ranked by patients and colleagues, and in gender mix. The income seems to be correlated with these factors. This gender effect can also be due to the fact that female physicians work less overtime and/or in private moonlighting than their male colleagues. However, the female share is high in i.a. primary care, which has seen a significant earnings increase lately. All analyses are made conditional on the physicians’ choice of specialty. Given the short-term perspective of this analysis, it is not possible to model the selection into specialties like in Nicholson and Soules (2001).

Hours per week at public hospitals are dependent on the number of physicians sharing a shift plan. This is partly decided by the chief physician at ward level and her preferences. For a private practitioner with a public contract the earnings are decided by a block grant from the municipality, and fees for services with fixed fees. Private practitioners without a public contract, e.g. hospital physicians working private ‘overtime’, are more market based in their price setting.

## 6. The labor market for registered nurses

According to Statistics Norway (2003) there were 77,819 registered nurses below retirement age in Norway in 2002, of whom 69,690 were employed. Those not employed were mainly on disability pensions, medical and vocational rehabilitation, early retirement or further education. Auxiliary nurses with a year of education after college are not included in these numbers. Norway is one of the countries with the highest density of nurses with 15.3 working nurses per 1,000 population in October 2002. More than 90% of the nurses are women. 91.4% of the employed nurses were public employees. Registered nurses receive a minimum of three years of education at college level. Personnel in administrative positions have often completed a year of administrative training. Nurse specialist training also adds one or two years.

50% of the nurses in our sample work in public hospitals. Close to 26% work in primary health care run by the municipalities in nursing homes, home nursing or health clinics. Only 5% are employed by private health services working in a private medical clinic or in the pharmaceutical industry. Some 15% work in non-health areas like public administration or in the service sector. Some of these teach at colleges or lower levels, work as occupational health nurses or in public health administration. 6% earn their main income from different types of transfers like disability benefits. Around 1% earn less than the minimum income required to qualify for public pensions, and do not receive transfers beyond the same limit of NOK 40,000.

There seems to be an underlying development over a nursing career that is impossible to identify through the short-term analysis presented in this thesis. The geographic location of colleges, family life and aging are probably important underlying forces. As shown in Figure 3-5 the share working shifts gradually decreases by age. Please observe that the figure is just a cross-sectional snapshot, and should be interpreted with caution. Almost all nurses work shifts in their first job, whereas 80% work shifts when they reach 60. The shift indicator includes different combinations of day, evening and night work that may also change by age. I do not have access to such details. The mean workload as measured by the percentage of a full-time position also varies by age from almost 95% when entering the job market, down to approximately 75% in the thirties and the years with small children, rising again to 85% by the late forties before sinking below 80% at the age of retirement.

The hospital share seems to gradually decrease by age from around 65% in their twenties to below 40% when they retire. The share living in municipalities with a high centrality index is at its highest right after graduation, decreasing to a stable level around 70% after a few years. This is probably an effect of RNs staying in the areas close to the nursing college for their first job, moving to less central areas when they establish a family.

The earnings are presented with three lines in Figure 5. The middle line represents the annual labor income. Surprisingly the mean earnings are at their peak right after graduation when most nurses work full-time and shifts. The lowest earning is reached in the thirties with an almost 15% lower mean income. The labor income then rises to a peak in the late forties, decreasing again before retirement.

The lowest line represents the income as reported by the Norwegian association of local authorities, NALRA. While NALRA reports monthly income by October 1st, 12 times this amounts to less than the annual income. One reason is that the local wage negotiations take place late in the fall. The month of September may also represent somewhat less overtime work than the annual average. Otherwise the NALRA measure follows the changes by age as the annual labor income. When looking at the top line however, the earnings dip in the thirties has disappeared due to public transfers related to maternity leave, child cash benefits and other social security benefits.

## 7. Register data at the Frisch Centre

Over the years the Ragnar Frisch Centre for Economic Research has built a database covering the entire Norwegian Population aged 16-69. I have matched this database with the register of licensed health personnel and an administrative register of wages and working time for health personnel employed by institutions organized by NALRA. The registers are collected by various public agencies and provided by Statistics Norway. The Norwegian Social Science Data Services (NSD) has provided a centrality index for the municipalities.

The register data provide an opportunity for rich data analysis and all papers are based on these. The measurement error is reduced dramatically with access to detailed personnel administrative data records like the NALRA register. Each individual record comprises demographic information (age, gender, country of birth, marital status, etc.), education, specialization, income, employment status, industry code, practice type, and also hours of work, wages and shift type for public employees. I have also matched information about spouse and children with each health worker.

## 8. Summaries and main conclusions

### *The Wage Impact on Physicians' Labor Supply and Practice Choice.*

In most countries the health authorities try to influence the physicians' choice of specialization, practice type and working hours. Regulations through quotas have been widely used in countries with a national health service (NHS). With the deregulation of health markets, incentives such as the physicians' pay and practice income play a relatively larger role in the implementation of health policies. The purpose of this paper is to analyze how economic incentives affect the labor supply of physicians. I do this by estimating the effects of increased wages on the physicians' total working hours, and their preferred combination of hours in their main job and hours in an extra job or private practice.

A combination of jobs is common for physicians, and it is important to focus on the job mix as it seems reasonable to assume that physicians work differently in public and private services, facing different sets of incentives and budget mechanisms. The interaction between the main job and the extra job is also interesting. An efficient implementation of the health priorities will thus embrace preferences of practice forms, including a preference of whether a consultant should spend his/her spare time working extra hours in a public facility or in a private practice.

In most OECD countries physicians are partially or fully publicly funded while practicing, by wage in the public sector and through financial contracts with private providers. Health authorities justify the funding with their responsibility to ensure that the population has access to health services. Yet many countries suffer from personnel shortages in general or within certain practice types and specialties. With a view to informing the policymaking process, the task of this paper is thus to identify the effects of increased wages on physicians' working hours and sector choices.

To analyze this question I apply a static neo-classical structural labor supply model with utility maximizing individuals. The model is inspired by approaches like that of Aaberge, Dagsvik and Strøm (1995). Relying on a discretization of the choice structure, I present an econometric framework that allows for non-convex budget sets, nonlinear labor supply curves and imperfect markets with institutional constraints. The physicians are assumed to make choices from a finite set of job possibilities, characterized by practice form, hours and wage rates. The individuals may combine their main position with an extra job (or private practice), making a variety of combinations of hours possible for each job. I take into account the complicated payment schemes for physicians, as well as taxes and household characteristics when estimating labor supply on Norwegian micro data. The results show a modest response in total hours to a wage increase, but a reallocation of hours in favor of the sector with increased wages. The predictions are evaluated by means of a 'natural experiment'; a policy reform significantly increasing hospital wages.

The analysis presents two types of settings. One with four possible practice types: hospital, municipal primary care, private practice and other jobs like public administration, NGOs, occupational health and private businesses that is not directly patient related. The other setting focuses on the hospital physicians and their choice between overtime work at the hospital or working in a private practice as an extra job.

***Will increased wages increase nurses' working hours in the health care sector?***

Whereas physicians traditionally work many hours per week, registered nurses often work part-time, at least during the years they have small children. In Norway there has also been some attention focused on RNs who are not working in the health sector and how one can motivate them to return to patient related work. The nurses' trade organizations claim that a wage increase will increase the short-term labor supply in the health care sector. This paper is an application of the framework presented above to identify the effects of job type-specific wage increases on the RNs practice type and hours through policy simulations on micro data.

As for the physicians the individual's labor supply decision can be considered as a choice from a set of discrete alternatives (job packages). These job packages are characterized by attributes such as hours of work, sector specific wages and other sector specific aspects of the jobs. There are no extra jobs in this model as this is much less common for RNs. The nurses choose the job package that maximizes their utility given a nonlinear budget set that incorporates taxes. The three sectors or job types are public hospitals, public primary care services and other "non-health" or "non-patient" jobs within public administration, private businesses and NGOs.

I undertake the analysis for married and single female RNs separately, as there is reason to believe that the two groups respond differently to financial incentives. For married females the results indicate job type specific wage elasticities for hours of work of 0.17 in hospitals and 0.39 in primary care. The total hours worked in health and non-health jobs combined are actually predicted to be slightly reduced, but the change is not significantly different from zero. Single females are somewhat more responsive to wage changes than married ones.

I do not analyze the impact of wage increases as an instrument to mobilize those not working. One argument for not including this group is the differences in personal characteristics compared to those working. Another is the relative small number of RNs not working, making the framework presented less suitable.

***Nurses' labor supply with endogenous choices of care level and shift type. A nested discrete choice model with nonlinear income.***

One weakness of the analysis of the nursing labor market as presented above is the disregard of the shift dimension, an important characteristic when RNs make their job choice. This paper explicitly includes shift choice in the analysis, but the sample is limited to the public health sector due to data restrictions. Where the preceding nursing paper addresses the possibility of attracting RNs to the health sector from other non-health jobs, this paper focuses on the job-choices and working hours of those already working in the health sector. The reason is that shift information is only included in the NALRA register, which covers hospitals and primary care institutions owned by local authorities.

Shift work has a documented negative impact on workers' health and social life, effects that 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 the health care sector . Omitting shift work in the evaluation of such policies may lead to biased estimates of the wage elasticities.

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.

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 of hours. Thus, the income effect seems to be dominating in the labor supply of nurses.

### *Compensating differentials for nurses*

When entering the job market registered nurses (RNs) face job alternatives with differences in wages and other job attributes. Previous studies of the nursing labor market have shown large earnings differences between similar hospital and non-hospital RNs. Corresponding differences can be found in some of the analyses of shift and regular daytime workers.

The theory of equalizing differences predicts that people with difficult working conditions are compensated with higher wages. Shift hours in Norway are compensated both with an hourly wage premium, and with shorter mandated working hours for a full-time position. Health workers may choose shift work because of compensating wage differentials, but it is also possible that they have preferences for shift work. Compared to other studies of compensating variation, this study has the advantage of focusing on differentials within a single occupation, so preferences and abilities are more homogeneous than for broader groups of workers.

Lehrer et al. (1991) refer to the differences in job attributes between hospital and non-hospital settings. If hospital jobs involve rather unpleasant characteristics, such as a high degree of stress and job hazards, then hospitals must pay a compensating differential in order to attract nurses of a given quality. In this paper I do not, however, compare the hospital RNs with colleagues working in a practitioner's office, but with nurses working shifts at nursing homes and in home nursing. They may have an equal need for compensation to care for a less prestigious patient group, often with less qualified colleagues and poorer staffing than is the case at hospitals.

In the first part of this paper I analyze the wage differentials in the Norwegian public health sector, applying a switching regression model. The motivation is to explore whether the wage differentials found in international studies prevail in a setting with highly centralized wage bargaining and monopsonistic employers. I find no hospital premium for the shift RNs and a slightly negative hospital premium for the daytime RNs, but it is not significant for the hospital job choice. I find a positive shift premium. The wage rate is 19% higher for the shift working hospital RNs and 18% higher for the sample of primary care workers. The shift premium is only weakly significant for the shift work choice for the sample of hospital RNs, and not for the primary care RNs. I identify certain selection effects.

In the second part of the paper I focus on the shift compensation, and present a structural labor supply model with a random utility function. I explicitly include the choice between shift work and daytime hours where the registered nurses (RNs) maximize utility given a nonlinear budget set that incorporates taxes. This is done to identify the expected compensation necessary for the nurses to remain on the same utility level when they are "forced" from a day job to a shift job. The expected compensating variations are derived by Monte Carlo simulations and presented for different categories of hours. I find that on average the offered combination of higher wages, shorter working hours and increased flexibility overcompensates for the health and social strains related to shift work.

## 9. References


Aaberge, R., Colombino, U., Strøm, S., 1999, Labour supply in Italy: An empirical analysis of joint household decisions, with taxes and quantity constraints, Journal of Applied Econometrics 14: 403-422.

Aaberge, R., Dagsvik, J.R., Strøm, S.,1995. Labor supply responses and welfare effects of tax reforms. Scandinavian Journal of Economics 97: 635-59.

Antonazzo, E., Scott, A., Skatun, D., Elliott, R.F., 2003, The labour market for nursing: a review of the labour supply literature. Health Economics. Vol. 12, pp. 465-478.

Blundell, R., Duncan, A., Meghir, C., 1998, Estimating labor supply responses using tax reforms. Economtrica, 66, 827-861.

Blundell, R.,MaCurdy, T., 1999, Labor Supply: A Review of Alternative Approaches. In Ashenfelter, O., Card, D. (eds), Handbook of Labor Economics, Vol. 3, 1559-1695.

Blundell, R., 2001, James Heckman's Contributions to Economics and Econometrics. Scandinavian Journal of Economics, 103, 191-203.

Dagsvik, J. K., 2003, Hvordan skal arbeidstilbudseffekter tallfestes? En oversikt over den mikrobaserte arbeidstilbudsforskningen i Statistisk Sentralbyrå. Notater 2003/71, Statistics Norway.

European Observatory on Health Care Systems, 2000, Health Care Systems in Transition, Norway. Copenhagen: WHO Regional office for Europe.

Feenberg, D., Poterba, J.M., 1993. Income inequality and the incomes of the very high taxpayers, in: James M. Poterba, ed., Tax policy and the economy, Vol. 7 (MIT Press, Cambridge) pp. 145-177.

Feldstein, M., 1995. The effect of marginal tax rates on taxable income: A panel study of the 1986 Tax Reform Act, Journal of Political Economy 103(5) 551-572.

Killingsworth, M.R., 1983, Labor Supply. Cambridge University Press, New York.

Killingsworth, M.R., Heckman, J.J., 1986, Female Labor Supply: A Survey. In Ashenfelter, O., Layard, L. (eds), Handbook of Labor Economics, Vol. 1, 104-204.

Lanfranchi, J., Ohlsson, H., Skalli, A., 2002, Compensating Wage Differentials and Shift Work Preferences. Economics letters 74, 393-398.

Lehrer, E. L., White, W.D., Young, W.B., 1991, The Three Avenues to a Registered Nurse License: A Comparative Analysis. Journal of Human Resources, Vol. 26, No. 2 (Spring), pp. 262-79.

Link, C.R., 1992, Labor Supply Behavior of Registered Nurses: Female Labor Supply in the Future? Res. Labor Econ. 13, 287-320.

Marschak, J., 1960, Binary Choice Constraints on Random Utility Indications. In Arrow, K. (ed.): Stanford Symposium on Mathematical Methods in the Social Science. Stanford University Press, Stanford, California, pp. 312-29.

Mroz, T.A., 1987, The Sensitivity of an Empirical Model of Married Women's Hours of Work to Economic and Statistical Assumptions. Econometrica, 55, 765-800.

Nicholson, S., 2002. Physician Speciality Choice under Uncertainty. Journal of labor Economics, 2002, vol. 20, no.4. The University of Chicago.

Noether, M., 1986. The growing supply of physicians: has the market become more competitive? Journal of Labor Economics, 4, 503-537.

Norwegian Medical Association, 2002. Homepage: www.legeforeningen.no.

OECD, 2002. OECD Health Data 2002. www.oecd.org.

Pencavel, J., 1986. Labor supply of men. In Ashenfelter, O., Layard, R., eds. Handbook of labor economics, pp. 3-102, North-Holland, Amsterdam.

Rosen, S., 1986, The Theory of Equalizing Differences. In: O. Ashenfelter and R. Layard, Editors, Handbook of Labor Economics Vol. 1, North-Holland, Amsterdam (1986), pp. 641–692 Chapter 12.

Rizzo, J.A., Blumenthal, D., 1994. Physician labor supply: Do income effects matter? Journal of Health Economics 13, 433-453.

Røed, K., Strøm, S., 2001, Progressive Taxes and the Labour Market - Is the Trade-Off between Equality and Efficiency Inevitable? Journal of Economic Surveys, Vol 16, No1, 77-110.

Schumacher, E. J., Hirsch, B.T., 1997, Compensating Differentials and Unmeasured Ability in the Labour Market for Nurses: Why do Hospitals Pay More? Industrial and Labor Relations Review, Vol. 50, No.4, July 1997, pp 557-79.

Showalter, M. H., Thurston, N.K., 1997, Taxes and labor supply of high-income physicians. Journal of Public Economics 66, 73-97.

Sintef, 2002, SAMDATA Sykehus. Hospital trends and statistics.

Sloan, F. 1975, Physician supply behavior in the short run. Industrial and Labor Relations Review 28, 549-569.

Statistics Norway, 2001, Specialist Health Service 1990-2000. General Hospitals, Psychiatric Institutions, etc. Kongsvinger.

Statistics Norway, 2003, www.ssb.no.

Thurstone, L., 1927, A Law of Comparative Judgement. Physiological Review, 34, 273-86.

van den Noord, P., Hagen, T.P., Iversen, T., 1998, The Norwegian Health Care System. Economics Department Working Papers no. 198. Paris: OECD.

## 10. Figures

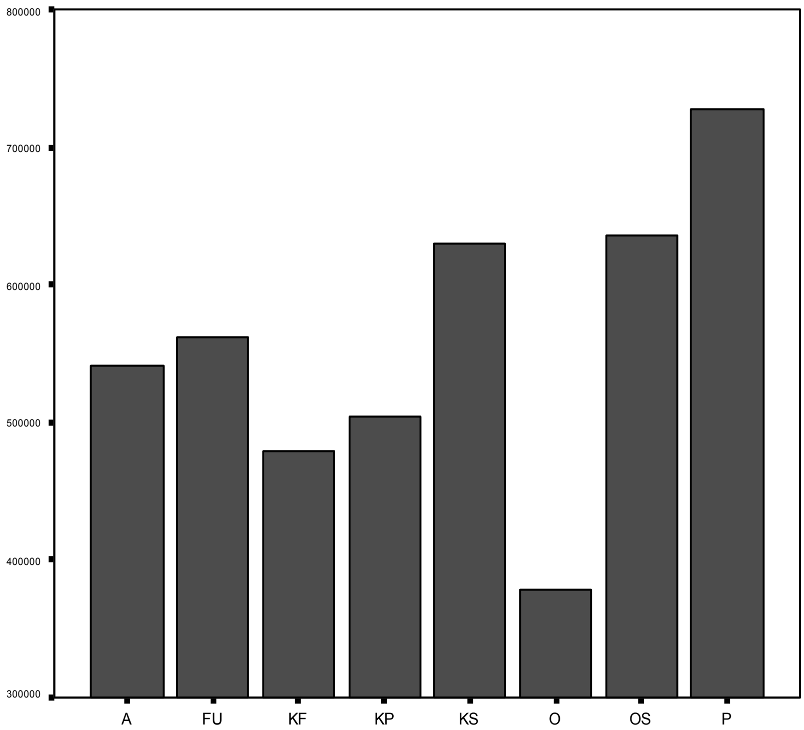


***Figure 1. Mean total annual income by sector, NOK in 1997.***

*Sector is allocated by the main source of income. Hospital and public primary care physicians working 75% or more in the public sector are allocated to the public sectors even if they earn more in their part-time private practices.*

| | ***Sector*** |
|---|---|
| A | Other activities, e.g. central administration, NGOs, non-health companies |
| FU | Research and development |
| KF | General and health sector administration in municipalities and counties |
| KP | Municipal medical officer |
| O | Social security and other transfers |
| KS | Hospitals outside of Oslo |
| OS | Hospitals situated in Oslo |
| P | Private |

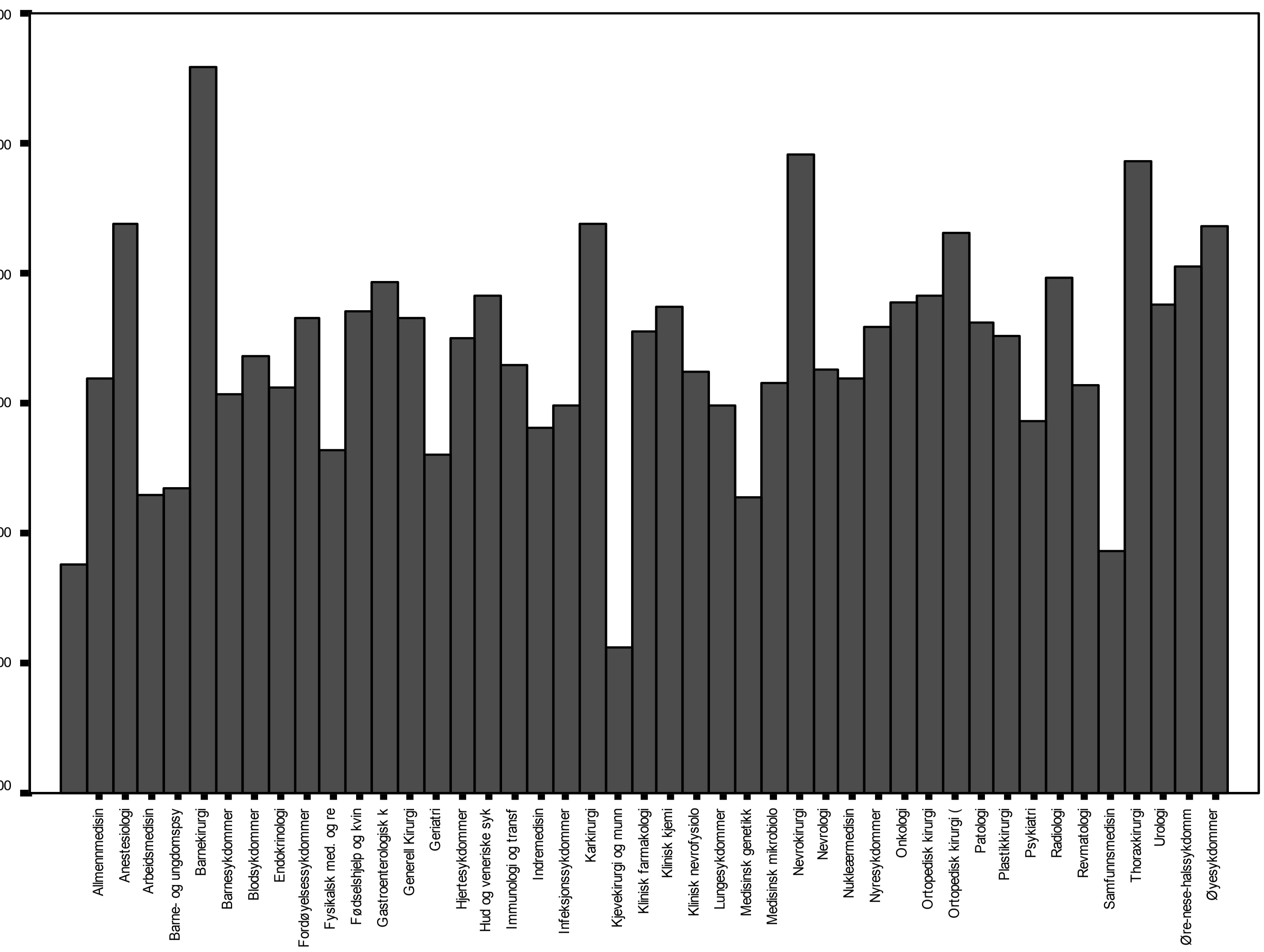


***Figure 2. Median total annual income by specialty, NOK in 1997.***

***To illustrate the earning differentials, the annual median total income is presented by the specialty. The left bar is the physicians without a specialty license.***

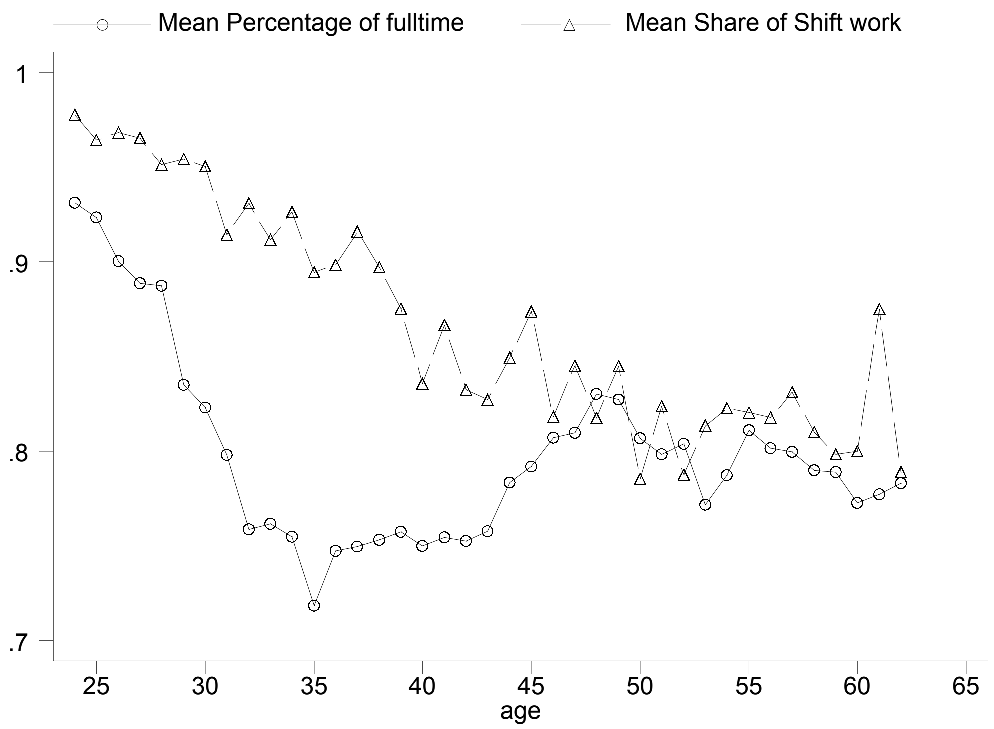


***Figure 3. Percentage of full-time and share working shifts for public registered nurses. Means by age in 2000.***


***Figure 4. Share of public RNs working in hospitals and share living in the most central municipalities. Means by age in 2000.***

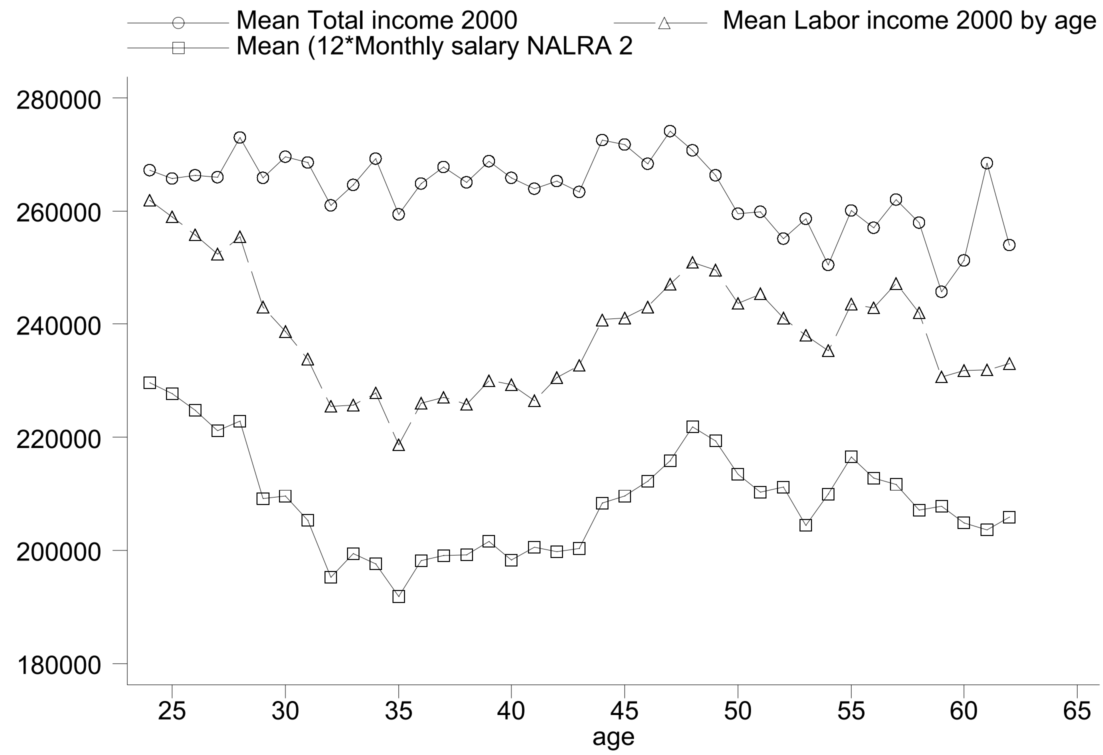


***Figure 5. Total income (upper line), labor income, and "NALRA income" (lower line). Annual means by age in 2000.***

# Chapter 2
# The Wage Impact on Physicians' Labor Supply and Practice Choice.

**Abstract**

There is a political objective within the NHS to strengthen the physician services in underserved sectors and areas. Increased wages is one instrument for boosting the hours provided by the personnel. Many physicians have several jobs, making the effect of a sector specific wage increase difficult to assess. E.g. an increase in public sector wages may influence the hours provided in private extra practice.

This study applies an econometric framework that allows for non-convex budget sets, nonlinear labor supply curves and imperfect markets with institutional constraints. The physicians are assumed to make choices from a finite set of job possibilities, characterized by practice form, hours and wage rates. Individuals may combine their main position with an extra job or private practice, making a variety of combinations of hours possible for each job. I take into account the complicated payment schemes for physicians, as well as taxes and household characteristics, when estimating labor supply on Norwegian micro data.

The results show a modest response in total hours to a wage increase, but a reallocation of hours in favor of the sector with increased wages. The predictions are evaluated by means of a 'natural experiment'; a policy reform significantly increasing hospital wages.

## 1. Introduction

In most countries the health authorities try to influence the physicians' choice of specialization, practice type and working hours. Regulations through quotas have been widely used in countries with a National Health Service (NHS). With the deregulation of health markets, incentives such as the physicians' pay and practice income play a relatively more important role in the implementation of health policies. The purpose of this paper is to analyze how economic incentives affect the labor supply of physicians. I will do this by estimating the effects of increased wages on the physicians' total working hours, and their preferred combination of hours in their main job and hours in an extra job or private practice.

A combination of jobs is common for physicians, and it is important to focus on the job mix as it seems reasonable to assume that physicians work differently in public and private services, facing different sets of incentives and budget mechanisms. The interaction between the main job and the extra jobs is also of interest (Iversen, 1997). An efficient implementation of the health priorities will thus embrace preferences of practice forms, including a preference of a whether a consultant should spend his/her spare time working extra hours in a public facility or in a private practice.

Physician labor is an important input both directly, and as the 'captain of the ship' with responsibility for initiating the treatment and choosing the quality of the care provided. In most OECD countries physicians are partially or fully publicly funded while practicing. Health authorities justify the funding with their responsibility to ensure the population access to health services. Yet many countries suffer from personnel shortages in general or have an uneven distribution of personnel, with shortages in the public sector, in certain medical specialties or practices and in some regions.

Pencavel (1986) summarizes the labor supply literature for men with the conclusion that the elasticities of hours with respect to wages are very small. Much of the literature has been focused on low- and middle-income individuals and families. Work by Feenberg and Poterba (1993) and Feldstein (1995) on high-income individuals suggests that these individuals are responsive to incentives. However, a number of other studies have found no such effect for the high-income group, as presented in the survey by Røed and Strøm (2002).

Showalter and Thurston (1997) present their analysis of US physicians as a continuation of the research on white-collar professions, and focus on tax effects on labor supply. A key finding is that self-employed physicians are sensitive to the marginal tax rate, with a supply elasticity of 0.33, whereas the effect is small and insignificant for employed physicians. In spite of the vast economic literature on physician behavior, labor supply studies are few and far between. Those that do exist show the wage elasticities of physicians who are not self-employed to be modest. Examples are Sloan (1975) and Noether (1986). Rizzo and Blumenthal (1994) focus on the impact on labor supply of wage and non-wage income for a sample of self-employed US physicians. They find an uncompensated wage elasticity for male doctors of 0.23, with a compensated wage elasticity of 0.44. There are no published studies of physician labor supply on Norwegian data[1].

A common criticism of traditional studies of labor supply is that they fail to address the complications created by institutional constraints, such as contracted working hours and absence of individual worker choice. The choice framework presented here is an attempt to address these issues. The physicians are faced with job packages consisting of a main job with specific hours and an extra job with specific hours. Each physician may choose between four sectors or practice types in the main job. The agents maximize utility given a nonlinear budget set that incorporates taxes in a static neo-classical structural labor supply model. The basic framework is similar to that of Aaberge et al (1995) and van Soest (1995).

The observed fact that physicians work long hours may either be due to economic incentives or other attributes of the job. There are many attributes of a job that are partly or fully unobservable to the researcher. Examples are shift work, the possibility for maternity leave, expected working hours, workload, how challenging the work is, etc. These characteristics will in many cases determine the labor supply. These characteristics, except for sector choice, are captured by random elements in preferences and choice sets.

[1] However there is a working paper by Baltagi, Bratberg and Holmås (2003) analysing 1303 Norwegian physicians working as hospital consultants over the period 1993-97. They estimate a long-run wage elasticity of about 0.55, and reject the static model that estimates the short run wage elasticities to slightly above 0.3. A possible reason for their high elasticities compared to other studies might be their use of a log-linear framework, with no explicit modelling of taxes and excluding seconds jobs in their analysis.

The main finding is a limited response in the total labor supply to a wage increase, corresponding to results reported in the literature for high-income professionals and employed physicians. Knowing the physicians' high initial workload, and the complicated institutional regulations, this seems reasonable. There is, however, a potential for changes in the sector mix in response to a sector-specific wage increase. The model predicts the observed changes in hours worked fairly satisfactory; the hours worked in the main job are slightly underpredicted whereas the hours in the extra job are slightly overpredicted.

The paper is organized as follows: The following section gives an overview of the characteristics of the physician labor market in Norway. The model and data are described in Section 3 and 4, while Section 5 present the results, and includes a section where the estimated parameters are used when predicting choices in 1997. The predictions are evaluated by comparison with the chosen alternatives. The final section provides conclusions and points out directions for further research.

## 2. Characteristics of the physician labor market

In Norway the health services are mainly publicly financed and provided by the government. Some services, however, especially in primary care, are provided by private practices and institutions on public contracts. The provision of outpatient services is shared between special wards at the hospitals and specialists in private practices. There is waiting time for almost all non-acute health services that are publicly provided, normally months. It is prohibited to supply privately financed inpatient services, with the exemption of some hospitals with a National capacity of less than 100 beds. However, there is ample supply of private outpatient services offering the same services as hospital outpatient clinics for those who are willing to pay. After public procurement to reduce NHS waiting lists, most private surgical procedures are paid out of pocket, as private health insurance schemes cover only a minimal share of the population. For an overview of the Norwegian health care system, see van den Noord et al. (1998) and European Observatory on Health Care Systems (2000).

Hospital physicians are salaried public employees. There are no general restrictions of private extra practice and moonlighting is common. Primary care physicians are today mainly provided by private practitioners on public contracts, but as we are focusing on the time period prior to the 2001 family physician reform, there was a mix of 50 percent private providers with contracts and 40 percent 'municipal health officers'. The rest were private providers with no or a part refund from the National Insurance Scheme, and interns in their final practice year before qualifying.

Around 800, or around 7% of the public positions were reported vacant in 1997. These vacancies existed in spite of campaigns to recruit foreign personnel, and as the increases in educational capacity were beginning to take effect. Even though the institutional setup and physician coverage rate varies a lot between countries, it is easy to find similar challenges in guiding personnel to serve the population with the highest needs in the other Scandinavian countries and the UK.

As this paper focuses on the supply side in the physician market, important aspects of the demand for physician labor are disregarded. The obvious reason is the need to simplify the model. The empirical argument is the amount of vacant positions, which should support the assumption that there were few restrictions on the demand side and ample opportunities for physicians to find their preferred combination of jobs and working hours. On the other hand, public providers faced block grants until July 1997 when an activity based funding was introduced. This budget restriction may have forced hospital administrations to reduce hours of planned overtime in order to stay within the budget. But even with restrictions on public hours, physicians are free to combine their hospital position with private practice or other jobs. Another motivation for public hospital physicians to have a second job in a private practice is the chance to deduct practice related expenses from their earnings prior to taxation. These expenses include rents for an office in their own home, PCs, books and journals. The register data used in this paper only reports income after a deduction of these expenses.

A selection process drives the choice of specialty, sector, participation and working hours. As almost all physicians work full-time, the variation in working hours consists of extended hours in the main job and/or extra private practice. Wage differentials between specialties and sectors are significantly compressed compared to in the US, and the matching process seems less driven by expected income than in many other countries. For instance, the acceptability of shift-work seems to be important for the sector choice. There are still specialty differences in status and gender mix, with a higher female share in primary care and psychiatrics. In private practice the importance of unobserved heterogeneity is probably higher as a determinant for earnings than for the other sectors.

All analyses are made conditional on the physicians' choice of specialty. Given the short-term perspective of this analysis it is impossible to model the selection into specialties like Nicholson (2002). However, the individual specific wages capture the effect specialty has on earnings. The four alternative job categories are made general enough to be relevant for all specialties. Each physician should be able to find attractive jobs in all categories. Individual specific choice sets are not implemented in this paper.

When analyzing the labor supply of physicians we face some additional difficulties which we are only partly able to cope with. The market for health personnel consists of a few large buyers in the public sector and a dominant public insurance scheme for the private practices. This implies that we have elements of a monopsonistic labor market where buyers face an upward-sloping supply curve. When considering a wage increase to attract the marginal worker, the hospital must take into account that they must also increase the wages of all physicians at the hospital. In the public sector the wage bargaining is centralized, and seniority, formal qualifications and working hours seem to determine earnings. Hours per week depend on the number of physicians sharing a shift plan. This is partly decided by the chief physician at ward level and his/her preferences. For a private practitioner with a public contract the earnings are decided by a block grant from the municipality, and fee for service with fixed fees. Private practitioners without a public contract, e.g. hospital physicians working private 'overtime', are more market based in their price setting.

In the following we let the physicians choose between different sectors or job types. The alternatives are given in Table 1: *Hospitals*, *Public primary care*, *Private practice* and *Other practices* like health administration and research and development. To simplify the analysis, there is only one possible extra job when the main job is selected. The extra job is *Private practice*, except *Other practices* for those who are self-employed. In Appendix 1, Table A1 presents the distribution of main jobs actually chosen. In part of this analysis I will focus on the hospital physicians with possibilities for moon-lightening in an extra private practice. I do, however, open up for a variety in the combinations of working hours in the two jobs. The reason for the focus on a subset of hospital physicians is the superiority of the data offering reliable observations of hours worked.

*Table 1. Choice of sectors – Main job and extra job.*

| **Main job** | **Extra job – The most common alternative given the main job** |
|---|---|
| Hospitals | Private practice |
| Public Primary Care/ Municipal Medical Officer | Private practice |
| Private practice | Other |
| Other (Public administration, research, NGOs etc.) | Private practice |

## 3. Model and econometric issues

I apply a static neo-classical structural labor supply model with single decision-makers. The physician's utility depends on income, leisure and other characteristics of the jobs. The utility maximization problem is solved by discretizing the nonlinear budget set and choosing the optimal job type, hours of work and income combination from a finite set of alternatives. The approach presented here assumes that agents choose among "job packages", or more specifically - combinations of jobs, each being defined by a main job and an extra job with specific choices of hours. Examples of other applications of this framework includes Aaberge et al (1995) and van Soest (1995).

A "job package" is described by *i*, the choice of main job (and the matching extra job), the hours $H_{ij}$ in the main job, and hours $h_{ik}$ in the extra job. The individual specific wage rate per hour in the main job $W_{ij}(H_{ij})$ depends on hours worked. The wage $w_{ik}$ in the extra job is independent of hours. In addition there are other job characteristics that may affect preferences and hence choices. As an example we may think of specific skills involved in the job, patient mix or shift work. I let the *i* represent these factors in the set-up.

Since preferences are unknown to the analyst, I will assume a random utility model. The utility depends on consumption *C*, hours in the main job *H*, hours in the side job *h* and other characteristics *i.*

$$U(C,H,h,i) = v(C,H,h) + \varepsilon(C,H,h,i) \qquad (1)$$

where

$C = C_{ijk}(H_{ij}W_{ij}(H_{ij}) + h_{ik}w_{ik})$ , $H = H_{ij}$ , $h = h_{ik}$

$C_{ijk}$ is consumption in the job-package, with practice type *i*, with specific hours of work $H_{ij}$ in the main job and $h_{ik}$ in the extra job. $\varepsilon_{ijk}$ is a stochastic term with an iid extreme value distribution with an expected mean of 0 and a variance of $\sigma^2\pi^2/6$. The random term $\varepsilon_{ijk}$ captures the fact that attributes other than income and hours not observed here affect labor supply, e.g. type of job, shift work etc. The last element in the random term represents other characteristics of both jobs in the job combination, as the choice of an extra job is fixed when the main job is chosen.

$W_{ij}(H_{ij})$ is a piecewise linear wage relation in main job *i* capturing the agreed terms of overtime compensation. This is particularly important when analyzing the labor supply of hospital consultants, as they have a relatively moderate regular wage rate, but a complicated package of different compensations for extended working hours and night shifts[2]. In the private practice, physicians face the same costs, reimbursements and fees for the marginal patient as for the first. This is only an approximation as fixed costs like office rent and medical equipment are significant for some specialties. The earnings in the main job and extra job are expressed as

$$R_{ij} = W_{ij}(H_{ij})\, H_{ij} \qquad (2)$$

[2] A hospital consultant has a basic 37.5 hours working week, but shift work reduces this to 35.5 hours per week. Most physicians have agreed to a contract of extended working hours with 2.5 hours per week. This is paid with a regular wage rate, but compensated for with an additional transfer of NOK 19,900 per year. For the interval from 38 to 40.5 hours per week they are compensated with 50 percent extra per hour on top of their regular wage. This rises to 100% for the next five hours, whereas shift plans with more than 45.5 hours per week compensate the additional hours with 200% extra.

$r_{ik} = w_{ik} h_{ik}$ *(3)*

The consumption or more correctly the disposable income corresponding to the choice *i, j, k* is given by the budget constraint

$C_{ijk}=f(R_{ij}+ r_{ik})+I$ *(4)*

The *f(.)* function represents the net-of-tax income, which is a compound of earnings in the main job and earnings in the extra job. *I* is family income other than the physician's own earnings (capital income after tax, spouses income after tax, transfers). A non trivial assumption made is that the spouse's hours of work are exogenous as there is reason to believe that the spouse's choice of working hours will correlate either negatively, e.g. if one of the parents must look after the children, or positively as they prefer spending their leisure time together.

Let *B* be the opportunity set, i.e. it contains all the feasible "job-packages" available to the individual. We exclude non-market opportunities from *B* as the share of physicians not participating in the labor market is negligible[3]. Thus for all physicians $H_{ij}>0$, but $h_{ik} \geq 0$ . The physicians do not differ with regard to the number of available job sectors or practice types, as I have chosen four practice categories that should be feasible to all physicians[4]. Note that for the same physician, wage rates may differ across jobs, and that the wage rates vary with hours worked at hospitals and in primary care. Having access to their employment contracts, we are able to derive the compensation schemes for extended hours.

The physicians have a choice of $H_{ij}$ ={18, 22, 28, 35.5, 37.5, 40.5, 45.5, 50, 55} hours per week in the main job. In addition to a main job, the model gives them the possibility for $h_{ik}$ = {0, 6, 12, 18, 24} hours per week in the extra job. As stated above I assume that the

[3] See Aaberge , Colombino, Strøm & Wennemo (1998) for an example including non-market opportunities.

[4] There are of course differences in choice sets related to specialties and geographic regions, but the broad categories of job types applied here should not be too limiting. The data restricts the number of job types we are able to model. E.g. we cannot separate income from a municipal casualty clinic or a private practice.

physicians chose the same type of extra job, given their main job. E.g. if the main job is as a hospital consultant, the extra job is in a private practice, the most common type of extra job observed for each practice type.

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 identical workers, and jobs with a specific number of hours may be more available in the market than other jobs, e.g. "full-time" jobs. I introduce an opportunity density where I assume that offered hours are uniformly distributed except for full-time hours and for private practice jobs. This density is assumed to reflect that offered hours, except for full-time workload, is equally available in the market. It also corrects for the fact that if the physicians choose to work in a private practice, the hours available in the market will be less regulated (or not at all) relative to jobs in the public sector. Hours in the side job are uniformly distributed.

Since hours of work and consumption are given when the job package is given, the physician's choice problem is a discrete one, namely to find the job that maximizes utility. As already mentioned, the analyst does not observe preferences and neither does he observe all details of the job-packages available in the market. The problem solved by the physician looks like this:

$$\max_{(i,H_{ij},h_{ik})} U[C_{ijk}, H_{ij} + h_{ik}, i] \tag{5}$$

*s.t.*

$$(H_{ij}, h_{ik}, W_{ij}(H_{ij}), w_{ik}, i) \in B. \tag{6}$$

Let $P_{ijk}(H_{ij}, h_{ik})$ be the probability that the physician will choose a "job package" with $H_{ij}$ hours of work in the main job and $h_{ik}$ hours of work in the side job. When the random error terms are iid extreme value distributed, the probability can be expressed as

$$P_{ijk}(H_{ij}, h_{ik}) = \Pr(U_{ijk} = \max_{\{r, H_{rt}, h_{rs}\} \in B} U_{rts}) \tag{7}$$

I follow the modeling explained in Aaberge, Colombino and Strøm (1999) and get

$$P_{ijk}(H_{ij}, h_{ik}) = \frac{\exp(V_{ijk}/\sigma)g(H_{ij})}{\sum_r \sum_s \sum_t \exp(V_{rst}/\sigma)g(H_{rs})} \tag{8}$$

Due to the assumption of extreme value distributed utilities it follows readily that the choice probabilities are multinominal logits. By setting $g(.)=1$ in (8) we get the standard multinominal logit.

The analyst has incomplete knowledge or information about variables entering the choice set *B,* and one way to take account of this incomplete knowledge is to specify probability distributions for these variables. The $g(.)$ function is a probability density that enters the choice probabilities due to job-specific offered hours available in the market. The interpretation of the "opportunity density extended" version of the standard multinominal logit given in (8), is that the attractiveness of a choice measured by $\exp(V_i/\sigma)$ is weighted by a function saying how available this choice is in the market. For more details about this methodology I refer to Aaberge, Colombino and Strøm (1999).

Next we have

$$g(H_{ij}) = \exp(\nu_1 K_{ij} + \nu_2 L_{ij}) \tag{9}$$

where $g(H_{ij})$ is the marginal probability density of offered hours. We will assume that offered hours are uniformly distributed except for full-time hours. This density is assumed to reflect that offered hours, except for full-time workloads, are equally available in the market. $K_{ij}=1$ if the main job is a full-time job (35.5 hours per week or more), and $K_{ij}=0$ otherwise. $L_{ij}=1$ if the main job is private, and $L_{ij}=0$ otherwise. The latter captures the fact that if the main job is private, the hours available in the market will be less regulated (or not at all) relative to jobs in the public sector.

It should be noted that the offered wages depend on hours worked; that is $W_{ij} = W_{ij}(H_{ij})$. This expression also enters the deterministic part of the utility function through disposable income $C_{ijk}$. The reason why I am able to identify $V_{ijk} / \sigma$ is because I use detailed institutional information to derive how offered wages $W_{ij}$ vary with hours worked. Given this institutional information, wage equations are estimated to capture how human capital characteristics and sector-specific constants affect expected wages.

The deterministic part of the preferences is represented by the following "Box-Cox" type utility function,

$$V_{ijk} = \alpha \frac{(10^{-6} C_{ijk})^{\lambda} - 1}{\lambda} + \beta(X) \frac{((8760 - H_{ij} - h_{ik}) / 8760)^{\gamma} - 1}{\gamma} \quad (10)$$

where

$$\beta(X) = \beta_0 + \beta_q X_q, q = 1,..,7$$

See for instance, Heckman and MaCurdy (1980), and Aaberge, Dagsvik and Strøm (1995) for empirical analyses applying this specification. An advantage of using this specification is that it is flexible enough to yield both negative (backward-bending labor supply curve) and positive wage elasticities. 8,760 is the total number of annual hours, while $\alpha$, $\lambda$, $\gamma$ and the $\beta's$ are unknown parameters. For the utility function to be quasi-concave, we require $\lambda$<1 and $\gamma$<1. Note that if $\lambda \to 0$ and $\gamma \to 0$, the utility function converges to a log-linear function. An alternative is to represent the utility function with a polynomial like van Soest (1995).

The characteristics are: $X_1$= Age of the physician, $X_2$= Number of children below six years of age, $X_3$=1, if the spouse is not working, =0 otherwise, $X_4$=1, if the individual is from Norway; =0 otherwise, $X_5$=1, if female, =0 otherwise. $X_6$=1, if the physician is a specialist in surgery, internal medicine or laboratory medicine, =0 otherwise.

The parameters *($\alpha$, $\lambda$, $\gamma$, $\beta_0$, $\beta_1$, $\beta_2$, $\beta_3$, $\beta_4$, $\beta_5$, $\beta_6$, $v_1$, $v_2$)* are estimated in a maximum-likelihood procedure. Note that $\sigma$ is not identified and is absorbed in $\alpha$ and $\beta$.

## 4. Sample and variable construction

This study is based on several of the administrative data registers covering Norwegian residents. Using the register of authorized health personnel as an identifier, I link information about demography, income and employment relations. The main years of analysis are 1995 and 1997. Our trimming procedure excludes personnel below 28 and above 66 years of age, as many retire at 67. Some personnel categories have access to early retirement, but it was not common at that time. Individuals with an inconsistent professional status or missing important variables are excluded. A discussion of the data quality and summary statistics for key individual level variables are provided in Appendix 1. The sample consists of 9,663 individuals in 1995 and 12,252 in 1997 as presented in Table A3. Some sets of analysis have additional restrictions, and the number of observations is reported in the respective sections.

Individuals who have multiple jobs have been assigned a main job and an extra job. Personnel working full-time in public hospitals, or at other institutions organized by the Norwegian Association of Local and Regional Authorities (NALRA), have this job assigned as their main job. For the rest of the sample the main job is the one with highest annual earnings. Each individual is only assigned two jobs. It is not uncommon to have even more jobs, but these tend to be minor both when it comes to hours and income, and are therefore disregarded. The annual taxable earnings do however include all jobs. Each individual is assigned an hourly wage not only in the sectors they are observed in, but also a predicted wage they would earn if they were to work in some of the other sectors. I exploit the richness of the register data in this procedure, including specialty, residency and observed experience from the previous 20 years. See Appendix 2 for wages, and Appendix 3 for taxes.

## 5. Empirical results

This section presents the results from four sets of analysis. The first three are based on subsets of hospital physicians working in 1995. The fourth set is an analysis of all physicians working in 1997. Each analysis contains a discussion of the estimated parameters of the model, before the observed and predicted choices of working hours and sector mix are presented. For hospital physicians I also present an 'experiment', using the parameters estimated on 1995 data to predict hours in 1997, using hourly wages in 1997. This is no genuine panel data analysis, but a cross-sectional analysis from 1995 used to make out-of-sample predictions in 1997. I evaluate these predictions through comparisons with the observed choices in 1997.

The physicians choose between nine categories, or intervals, of hours in their main job and five categories of hours in the extra job. This is of course a simplification of the actual variation in working time, but should cover the most common choices. E.g. a primary care physician may face the choice of a full-time private practice or a combination of four days a week in the private practice and one day working at the local mother & child health center. For hospital physicians a more common dilemma is whether to spend their spare time working extended hours at the public hospital, or in a private practice.

***Table 2. Four samples – Choices, wage data, and sample sizes.***

| Sample | Main job | Extra job | Wage data | Parameters estimated* and choices predicted on data from: | Sample size | Out-of-sample predictions (Table 7) | Sample size | Comments |
|---|---|---|---|---|---|---|---|---|
| **Hospital physicians with data on overtime work (Table 4)** | *Hospital* only | *Private* | NALRA & Estimates of private 'wages' | 1995 | *2775* | 1997 | *1553* | *Largest available data set with high quality data* |
| **Male sr. hospital consultants only (Table 5)** | *Hospital* only | *Private* | NALRA & Estimates of private 'wages' | 1995 | *1521* | 1997 | *790* | *Male qualified specialists are more active in the private market* |
| **Hospital physicians with complete data set before and after pay reform (Table 6)** | *Hospital* only | *Private* | NALRA & Estimates of private 'wages' | 1995 | *1036* | 1997 | *1036* | *Identical sample in 1995 & 1997 simplifies prediction evaluation* |
| **All physicians (Table 9)** | Choice of four sectors | *Private* *Other* if main job is *Private* | All available data sets | 1997 | *9528* | No | | Complete sample, but less robust data on hours and wages |

**All estimated parameters are presented in Table 3.*

Section 5.1 presents an analysis based on the largest available sets of hospital physicians with a complete NALRA data set from 1995 or 1997. Section 5.2 limits the sample to male specialist consultants working with internal medicine, surgery or laboratory medicine. This is done in order to focus on a more homogenous group with a particular potential for private extra practice as their training is completed. Like section 5.1, the analysis in section 5.3 includes jr. and sr. physicians, but only those observed with complete records in *both* 1995 and 1997. Using an identical sample for 1995 and 1997 simplifies the prediction evaluation when predicting out of sample in 1997.

I assume that hospital physicians have an extra job in a private practice. If they do not work in a second job I regard this as zero hours in this job. In sections 5.1-5.3 I present the observed choices of hours in the hospital job and in the private job in 1995, prior to four predictions for the same year. The first prediction is based on the observed wages, the second with a ten percent wage increase in the hospital sector, then a similar increase in private 'wages' only, and finally a ten percent increase in both wages. Section 5.4 continues with an 'experiment' - using the estimates from 1995 to predict the choices for the hospital physicians in 1997 based on observed wages for this year. The predictions are compared with the observed choices in 1997.

Section 5.5 adopts a broader perspective and includes all physicians allocated to four alternative sectors. The advantage of this approach is the ability to predict the changes in average working hours for all physicians from sector specific wage increases. The disadvantage is that I rely on data with poorer quality than the NALRA data. The extra job is also here restricted to private practice, the most common choice observed. The exception is private practitioners with *other job types* as their extra job. This includes education and research, health administration, NGOs, industrial medical officers etc. Section 5.6 sums up the general results. Appendix 4 presents figures illustrating the observations and predictions for the four sets.

From Table 3 we observe that all parameters are sharply determined and that $\lambda$ and $\gamma$ are estimated to yield a quasi-concave utility function. On the data set considered to be of the best quality, $\lambda$ is estimated to be close to 1, which implies that utility is a linear function of income. It is interesting to note that the estimates of $\lambda$ and $\gamma$ are similar across these first three data sets.

**Table 3 Estimation of parameters of the utility function and opportunity densities**

| | | Hospital physicians | | Male specialist consultants | | Hospital physicians observed 95-97 | | All physicians | |
|---|---|---|---|---|---|---|---|---|---|
| | | Estimate | P-value | Estimate | P-value | Estimate | P-value | Estimate | P-value |
| | ***Utility function*** | | | | | | | | |
| $\beta_0$ | Constant 'leisure element' | 18.09 | [.000] | 20.83 | [.000] | 19.40 | [.000] | 4.80 | [.000] |
| $\beta_1$ | Age | 0.05 | [.068] | 0.04 | [.338] | 0.13 | [.013] | 0.01 | [.009] |
| $\beta_2$ | Number of children below 6 years of age | 1.33 | [.000] | 1.05 | [.011] | 1.56 | [.005] | 0.15 | [.049] |
| $\beta_3$ | =1 if spouse does not work, =0 otherwise | 0.39 | [.451] | 1.46 | [.068] | -0.41 | [.655] | 0.85 | [.000] |
| $\beta_4$ | =1 if the physician is from Norway, =0 otherwise | -0.87 | [.109] | -1.23 | [.120] | -0.25 | [.793] | -0.21 | [.042] |
| $\beta_5$ | =1 if female, =0 if male | 3.72 | [.000] | | | 3.95 | [.000] | 0.48 | [.000] |
| $\beta_6$ | =1 if hospital specialist, =0 otherwise | -1.23 | [.004] | | | -1.31 | [.077] | | |
| $\alpha$ | Constant 'consumption element' | 2.23 | [.000] | 2.67 | [.000] | 2.79 | [.000] | 3.45 | [.000] |
| $\lambda$ | Exponent 'consumption element' | 0.86 | [.000] | 0.85 | [.000] | 0.93 | [.000] | 0.59 | [.000] |
| $\gamma$ | Exponent leisure | -1.50 | [.000] | -1.40 | [.000] | -1.31 | [.000] | -3.72 | [.000] |
| | ***Opportunity density**** | | | | | | | | |
| $v_1$ | =1 if working full-time, =0 otherwise | 4.93 | [.000] | 5.08 | [.000] | 5.62 | [.000] | -0.16 | [.000] |
| $v_2$ | =1 if Private practitioner, =0 otherwise | | | | | | | -2.10 | [.000] |
| Number of observations | | 2775 | | 1521 | | 1036 | | 9528 | |
| Log likelihood | | -8397.03 | | -4676.53 | | -3099.03 | | -32933.6 | |
| McFadden's Rho | | 0.21 | | 0.19 | | 0.21 | | 0.36 | |

* *For the wage equation see Appendix 2.*

## 5.1 Hospital physicians

The first subset contains all physicians working at NALRA hospitals in 1995 or 1997, with a complete record of overtime compensation. This includes physicians under specialist training and consultants. The model parameters presented in Table 3 are all significant with the exception of some of the $\beta s$ in the leisure component. The income term in the utility function *(10)* is estimated with a $\lambda$ of 0.86 and an $\alpha$ of 2.23. The $\gamma$ in the leisure component is estimated to -1.50. $\beta_2$ and $\beta_5$ are significant and positive, meaning that individuals with a child below 6 years of age and women value leisure more than average. The opposite occurs for the hospital specialist represented by $\beta_6$. The older physicians value leisure more than average, but this effect is not significant at the five percent level. The $\beta s$ related to whether the spouse works or not and country background are less sharply determined. The $g(H_{ij})$-function in *(9)* with a dummy representing a full-time position is represented with the significant parameter $v_1$ of 4.93.

***Table 4 Physicians at NALRA hospitals in 1995. Observed and predicted choices***
***Jr. physicians and hospital consultants***

| | Observed hours | | Predicted Hours | | Predictions with a 10% increase in hospital wages | | Predictions with a 10% increase in private wages | | Predictions with a 10% increase in all wages | |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Hours per week*** | | *s.d.* | | *s.d.* | | *s.d.* | | *s.d.* | | *s.d.* |
| Hospital | 42.3 | *(6.2)* | 41.8 | *(1.2)* | 42.5 | *(1.4)* | 41.7 | *(1.2)* | 42.4 | *(1.4)* |
| Private extra practice | 4.1 | *(6.2)* | 5.2 | *(0.9)* | 5.0 | *(0.9)* | 5.7 | *(1.0)* | 5.5 | *(1.0)* |
| Total | 46.5 | *(8.6)* | 47.0 | *(1.9)* | 47.5 | *(2.1)* | 47.4 | *(2.0)* | 47.9 | *(2.1)* |
| ***Hours per year*** | | | | | | | | | | |
| Hospital | 2032 | *(298)* | 2008 | *(60)* | 2041 | *(68)* | 2002 | *(59)* | 2034 | *(67)* |
| Private extra practice | 198 | *(296)* | 250 | *(43)* | 240 | *(41)* | 275 | *(49)* | 264 | *(47)* |
| Total | 2230 | *(413)* | 2258 | *(93)* | 2281 | *(98)* | 2277 | *(97)* | 2299 | *(102)* |

| ***Elasticities*** | Total | | Main job | | Extra job | |
|---|---|---|---|---|---|---|
| Effect of an increase in hospital wages | 0.10* | *(0.05)* | 0.16* | *(0.05)* | -0.40* | *(0.16)* |
| Effect of an increase in private wages | 0.08* | *(0.02)* | -0.03* | *(0.01)* | 0.99* | *(0.14)* |
| Effect of an increase in all wages | 0.18* | *(0.06)* | 0.13* | *(0.04)* | 0.56* | *(0.26)* |

N=2775

*Standard deviations in brackets.*
** Significantly different from zero at a 95 percent confidence level.*
*This table corresponds to Table P4 in Appendix 5.*

Table 4 presents the average hours in the hospital job and in the private extra practice. The corresponding Table P4 in Appendix 4 presents the observed shares and predicted probabilities for the alternative choices of 'job-mix' for the nine categories of hours in the main job, in combination with the five possible alternatives in the extra job, which are used to derive the hours of work. The 2,775 physicians have an 'observed' average of annual working hours per year of 2,230. Their labor is shared between 2,032 hours per year, or 42 hours per week, in their hospital job, and 198 hours per year in a private job, corresponding to 4 hours per week.

When I compare the 'observed' hours with the predictions from the model, I slightly underpredict hours in the hospital job (2,008 vs. 2,032 hours) and overpredict hours in the private practice (250 vs. 198 hours), in total an average of 28 hours less per year. The 'observed' hospital working hours lie within the predicted confidence interval (standard deviation of 60). The private practice hours are less accurately predicted with a standard deviation of 43. The model thus predicts the total hours reasonably well, but the predictions of sector mix are slightly biased.

In a policy simulation I now introduce a 10 percent wage increase for the hospital job, keeping private 'wages' constant. The predictions are a small increase in hours in the hospital job, 33 hours per year or a 1.6 percent increase. There is a predicted reduction in the private extra job of 10 hours per year, or a 4 percent reduction. The total effect is a predicted 23 hour, or 1 percent, increase. The opposite effect occurs with a 10 percent 'wage' (fee) increase in private practice - 6 hours less per year at the hospital, and 25 hours more in the private practice. With a 10 percent wage increase in both sectors, the model predicts a mean increase in labor supply of 41 hours per year, where the hospital job absorbs 26 hours of the increase.

The wage elasticities are positive and significantly different from zero. Looking at changes in total hours from an increase in the hospital wage, I find a wage elasticity of 0.10. The sector specific elasticities are 0.16 in the hospital job and -0.40 in the private practice. The wage elasticity when increasing the private wages is 0.08 for total working hours, -0.03 in the hospital job and 0.99 in the private practice. With an increase in both wages, the elasticity is 0.18 in total hours, 0.13 at the hospital and

0.56 in the private practice. In all cases the total change in hours worked is moderate, with elasticities in the range of 0.1-0.2. The exception is the private practice with a small number of hours worked in the reference case creating high elasticities up to 1.

### 5.2 Male hospital consultants

Restricting the sample to male hospital consultants working with internal medicine, surgery or laboratory medicine, leaves us with 1,521 observations in 1995. This group is expected to be more active both in the main job and in particular the extra practice as their training is completed. Male physicians traditionally also have less leisure than their female colleagues. The model parameters are presented in Table 3. The income term in the utility function is estimated with a $\lambda$ of 0.85 and an $\alpha$ of 2.67. The $\gamma$ in the leisure component is estimated to - 1.40. $\beta_2$ is positive and significant, meaning that those with children below 6 years of age value leisure more than average. The $g(H_{ij})$ -function is represented with a parameter $v_1$ of 5.08.

The consultants have an 'observed' average of annual working hours per year of 2,305, divided between 2,086 hours per year, or 43.5 hours per week, in their hospital job, and 219 hours per year in a private job, corresponding to 4.6 hours per week.

***Table 5 Male Hospital Consultants at NALRA Hospitals in 1995. Observed and Predicted Choices***

| | Observed hours | | Predicted hours | | Predictions with 10% increase in hospital wages | | Predictions with 10% increase in private wages | | Predictions with 10% increase in all wages | |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Hours per week*** | | | | | | | | | | |
| Hospital | 43.5 | *(6.1)* | 42.9 | *(1.0)* | 43.9 | *(1.1)* | 42.7 | *(1.0)* | 43.7 | *(1.1)* |
| Private extra practice | 4.6 | *(6.2)* | 5.4 | *(0.6)* | 5.1 | *(0.5)* | 6.0 | *(0.7)* | 5.7 | *(0.6)* |
| Total | 48.0 | *(8.3)* | 48.3 | *(1.1)* | 49.0 | *(1.2)* | 48.7 | *(1.2)* | 49.4 | *(1.2)* |
| ***Hours per year*** | | | | | | | | | | |
| Hospital | 2086 | *(295)* | 2061 | *(47)* | 2107 | *(54)* | 2052 | *(46)* | 2098 | *(54)* |
| Private extra practice | 219 | *(299)* | 257 | *(27)* | 244 | *(26)* | 288 | *(31)* | 275 | *(30)* |
| Total | 2305 | *(398)* | 2318 | *(54)* | 2352 | *(59)* | 2340 | *(55)* | 2373 | *(60)* |

| ***Elasticities*** | Total hours | | Main job | | Extra job | |
|---|---|---|---|---|---|---|
| Effect of an increase in hospital wages | 0.15* | *(0.03)* | 0.23* | *(0.03)* | -0.49* | *(0.09)* |
| Effect of an increase in private wages | 0.10* | *(0.02)* | -0.04* | *(0.01)* | 1.21* | *(0.08)* |
| Effect of an increase in all wages | 0.24* | *(0.03)* | 0.18* | *(0.03)* | 0.68* | *(0.12)* |

*N=1521*

*Standard deviations in brackets.*

*This table corresponds to Table P5 in Appendix 5.*

Comparing the ‘observed’ hours with the predictions from the model as presented in Table 5, I find an underprediction of hours in the hospital job (2,061 vs. 2,086 hours) and an overprediction of hours in the private practice (257 vs. 219 hours), totaling to 13 hours more per year on average. Like the first model the prediction of total hours is good, but the predictions of sector mix are biased. As expected this group works more in average in both jobs compared to the section above. Moving to the policy analysis I find a similar pattern to that of the whole group of hospital physicians, but higher elasticities.

### 5.3 Hospital physicians with full data sets in 1995 and 1997

The next set is an analysis of 1,036 hospital physicians with complete NALRA data of overtime work observed in both 1995 and 1997. An argument for looking at this group is to analyze the same individuals before and after the major wage increase in the health sector from 1995 to 1997, when undertaking the experiment in the next section.

As presented in Table 3, the income term in the utility function is estimated with a $\lambda$ of 0.93 and an $\alpha$ of 2.79. The $\gamma$ in the leisure component is estimated to - 1.31. Not all the variables in the $\beta$-function are significant, but the following are: age, number of children below six years of age, gender. The older the physician is, the more he/she values leisure, and the same goes for parents with small children and women. The hospital specialists values leisure less than average, but this effect is not significant at the five percent level.

***Table 6 Hospital Physicians, observed both in 1995 and 1997.***
***Observed and predicted Choices. Jr. physicians and hospital consultants***

| | Observed hours | | Predicted hours | | Predictions with a 10% increase in hospital wages | | Predictions with a 10% increase in private wages | | Predictions with a 10% increase in all wages | |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Hours per week*** | | *s.d.* | | *s.d.* | | *s.d.* | | *s.d.* | | *s.d.* |
| Hospital | 44.4 | *(5.8)* | 43.3 | *(1.5)* | 44.5 | *(1.7)* | 43.1 | *(1.4)* | 44.3 | *(1.7)* |
| Private extra practice | 3.6 | *(5.9)* | 4.9 | *(0.9)* | 4.6 | *(0.9)* | 5.6 | *(1.1)* | 5.2 | *(1.0)* |
| Total | 48.0 | *(8.4)* | 48.2 | *(2.0)* | 49.1 | *(2.2)* | 48.7 | *(2.1)* | 49.5 | *(2.2)* |
| ***Hours per year*** | | | | | | | | | | |
| Hospital | 2130 | *(279)* | 2079 | *(70)* | 2136 | *(83)* | 2070 | *(68)* | 2127 | *(81)* |
| Private extra practice | 174 | *(283)* | 234 | *(43)* | 219 | *(41)* | 267 | *(52)* | 251 | *(49)* |
| Total | 2304 | *(403)* | 2312 | *(95)* | 2355 | *(103)* | 2337 | *(99)* | 2378 | *(107)* |

| ***Elasticities*** | Total hours | | Main job | | Extra job | |
|---|---|---|---|---|---|---|
| Effect of an increase in hospital wages | 0.19* | *(0.06)* | 0.27* | *(0.06)* | -0.60* | *(0.17)* |
| Effect of an increase in private wages | 0.10* | *(0.03)* | -0.04* | *(0.01)* | 1.41* | *(0.18)* |
| Effect of an increase in all wages | 0.28* | *(0.06)* | 0.23* | *(0.06)* | 0.74* | *(0.27)* |

*N=1036*

*Standard deviations in brackets.*

*This table corresponds to Table P6 in Appendix.5.*

From Table 6 we see that the hospital physicians have an 'observed' average of annual working hours per year of 2,130 compared to the predicted 2,079 hours per year. The private practice hours are 'observed' with 174 hours and predicted with 234 hours per year. The sums for observed and predicted hours are close, at 48 hours per week - 2,304 hours and 2,312 hours respectively per year. Like in the previous models the prediction of total hours is good, but the predicted sector mix deviates from the observed one. From Table P6 in Appendix 4 we observe that common 'job packages' with 45.5 or 50 hours per week at the hospital and no private income, are underpredicted.

The next step is the policy analysis with a 10 percent wage increase for the hospital job, keeping private 'wages' constant. The prediction is an increase of 3 percent for hospital hours, or 57 hours per year. The private hours are predicted to be reduced by six percent or 15 hours per year. The total is an increase of 43 hours or 2 percent. Like in section 5.1 the opposite effect occurs with a 10 percent 'wage' (fee) increase in private practice: An average of 9 hours less per year in the hospital job or two percent reduction in hospital hours, and an increase of 33 hours or 14 percent in private practice hours, corresponding to a one percent increase in total hours.

With a 10 percent wage increase in both sectors, the model predicts a mean increase in the labor supply of 66 hours per year, of which the hospital job absorbs 48 hours. Looking at changes in total hours after an increase in the hospital wage, I find a wage elasticity of 0.19. The sector specific elasticities are 0.27 in the hospital job and -0.60 in the private practice. The wage elasticity when increasing the private wages is 0.10 for total working hours, -0.04 in the hospital job and 1.41 in the private practice. With an increase in both wages the elasticity is 0.28, 0.23 at the hospital and 0.74 in the private practice. In all policy simulations the total change in hours worked is small, with wage elasticities from 0.1 to 0.3.

### 5.4 Predictions based on 1997 data

In this section I present an 'experiment' applying the models in 5.1-5.3 based on 1995 data to predict the labor supply in 1997. I use the 'observed' hourly wages in 1997, in the meaning of the calculated wages based on income and available data on hours. Combining these wages with parameters estimated on 1995 data gives an opportunity to evaluate the reliability of the predictions by comparing the predicted choices with the observed ones. Table 7 displays the three subsets of hospital physicians with private extra practice presented in the sections above.

***Table 7 Prediction experiment on 1997 Data***

***Observed choices in 1997 and predicted choices in 1997.***

***Predictions based on 1995 model parameters and 1997 wages.***

| | **All hospital physicians** N=1553 | | | | **Male hospital consultants** N=790 | | | | **Hospital physicians observed in 1995 & 1997** N=1036 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Observed 1997 | | Predicted with 1997 wages | | Observed 1997 | | Predicted with 1997 wages | | Observed 1997 | | Predicted with 1997 wages | |
| Hours per week | | *s.d.* | | *s.d.* | | *s.d.* | | *s.d.* | | *s.d.* | | *s.d.* |
| Hospital | 43.4 | *(-7.1)* | 42.7 | *(-1.2)* | 45 | *(-6.8)* | 44.1 | *(-0.8)* | 43.7 | *(-6.5)* | 42.7 | *(-1.2)* |
| Private extra practice | 3.6 | *(-5.9)* | 5.5 | *(-1.3)* | 4 | *(-6.2)* | 6.2 | *(-0.9)* | 3.2 | *(-5.5)* | 5.5 | *(-1.3)* |
| Total | 47 | *(-9.1)* | 48.2 | *(-2.3)* | 49 | *(-9)* | 50.3 | *(-1.2)* | 46.9 | *(-8.6)* | 48.2 | *(-2.3)* |
| Hours per year | | | | | | | | | | | | |
| Hospital | 2082 | *(-342)* | 2049 | *(-59)* | 2160 | *(-326)* | 2116 | *(-40)* | 2096 | *(-310)* | 2049 | *(-59)* |
| Private extra practice | 171 | *(-285)* | 266 | *(-60)* | 194 | *(-299)* | 298 | *(-44)* | 156 | *(-266)* | 266 | *(-60)* |
| Total | 2254 | *(-435)* | 2315 | *(-110)* | 2354 | *(-432)* | 2414 | *(-55)* | 2252 | *(-411)* | 2315 | *(-110)* |

*Standard deviations in brackets. This table corresponds to Table P7 in Appendix 5.*

I find that the predictions overestimate the total hours in all alternatives by up to three percent. In all samples, the average labor supply at hospitals is underestimated, whereas the private extra job is overestimated.

In the first set the predicted amount of average hours in the hospital job is 2,049, compared to 2,082 hours per year observed. For the private practice the model predicts 266 hours per year compared to our calculated 171. The total hours predicted for hospital consultants are 2,414, compared to 2,354 hours observed per year. The number of private hours is also here significantly higher than the one calculated based on survey data. For the group observed with a complete data set for both years, the prediction is 2,049 hours per year in the hospital job and 266 in private practice, compared to 2,096 and 156 'observed' hours. The predicted total hours thus outnumber the 'observed' ones by 63, or almost 3 percent. The largest deviation between prediction and observation occurs in the sample using the same individuals to estimate the parameters used in the predictions.

The predictions of total hours are more or less in the region of the observed choices, and the predictions have the correct direction of changes in hospital hours from 1995 to 1997 when comparing Table 7 to Tables 4-6. The private hours are overpredicted, but the predicted direction is correct.

## 5.5 A note on the changes in observed hours from 1995 to 1997.

In light of the major increase in hospital wages from 1995 to 1997, it is also interesting just to look at the changes in observed hours. The focus here will be on the hospital hours, observed with a complete data set before and after the hospital pay reform. Table 8 reports two measures on hourly wages, a basic wage before compensations and benefits, and the mean of total income divided by total hours. We know that the marginal wage when working overtime is three times the wage of the first hour. The mean basic wage was around NOK 150 in 1995 increased by 12-14 percent the next two years after correcting for price increases. The total income divided by all hours gives a mean hourly wage of NOK 210-230 in 1995, increasing around 35 percent in 1997 due to changes in the payment structure for overtime work.

During the same period there was a small reduction in average number of hours worked, from 2,130 hours per year to 2,096 for individuals with a complete data set prior to and after the pay reform. This equals a reduction from 44.4 to 43.7 hours per week. Some specialists, like anesthetists, typically work 48 hours per week, others no more than the general contract of 37.5 hours per week. In a period with a significant wage increase we thus observe a small reduction in hours worked. This result may be due to a strong income effect, or institutional mechanisms reducing physicians' overtime in order to keep the budget in spite of a marked wage increase. For the first two subsets however, we observe a positive labor supply response of about 4 percent for the male specialists.

***Table 8***

***Changes in observed hours and mean hourly wages. Hospital physicians 1995-1997.***

| | N | | Hospital hours | | | Basic hourly wage | | | Income/Hours | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1995** | **1997** | **1995** | **1997** | **Change** | **1995** | **1997** | **Change** | **1995** | **1997** | **Change** |
| **Hospital physicians** | **2775** | **1553** | 2032 | 2082 | 2 % | 146 | 166 | 12 % | 211 | 278 | 33 % |
| | | | *(298)* | *(342)* | | *(17.0)* | *(14.6)* | | *(36.5)* | *(40.6)* | |
| **Male consultants** | **1521** | **790** | 2086 | 2160 | 4 % | 151 | 171 | 14 % | 228 | 308 | 35 % |
| | | | *(295)* | *(326)* | | *(14.1)* | *(9.5)* | | *(28.7)* | *(23.8)* | |
| **Hospital physicians obs. In 95-97** | **1036** | **1036** | 2130 | 2096 | -2 % | 150 | 169 | 12 % | 214 | 291 | 36 % |
| | | | *(279)* | *(310)* | | *(16.4)* | *(12.4)* | | *(36.5)* | *(36.9)* | |

*1995 prices*

The data on private hours are less reliable, but included in Figure 4 in Appendix 4. In all the sets of hospital physicians there is a reduction in private work. My calculations indicate a reduction in the extra job, with an average of about 20 hours per year. The direction of this change seems reasonable given the major increase in hospital wages, making it relatively more profitable to continue at the hospital instead of moving to a private practice. The size of the effect however, is uncertain.

### 5.6 All physicians practicing in 1997

Expanding the sample to include all physicians practicing in 1997 gives us an opportunity to analyze the impact on all sectors of changes in sector specific wages. The physicians have a job choice between four sectors as described by Table A8. 55 percent of the physicians have a main job in the hospital sector, 31 percent as private practitioners, 7 percent as municipal health officers and the remaining 6 percent have other jobs, e.g. within health administration and research. The extra job is restricted to private practice, the most common choice observed. The exception is private practitioners with *other* as their extra job. As before, the working hours are set to zero if they do not work in an extra job.

The parameter estimation, as presented in Table 3, gives an income term in the utility function with a $\lambda$ of 0.59 and an $\alpha$ of 3.45. The $\gamma$ in the leisure component is estimated to –3.72. The older the physician, the more he/she values leisure, and the same goes for parents with small children, individuals whose spouse does not work or who have a foreign background, and women. The $g(H_{ij})$-function is estimated with a dummy for full-time work and a dummy for private practitioners.

From Table 9 we see that the physicians have an 'observed' average of 1,953 working hours per year in their main job, compared to the predicted 1,895 hours per year. The more uncertain estimation of the extra job is 'observed' with 365 hours and predicted with 439 hours per year. The sums are close with 2,319 hours 'observed' and 2,333 hours predicted per year. This sample gives less precise predictions than the three subsets of hospital physicians, but the prediction of total hours is better than the predictions for the main job and the second job. The total working hours correspond to 48 hours per week. The amount of hours in the extra job is higher than in the previous samples for hospital physicians. This is not only due to the inclusion of other sectors, but also that private practitioners with a public contract receive income from several sources. As I have not been able to aggregate these sources in this set, I register the block grant from the municipality as an extra job.

In the policy analysis the predicted effect of a 10 percent increase in hospital wages is an increase of 3 percent, or 51 hours per year, in the hospital hours. The private hours are predicted to be reduced by five percent or 22 hours per year. This gives a total increase of 30 hours, or one percent. A ten percent increase in wages in public primary care has small effects on the mean working hours for all physicians, partly due to their limited share of the total population also after a simulated wage increase. A ten percent wage increase results in an average of 5 hours more worked in the main job, and 3 hours less in the extra job.

A 10 percent ‘wage‘ (fee) increase in private practice reduces the hours in the main job for those working private practice as their *extra* job, and increases the hours for those working private practice as their *main* job. The result is a minimal predicted change of 7 hours less per year in the main job. The hours in the extra job are increased by 4 percent, driven by the hospital physicians with a second job in private practice. A similar policy experiment with an increase in *other* wages, predicts no major change in the main job, and a 1.5 percent increase in extra job hours.

If all wages are raised by 10 percent, there is a mean increase of 50 hours per year in the main job and no change in the extra job. The wage elasticity in this case is 0.22 and significantly different from zero. As reported in Table 9 the elasticities for all the other policy experiments are small and positive, but not significant.

## *Table 9 All physicians in 1997. Observed and predicted choices.*

| | Observed share | | Predicted choice | | Predictions with a 10% increase in *hospital* wages | | Predictions with a 10% increase in *primary care* wages | | Predictions with a 10% increase in *private* wages | | Predictions with a 10% increase in *other* wages | | Predictions with a 10% increase in *all* wages | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Hours per week*** | | | | *s.d.* | | *s.d.* | | *s.d.* | | *s.d.* | | *s.d.* | | *s.d.* |
| Main | 40.7 | *10.5* | 39.5 | *(4.7)* | 40.5 | *(5.4)* | 39.6 | *(4.6)* | 39.3 | *(4.3)* | 39.4 | *(4.7)* | 40.5 | *(4.9)* |
| Extra | 7.6 | *7.3* | 9.1 | *(1.4)* | 8.7 | *(1.6)* | 9.1 | *(1.4)* | 9.5 | *(1.6)* | 9.3 | *(1.4)* | 9.2 | *(1.5)* |
| Total | 48.3 | *11.7* | 48.6 | *(4.1)* | 49.2 | *(4.5)* | 48.7 | *(4.0)* | 48.9 | *(3.9)* | 48.7 | *(4.0)* | 49.7 | *(4.2)* |
| ***Hours per year*** | | | | | | | | | | | | | | |
| Main | 1953 | *503* | 1895 | *(225)* | 1946 | *(260)* | 1900 | *(222)* | 1888 | *(208)* | 1893 | *(224)* | 1945 | *(235)* |
| Extra | 365 | *351* | 439 | *(68)* | 417 | *(77)* | 436 | *(66)* | 458 | *(77)* | 446 | *(67)* | 440 | *(74)* |
| Total | 2319 | *561* | 2333 | *(195)* | 2363 | *(215)* | 2336 | *(194)* | 2347 | *(187)* | 2338 | *(191)* | 2385 | *(200)* |

| ***Elasticities*** | **Total hours** | | **Main job** | | **Extra job** | |
|---|---|---|---|---|---|---|
| *Wage increase in* | | *s.d.* | | *s.d.* | | *s.d.* |
| Hospitals | 0.12 | *(0.11)* | 0.25 | *(0.23)* | -0.51 | *(0.47)* |
| Primary care | 0.01 | *(0.05)* | 0.03 | *(0.11)* | -0.04 | *(0.16))* |
| Private practice | 0.06 | *(0.07)* | -0.02 | *(0.22)* | 0.45 | *(0.63)* |
| Other jobs | 0.02 | *(0.03)* | -0.01 | *(0.09)* | 0.17 | *(0.31)* |
| All sectors | 0.22* | *(0.04)* | 0.26* | *(0.06)* | 0.01 | *(0.15)* |

*Standard deviation in brackets.*

*This table corresponds to Table P9 in Appendix 5.*

## 5.7 Discussions

The previous sections have presented three samples of hospital physicians and one complete set of all physicians working in Norway. The reason for the focus on hospital physicians is the superiority of the data on working time compared to the other sectors. It is important to remember that this discrete choice application is only an approximation, with 9 alternative hours in the main job and five alternatives when having a side job.

The observed and predicted choice of hours in the main job and extra job is presented in Figure 1 - Figure 3 in Appendix 4. The first bar to the left represents hours worked in 1995. The second is for predicted hours with unchanged wages. The third represents a prediction of hours with a 10 percent increase in hospital wages. The two subsequent bars represent similar policy experiments in private practice and for all sectors simultaneously. The two bars to the right represent observations in 1997 and predictions for 1997 in a policy experiment where I use the parameters estimated on 1995 data and the ‘observed’ wages from 1997 to predict the choices in 1997.

In all applications I find a modest response in the total hours worked to a wage increase in hospitals. The model predicts that the hospital physicians respond to a wage increase by increasing their hours at the hospital and reducing their private hours. The opposite goes for an increase in private practice fees. A similar pattern emerges in all samples of the model. The predictions are reasonable adequate, with the general tendency being that the hours worked at the hospital are slightly underpredicted, whereas the private hours are overpredicted. When increasing only hospital wages, the ‘hospital specific’ elasticities ranged from 0.16 to 0.27. Focusing on the total hours worked, the elasticities ranged from 0.10 to 0.19. When simulating an increase in all wages, the elasticities are higher, ranging from 0.18 to 0.28.

Compared to the high quality of the data for hospital physicians, the hours in the private sector must be seen as an approximation of the unobserved working hours. As presented in each table the effect of a wage increase on total labor supply is modest. The wage elasticities, in total and by sector, are presented in each table. There are no major deviations from this results related to gender, specialty and geographic region that are found in the predictions and not presented here. Of course, with such small predicted behavioral responses it is difficult to identify any differences. A reason for the lack of gender differences is probably that female hospital physicians choose to work, or are ‘forced’ to work, in the same shift plan as male physicians. A preference for shorter working hours would thus lead to a job choice in another sector like the health administration, as a municipal health officer/public primary care physician or a part-time private practice, for which we do not have access to data of the same detail as the NALRA data. The regional similarities are probably due to the centralized wage determination in the health sector, with almost identical wages and fees throughout the country.

This section also presented an ‘experiment’ with the hospital physicians – predicting choices in 1997 using the parameter estimates from 1995 and the ‘observed’ wages from 1997. The predictions of total hours are in the region of the observed choices, whereas the predictions only have the correct direction of changes in the hospital hours in two of the three cases. The private hours are overpredicted and the observed changes are in the opposite direction of the predicted ones.

## 6. Conclusions

The aim of this paper has been to identify the effect of increased wages on working hours and sector choice. I find that the physicians are sensitive to wage changes when determining their labor supply. This holds for the three subsamples of employed hospital physicians, studied in detail due to the superior data quality.

The predictions indicate ‘job specific’ elasticities that are modest yet positive and significant. The effect on total hours is lessened, however, as the responded increase of hours in the care sector where wages rise, is matched by a reduction of hours in the other practice types. The result is a change in the sector mix and a modest increase in total hours.

The Norwegian response to the increasing need for personnel, fueled by intensified specialization and institutional reforms, has been to increase the educational capacity and import foreign personnel. The results presented in this paper indicate that the alternative of increasing the hours worked for those already participating by increasing wages, would put a strain on public budgets. There is also a danger that a sector-specific wage increase may result in a “bidding war”. The history describes various health sector reforms with practice specific wage increases to attract personnel to their sector. The significant wage increase in the hospital sector used in this study is only one example.

Due to the limited time period presented here, I am unable to document changes in the choice of specialization as a response to changes in expected life-time earnings. This is an interesting topic for further research, but requires data from a long time period as it takes 5-15 years from completing university studies to becoming licensed as a specialist.

In a policy perspective, this analysis predicts a modest response to a wage increase in total hours worked. The results are in line with the existing research on employed physicians and the more general literature on high-income professionals. A high-income group with full participation and many hours worked per year is not responsive to increased wages in their total labor supply. However, there might be a potential in influencing the choice of sector mix as documented by this study.

## 7. References

Aaberge, R., Dagsvik, J. R., Strøm, S., 1995. Labor supply responses and welfare effects of tax reforms. Scandinavian Journal of Economics 97: 635-59.

Aaberge, R., Colombino, U., Strøm, S., Wennemo, T., 1998. Evaluating Alternative Tax Reforms in Italy with a Model of Joint Labor Supply of Married Couples. Structural Change and Economic Dynamics. Vol. 9, 1998, 415-433.

Aaberge, R., Colombino, U., Strøm, S., 1999. Labour supply in Italy: An empirical analysis of joint household decisions, with taxes and quantity constraints. Journal of Applied Econometrics 14: 403-422.

Baltagi, B.H., Bratberg, E. and Holmås, T.H, 2003. A panel data study of physicians' labor supply: The case of Norway. Working paper 4/03, University of Bergen.

European Observatory on Health Care Systems, 2000, Health Care Systems in Transition, Norway. Copenhagen: WHO Regional office for Europe.

Feldstein, M., 1995. The effect of marginal tax rates on taxable income: A panel study of the 1986 Tax Reform Act, Journal of Political Economy 103(5) 551-572.

Feenberg, D., Poterba, J.M., 1993. Income inequality and the incomes of the very high taxpayers, in: James M. Poterba, ed., Tax policy and the economy, Vol. 7 (MIT Press, Cambridge) pp. 145-177.

Headen, A.E., 1990. Wage, returns to ownership, and fee responses to physician supply. Review of Economics and Statistics 72, 30-37.

Heckman, J.J., 1993. What has been learned about labor supply in the past twenty years? American Economic Review, 82, Papers and proceedings of the $105^{th}$ annual meeting of the American Economic Association, 116-121.

Heckman, J.J., MaCurdy, T., 1980. A life cycle model of female labor supply. Review of Economic Studies 47, 47-74.

Iversen, T., 1997. The effect of a private sector on the waiting time in a national health service. Journal of Health Economics 16, 383-396.

Nicholson, S., 2002. Physician Speciality Choice under Uncertainty. Journal of labor Economics, 2002, vol. 20, no.4. The University of Chicago.

Noether, M., 1986. The growing supply of physicians: has the market become more competitive? Journal of Labor Economics, 4, 503-537.

Norwegian Medical Association, 2002. Homepage: www.legeforeningen.no.

OECD, 2002. OECD Health Data 2002. www.oecd.org.

Pencavel, J., 1986. Labor supply of men. In Ashenfelter, O., Layard, R., eds. Handbook of labor economics, pp. 3-102, North-Holland, Amsterdam.

Rizzo, J.A., Blumenthal, D., 1994. Physician labor supply: Do income effects matter? Journal of Health Economics 13, 433-453.

Røed, K., Strøm, S., 2001. Progressive Taxes and the Labour Market - Is the Trade-Off between Equality and Efficiency Inevitable? Journal of Economic Surveys, Vol 16, No1, 77-110.

Showalter, M. H., Thurston, N.K., 1997. Taxes and labor supply of high-income physicians. Journal of Public Economics 66, 73-97.

Sloan, F. 1975. Physician supply behavior in the short run. Industrial and Labor Relations Review 28, 549-569.

Statistics Norway, 1983. Standard Industrial Classification.

Statistics Norway. NACE Standard Industrial Classification. *www.ssb.no*.

Statistics Norway. General practitioner and specialist in private practice - Income and working hours in 1995 and 1998. Results from two surveys published as tables on www.ssb.no.

van den Noord, P., Hagen, T.P., Iversen, T., 1998, The Norwegian Health Care System. Economics Department Working Papers no. 198. Paris: OECD.

## Appendix 1 Data quality and summary statistics

There are asymmetries in the information levels depending on whether the physicians are employed or in private practice, and on the type of employer. For all groups I have information about annual earnings prior to and after taxation, employment status, and demographic variables. I have information about the date of medical authorization and specialization for up to three specialist licenses for all physicians 'accumulated' in 1998. I assume that the latest achieved specialty is the one that is practiced.

For employees I have days worked during the year and annual earnings by employer. Start and stop days are, however, a bit unclear as many employers report employment during the whole year even though the actual job was short term. Statistics Norway has developed an estimate of hours worked per year by employer and in total. There is also a more robust measure with information about hours worked presented in broad categories: Less than 4 hours, 4-19 hours, 20-29 hours, and 30 hours or more per week. All employers are coded by the NACE Standard Industrial Classification, which gives us detailed information of their sector and type of activity. Institutional knowledge of the different industries and categories of employers provides information of regular working hours.

For employees in institutions owned by municipalities and county authorities I also have information on wages and regular working hours for one month of each year. For most of these institutions I also have the possibility of calculating the amount of planned and unplanned extra hours. The Norwegian Association of Local and Regional Authorities (NALRA) collects the data on 1 October. At this time of the year the central wage bargaining is completed, but the local wage bargaining is not and therefore not registered. There are some minor inconsistencies, which I ignore, between the monthly salary and the registered annual income from the same employer. In addition to the aforementioned unregistered local wage increase, this is probably due to uneven workloads throughout the year as physicians work extra overtime during periods with high workloads or when many physicians are on holiday during the summer, or due to other extraordinary activities, such as campaigns to reduce patient waiting lists. The NALRA data covers most hospitals, public primary care and local health administrations.

For those working at hospitals owned by the central government or contracted charities, I have access to the contract terms of jr. physicians and specialist consultants. I also know that a physician working at one of the two hospitals owned by the central government has the same contract as those working for the municipality of Oslo. However, these prestigious hospitals have a reputation of ‘demanding’ an extra unpaid effort from aspiring physicians. Physicians working for non-profit private hospitals in other localities have the same terms as NALRA employees outside Oslo. I am thus able to have a well-informed opinion about their regular and extended working hours knowing their annual income, years of experience and specialty for all physicians. The same goes for other public employers like central health authorities or the general administration.

For self-employed physicians I have no information about hours worked in the register data. Using a study by Statistics Norway of self-reported working hours and income for primary care providers and private specialist consultants, I have some clues regarding the distribution of working hours for these groups. I assume that all of the self-employed physicians’ earnings are health related. Most of the PCPs and private specialist have a contract with their municipality or county council and the National Insurance Scheme.

I approximate the private hourly wages based on our knowledge on annual private income and average income per hour from survey data. This probably underestimates the private wages for hospital consultants, and thus overestimates the hours worked privately. Anecdotal evidence indicates an hourly wage of about NOK 1,000, or three times the average of the estimated wage for full-time private specialist practitioners. Looking more closely at private income, there are significant variations between specialties. Physicians working with ear, nose and throat and ophthalmology are on top with 20 percent of their total income from private practice, whereas others like brain surgeons had a significantly lower share. The physicians have the right to deduct private practice expenses from their earnings prior to taxation. These expenses include home office rent, PCs, professional literature, phone etc. and create an extra motivation for employees to work in a second job as a private practitioner. The register data only includes private income after these deductions. This leads to a downward bias in the estimated hours.

Hourly wage is the applied earnings measure for the employees too. For most physicians this is straightforward, as I know the monthly regular wage and working hours. The centralized wage determination in the health sector, with almost identical wages and fees trough out the country simplifies this task. For 2,775 physicians in 1995 and 1,553 in 1997 I also know the compensation for working extended hours, and when the different levels of overtime compensation (50%, 100% and 200%) take effect.
Hospital physicians have to work longer than their regular working hours of 37.5 hours per week or 35.5 hours per week for those working shifts. There is a national agreement to extend the number of weekly hours by 2.5. In addition there are local agreements at ward level extending the total hours per week up to 48 hours per week in the shift plan for all physicians. The amount of planned overtime depends on factors like patient load, amount of vacant positions and shift plan. In addition there is a need for “unplanned” overtime work in situations with absent personnel or a high workload. Some wards split the overtime “fairly” and include almost all overtime in the planned part. Other wards may reduce the planned overtime all physicians must share, and leave the rest to unplanned overtime for those who volunteer.

Authorized foreign physicians are excluded when they do not have a permanent residency in Norway or if they have a permanent residency code, but no income or address in Norway. Some people in this group obtain an authorization but never arrive in Norway. Others, like many of the Scandinavians, work in Norway for a shorter period (up to 6 months). These physicians are often fully employed in their home countries and work in Norway during holidays or when they have a week off in their shift plan.

***Table A1 Choice of main job sector. Samples from 1995 and 1997***

| Alternative | Comment | Payment | Observed 1995 | % | Observed 1997 | % | 7 sectors | 5 sectors | 3 sectors |
|---|---|---|---|---|---|---|---|---|---|
| **Hospital consultant outside of Oslo** | Work at a hospital outside of Oslo owned by local government (NALRA) or a private foundation with a NALRA wage contract. | Fixed wage with progressive overtime compensation | 4013 | *42* | 4879 | *40* | S_1 | *S_1* | SZ_1 |
| **Hospital consultant in Oslo** | Work at a hospital owned by the municipality of Oslo, at one of the national hospitals, or at a private foundation with a similar contract as the national hospitals (Higher wage than NALRA). | Fixed wage with progressive overtime compensation | 1268 | *13* | *1696* | *14* | S_2 | *S_2* | SZ_1 |
| **Municipal medical officer/Public primary care** | Work with public health issues, health administration in the municipalities. Patient care in some areas. | Fixed wage | 995 | *10* | *1382* | *11* | S_3 | *S_3* | SZ_3 |
| **Private practice without a municipal contract** | Funding contract without a municipality or county (non-PCP specialists). The majority of this group is partially reimbursed from the National Insurance Scheme. | Activity based | 1051 | *11* | 1053 | *9* | S_4 | *S_4* | SZ_2 |
| **Private practice with municipal contract** | Funding contract with the municipality or county (non-PCP specialists) in addition to reimbursement from the National Insurance Scheme. | Activity based & municipal block grant | 1323 | *14* | 1998 | *16* | S_7 | *S_4* | SZ_2 |
| **Medical research** | Universities or in private research. | Fixed wage | 516 | *5* | 608 | *5* | S_6 | *S_5* | SZ_3 |
| **Other work** | Central government, central health authorities, non-health industries, social work, non-governmental organizations (NGOs). | Fixed wage | 497 | *5* | 636 | *5* | S_5 | *S_5* | SZ_3 |
| | | | 9663 | *100* | 12252 | *100* | | | |

*Some of the individuals were dropped due to missing data .*

***Table A2 The more restrictive data sets used as a basis for the hospital analysis.***

***Data used in section 5.1-5.4***

| Variable | Label | Mean | Std Dev |
|---|---|---|---|
| b970_5 | No. of children below 6 years of age | 0.47 | *0.68* |
| ektejobb | Spouse does not work:  1=yes 0=No | 0.31 | *0.46* |
| ektelege | Spouse is a physician: 1=Yes 0=No | 0.19 | *0.39* |
| ektespl | Spouse is a Registered nurse: 1=Yes 0=No | 0.17 | *0.38* |
| cnorway | From Norway | 0.83 | *0.38* |
| female | Female | 0.26 | *0.44* |
| married | Married | 0.78 | *0.41* |
| age | Age | 46.3 | *8.85* |
| nonw | Nonwage income – spouse, capital, etc. | 208000 | *167000* |
| rek | Specialty with extra pay in hospitals | 0.13 | *0.34* |
| duma | Dummy if hospital | 0.49 | *0.5* |
| dumb | Dummy if private | 0.32 | *0.46* |
| dumc | Dummy for pai info | 0.37 | *0.48* |
| paitid | Pai info  - more restrictive | 0.31 | *0.46* |
| ubehagd | Pai info – more complete | 0.26 | *0.44* |
| nonspes | Not qualified specialist | 0.28 | *0.45* |
| s_gp | Specialist GP/Primary care medicine | 0.23 | *0.42* |
| s_non_gp | Specialist   (Except in GP/PCM) | 0.49 | *0.5* |
| s_surg | Spec.Surgery | 0.14 | *0.35* |
| s_int_me | Spec.Internal medicine | 0.2 | *0.4* |
| s_psych | Spec.Psychiatry | 0.07 | *0.26* |
| s_lab | Spec.Laboratory medicine | 0.06 | *0.23* |
| **SECTORS** | | | |
| Sector main job - dummies | | | |
| s_1 | KS – Hospitals out of Oslo | 0.35 | *0.48* |
| s_2 | OS – Oslo hospitals | 0.14 | *0.35* |
| s_3 | Municipal primary care | 0.09 | *0.28* |
| s_4 | Private without public contract | 0.1 | *0.31* |
| s_5 | Other | 0.05 | *0.22* |
| s_6 | Research and development | 0.05 | *0.23* |
| s_7 | Private with public contract | 0.21 | *0.41* |
| **Alternative sector allocation** | | | |
| sm1 | Hospitals | 0.49 | *0.5* |
| sm2 | Private practice | 0.32 | *0.46* |
| sm3 | Other | 0.19 | *0.39* |
| **Extra job** | | | |
| b_1 | Hospital, no extra job | 0.28 | *0.45* |
| b_2 | Hospital, with extra wage | 0.12 | *0.32* |
| b_3 | Hospital, with extra nonwage job | 0.09 | *0.28* |
| b_4 | Private, no extra job | 0.24 | *0.42* |
| b_5 | Private with extra job | 0.08 | *0.27* |
| b_6 | Other, no extra job | 0.07 | *0.26* |
| b_7 | Other, with extra job | 0.12 | *0.33* |
| **HOURS** | | | |
| HOURS MAIN JOB 4 alternatives | | | |
| h_m1 | Part–time <17.5 hours per week | 0.07 | *0.25* |
| h_m2 | Part–time <35 hours per week | 0.08 | *0.28* |
| h_m3 | Full-time | 0.62 | *0.48* |
| h_m4 | Full-time - extended hours >38 hours per week | 0.22 | *0.42* |
| Extra job - hours | | | |
| h_b1 | 0  (hours <1) | 0.59 | *0.49* |
| h_b2 | 1<hours<7*48 | 0.16 | *0.37* |
| h_b3 | Hours >7*48 | 0.24 | *0.43* |

*N=8718*

***Table A3 Summary statistics***
***All physicians in 1997 (after trimming). Data used in section 5.5***

| Variable | | Mean | Std Dev |
|---|---|---|---|
| rekr9697 | Specialist recruitment pay | 0.12 | *0.33* |
| kapinnt97 | Capital income | 49400 | *155000* |
| overf97 | Transfers | 10100 | *25700* |
| b970_5 | Children < 6 years | 0.54 | *0.71* |
| statsp97 | Savings | 4200 | *22600* |
| eies97 | Spouse's income after tax | 158000 | *156000* |
| Nonw | Nonwage income | 208000 | *199800* |
| Ektejobb | Spouse does not work=1 | 0.35 | *0.48* |
| Ektelege | Spouse is a physician=1 | 0.19 | *0.39* |
| Ektespl | Spouse is a nurse=1 | 0.16 | *0.37* |
| Cnorway | Born in Norway=1 | 0.81 | *0.40* |
| Female | Female | 0.29 | *0.45* |
| Married | Married | 0.76 | *0.43* |
| Age | Age | 45.0 | *9.1* |
| | Age - Hospital outside of Oslo | 44.3 | |
| | Age - Hospitals in Oslo | 44.9 | |
| | Age - Public primary care | 42.8 | |
| | Age - Private practice | 46.3 | |
| | Age - Other | 45.6 | |
| *S_1* | Hospital outside of Oslo | 0.35 | *0.48* |
| *S_2* | Hospitals in Oslo | 0.20 | *0.40* |
| *S_3* | Public Primary care | 0.07 | *0.25* |
| *S_4* | Private practice | 0.31 | *0.46* |
| *S_5* | Other | 0.06 | *0.24* |
| we1 | Wage per hour - S_1 | 242.8 | *34.5* |
| we2 | Wage per hour - S_2 | 218.9 | *37.1* |
| we3 | Wage per hour - S_3 | 199.3 | *20.9* |
| we4 | Wage per hour - S_4 | 265.0 | *46.9* |
| we5 | Wage per hour - S_5 | 191.1 | *30.7* |
| h_b1 | Hours extra job 1 *0 h/w* | 0.30 | *0.46* |
| h_b2 | Hours extra job 2 *6 h/w* | 0.39 | *0.49* |
| h_b3 | Hours extra job 3 *12 h/w* | 0.14 | *0.35* |
| h_b4 | Hours extra job 4 *18 h/w* | 0.08 | *0.27* |
| h_b5 | Hours extra job 5 *24 h/w* | 0.09 | *0.28* |
| h_m1 | Hours main job 1 *18 h/w* | 0.03 | *0.18* |
| h_m2 | Hours main job 2 *22 h/w* | 0.03 | *0.18* |
| h_m3 | Hours main job 3 *28 h/w* | 0.23 | *0.42* |
| h_m4 | Hours main job 4 35.5 *h/w* | 0.03 | *0.17* |
| h_m5 | Hours main job 5 *37.5 h/w* | 0.01 | *0.10* |
| h_m6 | Hours main job 6 *40.5 h/w* | 0.13 | *0.34* |
| h_m7 | Hours main job 7 *45.5 h/w* | 0.10 | *0.30* |
| h_m8 | Hours main job 8 *50 h/w* | 0.42 | *0.49* |
| h_m9 | Hours main job 9 *55 h/w* | 0.01 | *0.10* |

N=9528

Note that this is the sample after trimming. The allocation between sectors in this data set is somewhat different than in table A3, in an attempt to separate private practices with and without public funding. This data set does not contain such contract information.

## Appendix 2 Hourly wages

*Annual income by sector*

I have constructed sector-specific hourly wages for all physicians, including sectors where they are not participating. The first step in this process is to sort the jobs by the NACE standard industrial classification (supplemented with SAMDATA and NALRA hospital codes), and aggregate into sectors or job types. As described in table A3, I have chosen to use seven 'sectors' when I construct hourly wages: a) local hospitals outside of Oslo, b) Oslo hospitals, c) municipal medical officer/public primary care, d) private practice with a municipal contract, e) private practice without a municipal contract, f) medical research at universities or pharmaceutical companies and g) other work, for central health authorities, NGOs etc.

Private nonwage income, as well as wage income from private-for-profit health providers, is allocated to the private sector. The physicians are allocated to public jobs in hospitals and primary care if their working hours indicate that they work more hours in their public job than in their private practice. Otherwise the main job is the one with the highest annual earnings. In the analysis I have aggregated the sectors to four: local hospitals, Oslo hospitals, municipal medical officer, private practice, and other (*S_1-S_5*). For comparisons I have also used the alternative with three sectors: hospitals, private practice, and other (SZ_1-SZ_3).

I had to simplify the choice set of extra work and introduce the following rules:

- If you work within a *hospital, public primary care or "other"* then your extra job is *private.*
- If you work in the *private* sector your extra job is *other.*

*Hours*

The most challenging task is to find the number of hours worked per year. I have used the best available data in each sector, but their quality is very variable as described in section 4. For the NALRA hospitals this gives accurate observations, whereas we have reasonably good institutional knowledge for the other employees.

*Hourly wages in hospitals*

Using the detailed NALRA data, I am able to observe the hourly wage dependent on hours worked. This is important, as the marginal wage for overtime work for hospital consultants is up to 200 percent higher than the hourly wage they earn during their first 35.5 hours per week. The Oslo hospitals have the same wage structure as the rest of the country, but the basic wage is about 3 percent higher.

*Hourly wages in private practice*

For the self-employed we only have access to the group average of income and hours per year from a survey by Statistics Norway (1995 and 1998). I used this survey to calculate an average hourly wage for general practitioners and private specialists. I then approximated the hours worked, based on their reported income. An argument in defense of this practice is that all physicians with a public contract are covered by the same financing scheme. Private practitioners without such contracts will however have greater variations in hourly wages. Anecdotal evidence suggests that for some specialties the hourly wage may be considerably higher than the average reported in the survey. This is unobservable in our data.

*Weeks per year*

I assume that all physicians work 48 weeks per year, using their 4 weeks of paid holiday. For a standard job in public administration this equals 1,800 hours per year.

*Experience*

Experience is constructed on earnings histories available from the Norwegian National Insurance Scheme, which was established in 1967. Individual 'pension entitlements' in this scheme are linked to their income histories. An alternative measure, years since date of authorization, was also tested. There are small differences between the alternatives, but after testing I choose to use the measure based on 'pension entitlements'.

*Selection bias*

Intuitively there is reason to believe that there is a selection into the different sectors driven by unobserved factors like preferences and productivity. When I estimate hourly wages for each individual, also in sectors where they do not work, I should take this selection into consideration. In practice there seems to be no major differences between the hourly wages predicted by OLS and a Heckman two-step procedure. An effect occurs in the hospital sector, but for reasons of comparison, OLS is preferred. The wage regressions for 1995 are presented in table A4 and table A5. The regressions from 1997 are similar and not presented here.

*Table A4 Wage Relation 1995*

| OLS | | Public hospitals Basic wage | Public primary care Basic wage | Private practice w/o public contract | Private practice w/ public contract | Universities R & D | Other jobs |
|---|---|---|---|---|---|---|---|
| **Female** | **Female=1** | -0.0121 | -0.0319 | -0.0821 | -0.1183 | -0.0410 | -0.1236 |
| | | (0.0032) | (0.0067) | (0.0331) | (0.0239) | (0.0220) | (0.0345) |
| **Nonspes** | **Not registered specialist=1** | -0.0750 | -0.0247 | -0.0750 | 0.0366 | 0.0656 | 0.1440 |
| | | (0.0042) | (0.0089) | (0.0330) | (0.0244) | (0.0228) | (0.0452) |
| **s_surg** | **Specialist in surgery=1** | -0.0037 | 0.0162 | 0.0510 | 0.0311 | -0.0388 | 0.2324 |
| | | (0.0033) | (0.0366) | (0.0477) | (0.1138) | (0.0365) | (0.0667) |
| **s_prim** | **Specialist in primary care medicine=1** | -0.0394 | 0.0163 | -0.0741 | 0.1011 | -0.0665 | 0.0312 |
| | | (0.0058) | (0.0093) | (0.0293) | (0.0266) | (0.0444) | (0.0567) |
| **s_social** | **Specialist in social medicine/public health=1** | -0.0119 | 0.0387 | 0.1441 | 0.1458 | 0.1158 | 0.2792 |
| | | (0.0150) | (0.0154) | (0.1134) | (0.0786) | (0.0408) | (0.0485) |
| **s_psych** | **Specialist in psychiatry=1** | 0.0164 | 0.0153 | -0.0758 | 0.1030 | -0.0363 | 0.0242 |
| | | (0.0045) | (0.0419) | (0.0551) | (0.0602) | (0.0392) | (0.0656) |
| **s_lab** | **Specialist in laboratory medicine=1** | 0.0123 | -0.0102 | 0.0943 | (dropped) | 0.1276 | 0.0859 |
| | | (0.0049) | (0.0511) | (0.1529) | | (0.0294) | (0.1138) |
| **Regionb** | **Geographical region B =1** | 0.0000 | -0.0253 | 0.0333 | 0.0703 | 0.0112 | -0.0969 |
| | East except Oslo/Akershus | (0.0057) | (0.0154) | (0.0450) | (0.0285) | (0.0578) | (0.0627) |
| **Regionc** | **Geographical region C =1** | 0.0115 | -0.0055 | 0.0956 | 0.1269 | -0.2278 | 0.0373 |
| | West | (0.0051) | (0.0148) | (0.0430) | (0.0294) | (0.1296) | (0.0529) |
| **Regiond** | **Geographical region D =1** | 0.0017 | -0.0009 | 0.0235 | 0.1016 | -0.0270 | 0.0744 |
| | Middle | (0.0049) | (0.0135) | (0.0441) | (0.0310) | (0.0224) | (0.0489) |
| **Regione** | **Geographical region E =1** | 0.0253 | -0.0139 | 0.0960 | 0.0732 | -0.0479 | 0.0473 |
| | North | (0.0048) | (0.0144) | (0.0389) | (0.0321) | (0.0204) | (0.0529) |
| **Age** | **Age** | -0.1521 | 0.1896 | 0.8869 | 0.6346 | 0.0364 | 1.9380 |
| | | (0.0680) | (0.1745) | (0.8466) | (0.5769) | (0.4585) | (1.0886) |
| **age2** | **Age squared/10** | 0.6106 | -0.5437 | -3.0331 | -1.7766 | -0.1830 | -6.3723 |
| | | (0.2293) | (0.5965) | (2.7684) | (1.9298) | (1.4994) | (3.6865) |
| **age3** | **Age^3/1000** | -0.9815 | 0.6949 | 4.5466 | 2.1201 | 0.4259 | 9.3188 |
| | | (0.3381) | (0.8924) | (3.9726) | (2.8346) | (2.1447) | (5.4645) |
| **age4** | **Age^4/100000** | 0.5598 | -0.3346 | -2.5333 | -0.9110 | -0.3289 | -5.0985 |
| | | (0.1842) | (0.4935) | (2.1133) | (1.5441) | (1.1347) | (2.9940) |
| **AgeAFP** | **If age $\geq$ 62 years then =1** | -0.0214 | 0.0308 | 0.2157 | -0.0869 | 0.0526 | 0.3469 |
| | Qualify for early retirement | (0.0132) | (0.0511) | (0.1340) | (0.1364) | (0.0648) | (0.1874) |
| **erf95** | **Years of work experience last 20 years** | 0.0114 | 0.0067 | 0.0705 | 0.1192 | 0.1163 | 0.0418 |
| | | (0.0100) | (0.0182) | (0.1192) | (0.0840) | (0.1691) | (0.1911) |
| **erf952** | **Experience^2/10** | -0.1905 | 0.0742 | -0.8405 | -2.5934 | -2.2459 | -0.7048 |
| | | (0.1633) | (0.3057) | (1.9384) | (1.3299) | (2.3547) | (2.7971) |
| **erf953** | **Experience^3/1000** | 1.4876 | -1.1418 | 4.9185 | 17.7870 | 15.8168 | 4.7878 |
| | | (1.0414) | (2.0238) | (12.0914) | (8.1977) | (13.3914) | (16.6350) |
| **erf954** | **Experience^4/100000** | -3.7024 | 3.6146 | -9.7911 | -38.4166 | -35.4875 | -10.1518 |
| | | (2.2689) | (4.5491) | (25.7079) | (17.2955) | (26.7688) | (34.5831) |
| **Cnordic** | **From Nordic country except Norway=1** | 0.0083 | 0.0173 | 0.1105 | -0.0249 | -0.0563 | -0.0621 |
| | | (0.0063) | (0.0150) | (0.0590) | (0.0421) | (0.0439) | (0.0762) |
| **coecd_no** | **From OECD area except the Nordic countries=1** | -0.0048 | -0.0017 | 0.0338 | -0.0151 | -0.0329 | -0.0241 |
| | | (0.0056) | (0.0123) | (0.0501) | (0.0403) | (0.0457) | (0.0533) |
| **Cglobal** | **Non-OECD background=1** | -0.0060 | -0.0332 | -0.0717 | -0.0095 | -0.0182 | -0.0577 |
| | | (0.0067) | (0.0135) | (0.0811) | (0.0455) | (0.0512) | (0.0912) |
| **Married** | **Married=1** | 0.0111 | -0.0141 | -0.0074 | 0.0249 | 0.0126 | 0.0156 |
| | | (0.0032) | (0.0076) | (0.0327) | (0.0239) | (0.0201) | (0.0336) |
| **b950_5** | **No. Of Children Aged 0-5** | -0.0035 | -0.0130 | -0.0140 | -0.0047 | -0.0088 | -0.0220 |
| | | (0.0020) | (0.0041) | (0.0220) | (0.0148) | (0.0134) | (0.0212) |
| **kommsen1** | **Centrality index 1 =1** | 0.0183 | 0.0152 | -0.0376 | -0.0023 | 0.0198 | 0.0012 |
| | | (0.0069) | (0.0088) | (0.0709) | (0.0376) | (0.1028) | (0.0684) |
| **kommsen2** | **Centrality index 2 =1** | 0.0174 | 0.0177 | -0.1399 | -0.0024 | (dropped) | -0.0203 |
| | | (0.0058) | (0.0140) | (0.0963) | (0.0553) | | (0.0988) |
| **kommsen3** | **Centrality index 3 =1** | 0.0000 | 0.0126 | 0.0481 | -0.0280 | -0.0276 | -0.1055 |
| | | (0.0045) | (0.0117) | (0.0707) | (0.0334) | (0.1233) | (0.0807) |
| **kommsen4** | **Centrality index 4 =1** | -0.0055 | 0.0002 | -0.1090 | -0.0236 | (dropped) | -0.1024 |
| | | (0.0153) | (0.0130) | (0.0899) | (0.0551) | | (0.1074) |
| **kommsen5** | **Centrality index 5 =1** | -0.0003 | -0.0546 | 0.0091 | -0.0358 | (dropped) | -0.2751 |
| | | (0.0086) | (0.0218) | (0.0779) | (0.0427) | | (0.1198) |
| **kommsen6** | **Centrality index 6 =1** | 0.0058 | 0.0027 | -0.0680 | -0.0483 | 0.1169 | 0.0227 |
| | Centrality index 7 = reference (most central) | (0.0046) | (0.0133) | (0.0432) | (0.0275) | (0.0725) | (0.0640) |
| **Constant** | | 6.0794 | 2.4814 | -4.2482 | -2.7055 | 4.3360 | -17.1348 |
| | | (0.7441) | (1.8796) | (9.6029) | (6.3916) | (5.2087) | (11.9178) |
| **R2 adjusted** | | 0.5873 | 0.4446 | 0.0591 | 0.0766 | 0.4402 | 0.3404 |
| **Number of obs.** | | 3636 | 570 | 770 | 1192 | 459 | 331 |

*Dependent variable is log of hourly wage. Standard errors in parenthesis.*

***Table A5 Heckman selection correction as an alternative to OLS***
***Log basic wage per hour in the hospital sector***

| | | Coef. | Std. Err. | z |
|---|---|---|---|---|
| **Female** | **Female=1** | -0.0104 | *0.0035* | -2.97 |
| **Regionb** | **East except Oslo/Akershus** | -0.0008 | *0.005* | -0.17 |
| **Regionc** | **West** | 0.0029 | *0.0056* | 0.53 |
| **Regiond** | **Middle** | -0.0014 | *0.0051* | -0.28 |
| **Regione** | **North** | 0.0199 | *0.0051* | 3.91 |
| **Nonspes** | **Not registered specialist=1** | -0.0994 | *0.0044* | -22.72 |
| **s_surg** | **Specialist in surgery=1** | -0.0037 | *0.0037* | -1.02 |
| **s_prim** | **Specialist in primary care medicine=1** | -0.0384 | *0.0063* | -6.1 |
| **s_social** | **Specialist in social medicine/public health=1** | -0.015 | *0.0166* | -0.9 |
| **s_psych** | **Specialist in psychiatry=1** | 0.0242 | *0.005* | 4.83 |
| **s_lab** | **Specialist in laboratory medicine=1** | 0.0114 | *0.0054* | 2.12 |
| **erf95** | **Years of work experience last 20 years** | -0.0267 | *0.0107* | -2.51 |
| **erf952** | **Experience^2/10** | 0.3803 | *0.1724* | 2.21 |
| **erf953** | **Experience^3/1000** | -1.6976 | *1.0978* | -1.55 |
| **erf954** | **Experience^4/100000** | 2.876 | *2.3881* | 1.2 |
| **Constant** | | 4.968 | *0.0228* | 218.21 |
| | | | | |
| **Selection correction** | | | | |
| **Female** | **Female=1** | -0.2013 | *0.064* | -3.15 |
| **Regionb** | **East except Oslo/Akershus** | 0.4422 | *0.1086* | 4.07 |
| **Regionc** | **West** | 0.7033 | *0.1049* | 6.71 |
| **Regiond** | **Middle** | 0.2221 | *0.0852* | 2.61 |
| **Regione** | **North** | 0.3698 | *0.0866* | 4.27 |
| **Cnordic** | **From Nordic country except Norway=1** | -0.0336 | *0.1134* | -0.3 |
| **coecd_no** | **From OECD area except the Nordic countries=1** | 0.0081 | *0.1117* | 0.07 |
| **Cglobal** | **Non-OECD background=1** | -0.0559 | *0.1288* | -0.43 |
| **Nonspes** | **Not registered specialist=1** | 0.1902 | *0.0874* | 2.18 |
| **s_surg** | **Specialist in surgery=1** | 0.1043 | *0.0707* | 1.48 |
| **s_prim** | **Specialist in primary care medicine=1** | 0.1571 | *0.1282* | 1.23 |
| **s_social** | **Specialist in social medicine/public health=1** | 0.3516 | *0.3714* | 0.95 |
| **s_psych** | **Specialist in psychiatry=1** | -0.0548 | *0.0892* | -0.62 |
| **s_lab** | **Specialist in laboratory medicine=1** | 0.1949 | *0.1091* | 1.79 |
| **erf95** | **Years of work experience last 20 years** | 0.2577 | *0.1957* | 1.32 |
| **erf952** | **Experience^2/10** | -3.862 | *3.2166* | -1.2 |
| **erf953** | **Experience^3/1000** | 22.7395 | *20.6823* | 1.1 |
| **erf954** | **Experience^4/100000** | -49.2674 | *45.3462* | -1.09 |
| **Age** | **Age** | -2.6499 | *1.3505* | -1.96 |
| **age2** | **Age^2/10** | 9.2902 | *4.5359* | 2.05 |
| **age3** | **Age^3/1000** | -13.8651 | *6.6622* | -2.08 |
| **age4** | **Age^4/100000** | 7.546 | *3.6169* | 2.09 |
| **AgeAFP** | **If age >=62 years then =1** | -0.4121 | *0.2563* | -1.61 |
| **Married** | **Married=1** | -0.0355 | *0.0638* | -0.56 |
| **b950_5** | **No. Of children aged 0-5** | -0.0076 | *0.0398* | -0.19 |
| **kommsen1** | **Centrality index 1 =1** | 0.2741 | *0.1429* | 1.92 |
| **kommsen2** | **Centrality index 2 =1** | 0.7319 | *0.1586* | 4.61 |
| **kommsen3** | **Centrality index 3 =1** | 0.4864 | *0.1091* | 4.46 |
| **kommsen4** | **Centrality index 4 =1** | -0.3676 | *0.2455* | -1.5 |
| **kommsen5** | **Centrality index 5 =1** | 0.1217 | *0.1877* | 0.65 |
| **kommsen6** | **Centrality index 6 =1** | 0.0752 | *0.0982* | 0.77 |
| **Constant** | | 27.2178 | *14.8384* | 1.83 |
| | | | | |
| **/athrho** | | -0.7242 | *0.0978* | -7.4 |
| **/lnsigma** | | -2.4537 | *0.0172* | -142.26 |
| **Rho** | | -0.6195 | *0.0603* | |
| **Sigma** | | 0.086 | *0.0015* | |
| **Log likelihood** | | 2638.6 | | |
| **Number of obs.** | | 4086 | | |

***Table A4 Heckman selection correction as an alternative to OLS***

***Table A6 A comparison of log basic wage per hour in the hospital sector.***

| | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| **OLS** | 3636 | 4.98 | 0.09 | 4.73 | 5.13 |
| **Heckman** | 3636 | 4.99 | 0.09 | 4.77 | 5.10 |

*The basic wage is supplemented by compensations for shift work, extended hours and personal benefits. A compensation of 50%, 100% or 200% is added to the salary when working overtime.*

***Table A7 Observed wage per hour by sector. Predicted if missing. 1995.***

| Sector | Variable | Mean | *Std. Dev.* |
|---|---|---|---|
| **Basic wage – Hospital** | new1 | 144.0 | *13.7* |
| **Hospitals** | nwz1 | 210.4 | *36.7* |
| **Private w/o public contract** | new4 | 274.1 | *45.1* |
| **Private w/o public contract** | new7 | 268.6 | *41.3* |
| **Basic wage – Primary Care** | new3 | 148.1 | *8.8* |
| **Universities, R&D** | new6 | 154.7 | *26.9* |
| **Other** | new5 | 190.4 | *37.4* |

N=9874

*nwe1 and nwe3 are the basic salaries prior to a set of compensation benefits. I apply the exact compensation scheme. The other variables are total earnings divided by the estimated number of hours per year. The private sector categories are merged in the analysis. Universities and Other are also merged.*

# Appendix 3 Taxes

## *Income tax*

***Table A9 Tax rules applied in 1995***
***(Married class G4 and G5 and working singles)***

| 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 |

***Table A10 Tax rules applied in 1997***
***(Married class G4 and G5 and working singles)***

| Income = Y | Tax |
|---|---|
| 0 – 22 344 | 0 |
| 22 344 – 156 500 | 0.302Y – 6 748 |
| 156 500 – 233 000 | 0.358Y – 15 512 |
| 233 000 – 262 500 | 0.453Y – 37 647 |
| 262 500 - | 0.495Y – 48 672 |

## *Capital tax*

Capital income is taxed at 28 percent.

# Appendix 4 Figures

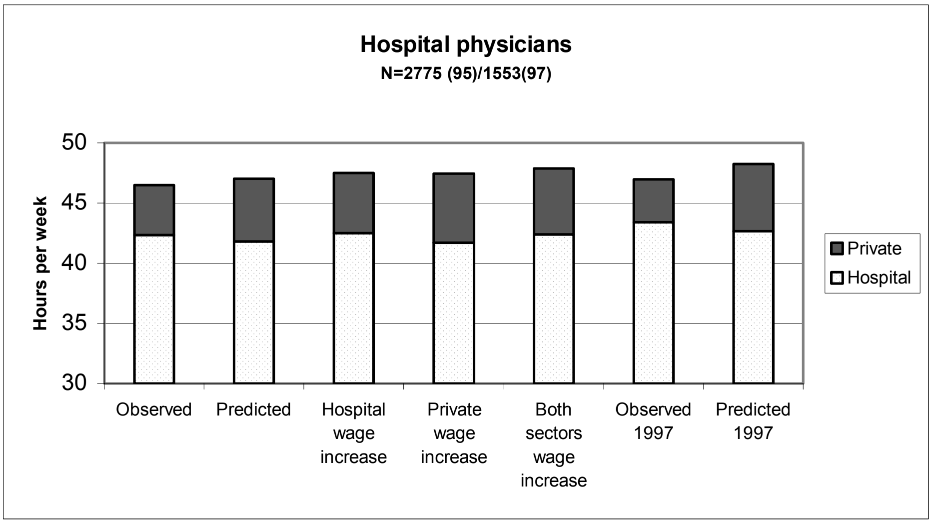


***Figure 1 Hours worked at the hospital and in a private extra practice.***

*All hospital physicians with data on extra hours. Observed and predicted hours in hospital job and in private extra practice. a) Observed hours in 1995; four predictions in 1995 based on: b) observed wages, c) a 10 percent wage increase in the hospital sector, d) a 10 percent 'wage' (fee) increase in the private sector and e) a 10 percent wage increase in both sectors. f) Observed hours in 1997 and g) predicted hours in 1997 based on observed wages and 'preferences' based on the 1995 data.*

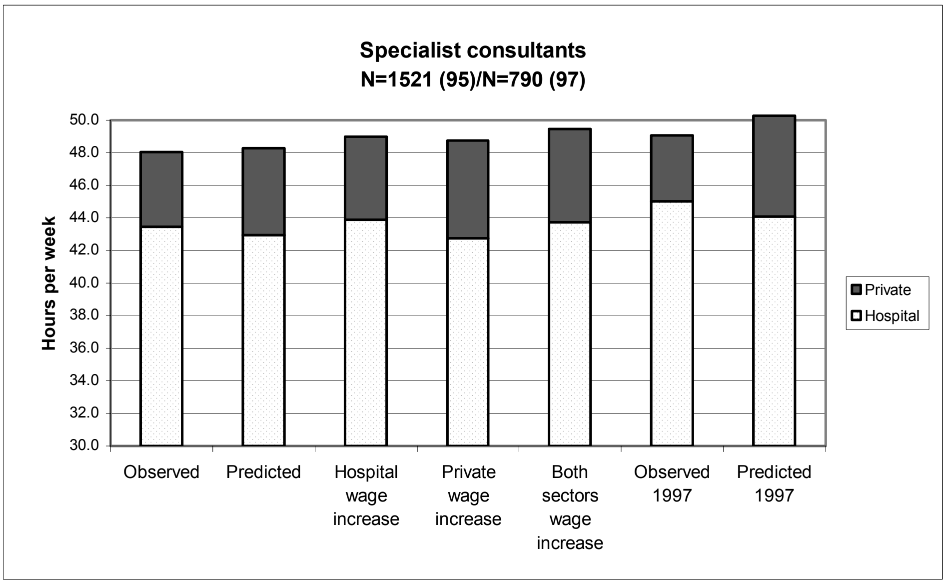


***Figure 2 Male hospital consultants - Hours worked at the hospital and in a private extra practice.***

*Male specialist consultants with data on extra hours. Observed and predicted hours in hospital job and in private extra practice. a) Observed hours in 1995; four predictions in 1995 based on: b) observed wages, c) a 10 percent wage increase in the hospital sector, d) a 10 percent 'wage' (fee) increase in the private sector and e) a 10 percent wage increase in both sectors. f) Observed hours in 1997 and g) predicted hours in 1997 based on observed wages and 'preferences' based on the 1995 data.*

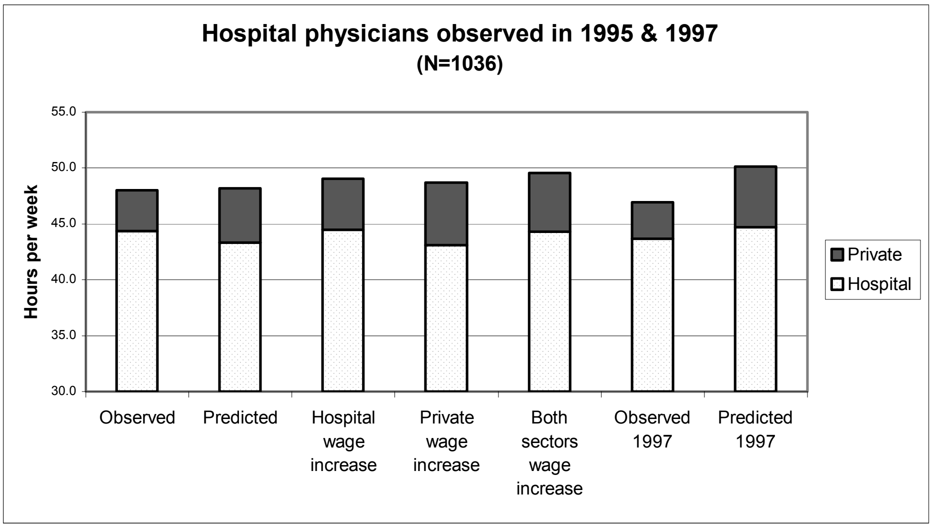


**Figure 3** ***Hospital physicians observed in 1995 & 1997- Hours worked at the hospital and in a private extra practice****. Observed and predicted hours in hospital job and in private extra practice. a) Observed hours in 1995; four predictions in 1995 based on: b) observed wages, c) a 10 percent wage increase in the hospital sector, d) a 10 percent 'wage' (fee) increase in the private sector and e) a 10 percent wage increase in both sectors. f) Observed hours in 1997 and g) predicted hours in 1997 based on observed wages and 'preferences' based on the 1995 data.*

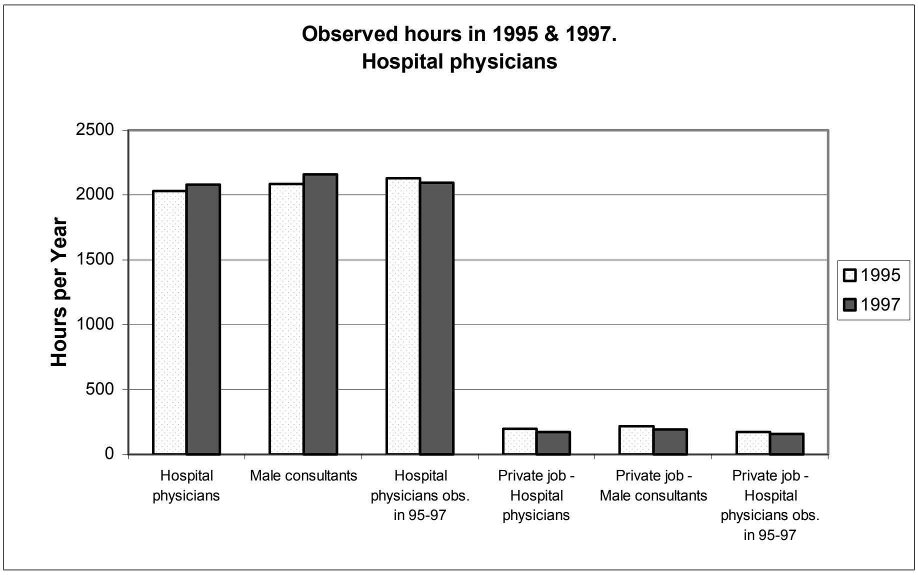


***Figure 4 Observed hours per year in 1995 and 1997 in hospital jobs, and calculated estimates of hours in private practice for hospital physicians.*** *Public hospital salaries increased significantly during this period.*

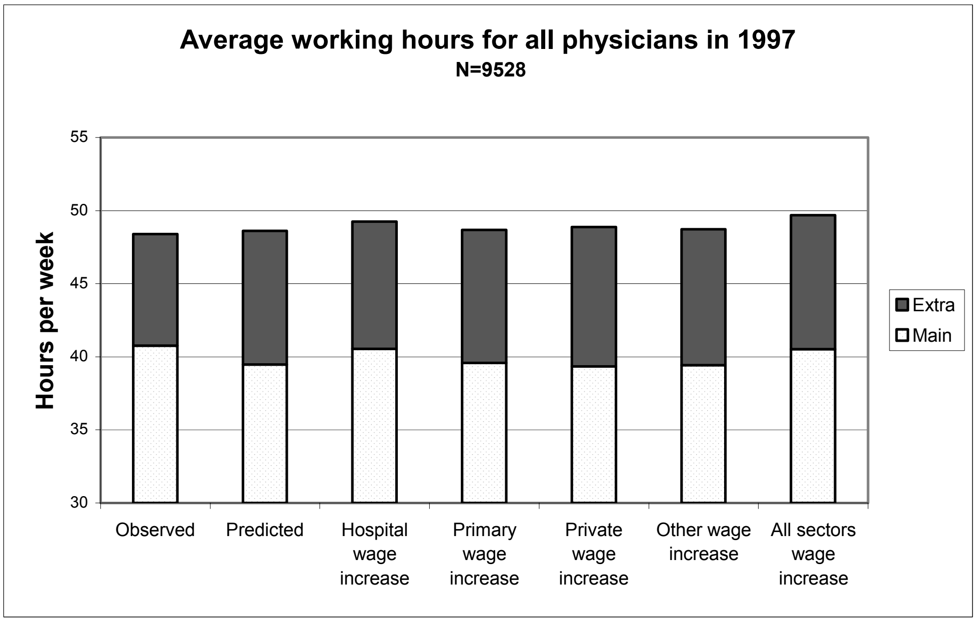


***Figure 5 Average working hours per week for all physicians in 1997 - Main and extra job**. a) Observed hours in 1997; six predictions in 1997 based on: b) observed wages, c) a 10 percent wage increase in the hospital sector, d) a 10 percent wage increase in the public primary care sector, e) a 10 percent 'wage' (fee) increase in the private sector, e) a 10 percent wage increase in the remaining sectors, and f) a 10 percent wage increase in all sectors.*

# Appendix 5 Observed and predicted choices

***Table P4 Physicians at NALRA hospitals in 1995. Observed and predicted choices Jr. physicians and hospital consultants***

| | Main hours | Extra hours | Observed shares | | Predicted probability | | Predictions with a 10% increase in hospital wages | | Predictions with a 10% increase in private wages | | Predictions with a 10% increase in both wages | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PH11 | 18 | 0 | 0.0050 | *0.0709* | 0.0036 | *0.0030* | 0.0029 | *0.0026* | 0.0034 | *0.0029* | 0.0028 | *0.0025* |
| PH12 | 18 | 6 | 0.0040 | *0.0628* | 0.0032 | *0.0021* | 0.0026 | *0.0018* | 0.0033 | *0.0022* | 0.0027 | *0.0019* |
| PH13 | 18 | 12 | 0.0011 | *0.0329* | 0.0026 | *0.0012* | 0.0021 | *0.0011* | 0.0028 | *0.0014* | 0.0023 | *0.0012* |
| PH14 | 18 | 18 | 0.0018 | *0.0424* | 0.0018 | *0.0007* | 0.0015 | *0.0006* | 0.0022 | *0.0008* | 0.0017 | *0.0007* |
| PH15 | 18 | 24 | 0.0004 | *0.0190* | 0.0012 | *0.0004* | 0.0009 | *0.0003* | 0.0015 | *0.0005* | 0.0012 | *0.0004* |
| PH21 | 22 | 0 | 0.0029 | *0.0536* | 0.0027 | *0.0020* | 0.0023 | *0.0018* | 0.0026 | *0.0019* | 0.0022 | *0.0017* |
| PH22 | 22 | 6 | 0.0011 | *0.0329* | 0.0023 | *0.0012* | 0.0019 | *0.0011* | 0.0024 | *0.0013* | 0.0020 | *0.0012* |
| PH23 | 22 | 12 | 0.0014 | *0.0379* | 0.0017 | *0.0006* | 0.0014 | *0.0006* | 0.0019 | *0.0007* | 0.0016 | *0.0006* |
| PH24 | 22 | 18 | 0.0004 | *0.0190* | 0.0011 | *0.0003* | 0.0009 | *0.0003* | 0.0014 | *0.0004* | 0.0011 | *0.0004* |
| PH25 | 22 | 24 | 0.0007 | *0.0268* | 0.0007 | *0.0002* | 0.0006 | *0.0002* | 0.0009 | *0.0003* | 0.0007 | *0.0002* |
| PH31 | 28 | 0 | 0.0072 | *0.0846* | 0.0017 | *0.0009* | 0.0015 | *0.0009* | 0.0016 | *0.0009* | 0.0014 | *0.0009* |
| PH32 | 28 | 6 | 0.0014 | *0.0379* | 0.0013 | *0.0005* | 0.0011 | *0.0004* | 0.0013 | *0.0005* | 0.0011 | *0.0005* |
| PH33 | 28 | 12 | 0.0011 | *0.0329* | 0.0009 | *0.0002* | 0.0007 | *0.0002* | 0.0009 | *0.0002* | 0.0008 | *0.0002* |
| PH34 | 28 | 18 | 0.0011 | *0.0329* | 0.0005 | *0.0001* | 0.0004 | *0.0001* | 0.0006 | *0.0001* | 0.0005 | *0.0001* |
| PH35 | 28 | 24 | 0.0011 | *0.0329* | 0.0003 | *0.0001* | 0.0002 | *0.0001* | 0.0003 | *0.0001* | 0.0003 | *0.0001* |
| PH41 | 38 | 0 | 0.1157 | *0.3199* | 0.1151 | *0.0373* | 0.1071 | *0.0378* | 0.1077 | *0.0369* | 0.1005 | *0.0372* |
| PH42 | 38 | 6 | 0.0422 | *0.2010* | 0.0743 | *0.0109* | 0.0684 | *0.0121* | 0.0751 | *0.0117* | 0.0694 | *0.0128* |
| PH43 | 38 | 12 | 0.0151 | *0.1221* | 0.0427 | *0.0055* | 0.0390 | *0.0053* | 0.0467 | *0.0059* | 0.0427 | *0.0057* |
| PH44 | 38 | 18 | 0.0058 | *0.0757* | 0.0214 | *0.0058* | 0.0194 | *0.0052* | 0.0253 | *0.0069* | 0.0230 | *0.0062* |
| PH45 | 38 | 24 | 0.0058 | *0.0757* | 0.0092 | *0.0039* | 0.0083 | *0.0035* | 0.0117 | *0.0050* | 0.0106 | *0.0045* |
| PH51 | 37.5 | 0 | 0.0962 | *0.2949* | 0.0918 | *0.0245* | 0.0867 | *0.0255* | 0.0859 | *0.0244* | 0.0813 | *0.0252* |
| PH52 | 37.5 | 6 | 0.0523 | *0.2226* | 0.0570 | *0.0055* | 0.0534 | *0.0066* | 0.0577 | *0.0060* | 0.0541 | *0.0071* |
| PH53 | 37.5 | 12 | 0.0216 | *0.1455* | 0.0314 | *0.0047* | 0.0291 | *0.0043* | 0.0343 | *0.0050* | 0.0319 | *0.0046* |
| PH54 | 37.5 | 18 | 0.0086 | *0.0926* | 0.0150 | *0.0046* | 0.0138 | *0.0041* | 0.0177 | *0.0054* | 0.0163 | *0.0049* |
| PH55 | 37.5 | 24 | 0.0050 | *0.0709* | 0.0060 | *0.0028* | 0.0055 | *0.0025* | 0.0077 | *0.0036* | 0.0071 | *0.0032* |
| PH61 | 40.5 | 0 | 0.0944 | *0.2925* | 0.0872 | *0.0153* | 0.0848 | *0.0168* | 0.0814 | *0.0157* | 0.0795 | *0.0171* |
| PH62 | 40.5 | 6 | 0.0295 | *0.1694* | 0.0508 | *0.0027* | 0.0490 | *0.0030* | 0.0513 | *0.0025* | 0.0496 | *0.0030* |
| PH63 | 40.5 | 12 | 0.0105 | *0.1017* | 0.0260 | *0.0054* | 0.0249 | *0.0048* | 0.0283 | *0.0057* | 0.0272 | *0.0052* |
| PH64 | 40.5 | 18 | 0.0040 | *0.0628* | 0.0114 | *0.0042* | 0.0108 | *0.0038* | 0.0134 | *0.0049* | 0.0128 | *0.0045* |
| PH65 | 40.5 | 24 | 0.0079 | *0.0887* | 0.0042 | *0.0021* | 0.0039 | *0.0020* | 0.0053 | *0.0027* | 0.0050 | *0.0025* |
| PH71 | 45.5 | 0 | 0.1438 | *0.3509* | 0.0649 | *0.0050* | 0.0679 | *0.0052* | 0.0605 | *0.0054* | 0.0634 | *0.0057* |
| PH72 | 45.5 | 6 | 0.0577 | *0.2331* | 0.0339 | *0.0059* | 0.0351 | *0.0055* | 0.0341 | *0.0056* | 0.0354 | *0.0053* |
| PH73 | 45.5 | 12 | 0.0180 | *0.1330* | 0.0152 | *0.0050* | 0.0156 | *0.0050* | 0.0165 | *0.0054* | 0.0170 | *0.0053* |
| PH74 | 45.5 | 18 | 0.0101 | *0.1000* | 0.0057 | *0.0027* | 0.0058 | *0.0027* | 0.0067 | *0.0032* | 0.0069 | *0.0032* |
| PH75 | 45.5 | 24 | 0.0076 | *0.0867* | 0.0017 | *0.0011* | 0.0018 | *0.0011* | 0.0022 | *0.0014* | 0.0022 | *0.0014* |
| PH81 | 50 | 0 | 0.1038 | *0.3050* | 0.0646 | *0.0133* | 0.0743 | *0.0146* | 0.0601 | *0.0122* | 0.0693 | *0.0134* |
| PH82 | 50 | 6 | 0.0559 | *0.2297* | 0.0301 | *0.0099* | 0.0342 | *0.0109* | 0.0302 | *0.0097* | 0.0345 | *0.0107* |
| PH83 | 50 | 12 | 0.0187 | *0.1356* | 0.0118 | *0.0055* | 0.0133 | *0.0061* | 0.0128 | *0.0059* | 0.0145 | *0.0065* |
| PH84 | 50 | 18 | 0.0065 | *0.0803* | 0.0038 | *0.0023* | 0.0042 | *0.0025* | 0.0044 | *0.0026* | 0.0050 | *0.0029* |
| PH85 | 50 | 24 | 0.0047 | *0.0683* | 0.0009 | *0.0007* | 0.0011 | *0.0008* | 0.0012 | *0.0009* | 0.0013 | *0.0010* |
| PH91 | 55 | 0 | 0.0180 | *0.1330* | 0.0585 | *0.0221* | 0.0747 | *0.0280* | 0.0543 | *0.0203* | 0.0695 | *0.0258* |
| PH92 | 55 | 6 | 0.0036 | *0.0599* | 0.0235 | *0.0116* | 0.0298 | *0.0146* | 0.0236 | *0.0115* | 0.0299 | *0.0145* |
| PH93 | 55 | 12 | 0.0029 | *0.0536* | 0.0078 | *0.0048* | 0.0098 | *0.0059* | 0.0084 | *0.0051* | 0.0106 | *0.0064* |
| PH94 | 55 | 18 | 0.0022 | *0.0465* | 0.0020 | *0.0015* | 0.0025 | *0.0018* | 0.0024 | *0.0017* | 0.0029 | *0.0021* |
| PH95 | 55 | 24 | 0.0014 | *0.0379* | 0.0065 | *0.0160* | 0.0046 | *0.0116* | 0.0061 | *0.0153* | 0.0043 | *0.0111* |
| | | | 1.0000 | | 1.0000 | | 1.0000 | | 1.0000 | | 1.0000 | |

*Standard deviations in italics*

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Hours per week*** | | | | | | | | | | |
| Hospital | 42.3 | *6.2* | 41.8 | *1.2* | 42.5 | *1.4* | 41.7 | *1.2* | 42.4 | *1.4* |
| Private extra practice | 4.1 | *6.2* | 5.2 | *0.9* | 5.0 | *0.9* | 5.7 | *1.0* | 5.5 | *1.0* |
| Total | 46.5 | *8.6* | 47.0 | *1.9* | 47.5 | *2.1* | 47.4 | *2.0* | 47.9 | *2.1* |
| ***Hours per year*** | | | | | | | | | | |
| Hospital | 2032 | *298* | 2008 | *60* | 2041 | *68* | 2002 | *59* | 2034 | *67* |
| Private extra practice | 198 | *296* | 250 | *43* | 240 | *41* | 275 | *49* | 264 | *47* |
| Total | 2230 | *413* | 2258 | *93* | 2281 | *98* | 2277 | *97* | 2299 | *102* |

| ***Elasticities*** | Total hours | | Main job | | Extra job | |
|---|---|---|---|---|---|---|
| Effect of an increase in hospital wages | 0.1007* | *0.0490* | 0.1627* | *0.0453** | -0.3961 | *0.1604** |
| Effect of an increase in private wages | 0.0831* | *0.0218* | -0.0304* | *0.0074** | 0.9896 | *0.1401** |
| Effect of an increase in all wages | 0.1800* | *0.0598* | 0.1318* | *0.0427** | 0.5633 | *0.2596** |

N=2775

***Table P5 Male hospital consultants at NALRA hospitals in 1995. Observed and predicted choices***

| | Main hours | Extra hours | Observed shares | | Predicted probability | | Predictions with a 10% increase in hospital wages | | Predictions with a 10% increase in private wages | | Predictions with a 10% increase in all wages | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PH11 | 18 | 0 | 0.0033 | *0.0573* | 0.0017 | *0.0008* | 0.0013 | *0.0007* | 0.0016 | *0.0007* | 0.0012 | *0.0006* |
| PH12 | 18 | 6 | 0.0039 | *0.0627* | 0.0019 | *0.0008* | 0.0014 | *0.0007* | 0.0019 | *0.0008* | 0.0015 | *0.0007* |
| PH13 | 18 | 12 | 0.0007 | *0.0256* | 0.0018 | *0.0007* | 0.0013 | *0.0006* | 0.0020 | *0.0008* | 0.0015 | *0.0006* |
| PH14 | 18 | 18 | 0.0013 | *0.0363* | 0.0015 | *0.0005* | 0.0011 | *0.0004* | 0.0018 | *0.0006* | 0.0013 | *0.0005* |
| PH15 | 18 | 24 | 0.0000 | *0.0000* | 0.0011 | *0.0004* | 0.0008 | *0.0003* | 0.0014 | *0.0005* | 0.0010 | *0.0004* |
| PH21 | 22 | 0 | 0.0020 | *0.0444* | 0.0015 | *0.0006* | 0.0012 | *0.0005* | 0.0013 | *0.0005* | 0.0011 | *0.0005* |
| PH22 | 22 | 6 | 0.0007 | *0.0256* | 0.0015 | *0.0005* | 0.0011 | *0.0005* | 0.0015 | *0.0005* | 0.0012 | *0.0005* |
| PH23 | 22 | 12 | 0.0013 | *0.0363* | 0.0013 | *0.0004* | 0.0010 | *0.0003* | 0.0014 | *0.0004* | 0.0011 | *0.0004* |
| PH24 | 22 | 18 | 0.0000 | *0.0000* | 0.0010 | *0.0003* | 0.0007 | *0.0002* | 0.0012 | *0.0003* | 0.0009 | *0.0003* |
| PH25 | 22 | 24 | 0.0007 | *0.0256* | 0.0006 | *0.0002* | 0.0005 | *0.0002* | 0.0008 | *0.0003* | 0.0006 | *0.0002* |
| PH31 | 28 | 0 | 0.0000 | *0.0000* | 0.0010 | *0.0003* | 0.0009 | *0.0003* | 0.0009 | *0.0003* | 0.0008 | *0.0003* |
| PH32 | 28 | 6 | 0.0013 | *0.0363* | 0.0009 | *0.0002* | 0.0007 | *0.0002* | 0.0009 | *0.0002* | 0.0007 | *0.0002* |
| PH33 | 28 | 12 | 0.0007 | *0.0256* | 0.0007 | *0.0001* | 0.0006 | *0.0001* | 0.0008 | *0.0002* | 0.0006 | *0.0002* |
| PH34 | 28 | 18 | 0.0000 | *0.0000* | 0.0004 | *0.0001* | 0.0004 | *0.0001* | 0.0005 | *0.0001* | 0.0004 | *0.0001* |
| PH35 | 28 | 24 | 0.0020 | *0.0444* | 0.0002 | *0.0001* | 0.0002 | *0.0001* | 0.0003 | *0.0001* | 0.0003 | *0.0001* |
| PH41 | 38 | 0 | 0.0815 | *0.2737* | 0.0906 | *0.0179* | 0.0804 | *0.0181* | 0.0833 | *0.0170* | 0.0740 | *0.0171* |
| PH42 | 38 | 6 | 0.0388 | *0.1932* | 0.0663 | *0.0089* | 0.0584 | *0.0097* | 0.0670 | *0.0091* | 0.0591 | *0.0099* |
| PH43 | 38 | 12 | 0.0151 | *0.1221* | 0.0419 | *0.0051* | 0.0366 | *0.0055* | 0.0465 | *0.0056* | 0.0408 | *0.0060* |
| PH44 | 38 | 18 | 0.0059 | *0.0767* | 0.0224 | *0.0039* | 0.0195 | *0.0037* | 0.0272 | *0.0047* | 0.0237 | *0.0045* |
| PH45 | 38 | 24 | 0.0039 | *0.0627* | 0.0099 | *0.0026* | 0.0085 | *0.0023* | 0.0131 | *0.0035* | 0.0114 | *0.0031* |
| PH51 | 37.5 | 0 | 0.0631 | *0.2433* | 0.0744 | *0.0125* | 0.0673 | *0.0130* | 0.0683 | *0.0120* | 0.0619 | *0.0124* |
| PH52 | 37.5 | 6 | 0.0598 | *0.2372* | 0.0520 | *0.0054* | 0.0466 | *0.0063* | 0.0525 | *0.0055* | 0.0472 | *0.0064* |
| PH53 | 37.5 | 12 | 0.0263 | *0.1601* | 0.0311 | *0.0034* | 0.0278 | *0.0036* | 0.0345 | *0.0036* | 0.0309 | *0.0039* |
| PH54 | 37.5 | 18 | 0.0131 | *0.1140* | 0.0157 | *0.0028* | 0.0139 | *0.0026* | 0.0190 | *0.0034* | 0.0169 | *0.0032* |
| PH55 | 37.5 | 24 | 0.0066 | *0.0808* | 0.0065 | *0.0018* | 0.0057 | *0.0016* | 0.0086 | *0.0023* | 0.0076 | *0.0021* |
| PH61 | 40.5 | 0 | 0.0828 | *0.2757* | 0.0779 | *0.0093* | 0.0732 | *0.0103* | 0.0715 | *0.0093* | 0.0673 | *0.0100* |
| PH62 | 40.5 | 6 | 0.0342 | *0.1818* | 0.0503 | *0.0028* | 0.0469 | *0.0038* | 0.0507 | *0.0028* | 0.0474 | *0.0038* |
| PH63 | 40.5 | 12 | 0.0092 | *0.0955* | 0.0276 | *0.0028* | 0.0255 | *0.0028* | 0.0305 | *0.0029* | 0.0283 | *0.0030* |
| PH64 | 40.5 | 18 | 0.0039 | *0.0627* | 0.0126 | *0.0024* | 0.0115 | *0.0022* | 0.0152 | *0.0029* | 0.0140 | *0.0027* |
| PH65 | 40.5 | 24 | 0.0079 | *0.0885* | 0.0046 | *0.0014* | 0.0042 | *0.0012* | 0.0061 | *0.0018* | 0.0056 | *0.0017* |
| PH71 | 45.5 | 0 | 0.1368 | *0.3437* | 0.0662 | *0.0045* | 0.0680 | *0.0046* | 0.0607 | *0.0049* | 0.0625 | *0.0050* |
| PH72 | 45.5 | 6 | 0.0592 | *0.2360* | 0.0372 | *0.0023* | 0.0379 | *0.0018* | 0.0374 | *0.0022* | 0.0382 | *0.0017* |
| PH73 | 45.5 | 12 | 0.0178 | *0.1321* | 0.0174 | *0.0026* | 0.0176 | *0.0025* | 0.0192 | *0.0028* | 0.0195 | *0.0026* |
| PH74 | 45.5 | 18 | 0.0099 | *0.0988* | 0.0066 | *0.0016* | 0.0066 | *0.0016* | 0.0080 | *0.0020* | 0.0080 | *0.0019* |
| PH75 | 45.5 | 24 | 0.0072 | *0.0848* | 0.0020 | *0.0007* | 0.0020 | *0.0007* | 0.0026 | *0.0009* | 0.0026 | *0.0009* |
| PH81 | 50 | 0 | 0.1446 | *0.3519* | 0.0781 | *0.0116* | 0.0900 | *0.0125* | 0.0714 | *0.0110* | 0.0828 | *0.0120* |
| PH82 | 50 | 6 | 0.0789 | *0.2697* | 0.0380 | *0.0067* | 0.0434 | *0.0071* | 0.0381 | *0.0066* | 0.0438 | *0.0071* |
| PH83 | 50 | 12 | 0.0243 | *0.1541* | 0.0151 | *0.0037* | 0.0172 | *0.0040* | 0.0166 | *0.0040* | 0.0189 | *0.0044* |
| PH84 | 50 | 18 | 0.0092 | *0.0955* | 0.0048 | *0.0016* | 0.0054 | *0.0017* | 0.0057 | *0.0019* | 0.0065 | *0.0021* |
| PH85 | 50 | 24 | 0.0053 | *0.0724* | 0.0011 | *0.0005* | 0.0013 | *0.0005* | 0.0015 | *0.0006* | 0.0017 | *0.0007* |
| PH91 | 55 | 0 | 0.0230 | *0.1500* | 0.0830 | *0.0220* | 0.1086 | *0.0285* | 0.0757 | *0.0203* | 0.0999 | *0.0265* |
| PH92 | 55 | 6 | 0.0053 | *0.0724* | 0.0339 | *0.0101* | 0.0440 | *0.0129* | 0.0339 | *0.0101* | 0.0443 | *0.0130* |
| PH93 | 55 | 12 | 0.0046 | *0.0677* | 0.0110 | *0.0040* | 0.0142 | *0.0050* | 0.0120 | *0.0043* | 0.0156 | *0.0055* |
| PH94 | 55 | 18 | 0.0026 | *0.0512* | 0.0027 | *0.0012* | 0.0035 | *0.0015* | 0.0033 | *0.0014* | 0.0042 | *0.0018* |
| PH95 | 55 | 24 | 0.0013 | *0.0363* | 0.0020 | *0.0050* | 0.0013 | *0.0033* | 0.0017 | *0.0042* | 0.0012 | *0.0030* |
| | | | 1.0000 | | 1.0000 | | 1.0000 | | 1.0000 | | 1.0000 | |

*Standard deviations in italics*

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Hours per week*** | | | | | | | | | |
| Hospital | 43.5 | *6.1* | 42.9 | *1.0* | 43.9 | *1.1* | 42.7 | *1.0* | 43.7 | *1.1* |
| Private extra practice | 4.6 | *6.2* | 5.4 | *0.6* | 5.1 | *0.5* | 6.0 | *0.7* | 5.7 | *0.6* |
| Total | 48.0 | *8.3* | 48.3 | *1.1* | 49.0 | *1.2* | 48.7 | *1.2* | 49.4 | *1.2* |
| ***Hours per year*** | | | | | | | | | | |
| Hospital | 2086 | *295* | 2061 | *47* | 2107 | *54* | 2052 | *46* | 2098 | *54* |
| Private extra practice | 219 | *299* | 257 | *27* | 244 | *26* | 288 | *31* | 275 | *30* |
| Total | 2305 | *398* | 2318 | *54* | 2352 | *59* | 2340 | *55* | 2373 | *60* |

| ***Elasticities*** | Total hours | | Main job | | Extra job | |
|---|---|---|---|---|---|---|
| Effect of an increase in hospital wages | 0.1461* | *0.0301* | 0.2252* | *0.0342* | -0.4911* | *0.0928* |
| Effect of an increase in private wages | 0.0957* | *0.0158* | -0.0434* | *0.0074* | 1.2072* | *0.0792* |
| Effect of an increase in all wages | 0.2390* | *0.0279* | 0.1833* | *0.0337* | 0.6773* | *0.1237* |

N=1521

***Table P6 Hospital physicians, observed both in 1995 and 1997.***
***Observed and predicted choices. Jr. physicians and hospital consultants***

| | Main hours | Extra hours | Observed share | | Predicted probability | | Predictions with a 10% increase in hospital wages | | Predictions with a 10% increase in private wages | | Predictions with a 10% increase in all wages | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PH11 | 18 | 0 | 0.0019 | *0.0439* | 0.0017 | *0.0016* | 0.0012 | *0.0013* | 0.0015 | *0.0015* | 0.0011 | *0.0012* |
| PH12 | 18 | 6 | 0.0029 | *0.0538* | 0.0016 | *0.0012* | 0.0011 | *0.0009* | 0.0017 | *0.0012* | 0.0012 | *0.0010* |
| PH13 | 18 | 12 | 0.0000 | *0.0000* | 0.0013 | *0.0007* | 0.0009 | *0.0006* | 0.0015 | *0.0009* | 0.0011 | *0.0007* |
| PH14 | 18 | 18 | 0.0010 | *0.0311* | 0.0010 | *0.0004* | 0.0007 | *0.0004* | 0.0013 | *0.0006* | 0.0009 | *0.0005* |
| PH15 | 18 | 24 | 0.0000 | *0.0000* | 0.0007 | *0.0003* | 0.0005 | *0.0002* | 0.0010 | *0.0004* | 0.0007 | *0.0003* |
| PH21 | 22 | 0 | 0.0010 | *0.0311* | 0.0013 | *0.0010* | 0.0010 | *0.0009* | 0.0012 | *0.0010* | 0.0009 | *0.0008* |
| PH22 | 22 | 6 | 0.0000 | *0.0000* | 0.0011 | *0.0007* | 0.0008 | *0.0006* | 0.0012 | *0.0007* | 0.0009 | *0.0006* |
| PH23 | 22 | 12 | 0.0019 | *0.0439* | 0.0009 | *0.0004* | 0.0006 | *0.0003* | 0.0010 | *0.0004* | 0.0007 | *0.0004* |
| PH24 | 22 | 18 | 0.0000 | *0.0000* | 0.0006 | *0.0002* | 0.0004 | *0.0002* | 0.0008 | *0.0003* | 0.0006 | *0.0002* |
| PH25 | 22 | 24 | 0.0000 | *0.0000* | 0.0004 | *0.0002* | 0.0003 | *0.0001* | 0.0005 | *0.0002* | 0.0004 | *0.0002* |
| PH31 | 28 | 0 | 0.0039 | *0.0620* | 0.0008 | *0.0005* | 0.0006 | *0.0004* | 0.0007 | *0.0005* | 0.0006 | *0.0004* |
| PH32 | 28 | 6 | 0.0000 | *0.0000* | 0.0006 | *0.0003* | 0.0005 | *0.0002* | 0.0006 | *0.0003* | 0.0005 | *0.0002* |
| PH33 | 28 | 12 | 0.0000 | *0.0000* | 0.0004 | *0.0001* | 0.0003 | *0.0001* | 0.0005 | *0.0001* | 0.0004 | *0.0001* |
| PH34 | 28 | 18 | 0.0010 | *0.0311* | 0.0003 | *0.0001* | 0.0002 | *0.0001* | 0.0003 | *0.0001* | 0.0002 | *0.0001* |
| PH35 | 28 | 24 | 0.0000 | *0.0000* | 0.0001 | *0.0001* | 0.0001 | *0.0000* | 0.0002 | *0.0001* | 0.0001 | *0.0001* |
| PH41 | 38 | 0 | 0.0772 | *0.2671* | 0.0998 | *0.0373* | 0.0857 | *0.0370* | 0.0914 | *0.0364* | 0.0790 | *0.0357* |
| PH42 | 38 | 6 | 0.0232 | *0.1505* | 0.0657 | *0.0129* | 0.0558 | *0.0142* | 0.0669 | *0.0137* | 0.0572 | *0.0149* |
| PH43 | 38 | 12 | 0.0068 | *0.0820* | 0.0381 | *0.0065* | 0.0321 | *0.0066* | 0.0432 | *0.0071* | 0.0366 | *0.0073* |
| PH44 | 38 | 18 | 0.0010 | *0.0311* | 0.0191 | *0.0058* | 0.0160 | *0.0050* | 0.0241 | *0.0073* | 0.0203 | *0.0063* |
| PH45 | 38 | 24 | 0.0048 | *0.0693* | 0.0080 | *0.0037* | 0.0067 | *0.0031* | 0.0113 | *0.0053* | 0.0094 | *0.0045* |
| PH51 | 37.5 | 0 | 0.0753 | *0.2640* | 0.0783 | *0.0247* | 0.0687 | *0.0254* | 0.0717 | *0.0243* | 0.0633 | *0.0246* |
| PH52 | 37.5 | 6 | 0.0309 | *0.1731* | 0.0494 | *0.0072* | 0.0429 | *0.0086* | 0.0502 | *0.0077* | 0.0439 | *0.0091* |
| PH53 | 37.5 | 12 | 0.0048 | *0.0693* | 0.0273 | *0.0047* | 0.0235 | *0.0046* | 0.0309 | *0.0051* | 0.0267 | *0.0050* |
| PH54 | 37.5 | 18 | 0.0039 | *0.0620* | 0.0129 | *0.0042* | 0.0110 | *0.0036* | 0.0163 | *0.0053* | 0.0140 | *0.0046* |
| PH55 | 37.5 | 24 | 0.0048 | *0.0693* | 0.0051 | *0.0024* | 0.0043 | *0.0021* | 0.0071 | *0.0035* | 0.0061 | *0.0030* |
| PH61 | 40.5 | 0 | 0.0985 | *0.2981* | 0.0812 | *0.0180* | 0.0745 | *0.0199* | 0.0743 | *0.0182* | 0.0684 | *0.0197* |
| PH62 | 40.5 | 6 | 0.0270 | *0.1622* | 0.0478 | *0.0037* | 0.0434 | *0.0052* | 0.0485 | *0.0038* | 0.0443 | *0.0054* |
| PH63 | 40.5 | 12 | 0.0068 | *0.0820* | 0.0243 | *0.0049* | 0.0219 | *0.0044* | 0.0275 | *0.0052* | 0.0249 | *0.0048* |
| PH64 | 40.5 | 18 | 0.0029 | *0.0538* | 0.0105 | *0.0038* | 0.0093 | *0.0034* | 0.0132 | *0.0048* | 0.0118 | *0.0042* |
| PH65 | 40.5 | 24 | 0.0058 | *0.0759* | 0.0037 | *0.0019* | 0.0033 | *0.0017* | 0.0052 | *0.0027* | 0.0046 | *0.0024* |
| PH71 | 45.5 | 0 | 0.1834 | *0.3872* | 0.0668 | *0.0065* | 0.0678 | *0.0076* | 0.0609 | *0.0073* | 0.0622 | *0.0083* |
| PH72 | 45.5 | 6 | 0.0714 | *0.2577* | 0.0346 | *0.0046* | 0.0349 | *0.0038* | 0.0351 | *0.0043* | 0.0355 | *0.0035* |
| PH73 | 45.5 | 12 | 0.0164 | *0.1271* | 0.0152 | *0.0045* | 0.0152 | *0.0042* | 0.0172 | *0.0049* | 0.0173 | *0.0046* |
| PH74 | 45.5 | 18 | 0.0097 | *0.0978* | 0.0055 | *0.0025* | 0.0055 | *0.0024* | 0.0069 | *0.0031* | 0.0069 | *0.0030* |
| PH75 | 45.5 | 24 | 0.0097 | *0.0978* | 0.0016 | *0.0009* | 0.0015 | *0.0009* | 0.0022 | *0.0013* | 0.0022 | *0.0013* |
| PH81 | 50 | 0 | 0.1535 | *0.3606* | 0.0832 | *0.0160* | 0.0970 | *0.0167* | 0.0757 | *0.0147* | 0.0888 | *0.0157* |
| PH82 | 50 | 6 | 0.0792 | *0.2701* | 0.0379 | *0.0108* | 0.0439 | *0.0115* | 0.0384 | *0.0107* | 0.0446 | *0.0114* |
| PH83 | 50 | 12 | 0.0261 | *0.1594* | 0.0143 | *0.0060* | 0.0165 | *0.0066* | 0.0161 | *0.0067* | 0.0186 | *0.0073* |
| PH84 | 50 | 18 | 0.0068 | *0.0820* | 0.0043 | *0.0024* | 0.0049 | *0.0027* | 0.0054 | *0.0030* | 0.0062 | *0.0034* |
| PH85 | 50 | 24 | 0.0077 | *0.0876* | 0.0010 | *0.0007* | 0.0011 | *0.0008* | 0.0014 | *0.0010* | 0.0016 | *0.0011* |
| PH91 | 55 | 0 | 0.0319 | *0.1757* | 0.0962 | *0.0345* | 0.1313 | *0.0454* | 0.0873 | *0.0312* | 0.1199 | *0.0414* |
| PH92 | 55 | 6 | 0.0087 | *0.0928* | 0.0372 | *0.0168* | 0.0504 | *0.0219* | 0.0376 | *0.0167* | 0.0512 | *0.0221* |
| PH93 | 55 | 12 | 0.0029 | *0.0538* | 0.0116 | *0.0065* | 0.0156 | *0.0086* | 0.0130 | *0.0073* | 0.0176 | *0.0096* |
| PH94 | 55 | 18 | 0.0039 | *0.0620* | 0.0028 | *0.0019* | 0.0037 | *0.0025* | 0.0035 | *0.0024* | 0.0047 | *0.0032* |
| PH95 | 55 | 24 | 0.0019 | *0.0439* | 0.0037 | *0.0108* | 0.0022 | *0.0068* | 0.0035 | *0.0101* | 0.0021 | *0.0064* |
| | | | 1.0000 | | 1.0000 | | 1.0000 | | 1.0000 | | 1.0000 | |

*Standard deviation in italics*

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Hours per week | | | | | | | | | | |
| Hospital | 44.4 | *5.8* | 43.3 | *1.5* | 44.5 | *1.7* | 43.1 | *1.4* | 44.3 | *1.7* |
| Private extra practice | 3.6 | *5.9* | 4.9 | *0.9* | 4.6 | *0.9* | 5.6 | *1.1* | 5.2 | *1.0* |
| Total | 48.0 | *8.4* | 48.2 | *2.0* | 49.1 | *2.2* | 48.7 | *2.1* | 49.5 | *2.2* |
| | | | | | | | | | | |
| Hours per year | | | | | | | | | | |
| Hospital | 2130 | *279* | 2079 | *70* | 2136 | *83* | 2070 | *68* | 2127 | *81* |
| Private extra practice | 174 | *283* | 234 | *43* | 219 | *41* | 267 | *52* | 251 | *49* |
| Total | 2304 | *403* | 2312 | *95* | 2355 | *103* | 2337 | *99* | 2378 | *107* |

| Elasticities | Total hours | | Main job | | Extra job | |
|---|---|---|---|---|---|---|
| Effect of an increase in hospital wages | 0.1855* | *0.0565* | 0.2735* | *0.0601* | -0.6019* | *0.1688* |
| Effect of an increase in private wages | 0.1048* | *0.0265* | -0.0434* | *0.0117* | 1.4141* | *0.1752* |
| Effect of an increase in all wages | 0.2821* | *0.0621* | 0.2290* | *0.0558* | 0.7402* | *0.2720* |

N=1036

***Table P7 A prediction experiment on 1997 data***
***Observed choices in 1997 and predicted choices in 1997.***
***Predictions based on 1995 model parameters and 1997 wages.***

| | | | All hospital physicians | | | | Male hospital consultants | | | | Hospital physicians observed in 1995 & 1997 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | N=1553 | | | | N=790 | | | | N=1036 | | | |
| | Main hours | Extra hours | Observed 1997 | | Predicted with 1997 wages | | Observed 1997 | | Predicted with 1997 wages | | Observed 1997 | | Predicted with 1997 wages | |
| PH11 | 18 | 0 | 0.0064 | *0.0800* | 0.0025 | *0.0022* | 0.0025 | *0.0503* | 0.0009 | *0.0004* | 0.0029 | *0.0538* | 0.0025 | *0.0022* |
| PH12 | 18 | 6 | 0.0013 | *0.0359* | 0.0024 | *0.0015* | 0.0000 | *0.0000* | 0.0012 | *0.0004* | 0.0000 | *0.0000* | 0.0024 | *0.0015* |
| PH13 | 18 | 12 | 0.0019 | *0.0439* | 0.0020 | *0.0009* | 0.0025 | *0.0503* | 0.0013 | *0.0004* | 0.0019 | *0.0439* | 0.0020 | *0.0009* |
| PH14 | 18 | 18 | 0.0013 | *0.0359* | 0.0016 | *0.0005* | 0.0013 | *0.0356* | 0.0013 | *0.0005* | 0.0010 | *0.0311* | 0.0016 | *0.0005* |
| PH15 | 18 | 24 | 0.0032 | *0.0567* | 0.0011 | *0.0004* | 0.0051 | *0.0710* | 0.0012 | *0.0005* | 0.0010 | *0.0311* | 0.0011 | *0.0004* |
| PH21 | 22 | 0 | 0.0058 | *0.0759* | 0.0020 | *0.0015* | 0.0038 | *0.0615* | 0.0008 | *0.0003* | 0.0048 | *0.0693* | 0.0020 | *0.0015* |
| PH22 | 22 | 6 | 0.0019 | *0.0439* | 0.0018 | *0.0010* | 0.0025 | *0.0503* | 0.0010 | *0.0003* | 0.0010 | *0.0311* | 0.0018 | *0.0010* |
| PH23 | 22 | 12 | 0.0013 | *0.0359* | 0.0014 | *0.0005* | 0.0000 | *0.0000* | 0.0010 | *0.0003* | 0.0010 | *0.0311* | 0.0014 | *0.0005* |
| PH24 | 22 | 18 | 0.0000 | *0.0000* | 0.0010 | *0.0002* | 0.0000 | *0.0000* | 0.0009 | *0.0003* | 0.0000 | *0.0000* | 0.0010 | *0.0002* |
| PH25 | 22 | 24 | 0.0019 | *0.0439* | 0.0007 | *0.0002* | 0.0025 | *0.0503* | 0.0007 | *0.0003* | 0.0000 | *0.0000* | 0.0007 | *0.0002* |
| PH31 | 28 | 0 | 0.0097 | *0.0978* | 0.0014 | *0.0008* | 0.0013 | *0.0356* | 0.0007 | *0.0002* | 0.0077 | *0.0876* | 0.0014 | *0.0008* |
| PH32 | 28 | 6 | 0.0019 | *0.0439* | 0.0011 | *0.0004* | 0.0000 | *0.0000* | 0.0007 | *0.0002* | 0.0019 | *0.0439* | 0.0011 | *0.0004* |
| PH33 | 28 | 12 | 0.0026 | *0.0507* | 0.0008 | *0.0001* | 0.0000 | *0.0000* | 0.0006 | *0.0001* | 0.0010 | *0.0311* | 0.0008 | *0.0001* |
| PH34 | 28 | 18 | 0.0039 | *0.0621* | 0.0005 | *0.0001* | 0.0038 | *0.0615* | 0.0005 | *0.0001* | 0.0019 | *0.0439* | 0.0005 | *0.0001* |
| PH35 | 28 | 24 | 0.0019 | *0.0439* | 0.0003 | *0.0001* | 0.0025 | *0.0503* | 0.0003 | *0.0001* | 0.0000 | *0.0000* | 0.0003 | *0.0001* |
| PH41 | 38 | 0 | 0.1120 | *0.3155* | 0.0967 | *0.0392* | 0.0506 | *0.2194* | 0.0633 | *0.0140* | 0.0956 | *0.2941* | 0.0967 | *0.0392* |
| PH42 | 38 | 6 | 0.0212 | *0.1443* | 0.0663 | *0.0115* | 0.0127 | *0.1119* | 0.0548 | *0.0074* | 0.0154 | *0.1234* | 0.0663 | *0.0115* |
| PH43 | 38 | 12 | 0.0058 | *0.0759* | 0.0412 | *0.0056* | 0.0025 | *0.0503* | 0.0412 | *0.0057* | 0.0039 | *0.0620* | 0.0412 | *0.0056* |
| PH44 | 38 | 18 | 0.0019 | *0.0439* | 0.0228 | *0.0075* | 0.0000 | *0.0000* | 0.0263 | *0.0060* | 0.0000 | *0.0000* | 0.0228 | *0.0075* |
| PH45 | 38 | 24 | 0.0026 | *0.0507* | 0.0110 | *0.0058* | 0.0013 | *0.0356* | 0.0139 | *0.0048* | 0.0019 | *0.0439* | 0.0110 | *0.0058* |
| PH51 | 37.5 | 0 | 0.0824 | *0.2751* | 0.0786 | *0.0275* | 0.0633 | *0.2436* | 0.0535 | *0.0107* | 0.0936 | *0.2915* | 0.0786 | *0.0275* |
| PH52 | 37.5 | 6 | 0.0373 | *0.1897* | 0.0519 | *0.0064* | 0.0266 | *0.1610* | 0.0443 | *0.0049* | 0.0405 | *0.1973* | 0.0519 | *0.0064* |
| PH53 | 37.5 | 12 | 0.0097 | *0.0978* | 0.0310 | *0.0051* | 0.0063 | *0.0794* | 0.0315 | *0.0041* | 0.0135 | *0.1155* | 0.0310 | *0.0051* |
| PH54 | 37.5 | 18 | 0.0052 | *0.0716* | 0.0164 | *0.0060* | 0.0025 | *0.0503* | 0.0189 | *0.0044* | 0.0048 | *0.0693* | 0.0164 | *0.0060* |
| PH55 | 37.5 | 24 | 0.0058 | *0.0759* | 0.0074 | *0.0042* | 0.0013 | *0.0356* | 0.0094 | *0.0033* | 0.0058 | *0.0759* | 0.0074 | *0.0042* |
| PH61 | 40.5 | 0 | 0.1017 | *0.3024* | 0.0776 | *0.0204* | 0.1316 | *0.3383* | 0.0593 | *0.0099* | 0.1245 | *0.3303* | 0.0776 | *0.0204* |
| PH62 | 40.5 | 6 | 0.0258 | *0.1585* | 0.0482 | *0.0028* | 0.0367 | *0.1882* | 0.0453 | *0.0032* | 0.0319 | *0.1757* | 0.0482 | *0.0028* |
| PH63 | 40.5 | 12 | 0.0071 | *0.0839* | 0.0268 | *0.0059* | 0.0101 | *0.1002* | 0.0295 | *0.0035* | 0.0097 | *0.0978* | 0.0268 | *0.0059* |
| PH64 | 40.5 | 18 | 0.0026 | *0.0507* | 0.0130 | *0.0056* | 0.0025 | *0.0503* | 0.0160 | *0.0038* | 0.0029 | *0.0538* | 0.0130 | *0.0056* |
| PH65 | 40.5 | 24 | 0.0045 | *0.0670* | 0.0054 | *0.0033* | 0.0051 | *0.0710* | 0.0070 | *0.0026* | 0.0068 | *0.0820* | 0.0054 | *0.0033* |
| PH71 | 45.5 | 0 | 0.1410 | *0.3482* | 0.0637 | *0.0081* | 0.1291 | *0.3355* | 0.0581 | *0.0071* | 0.1448 | *0.3521* | 0.0637 | *0.0081* |
| PH72 | 45.5 | 6 | 0.0528 | *0.2237* | 0.0356 | *0.0050* | 0.0392 | *0.1943* | 0.0384 | *0.0009* | 0.0483 | *0.2144* | 0.0356 | *0.0050* |
| PH73 | 45.5 | 12 | 0.0116 | *0.1071* | 0.0175 | *0.0060* | 0.0190 | *0.1366* | 0.0213 | *0.0029* | 0.0125 | *0.1114* | 0.0175 | *0.0060* |
| PH74 | 45.5 | 18 | 0.0077 | *0.0876* | 0.0073 | *0.0039* | 0.0114 | *0.1062* | 0.0096 | *0.0026* | 0.0068 | *0.0820* | 0.0073 | *0.0039* |
| PH75 | 45.5 | 24 | 0.0032 | *0.0567* | 0.0025 | *0.0018* | 0.0038 | *0.0615* | 0.0034 | *0.0014* | 0.0039 | *0.0620* | 0.0025 | *0.0018* |
| PH81 | 50 | 0 | 0.1436 | *0.3508* | 0.0722 | *0.0103* | 0.1696 | *0.3755* | 0.0819 | *0.0108* | 0.1458 | *0.3530* | 0.0722 | *0.0103* |
| PH82 | 50 | 6 | 0.0534 | *0.2250* | 0.0362 | *0.0103* | 0.0759 | *0.2651* | 0.0468 | *0.0050* | 0.0550 | *0.2281* | 0.0362 | *0.0103* |
| PH83 | 50 | 12 | 0.0219 | *0.1464* | 0.0156 | *0.0073* | 0.0367 | *0.1882* | 0.0220 | *0.0043* | 0.0203 | *0.1410* | 0.0156 | *0.0073* |
| PH84 | 50 | 18 | 0.0116 | *0.1071* | 0.0056 | *0.0036* | 0.0190 | *0.1366* | 0.0082 | *0.0026* | 0.0097 | *0.0978* | 0.0056 | *0.0036* |
| PH85 | 50 | 24 | 0.0071 | *0.0839* | 0.0016 | *0.0013* | 0.0114 | *0.1062* | 0.0023 | *0.0010* | 0.0029 | *0.0538* | 0.0016 | *0.0013* |
| PH91 | 55 | 0 | 0.0419 | *0.2003* | 0.0750 | *0.0221* | 0.0570 | *0.2319* | 0.1051 | *0.0212* | 0.0415 | *0.1996* | 0.0750 | *0.0221* |
| PH92 | 55 | 6 | 0.0200 | *0.1399* | 0.0327 | *0.0146* | 0.0266 | *0.1610* | 0.0502 | *0.0106* | 0.0193 | *0.1377* | 0.0327 | *0.0146* |
| PH93 | 55 | 12 | 0.0090 | *0.0945* | 0.0119 | *0.0073* | 0.0152 | *0.1224* | 0.0192 | *0.0055* | 0.0077 | *0.0876* | 0.0119 | *0.0073* |
| PH94 | 55 | 18 | 0.0039 | *0.0621* | 0.0035 | *0.0027* | 0.0051 | *0.0710* | 0.0056 | *0.0022* | 0.0039 | *0.0620* | 0.0035 | *0.0027* |
| PH95 | 55 | 24 | 0.0006 | *0.0254* | 0.0043 | *0.0103* | 0.0000 | *0.0000* | 0.0006 | *0.0015* | 0.0010 | *0.0311* | 0.0043 | *0.0103* |
| | | | 1.0000 | | 1.0000 | | 1.0000 | | 1.0000 | | 1.0000 | | 1.0000 | |

*Standard deviations in italics*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Hours per week*** | | | | | | | | | | | | |
| Hospital | 43.4 | *7.1* | 42.7 | *1.2* | 45.0 | *6.8* | 44.1 | *0.8* | 43.7 | *6.5* | 42.7 | *1.2* |
| Private extra practice | 3.6 | *5.9* | 5.5 | *1.3* | 4.0 | *6.2* | 6.2 | *0.9* | 3.2 | *5.5* | 5.5 | *1.3* |
| Total | 47.0 | *9.1* | 48.2 | *2.3* | 49.0 | *9.0* | 50.3 | *1.2* | 46.9 | *8.6* | 48.2 | *2.3* |
| ***Hours per year*** | | | | | | | | | | | | |
| Hospital | 2082 | *342* | 2049 | *59* | 2160 | *326* | 2116 | *40* | 2096 | *310* | 2049 | *59* |
| Private extra practice | 171 | *285* | 266 | *60* | 194 | *299* | 298 | *44* | 156 | *266* | 266 | *60* |
| Total | 2254 | *435* | 2315 | *110* | 2354 | *432* | 2414 | *55* | 2252 | *411* | 2315 | *110* |

***Table P9 All physicians in 1997. Observed and predicted choices.***

| | Main hours | Extra hours | Observed share | | Predicted choice | | Predictions with a 10% increase in *hospital* wages | | Predictions with a 10% increase in *primary care* wages | | Predictions with a 10% increase in *private* wages | | Predictions with a 10% increase in *other* wages | | Predictions with a 10% increase in *all* wages | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PH11 | 18 | 0 | 0.0091 | 0.0951 | 0.0088 | *0.0077* | 0.0082 | *0.0078* | 0.0087 | *0.0077* | 0.0077 | *0.0070* | 0.0084 | *0.0074* | 0.0069 | *0.0066* |
| PH12 | 18 | 6 | 0.0106 | 0.1024 | 0.0132 | *0.0088* | 0.0121 | *0.0090* | 0.0131 | *0.0087* | 0.0122 | *0.0082* | 0.0130 | *0.0086* | 0.0107 | *0.0080* |
| PH13 | 18 | 12 | 0.0043 | 0.0655 | 0.0183 | *0.0097* | 0.0164 | *0.0102* | 0.0180 | *0.0095* | 0.0178 | *0.0095* | 0.0183 | *0.0095* | 0.0155 | *0.0092* |
| PH14 | 18 | 18 | 0.0048 | 0.0693 | 0.0232 | *0.0107* | 0.0204 | *0.0115* | 0.0227 | *0.0103* | 0.0239 | *0.0117* | 0.0235 | *0.0102* | 0.0206 | *0.0107* |
| PH15 | 18 | 24 | 0.0047 | 0.0686 | 0.0263 | *0.0125* | 0.0228 | *0.0131* | 0.0258 | *0.0118* | 0.0290 | *0.0155* | 0.0269 | *0.0114* | 0.0246 | *0.0131* |
| PH21 | 22 | 0 | 0.0057 | 0.0751 | 0.0118 | *0.0090* | 0.0111 | *0.0092* | 0.0117 | *0.0090* | 0.0105 | *0.0083* | 0.0113 | *0.0085* | 0.0095 | *0.0080* |
| PH22 | 22 | 6 | 0.0079 | 0.0884 | 0.0165 | *0.0095* | 0.0153 | *0.0100* | 0.0164 | *0.0094* | 0.0154 | *0.0088* | 0.0163 | *0.0093* | 0.0138 | *0.0089* |
| PH23 | 22 | 12 | 0.0054 | 0.0730 | 0.0212 | *0.0095* | 0.0193 | *0.0104* | 0.0210 | *0.0093* | 0.0207 | *0.0092* | 0.0213 | *0.0094* | 0.0185 | *0.0094* |
| PH24 | 22 | 18 | 0.0063 | 0.0791 | 0.0247 | *0.0097* | 0.0221 | *0.0108* | 0.0244 | *0.0093* | 0.0256 | *0.0104* | 0.0251 | *0.0093* | 0.0226 | *0.0101* |
| PH25 | 22 | 24 | 0.0068 | 0.0823 | 0.0255 | *0.0106* | 0.0224 | *0.0114* | 0.0251 | *0.0101* | 0.0281 | *0.0131* | 0.0262 | *0.0099* | 0.0245 | *0.0115* |
| PH31 | 28 | 0 | 0.0826 | 0.2753 | 0.0170 | *0.0110* | 0.0162 | *0.0114* | 0.0169 | *0.0109* | 0.0156 | *0.0106* | 0.0163 | *0.0103* | 0.0143 | *0.0102* |
| PH32 | 28 | 6 | 0.0569 | 0.2316 | 0.0213 | *0.0103* | 0.0200 | *0.0111* | 0.0212 | *0.0102* | 0.0202 | *0.0097* | 0.0210 | *0.0100* | 0.0187 | *0.0101* |
| PH33 | 28 | 12 | 0.0330 | 0.1785 | 0.0242 | *0.0088* | 0.0224 | *0.0101* | 0.0241 | *0.0087* | 0.0240 | *0.0082* | 0.0244 | *0.0090* | 0.0222 | *0.0093* |
| PH34 | 28 | 18 | 0.0276 | 0.1638 | 0.0245 | *0.0078* | 0.0224 | *0.0092* | 0.0243 | *0.0076* | 0.0255 | *0.0078* | 0.0251 | *0.0079* | 0.0235 | *0.0086* |
| PH35 | 28 | 24 | 0.0324 | 0.1772 | 0.0213 | *0.0077* | 0.0191 | *0.0084* | 0.0211 | *0.0074* | 0.0234 | *0.0091* | 0.0220 | *0.0075* | 0.0214 | *0.0086* |
| PH41 | 38 | 0 | 0.0055 | 0.0737 | 0.0199 | *0.0118* | 0.0193 | *0.0122* | 0.0199 | *0.0118* | 0.0190 | *0.0123* | 0.0191 | *0.0108* | 0.0178 | *0.0117* |
| PH42 | 38 | 6 | 0.0092 | 0.0957 | 0.0214 | *0.0097* | 0.0205 | *0.0104* | 0.0214 | *0.0097* | 0.0209 | *0.0098* | 0.0212 | *0.0094* | 0.0200 | *0.0102* |
| PH43 | 38 | 12 | 0.0057 | 0.0751 | 0.0203 | *0.0072* | 0.0193 | *0.0081* | 0.0203 | *0.0072* | 0.0206 | *0.0067* | 0.0206 | *0.0075* | 0.0198 | *0.0080* |
| PH44 | 38 | 18 | 0.0055 | 0.0737 | 0.0165 | *0.0053* | 0.0154 | *0.0060* | 0.0164 | *0.0052* | 0.0174 | *0.0049* | 0.0170 | *0.0058* | 0.0167 | *0.0060* |
| PH45 | 38 | 24 | 0.0035 | 0.0588 | 0.0108 | *0.0041* | 0.0100 | *0.0043* | 0.0108 | *0.0040* | 0.0120 | *0.0044* | 0.0113 | *0.0044* | 0.0115 | *0.0047* |
| PH51 | 37.5 | 0 | 0.0020 | 0.0446 | 0.0210 | *0.0125* | 0.0205 | *0.0129* | 0.0210 | *0.0125* | 0.0203 | *0.0134* | 0.0202 | *0.0114* | 0.0192 | *0.0126* |
| PH52 | 37.5 | 6 | 0.0038 | 0.0614 | 0.0216 | *0.0100* | 0.0208 | *0.0107* | 0.0216 | *0.0100* | 0.0213 | *0.0104* | 0.0214 | *0.0097* | 0.0205 | *0.0107* |
| PH53 | 37.5 | 12 | 0.0018 | 0.0422 | 0.0194 | *0.0072* | 0.0185 | *0.0080* | 0.0194 | *0.0072* | 0.0197 | *0.0069* | 0.0197 | *0.0075* | 0.0192 | *0.0081* |
| PH54 | 37.5 | 18 | 0.0009 | 0.0307 | 0.0146 | *0.0050* | 0.0138 | *0.0056* | 0.0146 | *0.0050* | 0.0155 | *0.0046* | 0.0151 | *0.0055* | 0.0151 | *0.0058* |
| PH55 | 37.5 | 24 | 0.0012 | 0.0340 | 0.0088 | *0.0035* | 0.0082 | *0.0037* | 0.0088 | *0.0035* | 0.0098 | *0.0037* | 0.0092 | *0.0038* | 0.0095 | *0.0041* |
| PH61 | 40.5 | 0 | 0.0324 | 0.1772 | 0.0257 | *0.0117* | 0.0251 | *0.0122* | 0.0258 | *0.0117* | 0.0250 | *0.0134* | 0.0249 | *0.0105* | 0.0239 | *0.0124* |
| PH62 | 40.5 | 6 | 0.0489 | 0.2157 | 0.0248 | *0.0081* | 0.0239 | *0.0089* | 0.0248 | *0.0081* | 0.0247 | *0.0090* | 0.0246 | *0.0078* | 0.0239 | *0.0093* |
| PH63 | 40.5 | 12 | 0.0252 | 0.1567 | 0.0205 | *0.0051* | 0.0195 | *0.0058* | 0.0205 | *0.0051* | 0.0211 | *0.0050* | 0.0207 | *0.0053* | 0.0206 | *0.0061* |
| PH64 | 40.5 | 18 | 0.0106 | 0.1024 | 0.0139 | *0.0036* | 0.0131 | *0.0040* | 0.0139 | *0.0036* | 0.0149 | *0.0036* | 0.0143 | *0.0040* | 0.0145 | *0.0042* |
| PH65 | 40.5 | 24 | 0.0139 | 0.1169 | 0.0072 | *0.0027* | 0.0068 | *0.0027* | 0.0072 | *0.0027* | 0.0081 | *0.0031* | 0.0076 | *0.0029* | 0.0079 | *0.0031* |
| PH71 | 45.5 | 0 | 0.0261 | 0.1595 | 0.0345 | *0.0093* | 0.0347 | *0.0096* | 0.0348 | *0.0094* | 0.0338 | *0.0121* | 0.0337 | *0.0081* | 0.0334 | *0.0106* |
| PH72 | 45.5 | 6 | 0.0381 | 0.1914 | 0.0293 | *0.0052* | 0.0291 | *0.0054* | 0.0295 | *0.0052* | 0.0295 | *0.0065* | 0.0292 | *0.0047* | 0.0295 | *0.0061* |
| PH73 | 45.5 | 12 | 0.0187 | 0.1354 | 0.0205 | *0.0040* | 0.0202 | *0.0039* | 0.0207 | *0.0040* | 0.0214 | *0.0042* | 0.0208 | *0.0039* | 0.0215 | *0.0041* |
| PH74 | 45.5 | 18 | 0.0079 | 0.0884 | 0.0112 | *0.0035* | 0.0109 | *0.0033* | 0.0113 | *0.0036* | 0.0122 | *0.0039* | 0.0115 | *0.0036* | 0.0123 | *0.0037* |
| PH75 | 45.5 | 24 | 0.0121 | 0.1092 | 0.0044 | *0.0021* | 0.0042 | *0.0020* | 0.0044 | *0.0022* | 0.0050 | *0.0025* | 0.0046 | *0.0021* | 0.0050 | *0.0024* |
| PH81 | 50 | 0 | 0.1285 | 0.3346 | 0.0573 | *0.0205* | 0.0613 | *0.0234* | 0.0578 | *0.0202* | 0.0546 | *0.0175* | 0.0564 | *0.0208* | 0.0584 | *0.0198* |
| PH82 | 50 | 6 | 0.2146 | 0.4106 | 0.0424 | *0.0166* | 0.0448 | *0.0182* | 0.0428 | *0.0164* | 0.0421 | *0.0151* | 0.0423 | *0.0166* | 0.0451 | *0.0164* |
| PH83 | 50 | 12 | 0.0436 | 0.2041 | 0.0248 | *0.0118* | 0.0259 | *0.0125* | 0.0250 | *0.0118* | 0.0258 | *0.0119* | 0.0250 | *0.0117* | 0.0275 | *0.0124* |
| PH84 | 50 | 18 | 0.0172 | 0.1301 | 0.0107 | *0.0065* | 0.0110 | *0.0066* | 0.0108 | *0.0065* | 0.0117 | *0.0071* | 0.0108 | *0.0064* | 0.0124 | *0.0073* |
| PH85 | 50 | 24 | 0.0132 | 0.1142 | 0.0031 | *0.0024* | 0.0031 | *0.0024* | 0.0031 | *0.0024* | 0.0035 | *0.0028* | 0.0031 | *0.0024* | 0.0037 | *0.0028* |
| PH91 | 55 | 0 | 0.0048 | 0.0693 | 0.0998 | *0.0679* | 0.1177 | *0.0833* | 0.1008 | *0.0673* | 0.0928 | *0.0586* | 0.0991 | *0.0684* | 0.1101 | *0.0734* |
| PH92 | 55 | 6 | 0.0025 | 0.0501 | 0.0605 | *0.0440* | 0.0702 | *0.0525* | 0.0610 | *0.0437* | 0.0592 | *0.0411* | 0.0604 | *0.0440* | 0.0696 | *0.0496* |
| PH93 | 55 | 12 | 0.0018 | 0.0422 | 0.0273 | *0.0222* | 0.0313 | *0.0259* | 0.0275 | *0.0221* | 0.0282 | *0.0225* | 0.0274 | *0.0221* | 0.0328 | *0.0263* |
| PH94 | 55 | 18 | 0.0002 | 0.0145 | 0.0084 | *0.0079* | 0.0095 | *0.0090* | 0.0084 | *0.0079* | 0.0091 | *0.0086* | 0.0084 | *0.0079* | 0.0105 | *0.0098* |
| PH95 | 55 | 24 | 0.0008 | 0.0290 | 0.0014 | *0.0060* | 0.0013 | *0.0059* | 0.0014 | *0.0060* | 0.0011 | *0.0044* | 0.0014 | *0.0056* | 0.0009 | *0.0039* |
| | | | 1.0000 | | 1.0000 | | 1.0000 | | 1.0000 | | 1.0000 | | 1.0000 | | 1.0000 | |

*Standard deviation in italics*

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Hours per week*** | | | | | | | | | | | | | | |
| Main | 40.7 | *10.5* | 39.5 | *4.7* | 40.5 | *5.4* | 39.6 | *4.6* | 39.3 | *4.3* | 39.4 | *4.7* | 40.5 | *4.9* |
| Extra | 7.6 | *7.3* | 9.1 | *1.4* | 8.7 | *1.6* | 9.1 | *1.4* | 9.5 | *1.6* | 9.3 | *1.4* | 9.2 | *1.5* |
| Total | 48.3 | *11.7* | 48.6 | *4.1* | 49.2 | *4.5* | 48.7 | *4.0* | 48.9 | *3.9* | 48.7 | *4.0* | 49.7 | *4.2* |
| ***Hours per year*** | | | | | | | | | | | | | | |
| Main | 1953 | *503* | 1895 | *225* | 1946 | *260* | 1900 | *222* | 1888 | *208* | 1893 | *224* | 1945 | *235* |
| Extra | 365 | *351* | 439 | *68* | 417 | *77* | 436 | *66* | 458 | *77* | 446 | *67* | 440 | *74* |
| Total | 2319 | *561* | 2333 | *195* | 2363 | *215* | 2336 | *194* | 2347 | *187* | 2338 | *191* | 2385 | *200* |

| ***Elasticities*** | Total hours | | Main job | | Extra job | |
|---|---|---|---|---|---|---|
| *Wage increase in* | | | | | | |
| Hospitals | 0.1236 | *0.1134* | 0.2527 | *0.2299* | -0.5128 | *0.4703* |
| Primary care | 0.0141 | *0.0518* | 0.0307 | *0.1131* | -0.0412 | *0.1558* |
| Private practice | 0.0603 | *0.0689* | -0.0221 | *0.2243* | 0.4527 | *0.6261* |
| Other jobs | 0.0230 | *0.0346* | -0.0097 | *0.0884* | 0.1677 | *0.3073* |
| All sectors | 0.2221* | *0.0400* | 0.2636* | *0.0614* | 0.0127 | *0.1573* |

# Chapter 3
# Will increased wages increase nurses' working hours in the health care sector?

**Abstract**

Many registered nurses (RNs) in Norway work part-time, or in non-health jobs. The nurses' trade organizations claim that a wage increase will increase the short-term labor supply in health care. This paper is an attempt to identify the effects of job-type specific wage increases through policy simulations on micro data. The individual's labor supply decision can be considered as a choice from a set of discrete alternatives (job packages). These job packages are characterized by attributes such as hours of work, sector specific wages and other sector specific aspects of the jobs. The unique data set covers all RNs registered in Norway and their families. The spouses' incomes and age of the children are vital when estimating the labor supply of this profession. For married females the results indicate job type specific wage elasticities for hours of work of 0.17 in hospitals and 0.39 in primary care. The total hours worked in health and non-health jobs combined are actually predicted to be slightly reduced, but the change is not significantly different from zero. Single females are somewhat more responsive to wage changes than married ones.

## 1. Introduction

The excess demand for nursing labor in the national health services persists in many developed countries in spite of systematic increases in the education capacity in order to meet the demand. Finlayson, et.al. (2002) reports a nursing shortage in the UK of 10,000 to 22,000 depending on the way vacancies are calculated. In the US, the national supply of registered nurses was estimated at 1.89 million full-time equivalents in 2000 while the demand was estimated at 2 million, a shortage of 110,000 or 6 percent, by the U.S. Department of Health and Human Services (2002). In Norway, the Ministry of Labor and Government Administration estimated the number of vacancies at 3,300 full-time positions in 1998. The nurse shortage is a problem as it reduces the quality of the services provided. In a survey initiated by Nurseweek (2002), three-fourths responded that they in the past year, had witnessed a negative impact on the quality of patient care as a result of a greater number of patients per nurse and higher turnover among experienced RNs.

Many registered nurses (RNs) work part-time, in non-health jobs or are temporarily out of the workforce. Nurses' trade unions claim that a wage increase will increase not only recruitment into the nursing profession, but also the *short-term* labor supply of those already qualified. Higher wages are claimed to increase hours worked by personnel employed in the health sector, and attract nurses from non-health activities. When the tax schedule is nonlinear in income, estimation of labor supply parameters is difficult. This paper is an attempt to quantify these short-term effects through policy simulations in a discrete choice framework. I apply a structural labor supply model with nonlinear budget constraints. Structural methods, though controversial, are advantageous when the objective is to analyze the effects of a policy alternative that may change the budget sets in complicated ways.

The nurses choose the job package that maximizes their utility given a nonlinear budget set that incorporates taxes. These job packages are characterized by attributes such as hours of work, sector specific wages and other sector specific aspects of the jobs. The three sectors or job-types are public hospitals, public primary care services and other "non-health" or "non-patient" jobs in public administration, private business and NGOs. The model is a static neo-classical structural labor supply model inspired by approaches like Aaberge, Dagsvik and Strøm (1995) and van Soest (1995).

I will not analyze the impact of wage increases as an instrument to mobilize those not working. One argument for not including this group is the differences in personal characteristics compared to those working, as discussed in the data section. Another is the small number of people not working in 1995; only 0.9 percent of the workforce, when subtracting the group with disability benefits or other social benefits as their main income.

As most registered nurses are women, the literature on female labor supply provides an important background to this discussion. Killingsworth and Heckman (1986) provide a comprehensive review of research indicating that women's workforce participation is responsive to changes in the wage rate, unearned income, spouse's wage and marital status, as well as having children, particularly of preschool age. The survey indicates that labor supply elasticities for females are positive, i.e. the positive substitution effect outweighs the negative income effect.

In relation to the nursing profession itself, a survey by Link (1992) summarizes the literature and finds that wage levels, and having children, influence labor force participation, although the responsiveness to wage changes has declined considerably over time. The latter finding reflects the fact that most RNs are now working.

In a recent review of the labor supply literature for nurses, Antonazzo et.al. (2003) confirms the increasing use of panel data models, limited dependent variable models, and treatment of sample selection issues. They find that results vary considerably depending on the methods used, particularly on the effect of wages. The impact of one's own wage on labor force participation is not significant in most of the studies on North American data, whereas there are some 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.

There are fewer British studies available. One example is Phillips (1995) which estimates labor market participation elasticities with respect to the wage rate, non-labor income, and costs incurred through work, reported for qualified and unqualified nurses. Participation is found to be highly responsive to wage changes, and some discontinuity is found in the supply function. The econometric model traditionally applied to nurses has been a logit model for the participation, and a selection-corrected hours-of-work regression.

A newly published study on Norwegian data by Askildsen et al. (2003) applies, however, a matched panel data set to estimate wage elasticities ranging from –0.06 to 0.46 depending on the setup of regression of hours against log wage. They find that individual and institutional features are statistically significant and important for working hours, and find their estimate of 0.21 most reliable. This paper has a different and larger sample of nurses, including those working in non-health jobs, and separates the analysis for single and married females as their behavioral response is expected to be different. Two important features of this study are firstly the inclusion of the spouse's income and other non-work income like capital income, transfers and savings. Omitting the non-work income is of extra concern when focusing on the married nurses, as it might lead to an upward bias of the wage elasticities.

In their agenda for research on nurses' labor supply Antonazzo et.al. (2003) advertised the need for econometric models that can handle nonlinearity in the labor supply function. I argue that the application of a discrete choice model, as presented in my study, is a feasible way to address this problem. A weakness in many of the existing studies is the small sample size and/or the exclusion of nurses not practicing in the health sector. An advantage of the matched registered data used in this study is the inclusion of all qualified nurses. Another benefit is the possibility to match family characteristics that are important for the nurses' labor supply, such as spouse's income and children's age.

In a policy perspective I find that there are reasons to have moderate expectations of what wages can achieve as a tool to reduce the overall shortage of nurses. The predictions of this paper are that wage changes have a minor impact on hours worked by the personnel employed in the health sector. Wage rates probably have a minor impact on nurses' working hours compared to non-pecuniary factors. Furthermore, there are obvious weaknesses in focusing solely on the supply side of the labor market for health personnel, and the term 'nursing shortage' is slightly misleading. A higher wage level may both reduce the employers' demand for nursing hours, as well as affect the hours offered by the nurses.

For married women I find job type specific wage elasticities of 0.166 for the hospital jobs. The increase in hours is due to attracting nurses from primary care and non-health jobs, as the average amount of working hours in the hospital sector is reduced through the wage increase. The total hours produced by our sample of RNs in both health and non-health jobs, taking job changes into account, are predicted to be inelastic. The wage elasticity for the primary care jobs is predicted to be 0.390, attracting labor from hospitals and non-health jobs. A simultaneous wage increase for hospital and primary care personnel reduces the number of nurses preferring a non-health job. A simulated wage increase for health-jobs by 10% reduces the predicted share of nurses preferring a non-health job from 16.8% to 16.1%. The predicted wage elasticities of hours worked in this simulation are -0.002 for hospital jobs and 0.153 for primary care jobs. The elasticities are only significantly different from zero at a 10% level.

For single women the job specific wage elasticities are stronger, especially in the primary care sector. Part of this effect is probably due to the fact that there are relatively few single nurses in the primary care sector, as nurses often start their career with a hospital job.

After a presentation of the data and the context in Section 2, the model is presented in Section 3. In Section 4 the results are elaborated and Section 5 includes some calculations of the changes in the job-specific costs and total labor costs of a wage increase in one or more of the jobs. Section 6 concludes.

## 2. Data

According to Statistics Norway (2003) there were 77,819 registered nurses below retirement age in Norway in 2002, of whom 69,690 were employed. Those not employed were mainly on disability pensions, medical and vocational rehabilitation, early retirement or further education. Auxiliary nurses with a year of education after college are not included in these numbers. Norway is one of the countries with the highest density of nurses with 15.3 working nurses per 1,000 population in October 2002. Over 90% of the nurses are women. 91.4% of the employed nurses were public employees. Registered nurses receive a minimum of three years of education at college level. Personnel in administrative positions have often completed a year of administrative training. Nurse specialist training also adds one or two years.

The study presented here is, however, based on the 51,500 nurses below retirement age permanently living in Norway in 1995. The Norwegian health services are primarily run by national and local government authorities. 50% of the nurses in our sample work in public hospitals. Close to 26% work in primary health care run by the municipalities in nursing homes, home nursing or health clinics. Only 5% are employed by private health services working in a private medical clinic or in the pharmaceutical industry. Some 15% work in non-health areas like public administration or in the service sector. Some of these teach at colleges or lower levels, work in occupational health in the industry or in public health administration. 6% earn their main income from different types of transfers like disability benefits. About 1% earn less than the minimum income required to qualify for public pensions, and do not receive transfers beyond the same limit of NOK 40,000.

***Table 1. Registered nurses by job type in 1995***

| *Category* | Share |
|---|---|
| Hospitals | *49.9%* |
| Public primary care | *25.7%* |
| Private healthcare | *5.1%* |
| Non-health | *15.3%* |
| Non-work | |
| Do not earn sufficient to qualify for national insurance: | |
| 1G ≈ NOK 40 000 >Labor income>Social benefits. | *0.9%* |
| Disability pensions and social security benefits | *6.1%* |

The public health sector is responsible for most of the production of health care services and for their financing. Primary health care is the responsibility of municipalities, but a considerable share of general practitioners run private practices. Municipalities are also responsible for general public health services, home nursing and nursing homes. The demand side is dominated by a few large groups of buyers that may be considered monopsonists. 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).

One explanation for nursing shortages as reported in Hirsch and Schumacher (1995, 1998), is that hospitals face an upward sloping labor supply curve which results in a lower wage and employment level for nurses than if the market was competitive. “Monopsony would help explain reported shortages, since hospitals will list vacancies and desire to hire additional workers at the monopsonistic wage, but would decrease their profitability were they to raise wages to attract more applicants.” There is a parallel in a public setting, where the health care institutions are equipped with a fixed budget and an increase in wages could reduce the staffing they can afford. The empirical evidence for monopsony power in nursing labor markets is, however, sparse.

This paper uses a matched data set covering all registered nurses working in Norway. A drawback of using the complete sample of RNs is the lack of information about whether the nurses work shifts or regular hours. Askildsen et.al. (2003) point to the fact that the true wage effect thus may be underestimated for some groups. The data set is based on several of the administrative data registers delivered by Statistics Norway. Using the register of authorized health personnel as an identifier we can link information about demography, including children, income and employment relations. We also know the spouses' income and employment. It is assumed that this years saving for next years vacation is equal to the amount saved last year. Appendix 1 provides details about variable construction, trimming procedure and summary statistics for key individual level variables by job category.

Hourly wage is the applied earnings measure, and is calculated by dividing annual earnings by hours in a full-time position for those working full-time. These calculated wages are used when assigning predicted hourly wages for all nurses in all the three job alternatives in the model below. I exploit the richness of the register data in this procedure, including residency and observed experience from the past 20 years. I control for the selection effect by 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, or not work at all. See Appendix 2 for wages, and Appendix 3 for taxes.

I considered it likely that the decision process is affected by gender and family status. I have chosen to focus the analysis on the two subsamples of married and single females, as women dominate the nursing profession. Many individuals registered as *single* will be cohabitants, but when cohabitants have a child together they are registered as married. Table A3 confirms the differences in characteristics; single nurses are younger and many of them prefer to live in central areas. Almost 30% live in greater Oslo. Two-thirds of the single nurses work at hospitals compared to 50% of the married females. 61% of the single nurses work full-time compared to 35% of the married ones.

In the following model the RNs choose between three job alternatives: *Hospitals*, *public primary care* and *non-health* jobs in the service sector and employment in public administration. These are the dominating categories of work covering almost 95 percent of those working. As reported in Table A2 those working in the private health care sector have other individual characteristics, including a higher spouse's income. Nurses not working and those with public transfers as their main source of income, are excluded from this analysis.

In our sample of married females 50% work at the hospitals, 33% in primary care and 17% with other non-health tasks. The working hours are not observable, but calculated by division of annual income by predicted hourly wage. The hours are then categorized into 9 groups as reported in the first column in Table 4. In the estimation of working hours each alternative is allocated the average amount of working hours in that category, implying that within each category hours offered are uniformly distributed. For those who actually work at hospitals we estimate the average weekly working hours to be 28.9, compared to 30 hours in the primary care jobs and 25.5 hours in the non-health jobs. For reasons of comparisons with later predictions we can construct an imaginary 'average nurse' by multiplying the shares for each hour category with the mean hours in the categories, and then multiplying by the job-type shares. We then get the following distribution of weekly hours by job type: 14.6 hospital hours, 9.9 primary care hours and 4.3 non-health hours.

**3. Model**

The model focuses on the supply side of the labor market and implicitly assumes that the nurses are employed in the jobs they prefer. This is of courses a strict assumption, but on the other hand it was not far from the actual situation in 1995 with plenty of job offers in all practice types. However, the model does take account for the fact that most jobs offered are full-time jobs and that hospital jobs are more available in central areas.

The nurses choose between job packages, each being defined by a job or practice type $i$, specific choice of hours $h$, and a wage rate per hour $w$. The three alternative job types or practice types are hospitals, primary care and non-health. There are unobserved job characteristics associated with practice type $i$, that may affect preferences and hence choices. As an example we may think of specific skills involved in the job, patient mix or shift work.

Because the analyst does not know the nurses' preferences, I will assume a random utility model

$$U_i = V_i + \varepsilon_i, \tag{1}$$

where $U_i$ is the utility when the nurse works $h_i$ hours in job type $i$, $V_i$ is the deterministic element in the utility function and $\varepsilon_i$ is a stochastic term with an iid extreme value distribution with an expected mean of 0 and a variance of $\sigma^2\pi^2/6$. The random term $\varepsilon_i$ also captures the unobserved job characteristics associated with practice type *i.*

The utility for job number *i* is given by

$$U(C,h,i) = V(C(h),h) + \varepsilon(C,h,i), \tag{2}$$

where *C* is the disposable household income after tax per year, *h* is hours of work representing leisure time, and *i* the unobserved job characteristics.

The budget constraint, for given job number *i,* is

$$C=f(hw)+I;\ h=H_i,\ w=W_i, \tag{3}$$

where $H_i$ is the job *i* specific hours of work, and $W_i$ the pre-tax hourly wage for job *i*. The nurses have a choice between nine categories of hours per week. The categories are constructed so that they represent the common work contracts. The categories are represented by the mean in each category, $h=\{18, 21, 25, 28, 30, 33, 35.5, 37.5, 40\}$ hours per week. I also exclude non-market opportunities ($h$=0), meaning that all nurses in the analysis have to participate in the workforce. This is not a strong limitation, as almost all nurses observed not to be participating in the workforce are categorized as unable to work and granted a disability benefit.

Note that for the same job, wage rates may differ across nurses by personal characteristics like experience, residency and country background. In addition, for the same nurse, wage rates may differ across jobs. For all individuals a pre-tax hourly wage is estimated for each job applying a Heckman two-step selection correction procedure. See Appendix 2 for the estimation of wages.

The *f(.)* function represents the net-of-tax labor income while *I* is the family income other than the nurse's own earnings (capital income after tax, spouse's income after tax, transfers). A non trivial assumption made is that the spouse's hours of work are exogenous as there is reason to believe that the spouse's choice of working hours will correlate, either negatively, e.g. if one of the parents must look after the children, or positively as they have preferences for spending their leisure together.

In traditional labor supply offered wages are determined by human capital characteristics and hours offered are uniformly distributed. However, in real life wages may vary across job types for observationally identical workers, and jobs with a specific number of hours may be more available in the market than other jobs, e.g. "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.

I assume that the nurses make their choices by maximizing utility, given the job-packages available in the market. As already mentioned, the analyst does not observe preferences neither does he observe all details of the job-packages available in the market. Let $B_i(h,l)$ denote the set of feasible jobs with hours of work $H_i$ equal to $h$, when the individual lives in a geographic location categorized by a centrality dummy $l$. Let $g_i(h,l)$ be the frequency of jobs in $B_i(h,l)$, which is related to the institutional availability of full-time jobs and the geographical location, as hospital jobs are more available in central areas. The geographical location only influences the availability of hospital jobs. It follows from above that the utility function can be written as

$$\tilde{U}_i = U(f(H_i\ W_i)+I,\ H_i,\ i) = V(f(H_i\ W_i)+ I,\ H_i) + \tilde{\varepsilon}_i \qquad (4)$$

where

$$\tilde{\varepsilon}_i = \varepsilon(f(H_i\ W_i)+I,\ H_i,\ i). \qquad (5)$$

Since hours of work and consumption are given when the job is given, the agent's choice problem is a discrete one, namely to find the job that maximizes utility. Let $P(h,l)$ denote the probability that the agent chooses a job with hours of work *h*, when he/she lives in an area with centrality *l*. This is the same as choosing a job (any job) within *P(h,l).* When the random error terms $\{\tilde{\varepsilon}_i\}$ are ii extreme value distributed, the probability $P(h,l)$ can be expressed as

$P(h,l) =$ *P(choosing any job within B(h,l))*

$= P(\tilde{U}_i = \max_k \tilde{U}_k \mid i,k \in B(h,l))$

$$= \frac{\exp(\psi(h;w,I))g(h,l)}{\sum_{x,y \in D} \exp(\psi(x;w,I)g(x,y)}, \qquad (6)$$

where *D* is the set of feasible hours of work and

$$\psi(h;w,I) = v(f(hw)+I,h) = V/\sigma. \qquad (7)$$

Due to the assumption of extreme value distributed utilities, it follows readily that the choice probabilities are multinominal logits. By setting $g_i(h,l)$=1 in *(6)* we get the standard multinominal logit. The interpretation of the "opportunity density extended version of the standard multinominal logit" given in *(6),* is that the attractiveness of a choice measured by $\exp(\psi)$ is weighted by a function saying how available this choice is in the market. The weight is determined by

$$g_i(h,l) = \exp(v_1 k_i + v_2 l) \qquad (8)$$

where $k_i$ =1 if the main job is full-time (35.5 hours per week or more), and $k_i$ =0 otherwise. *l*=1 if the individual lives in a central area and the choice is the hospital job type*,* and *l* =0 otherwise. For more details about this methodology I refer to Aaberge, Colombino and Strøm (1999).

In an extended version of the model I also include a component in the opportunity index that corrects for the fact that the nurses have an education where the dominating pool of available jobs are found with the health care providers. There is however a possible endogeniety problem with this formulation, and that is why both alternatives are reported in the next section. The modified $g(.)$ function is then

$$g_i(h,l,m) = \exp(\nu_1 k_i + \nu_2 l + \nu_3 m_i) \tag{9}$$

where $m_i$=1 if the job *i* is with a health care provider, and $m_i$=0 otherwise.

The deterministic part of the preferences is represented by the following "Box-Cox" type utility function,

$$V_i = \alpha \frac{(10^{-6} C_i)^{\lambda} - 1}{\lambda} + \beta(X) \frac{(8760 - (8*365) - h_i)/8760)^{\gamma} - 1}{\gamma} \tag{10}$$

where

$$\beta(X) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$$

The first element represents the utility from consumption and the second element the utility of leisure time. See Aaberge, Dagsvik and Strøm (1995) for an empirical analysis applying this specification. An advantage of this specification is that it is flexible enough to yield both negative (back-ward bending labor supply curve) and positive wage elasticities. 8,760 is the total number of annual hours, from which 8 hours per day are subtracted for sleep. $\alpha$ , $\lambda$ , $\gamma$ and the $\beta's$ are unknown parameters. For the utility function to be quasi-concave, we require $\lambda$<1 and $\gamma$<1. Note that if $\lambda \to 0$ and $\gamma \to 0$, the utility function converges to a log-linear function. The characteristics are: $X_1$= age of the nurse, $X_2$= number of children below six years of age, $X_3$= 1 if the person is born in Norway, 0 otherwise. An alternative specification is to use a semi-parametric approach like van Soest (1995), where the deterministic part of the preferences is represented by a polynomial. The parameters $(\alpha, \lambda, \gamma, \beta_0, \beta_1, \beta_2, \nu_1, \nu_2, (\nu_3))$ are estimated in a maximum-likelihood procedure. Note that $\sigma$ is not identified and is absorbed in $\alpha$ and $\beta$.

## 4. Results

The following analysis contains a discussion of the estimated parameters of the model, before the observed and predicted choices of working hours and job types are presented. For both married and single nurses, the procedures presented in Section 4.1-4.2 are undertaken twice, with and without an opportunity index that corrects for the fact that the RNs have an education where the dominating pool of available jobs are found with the health care providers (Model A and B, respectively). The predicted choices from Model A, with less accurate predictions, are presented in Appendix 4, as a backdrop to the predictions from Model B discussed in the following two sections. In Section 4.3 an analysis of the total wage cost of a job specific wage increase is presented.

***Table 2.Two model specifications applied on two samples.***

| Sample | Sample size | Mean age | Estimated parameters | Predicted probabilities |
|---|---|---|---|---|
| Married females | 25,242 | 43 | Table 3 | Model A: Appendix 4.1<br>Model B: Section 4.1 |
| Single females | 7,782 | 35 | Table 6 | Model A: Appendix 4.2<br>Model B: Section 4.2 |

### 4.1 Married females

From Table 3 we observe that all parameters except $\beta_1$ are sharply determined and that $\lambda$ and $\gamma$ are estimated to yield a quasi-concave utility function. The income term in the utility function (10) is estimated with a $\lambda$ of –2.8 and an $\alpha$, the constant in the consumption term, of 0.7, meaning that the nurses prefer the job that pays best if otherwise similar. The $\gamma$ in the leisure component is estimated to –6.4. Like $\alpha$, the constant $\beta_0$ in the leisure term is positive and significant, meaning that more hours of leisure increases the utility. Surprisingly $\beta_1$ is not significantly different from zero, as one might expect that the nurses would prefer jobs with less working hours when they get older. On the other hand they are responsible for their children earlier in their career and many choose to work part-time. This is confirmed by the positive, yet small, $\beta_2$ of 0.03, which I interpret as a higher preference for part-time jobs for mothers of children below six years of age, than for the average nurse. The parameters in the opportunity index are also significant with $\nu_1$ of 0.8 and $\nu_2$ of 0.5. It is worth noting that the McFadden's Rho is very low, especially for the married females. One interpretation is that wage and working hours are relatively less important than other factors not observed, such as shift work, patient load, travel distance from home etc. when choosing a job. It is a similar situation for Model B, which takes into account that the dominating pool of jobs for the registered nurses is with the health care providers. The parameter $\nu_3$ is positive and significantly different from zero. The signs of the other parameters are unchanged. Observe that McFadden's Rho is slightly higher in the extended model (B), but still worrying low.

*Model performance*

The basic model (A) performs poorly in the predictions of job type choices, as it seems that the multinominal model distributes the predictions almost evenly: 38% hospital, 30% primary care and 32% non-health (Column 2 in Table 4). The predicted choices of hour categories are generally in line with the observed ones with half-time and full-time preferred. The extended model (B) has much sharper predictions with 52% working at hospitals, 31% working in primary care and 17 % in non-health jobs (Column 3 in Table 4). The predicted distribution of weekly hours is 14.7 in hospitals, 8.4 in primary care and 4.6 in non-health work. The predicted hourly pre-tax wages used in the analysis were on average NOK 159 in the hospital sector, NOK 148 in the primary care sector and NOK 187 in non-health.

*Out-of-sample predictions*

In order to evaluate the model's prediction properties, I use the estimated parameters from 1995 and predict preferred working hours in 2000. I use the pre-tax hourly wages, the tax system and the personal characteristics applicable in 2000. This procedure is undertaken for all females in 2000 and for those who were married in 1995 and 2000. I compare the predictions with the observed choices. Only the predictions of the extended model (B) are presented in Table 5.

Looking at all observed married females, the mean price corrected pre-tax hourly wages increased by 26% in the hospital sector, 32% in the primary care sector and 14% in non-health. (N=25,242 in 1995 and 25,363 in 2000). The average age was 43.1 in 1995 and 44.3 in 2000. Part of the wage increase is due to the higher seniority of the 2000 sample, as seniority is an important determinant for the wage in the public sector.

The higher wage increase in the public sector, especially at primary care level, makes it natural to expect a reallocation of hours to this sector. Before I compare the observed and predicted choices in 2000, it is important to emphasize that the public health services were significantly strengthened from 1995 to 2000. The capacity boost took place at both care levels. Major structural changes in the health care sector make the comparison over time complicated.

There was a 14% increase from 1995 to 2000 in the number of employees at psychiatric and somatic institutions in the specialist health services. According to Statistics Norway (2001) the number of full-time nursing positions increased by 23% to 27,415 in 2000. The number of full-time positions for auxiliary nurses was reduced by 4% to 8,386 in 2000, continuing the trend that this personnel category is replaced by registered nurses in hospitals.

The number of full-time positions for physicians was increased by 23% to 8,288 in 2000. However, there was also a significant increase in the production capacity, partly fuelled by the transition to an activity based funding system. In the specialist services, the number of discharges increased by 11% to 760,893 in 2000. Outpatient-consultations were increased by 13%. The number of full-time positions, for all professions, increased by 30% in the primary care sector to 89,670 in 2000, reducing the ratio of full-time positions per patients to 0.44.

The first column in Table 5 presents the observed and predicted choices for all married females working in 1995 who were also observed in 2000. The next column shows the same group's choices in 2000. 18,244 married females were observed both in 1995 and 2000. The average age was 41.3 years in 1995, and naturally 46.3 years in 2000. The third column presents all the married females with complete data in 2000.

The observed changes in the five-year period deserve a few comments. Looking at the sample observed in both 1995 and 2000, there is a striking increase in the number of nurses employed in the primary care sector. There are at least four factors causing this development. Firstly, the relative wage has increased in favor of the primary care sector. The sample observed in both years has a pre-tax hourly wage increase of 20% in the hospital sector, 26% in the primary care sector and 9% in the non-health jobs. Secondly, the nurses in the sample are five years older in 2000 and they are simply following the normal trend of switching to the primary care services with age. One reason is probably an interest in moving their family out of the cities. There are less hospital jobs available in the suburbs and rural areas. Thirdly, the significant structural changes in the public health sector have boosted the mobility of the workforce. And finally, there is also a possibility that some specialized institutions, still not hospitals, are categorized as hospitals in 1995 and primary care institutions in 2000, exaggerating the changes. The average number of hours worked is stable, however, with a reallocation between the sectors as described above.

The predictions respond to the wage changes as expected; an increased share is predicted to work in the primary care institutions, with reductions in the others. The average number of working hours is underpredicted, and as in 1995 it is the hours in the primary care sector that are incorrectly predicted by the model. A conclusion thus seems to be that the model predicts the correct directions of changes, but underpredicts the hours. However, it is not surprising that the predictions are biased when taking the huge structural changes into consideration.

*What happens if the wage increases in the health care jobs?*

A wage increase for hospital personnel might change the hours worked for those already working there, and attract nurses from non-health jobs. The introduction of a policy simulation, repeating the predictions above and keeping the parameters previously estimated, but now with a 10 percent wage increase in the hospital jobs, is a way to predict the net magnitude of these effects. The probability of choosing a hospital job increases from 52.4% to 53.5%, as presented in Table 6, and the predicted hospital working hours increase by 0.3 hours per week per nurse. With almost 48 weeks of work per year this adds up to 175 extra full-time positions. The gain in hospital hours must be weighted against the simulated reduction in primary care jobs pf 133 full-time positions, and the reduction in non-health jobs totalling 75 positions.

The impact on the total working hours produced by all nurses in the sample, in health and non-health jobs, is a small reduction of 0.1 hours per week per nurse, or 33 full-time positions. The wage elasticity in the hospital sector is predicted to be 0.166. This pattern of changes in the probability of a job type being selected and hours worked repeats itself when undertaking similar policy simulations for the primary care jobs, for both health jobs and for non-health jobs as presented in Table 6.

In wage bargaining the hospital and primary care sectors normally follow the same pattern. When increasing the wage in both public health sectors, the model predicts a wage elasticity of 0.153 in the primary care sector, and zero (-0.002) in the hospital sector. The model predicts an increased probability of choosing a job in both the hospital and the primary care sector, but predicts fewer hours worked in average by those employed.

Finally two attempts are made to identify the income effect. First a lump-sum transfer of NOK 50.000 is introduced, an amount equivalent to about 27% percent of the average annual income. Somewhat surprisingly this slightly alters the predicted mix of job types, as fewer RNs are expected to work in hospitals and non-health jobs, matched by more people preferring home care and nursing homes. Adding up the working hours for all sectors, the model predicts a reduction in expected average hours of 1.6% or more than 300 full-time positions. The other attempt is to repeat the simulation with a 10% increase of the non-wage income. The income elasticity is found to be –0.063 for all hours, -0.138 for hospital hours and 0.075 for primary care hours. The elasticity for primary care hours is not significantly different from zero at a 10% level. Generally, many of the elasticities reported in this section are only weakly significant. It is important to keep in mind, however, that the standard deviation reported in the prediction contains both the uncertainty of the prediction for each individual, and information about the distribution of the predictions across individuals. The significance level is reported in Table 6, where * represents the 10% level, and ** the 5% level.

***Table 3 Estimation of parameters of the utility function and opportunity densities. Married females.***

| | | Model A | | | Model B | | |
|---|---|---|---|---|---|---|---|
| | | **Estimate** | **Std.error** | **P-value** | **Estimate** | **Std.error** | **P-value** |
| | ***Utility function*** | | | | | | |
| $\beta_0$ | Constant 'leisure element' | 0.052 | 0.010 | [.000] | 0.371 | 0.039 | [.000] |
| $\beta_1$ | Age | 0.000 | 0.000 | [.585] | 0.000 | 0.001 | [.558] |
| $\beta_2$ | Number of children below 6 years of age | 0.027 | 0.005 | [.000] | 0.095 | 0.011 | [.000] |
| $\gamma$ | Exponent 'leisure element' | -6.415 | 0.237 | [.000] | -4.050 | 0.134 | [.000] |
| $\alpha$ | Constant 'consumption element' | 0.690 | 0.107 | [.000] | 2.007 | 0.109 | [.000] |
| $\lambda$ | Exponent 'consumption element' | -2.806 | 0.268 | [.000] | -1.508 | 0.128 | [.000] |
| | ***Opportunity density**** | | | | | | |
| $\nu_1$ | 1 if living in a central area, 0 otherwise | 0.821 | 0.015 | [.000] | 0.530 | 0.017 | [.000] |
| $\nu_2$ | 1 if the job is full-time, 0 otherwise | 0.533 | 0.034 | [.000] | 0.546 | 0.032 | [.000] |
| $\nu_3$ | 1 if the job is with a health care provider, 0 otherwise | | | | 0.739 | 0.020 | [.000] |
| | Number of observations | 25,242 | | | 25,242 | | |
| | Log likelihood | -80,642 | | | -79,878.5 | | |
| | McFadden's Rho | 0.03 | | | 0.04 | | |

** For the wage equation see Appendix 2.*

## *Table 4 Observed and predicted hours for married females*

| | Observed | | Model A | | Model B | |
|---|---|---|---|---|---|---|
| **Observed and predicted hours** | | | **Main model*** | | **Extended model** | |
| **Married females** | | | **Predicted** | | **Predicted** | |
| **N=25242** | **shares** | | **probability** | | **probability** | |
| | **Mean** | **St.dev.** | **Mean** | **St.dev.** | **Mean** | **St.dev.** |
| *Job type choice* | | | | | | |
| Hospital | 0.505 | | 0.378 | *0.020* | 0.524 | *0.052* |
| Primary care | 0.328 | | 0.304 | *0.014* | 0.308 | *0.037* |
| Non-health | 0.168 | | 0.317 | *0.010* | 0.168 | *0.017* |
| | 1.000 | | 1.000 | | 1.000 | |
| | *Share (Job type) * Mean hours in job type* | | *Pr (Job type) * Mean hours in job type* | | *Pr (Job type) * Mean hours in job type* | |
| Hospital | 14.6 | *15.2* | 10.9 | *0.7* | 14.7 | *1.6* |
| Primary care | 9.9 | *14.7* | 8.3 | *0.5* | 8.4 | *1.0* |
| Non-health | 4.3 | *10.0* | 8.6 | *0.5* | 4.6 | *0.5* |
| All | 28.7 | *7.1* | 27.8 | *0.7* | 27.7 | *0.9* |
| *Categories of hours* | | | | | | |
| Hours Cat.1 (Mean=18h/w) | 0.139 | | 0.168 | *0.022* | 0.172 | *0.030* |
| Hours Cat.2 (Mean=21h/w) | 0.132 | | 0.154 | *0.014* | 0.157 | *0.019* |
| Hours Cat.3 (Mean=25h/w) | 0.118 | | 0.130 | *0.004* | 0.131 | *0.009* |
| Hours Cat.4 (Mean=28h/w) | 0.138 | | 0.109 | *0.003* | 0.109 | *0.005* |
| Hours Cat.5 (Mean=30h/w) | 0.085 | | 0.094 | *0.005* | 0.094 | *0.005* |
| Hours Cat.6 (Mean=33h/w) | 0.091 | | 0.071 | *0.008* | 0.071 | *0.007* |
| Hours Cat.7 (Mean=35.5h/w) | 0.138 | | 0.161 | *0.023* | 0.146 | *0.053* |
| Hours Cat.8 (Mean=37.5h/w) | 0.086 | | 0.068 | *0.014* | 0.071 | *0.011* |
| Hours Cat.9 (Mean=40h/w) | 0.074 | | 0.044 | *0.012* | 0.049 | *0.010* |
| | 1.000 | | 1.000 | | 1.000 | |

*Standard deviation in italics. * See wage elasticities in Appendix 4.*

***Table 5 Observed and predicted hours for married females 2000 (Model B only)***

| | **1995 (If observed in 2000)** | | | | **2000 (If observed in 1995)** | | | | All married females in 2000 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Married females** | **Observed shares** | | **Predicted probability** | | **Observed shares** | | **Predicted probability** | | **Observed shares** | | **Predicted probability** | |
| | **Mean** | **St.dev.** | **Mean** | **St.dev.** | **Mean** | **St.dev.** | **Mean** | **St.dev.** | **Mean** | **St.dev.** | **Mean** | **St.dev.** |
| *Sector choice* | | | | | | | | | | | | |
| Hospital | 0.518 | *0.500* | 0.523 | *0.052* | 0.441 | *0.497* | 0.508 | *0.051* | 0.432 | *0.495* | 0.508 | *0.051* |
| Primary care | 0.324 | *0.468* | 0.309 | *0.037* | 0.434 | *0.496* | 0.330 | *0.035* | 0.452 | *0.498* | 0.329 | *0.035* |
| Other | 0.157 | *0.364* | 0.168 | *0.017* | 0.125 | *0.330* | 0.163 | *0.016* | 0.116 | *0.320* | 0.163 | *0.017* |
| | 1.000 | | 1.000 | | 1.000 | | 1.000 | | 1.000 | | 1.000 | |
| | *Share (Job type) * Mean hours in job type* | | *Pr (Job type) * Mean hours in job type* | | *Share (Job type) * Mean hours in job type* | | *Pr (Job type) * Mean hours in job type* | | *Share (Job type) * Mean hours in job type* | | *Pr (Job type) * Mean hours in job type* | |
| Hospital | 15.1 | *15.3* | 14.7 | *1.6* | 13.0 | *15.2* | 13.9 | *1.4* | 12.5 | *15.0* | 14.0 | *1.4* |
| Primary care | 9.9 | *14.7* | 8.4 | *1.0* | 12.5 | *14.8* | 8.9 | *1.0* | 12.8 | *14.8* | 8.9 | *1.0* |
| Other | 4.1 | *9.9* | 4.6 | *0.5* | 3.7 | *10.1* | 4.4 | *0.5* | 3.3 | *9.5* | 4.4 | *0.5* |
| All | 29.1 | *6.9* | 27.7 | *0.9* | 29.1 | *6.6* | 27.3 | *0.6* | 28.7 | *6.6* | 27.3 | *0.7* |
| *Categories of hours* | | | | | | | | | | | | |
| Hours Cat.1 (Mean=18h/w) | 0.113 | *0.317* | 0.172 | *0.028* | 0.104 | *0.305* | 0.184 | *0.021* | 0.117 | *0.322* | 0.185 | *0.023* |
| Hours Cat.2 (Mean=21h/w) | 0.130 | *0.337* | 0.157 | *0.018* | 0.116 | *0.321* | 0.165 | *0.013* | 0.121 | *0.327* | 0.165 | *0.014* |
| Hours Cat.3 (Mean=25h/w) | 0.121 | *0.326* | 0.131 | *0.008* | 0.136 | *0.342* | 0.135 | *0.005* | 0.138 | *0.345* | 0.135 | *0.005* |
| Hours Cat.4 (Mean=28h/w) | 0.143 | *0.350* | 0.109 | *0.005* | 0.136 | *0.343* | 0.112 | *0.002* | 0.140 | *0.347* | 0.111 | *0.003* |
| Hours Cat.5 (Mean=30h/w) | 0.089 | *0.285* | 0.094 | *0.005* | 0.107 | *0.308* | 0.095 | *0.003* | 0.108 | *0.310* | 0.095 | *0.003* |
| Hours Cat.6 (Mean=33h/w) | 0.096 | *0.295* | 0.071 | *0.007* | 0.125 | *0.331* | 0.072 | *0.004* | 0.119 | *0.324* | 0.072 | *0.005* |
| Hours Cat.7 (Mean=35.5h/w) | 0.143 | *0.351* | 0.145 | *0.050* | 0.140 | *0.347* | 0.115 | *0.030* | 0.131 | *0.337* | 0.116 | *0.031* |
| Hours Cat.8 (Mean=37.5h/w) | 0.089 | *0.285* | 0.072 | *0.012* | 0.070 | *0.254* | 0.072 | *0.007* | 0.064 | *0.245* | 0.071 | *0.008* |
| Hours Cat.9 (Mean=40h/w) | 0.074 | *0.262* | 0.049 | *0.010* | 0.067 | *0.250* | 0.049 | *0.006* | 0.061 | *0.239* | 0.049 | *0.007* |
| | 1.000 | | 1.000 | | 1.000 | | 1.000 | | 1.000 | | 1.000 | |
| Age | 41.3 | *7.5* | | | 46.3 | *7.5* | | | 44.3 | *8.5* | | |
| Sample size | 18,244 | | | | 18,244 | | | | 25,363 | | | |

*Table 6 Predictions of a policy experiment for married females*

| | Predicted | | Predictions with 10% increase in hospital wages | | Predictions with 10% increase in prim. care wages | | Predictions with 10% increase in both wages | | Predictions with 10% increase in non-health wages | | Predictions with 10% increase in all wages | | Predictions with 10% increase in non-work income | | Predictions with NOK 50,000 added to non-work income | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | St.dev. | Mean | St.dev. | Mean | St.dev. | Mean | St.dev. | Mean | St.dev. | Mean | St.dev. | | | Mean | St.dev. |
| Prob (Job type choice) | | | | | | | | | | | | | | | | |
| Hospital | 0.524 | 0.052 | 0.535 | 0.053 | 0.515 | 0.050 | 0.526 | 0.052 | 0.520 | 0.051 | 0.522 | 0.051 | 0.521 | 0.052 | 0.516 | 0.050 |
| Primary care | 0.308 | 0.037 | 0.301 | 0.038 | 0.320 | 0.035 | 0.313 | 0.036 | 0.305 | 0.037 | 0.310 | 0.036 | 0.312 | 0.037 | 0.318 | 0.035 |
| Non-health | 0.168 | 0.017 | 0.164 | 0.017 | 0.165 | 0.016 | 0.161 | 0.016 | 0.175 | 0.019 | 0.168 | 0.017 | 0.167 | 0.017 | 0.166 | 0.017 |
| | 1.000 | | 1.000 | | 1.000 | | 1.000 | | 1.000 | | 1.000 | | 1.000 | | 1.000 | |
| Pr (Job type) * Mean hours in job type | | | | | | | | | | | | | | | | |
| Hospital | 14.7 | 1.6 | 15.0 | 1.7 | 14.5 | 1.5 | 14.7 | 1.6 | 14.6 | 1.6 | 14.6 | 1.5 | 14.5 | 1.6 | 14.2 | 1.3 |
| Primary care | 8.4 | 1.0 | 8.2 | 1.0 | 8.7 | 1.0 | 8.5 | 1.0 | 8.3 | 1.0 | 8.4 | 1.0 | 8.5 | 1.0 | 8.6 | 1.0 |
| Non-health | 4.6 | 0.5 | 4.5 | 0.5 | 4.5 | 0.5 | 4.4 | 0.5 | 4.8 | 0.6 | 4.6 | 0.5 | 4.5 | 0.5 | 4.5 | 0.5 |
| Total | 27.7 | 0.9 | 27.6 | 0.9 | 27.7 | 0.9 | 27.6 | 0.9 | 27.7 | 0.9 | 27.6 | 0.9 | 27.5 | 0.9 | 27.3 | 0.6 |
| Wage elasticities | (New pred. hours-Old pred. hours)/Old pred. hours*10 | | | | | | | | | | | | | | | |
| All hours | | | -0.016 | 0.014 | -0.007 | 0.008 | -0.022 | 0.02 | -0.004 | 0.006 | -0.026 | 0.025 | -0.063** | 0.020 | | |
| Hospital hours | | | 0.166** | 0.059 | -0.169** | 0.085 | -0.002 | 0.043 | -0.090* | 0.052 | -0.087 | 0.084 | -0.138** | 0.058 | | |
| Primary care hours | | | -0.230** | 0.117 | 0.39 | 0.283 | 0.153 | 0.17 | -0.090* | 0.052 | 0.065 | 0.126 | 0.075 | 0.047 | | |
| Non-health hours | | | -0.230** | 0.117 | -0.169** | 0.085 | -0.390** | 0.186 | 0.431* | 0.244 | 0.024 | 0.067 | -0.076** | 0.037 | | |

Standard deviation in italics. * Significantly different from zero at a 10% level. ** Significantly different from zero at a 5% level.

### 4.2 Are single females more responsive to wage?

It seems reasonable to expect that single females are more flexible in their choices and more able to choose jobs with higher working hours and overtime work. On the other hand most of them already work full-time, so the potential for increased hours of work is less than for married females. The average number of observed hours prior to categorization is 1,541 for the single females, compared to 1,353 for married ones. The non-work income is naturally much lower for the single females at NOK 43,567, compared to NOK 229,537 for the married ones. The average age is 35 years, 8 years younger than the married females.

A complicating factor is the choices of the single mothers who are likely to be highly restricted by their parenting obligations and depending on childcare, which often is difficult to combine with shift work. This group, however, is small. The sample of single nurses also includes cohabitants without joint children.

Most of the single nurses are young and work in central areas, often at hospitals. As they get older many of the single nurses too move to less central areas and work in the primary care sector. However, they do not reduce their hours of work like the married ones do in their late twenties and thirties, except for the single mothers. There is a selection out of the single status by age. It is thus somewhat problematic that my out-of-sample prediction is based on those observed as single in both 1995 and 2000. The average nurse marries during the first five years after graduation.

The parameters estimated for the single females follow a similar pattern to those of the married ones. The estimates are reported in Table 7. For the single nurses, the extension of the opportunity index (Model B) has a somewhat different effect on the parameter changes in the leisure component in the utility function, when comparing to the married nurses. Both $\beta_0$ and $\gamma$ are reduced with this extension. As seen in Table 8, the extension of the opportunity index improves the accuracy of the predicted sector choices. A higher share of the single nurses prefer hospital jobs and full-time jobs. The predicted shares, with the observed in parenthesis, are 68.0% (65.8%) for hospitals, 21.2% (21.9%) for primary care and 10.8% (12.3%) for non-health. The single nurses work more hours than the married ones, 32.1 hours per week predicted, 32.3 hours per week observed.

Looking at the whole sample available in 1995 and 2000, hospital wages increased on average by 9%, the primary care wages by 14% and the non-health wages by 3%. The pre-tax hourly wages were on average NOK 154 at hospitals, NOK 146 in primary care and NOK 184 in non-health jobs. Limiting the sample to those observed in both years, the seniority effect is more important. The hospital wages increased by 23% during the five-year period, while wages in primary care and non-health jobs increased by 28% and 11% respectively.

The observed changes from 1995 to 2000 indicate almost a doubling of the share working in primary care to 0.390 as found in Table 9. The shares of both hospitals and non-health jobs are reduced. The average number of working hours, is reduced by 5.5%, mainly due to the reduced share at hospitals. Looking at the whole sample of 11,091 single nurses in 2000 confirms this significant change in the share preferring a primary care job. But the reduction in hours is smaller when looking at the whole sample.

The out-of-sample predictions presented in Table 9 are subject to the same complications due to structural changes in the health care sector as discussed for the married females. The predictions respond to the relative wage changes in the right direction, but underpredict the strength of the effects.

*Wage elasticities*

The wage elasticities are higher for the single nurses as presented in Table 10. The job specific wage elasticity for nurses working in hospitals is 0.196, while the elasticity for primary care jobs is 1.743. Part of this effect is probably due to the fact that there are relatively few single nurses in the primary care sector compared to married ones, as nurses often start their career with a hospital job. This predicted elasticity should thus be interpreted with care. When simulating an increase in both health jobs, the probability for choosing a non-health job is reduced to 0.094 from the previous 0.108. The predicted wage elasticity is found to be -0.235 for hospital jobs and 0.724 for primary care jobs. The predicted elasticity in the primary care sector is only significantly different from zero at a 10% significance level. The income elasticities are not significantly different from zero. The non-wage income of single nurses is quite low compared to the married ones. It may thus be unrealistic to expect that a 10% increase in this component will have any identifiable effect.

To conclude we find that the single nurses seem to be more responsive to wage changes than the married ones. The predicted effect is small however, and some of the elasticities are only significantly different from zero at a 10% level. Generally the effect of a job-specific wage rise is an increase in the number of people and the total hours worked in that job type, but with a corresponding reduction in hours in other job types. It also seems to be the case that those already working in the job where the wage is increased, reduce their expected average working hours slightly.

***Table 7. Estimation of parameters of the utility function and opportunity densities. Single females.***

| | | Model A | | | Model B | | |
|---|---|---|---|---|---|---|---|
| | | **Estimate** | **Std.error** | **P-value** | **Estimate** | **Std.error** | **P-value** |
| | ***Utility function*** | | | | | | |
| $\beta 0$ | Constant 'leisure element' | 1.47 | *0.309* | *[.000]* | 0.894 | *0.179* | *[.000]* |
| $\beta 1$ | Age | -0.002 | *0.003* | *[.570]* | 0.001 | *0.001* | *[.642]* |
| $\gamma$ | Exponent 'leisure element' | -1.424 | *0.431* | *[.001]* | -2.741 | *0.358* | *[.000]* |
| $\alpha$ | Constant 'consumption element' | 0.283 | *0.051* | *[.000]* | 0.832 | *0.096* | *[.000]* |
| $\lambda$ | Exponent 'consumption element' | -3.592 | *0.214* | *[.000]* | -2.502 | *0.146* | *[.000]* |
| | ***Opportunity density**** | | | | | | |
| $\nu 1$ | 1 if living in a central area, 0 otherwise | 1.428 | *0.03* | *[.000]* | 0.977 | *0.033* | *[.000]* |
| $\nu 2$ | 1 if the job is full-time, 0 otherwise | 0.487 | *0.053* | *[.000]* | 0.538 | *0.056* | *[.000]* |
| $\nu 3$ | 1 if the job is with a health care provider, 0 otherwise | | | | 1.137 | *0.043* | *[.000]* |
| | Number of observations | | 7,782 | | 7,782 | | |
| | Log likelihood | | -22,762 | | -22,342.6 | | |
| | McFadden's Rho | | 0.11 | | 0.13 | | |

* *For the wage equation see Appendix 2.*

*Table 8 Observed and predicted hours for single females*

| Observed and predicted hours Single females N=7782 | Observed shares | | Main model Predicted probability | | Extended model Predicted probability | |
|---|---|---|---|---|---|---|
| | **Mean** | **St.dev.** | **Mean** | **St.dev.** | **Mean** | **St.dev.** |
| *Job type choice* | | | | | | |
| Hospital | 0.658 | *0.474* | 0.579 | *0.114* | 0.680 | *0.071* |
| Primary care | 0.219 | *0.413* | 0.182 | *0.056* | 0.212 | *0.061* |
| Non-health | 0.123 | *0.329* | 0.239 | *0.062* | 0.108 | *0.018* |
| | *1.000* | | *1.000* | | *1.000* | |
| | *Share(Job type) * Mean hours in job type* | | *Pr (Job type) * Mean hours in job type* | | *Pr (Job type) * Mean hours in job type* | |
| Hospital | 21.8 | *16.4* | 19.1 | *3.8* | 22.1 | *3.2* |
| Primary care | 7.2 | *13.9* | 6.0 | *1.7* | 6.7 | *1.5* |
| Non-health | 3.3 | *9.2* | 7.7 | *2.0* | 3.3 | *0.6* |
| | *Sum over [Share(Job type) * Mean hours in job type]* | | *Sum over [Pr (Job type) * Mean hours in job type]* | | *Sum over [Pr (Job type) * Mean hours in job type]* | |
| All | 32.3 | *6.4* | 32.7 | *1.6* | 32.1 | *2.3* |
| *Categories of hours* | | | | | | |
| Hours Cat.1 (Mean=18h/w) | 0.064 | *0.245* | 0.039 | *0.042* | 0.049 | *0.064* |
| Hours Cat.2 (Mean=21h/w) | 0.057 | *0.233* | 0.056 | *0.034* | 0.062 | *0.050* |
| Hours Cat.3 (Mean=25h/w) | 0.067 | *0.250* | 0.082 | *0.018* | 0.082 | *0.028* |
| Hours Cat.4 (Mean=28h/w) | 0.092 | *0.289* | 0.096 | *0.008* | 0.092 | *0.014* |
| Hours Cat.5 (Mean=30h/w) | 0.082 | *0.274* | 0.103 | *0.008* | 0.094 | *0.010* |
| Hours Cat.6 (Mean=33h/w) | 0.121 | *0.326* | 0.108 | *0.012* | 0.089 | *0.012* |
| Hours Cat.7 (Mean=35.5h/w) | 0.225 | *0.418* | 0.176 | *0.062* | 0.316 | *0.111* |
| Hours Cat.8 (Mean=37.5h/w) | 0.159 | *0.366* | 0.173 | *0.028* | 0.120 | *0.025* |
| Hours Cat.9 (Mean=40h/w) | 0.132 | *0.339* | 0.166 | *0.030* | 0.097 | *0.024* |
| | *1.000* | | *1.000* | | *1.000* | |

***Table 9. Out-of-sample predictions. Single females, 2000.***

| | 1995 (If observed in 2000) | | | | 2000 (If observed in 1995) | | | | All married females in 2000 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Single females** | **Observed shares** | | **Predicted probability** | | **Observed shares** | | **Predicted probability** | | **Observed shares** | | **Predicted probability** | |
| | **Mean** | **St.dev.** | **Mean** | **St.dev.** | **Mean** | **St.dev.** | **Mean** | **St.dev.** | **Mean** | **St.dev.** | **Mean** | **St.dev.** |
| *Sector choice* | | | | | | | | | | | | |
| Hospital | 0.664 | *0.472* | 0.678 | *0.074* | 0.517 | *0.500* | 0.611 | *0.066* | 0.529 | *0.499* | 0.612 | *0.058* |
| Primary care | 0.220 | *0.414* | 0.214 | *0.063* | 0.390 | *0.488* | 0.248 | *0.050* | 0.394 | *0.489* | 0.236 | *0.047* |
| Other | 0.116 | *0.321* | 0.108 | *0.018* | 0.094 | *0.291* | 0.141 | *0.021* | 0.077 | *0.266* | 0.152 | *0.025* |
| | 1.000 | | 1.000 | | 1.000 | | 1.000 | | 1.000 | | 1.000 | |
| | *Share (Job type) * Mean hours in job type* | | *Pr (Job type) * Mean hours in job type* | | *Share (Job type) * Mean hours in job type* | | *Pr (Job type) * Mean hours in job type* | | *Share (Job type) * Mean hours in job type* | | *Pr (Job type) * Mean hours in job type* | |
| Hospital | 22.1 | *16.4* | 22.0 | *3.3* | 16.3 | *16.4* | 19.6 | *3.1* | 16.9 | *16.5* | 20.0 | *2.7* |
| Primary care | 7.3 | *14.0* | 6.7 | *1.5* | 11.8 | *15.2* | 7.5 | *1.2* | 12.1 | *15.5* | 7.2 | *1.1* |
| Other | 3.2 | *9.2* | 3.3 | *0.6* | 2.8 | *9.0* | 4.2 | *0.6* | 2.2 | *7.9* | 4.6 | *0.8* |
| All | 32.6 | *6.1* | 32.1 | *2.3* | 30.8 | *6.4* | 31.3 | *2.0* | 31.2 | *6.3* | 31.9 | *1.8* |
| *Categories of hours* | | | | | | | | | | | | |
| Hours Cat.1 (Mean=18h/w) | 0.050 | *0.217* | 0.050 | *0.065* | 0.073 | *0.260* | 0.065 | *0.056* | 0.067 | *0.249* | 0.051 | *0.048* |
| Hours Cat.2 (Mean=21h/w) | 0.053 | *0.224* | 0.063 | *0.051* | 0.082 | *0.274* | 0.080 | *0.043* | 0.071 | *0.257* | 0.068 | *0.039* |
| Hours Cat.3 (Mean=25h/w) | 0.070 | *0.255* | 0.083 | *0.028* | 0.094 | *0.292* | 0.094 | *0.023* | 0.085 | *0.279* | 0.086 | *0.023* |
| Hours Cat.4 (Mean=28h/w) | 0.095 | *0.293* | 0.092 | *0.014* | 0.120 | *0.325* | 0.096 | *0.012* | 0.120 | *0.325* | 0.091 | *0.014* |
| Hours Cat.5 (Mean=30h/w) | 0.079 | *0.270* | 0.094 | *0.009* | 0.112 | *0.316* | 0.092 | *0.008* | 0.114 | *0.317* | 0.090 | *0.009* |
| Hours Cat.6 (Mean=33h/w) | 0.123 | *0.329* | 0.089 | *0.012* | 0.147 | *0.354* | 0.079 | *0.008* | 0.152 | *0.359* | 0.079 | *0.007* |
| Hours Cat.7 (Mean=35.5h/w) | 0.230 | *0.421* | 0.313 | *0.111* | 0.174 | *0.379* | 0.337 | *0.121* | 0.189 | *0.391* | 0.370 | *0.115* |
| Hours Cat.8 (Mean=37.5h/w) | 0.167 | *0.373* | 0.120 | *0.025* | 0.098 | *0.297* | 0.091 | *0.016* | 0.108 | *0.310* | 0.095 | *0.014* |
| Hours Cat.9 (Mean=40h/w) | 0.133 | *0.340* | 0.097 | *0.024* | 0.100 | *0.301* | 0.066 | *0.014* | 0.094 | *0.292* | 0.070 | *0.013* |
| | 1.000 | | 1.000 | | 1.000 | | 1.000 | | 1.000 | | 1.000 | |
| Age | 5,677 | | | | 5,677 | | | | 11,091 | | | |
| Sample size | 34.3 | *7.3* | | | 39.3 | *7.3* | | | 34.8 | *8.1* | | |

*** Significantly different from zero at a 10% level. ** Significantly different from zero at a 5% level.**

***Table 10. Predictions of a policy experiment for single females***

| | Predicted | | Predictions with a 10% increase in hospital wages | | Predictions with a 10% increase in prim. care wages | | Predictions with a 10% increase in both wages | | Predictions with a 10% increase in non-health wages | | Predictions with a 10% increase in all wages | | Predictions with a 10% increase in non-wage income | | Predictions with NOK 50,000 in transfers | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | | | *Mean* | *St.dev.* |
| *Prob (Sector choice)* | | | | | | | | | | | | | | | | |
| Hospital | 0.680 | *0.071* | 0.706 | *0.078* | 0.648 | *0.066* | 0.676 | *0.073* | 0.667 | *0.068* | 0.664 | *0.071* | 0.679 | 0.072 | 0.640 | *0.077* |
| Primary care | 0.212 | *0.061* | 0.196 | *0.066* | 0.249 | *0.053* | 0.230 | *0.059* | 0.208 | *0.061* | 0.226 | *0.059* | 0.213 | 0.061 | 0.256 | *0.059* |
| Non-health | 0.108 | *0.018* | 0.099 | *0.018* | 0.103 | *0.016* | 0.094 | *0.017* | 0.125 | *0.022* | 0.109 | *0.019* | 0.108 | 0.018 | 0.104 | *0.020* |
| | *1.000* | | *1.000* | | *1.000* | | *1.000* | | *1.000* | | 1.000 | | 1.000 | | *1.000* | |
| *Pr (Sector) * Mean hours in sector* | | | | | | | | | | | | | | | | |
| Hospital | 22.1 | *3.2* | 22.6 | *3.3* | 21.1 | *2.8* | 21.6 | *3* | 21.7 | *3* | 21.2 | *2.9* | 22.1 | 3.2 | 19.1 | *2.3* |
| Primary care | 6.7 | *1.5* | 6.1 | *1.6* | 7.8 | *1.4* | 7.2 | *1.5* | 6.6 | *1.5* | 7 | *1.5* | 6.7 | 1.5 | 7.5 | *1.6* |
| Non-health | 3.3 | *0.6* | 3 | *0.6* | 3.2 | *0.5* | 2.9 | *0.5* | 3.8 | *0.8* | 3.3 | *0.6* | 3.3 | 0.6 | 3 | *0.6* |
| *Sum over [Pr (Sector) *Mean hours in sector]* | | | | | | | | | | | | | | | | |
| Total | 32.2 | *2.3* | 31.8 | *2.2* | 32 | *2.3* | 31.6 | *2.1* | 32.1 | *2.3* | 31.6 | *2.1* | 32.1 | 2.4 | 29.6 | *1.2* |
| *Wage elasticities* | *(New pred. hours-Old pred. hours)/Old pred. hours*10* | | | | | | | | | | | | | | | |
| All hours | | | -0.118** | *0.057* | -0.044** | *0.021* | -0.152** | *0.066* | -0.030* | *0.016* | -0.175** | *0.076* | -0.022 | 0.027 | | |
| Hospital hours | | | 0.196** | *0.075* | -0.466** | *0.208* | -0.235* | *0.135* | -0.192** | *0.094* | -0.394* | *0.207* | -0.039 | 0.046 | | |
| Primary care hours | | | -0.883** | *0.426* | 1.743** | *0.854* | 0.724* | *0.429* | -0.192** | *0.094* | 0.545 | *0.342* | 0.026 | 0.030 | | |
| Non-health hours | | | -0.883** | *0.426* | -0.466** | *0.208* | -1.263** | *0.537* | 1.373** | *0.647* | -0.068 | *0.196* | -0.033 | 0.050 | | |

Standard deviation in italics. * Significantly different from zero at a 10% level. ** Significantly different from zero at a 5% level.

## 5. The costs of an active wage policy

The total cost of a policy reform is of course strongly correlated to the change in hours worked in the different job types. As shown in the previous sections a job-specific wage increase is predicted to have a modest impact on the choice of job types and hours worked. The analysis so far has focused on the average effect on hours of a change in wages. It is, however, not unlikely that the nurses are heterogeneous in their response to a wage reform, e.g. according to their position on the wage scale. Using individual specific hourly wages in combination with our predicted changes in job type and hours for each individual, we capture the total expected changes in wage costs. Focusing on wage increases in the public health sector defends disregarding the employers' taxes, e.g. the proportional tax on labor costs. The additional tax paid by the public hospitals and nursing homes return as increased tax income in the state budget.

A 10% simulated increase in hospital wages will increase the wage costs for the hospital jobs for the married females by approximately 1.7 percent, identical to the change in hours (Table A8 in Appendix 5). The average cost per hour is calculated to NOK 158.6 both *prior to* and *after* the simulated wage increase. I must thus be a predicted change in the personnel mix, where those with a higher wage than the average work less and those with a lower wage than the average work more, cancelling out the 10% hourly wage increase. Thus the RNs attracted to the hospital by the wage increase have a lower mean hourly salary than those already working at hospitals. The average hourly wage in the primary care sector is predicted to be reduced by 9.1% to NOK 135.0, as those changing jobs from primary care to hospitals have a higher than average wage in the primary care sector. The primary care hours are predicted to be reduced by 2.2%, while the costs are reduced by 11.1%. Due to reductions in the two other job types, the total costs of all employed married nurses will be reduced by 2.7%.

Looking at both hospitals and primary care jobs, a 10% wage increase will reduce the non-health hours and wage costs by 4.0%. Of the 166 RNs predicted to leave their non-health jobs, 45 find a hospital job and 141 a primary care job. However, the hospital hours and costs are unchanged, while the primary care hours and costs are increased by 1.5%. I interpret this as a reduction of hours for those already in the sector, reducing costs in spite of the hourly wage increase. Those entering the hospital and primary care jobs have a lower average wage canceling out added costs from the wage increases. The predicted changes in the costs for the single nurses mirror those of the married nurses (Table A9 in Appendix 5).

## 6. Conclusions

The purpose of this study has been to identify the short-term effect of increases in hourly wages on hours worked in the health sector, both hoping to boost the hours worked by RNs already employed in the health sector and attract personnel from non-health jobs. Wage is probably increasingly important to attract people to the nursing profession as is becomes less of a calling and more of a regular job. But this study indicates that once qualified, wage seems to have a modest impact on hours worked for the nurses, especially for married women. Wage also has a modest impact on the choice of job-type, but a simulated wage increase by 10% in health-jobs merely reduces the share of nurses preferring a non-health job from 16.8% to 16.1% for those married, and from 10.8% to 9.4% for the single females.

For married women I find job type specific wage elasticities of 0.17 for the hospital jobs. The increase in hours is partly due to the attraction of nurses from primary care and non-health jobs and partly due to an increase in the hours worked by those already working at the hospitals. The wage elasticity is predicted to be 0.39 for primary care jobs, and 0.43 for non-health jobs, but these elasticities are only significant at lower levels (80% and 90% respectively). For all hours worked by married female nurses, health and non-health, the income effect dominates the substitution effect with a wage elasticity of -0.026. This elasticity however is not significantly different from zero.

For the single women the job specific wage elasticities are stronger, especially in the primary care sector. The wage elasticity for hospital hours is 0.20. The elasticity is much higher for primary care (1.7), but part of this effect is probably due to the fact that there are relatively few single nurses in the primary care sector compared to married ones, as nurses often start their career with a hospital job. For all hours worked by single female nurses, in health and non-health jobs, the wage elasticity is –0.18. The elasticities for this group are more uncertain, with higher standard deviations. But they are all significantly different from zero.

It is worth noting that the predicted effects of a public sector wage increase on the hours worked in the National Health Service, as presented in this paper, is reasonable close to the estimates presented by Askildsen et al. (2003). They also use Norwegian data but a different econometric framework. They combine the analysis for single and married RNs and present a wage elasticity of 0.21 as their most reliable estimate.

The conclusion is that wage has the effect of increasing hours worked in the health sector. But there is a loss incurred as the average nurse's working hours are predicted to be slightly reduced by such a policy. Single nurses are more responsive to wage than those who are married. The complexity of the nurses' choices and the many other characteristics that are important with regard to the choice of job type and hours worked, reduces the sharpness of the predicted elasticities.

## 7. References

Aaberge, R., Dagsvik, J.R., Strøm, S.,1995. Labor supply responses and welfare effects of tax reforms. Scandinavian Journal of Economics 97: 635-59.

Aaberge, R., Colombino, U., Strøm, S., 1999, Labour supply in Italy: An empirical analysis of joint household decisions, with taxes and quantity constraints, Journal of Applied Econometrics 14: 403-422.

Antonazzo, E., Scott, A., Skatun, D., Elliott, R.F., 2003, The labour market for nursing: a review of the labour supply literature. Health Economics. Vol. 12, pp. 465-478.

Askildsen, J., Baltagi, B., Holmås T.H., 2003, Wage Policy in the Health Care Sector: A Panel Data Analysis of Nurses' Labour Supply, Health Economics, Vol. 12 pp. 705-719.

Box, G.E.P, Cox, D.R., 1964, An Analysis of Transformations. Journal of the Royal Statistical Society, 211-243, discussion 244-252.

European Observatory on Health Care Systems, 2000, Health Care Systems in Transition, Norway. Copenhagen: WHO Regional office for Europe.

Finlayson, B., Dixon, J., Meadows, S., Blair, G., 2002, Mind the gap: the extent of the NHS nursing shortage. BMJ 2002;325:538-541.

Hirsch, B.T., Schumacher, E.J., 1995, Monopsony Power and Relative Wages in the Labor Market for Nurses. Journal of Health Economics, Vol. 14, No. 4 (November), 443-76.

Hirsch BT. Schumacher E., 1998, Union wages, rents, and skills in health care labour markets. J Labour Res. 19; 125-147.

Killingworth MR, Heckman JJ., 1986, Female labour supply: a survey. In Handbook of Labour Economics, vol. 1, Ashenfelter OC, Layard R (eds). North-Holland: Amsterdam.

Link, C.R., 1992, Labor Supply Behavior of Registered Nurses: Female Labor Supply in the Future? Res. Labor Econ. 13, 287-320.

Moore, M.J., Viscusi, W.K., 1990. Compensating mechanisms for Job Risks. Princeton University press, Princeton NJ.

Nurseweek/American Organization of Nurse Executives (AONE), 2002, Survey published at website www.nurseweek.com. Undertaken by AONE Institute for Patient Care Research and Education and Harris Interactive.

Phillips, V.L., 1995, Nurses´ labor supply: Participation, Hours of Work, and Discontinuities in the Supply Function. Journal of Health Economics, 14, 567-582.

Statistics Norway, 2001, Specialist Health Service 1990-2000. General Hospitals, Psychiatric Institutions, etc. Kongsvinger.

Statistics Norway, 2003, www.ssb.no.

U.S. Department of Health and Human Services, 2002. Projected Supply, Demand, and Shortages of Registered Nurses: 2000-2020. Health Resources and Services Administration. Bureau of Health Professions. National Center for Health Workforce Analysis.

van den Noord, P., Hagen, T.P., Iversen, T., 1998, The Norwegian Health Care System. Economics Department Working Papers no. 198. Paris: OECD.

Van Soest, A., 1995, Discrete Choice Models of Family labor supply. Journal of Human Resources 30, 63-88.

## 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 temporarily 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 on 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 |
| | **51,451** |

*Table A2 Key variables by sector*

| Variable<br>1995 | Hospital<br>Mean | <br>St.d. | Primary care<br>Mean | <br>St.d. | Private health care<br>Mean | <br>St.d. | Non-health<br>Mean | <br>St.d. | Non-work<br>Mean | <br>St.d. | Transfers<br>Mean | <br>St.d. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sector share | 49.9% | | 25.7% | | 5.1% | | 15.3% | | 0.9% | | 6.1% | |
| N | 24,144 | | 13,208 | | 2,617 | | 7,876 | | 479 | | 3,127 | |
| Age | 40.0 | *9.8* | 42.0 | *10.1* | 43.9 | *9.2* | 43.1 | *9.4* | 50.4 | *11.3* | 50.8 | *11.8* |
| Female=1 | 92.4% | | 93.2% | | 90.9% | | 86.8% | | 97.7% | | 97.2% | |
| Single=1 | 23.9% | | 14.3% | | 10.4% | | 14.6% | | 9.4% | | 12.0% | |
| Married=1 | 64.6% | | 73.2% | | 78.6% | | 69.7% | | 85.2% | | 68.0% | |
| Divorced=1 | 7.8% | | 8.2% | | 7.3% | | 10.4% | | 2.5% | | 10.5% | |
| Born in Norway=1 | 91.5% | | 92.2% | | 91.9% | | 92.5% | | 85.6% | | 91.1% | |
| Gave birth in 1994 or 1995 =1 | 13.4% | | 12.7% | | 8.5% | | 9.4% | | 3.3% | | 1.7% | |
| # of children if parent | 2.2 | *0.9* | 2.4 | *1.0* | 2.4 | *0.9* | 2.4 | *1.0* | 2.5 | *1.2* | 2.6 | *1.1* |
| Years since authorization | 14.3 | *10.4* | 16.2 | *11.0* | 18.7 | *10.1* | 17.5 | *10.3* | 24.4 | *12.0* | 24.9 | *11.9* |
| Number of years worked last 20 years | 13.7 | *5.3* | 13.9 | *5.2* | 14.9 | *4.7* | 14.9 | *4.8* | 9.7 | *5.8* | 13.0 | *5.5* |
| Income from work | 199 810 | *54 731* | 193 071 | *54 028* | 201 416 | *87 267* | 205 423 | *122 333* | 12 768 | *14 566* | 5 402 | *9 599* |
| Total Income | 219 410 | *57 530* | 215 255 | *57 450* | 223 549 | *93 865* | 238 877 | *147 162* | 26 326 | *54 621* | 122 104 | *69 940* |
| Transfers | 16 482 | *22 057* | 19 245 | *22 790* | 16 491 | *21 743* | 6 207 | *13 763* | 6 207 | *13 763* | 109 689 | *60 705* |
| Wage per hour | 136 | *7* | 128 | *4* | 114 | *7* | 163 | *10* | | | | |
| Hours per year | 1 470 | *390* | 1 510 | *410* | 1 770 | *750* | 1 260 | *720* | | | | |
| Hours Cat.1 | 20.7% | | 21.6% | | 22.2% | | 33.4% | | | | | |
| Hours Cat.2 | 29.1% | | 33.0% | | 26.1% | | 29.5% | | | | | |
| Hours Cat.3 | 50.1% | | 45.4% | | 51.7% | | 37.2% | | | | | |
| Spouse's total income | 315 907 | *319 714* | 288 086 | *204 982* | 395 412 | *589 663* | 324 689 | *293 860* | 371 194 | *420 800* | 355 575 | *417 588* |
| Spouse's income after tax | 214 552 | *224 655* | 199 661 | *142 419* | 260 930 | *383 139* | 222 007 | *215 751* | 257 360 | *324 146* | 246 959 | *325 082* |
| Spouse does not work =1 | 8.8% | | 12.8% | | 10.3% | | 12.6% | | 29.2% | | 27.8% | |

## *Table A3 Samples used in the analysis, 1995*

| Variable | Married females | | Single females | | All nurses with data | |
|---|---|---|---|---|---|---|
| N | 25,242 | | 7,782 | | 45,228 | |
| Age | 43.1 | 9.2 | 35.0 | 8.9 | 41.17 | 9.89 |
| Female=1 | 1 | | 1 | | 0.92 | |
| Single=1 | 0 | | 1 | | 0.19 | |
| Married=1 | 1 | | 0 | | 0.68 | |
| Divorced=1 | 0 | | 0 | | 0.08 | |
| Born in Norway=1 | 0.93 | | 0.91 | | 0.92 | |
| Gave birth in 1994 or 1995 | 0.12 | | 0.15 | | 0.13 | |
| Number of children in 1995 | 2.5 | 0.9 | 1.3 | 0.6 | 2.1 | 1.0 |
| # of children if mother | 2.5 | 0.9 | 1.5 | 0.7 | 2.3 | 1.0 |
| Years since authorization | 17.7 | 10.2 | 9.3 | 9.0 | 15.4 | 10.6 |
| Number of years worked last 20 years | 14.8 | 4.6 | 11.2 | 5.6 | 13.9 | 5.2 |
| Income from work | 185 797 | 72 916 | 206 582 | 52 403 | 198 810 | 71 208 |
| Total income | 208 383 | 71 269 | 222 907 | 49 959 | 221 576 | 81 017 |
| Transfers | 19 658 | 20 193 | 13 665 | 24 579 | 19 136 | 26 646 |
| Non-work | 229 537 | 86 597 | 43 567 | 80 790 | 169 530 | 200 345 |
| Wage per hour, ca | 138 | 13 | 135 | 13 | 138 | 14 |
| Hours per year, ca | 1,353 | 485 | 1,541 | 379 | 1,445 | 477 |
| Hours Cat.1 Half time and less | 0.30 | | 0.14 | | 0.23 | |
| Hours Cat.2 Part-time | 0.35 | | 0.25 | | 0.30 | |
| Hours Cat.3 Full-time | 0.35 | | 0.61 | | 0.46 | |
| Hospital | 0.50 | | 0.66 | | 0.53 | |
| Primary care | 0.33 | | 0.22 | | 0.29 | |
| Non-health | 0.17 | | 0.12 | | 0.17 | |
| Centrality Index 1 (Least Central) | 0.08 | | 0.08 | | 0.07 | |
| Centrality Index 2 | 0.04 | | 0.05 | | 0.04 | |
| Centrality Index 3 | 0.09 | | 0.09 | | 0.09 | |
| Centrality Index 4 | 0.02 | | 0.01 | | 0.02 | |
| Centrality Index 5 | 0.04 | | 0.03 | | 0.03 | |
| Centrality Index 6 | 0.20 | | 0.14 | | 0.19 | |
| Centrality Index 7 | 0.52 | | 0.61 | | 0.55 | |
| Work Region A Oslo/Akershus | 0.19 | | 0.30 | | 0.22 | |
| Work Region East excl.Oslo/Ak. | 0.25 | | 0.17 | | 0.24 | |
| Work Region South Agder/Rogaland | 0.16 | | 0.09 | | 0.14 | |
| Work Region West | 0.18 | | 0.15 | | 0.16 | |
| Work Region North | 0.18 | | 0.24 | | 0.19 | |

## Appendix 2. Wages

*Annual income by sector*

I have constructed sector-specific hourly wages for all nurses, including sectors where they not are participating. The first step in this process is to sort the jobs by the NACE standard industrial classification and aggregate into sectors or practice types. As described in table A3 I have chosen to use seven 'sectors' when I construct hourly wages: a) hospitals, b) public primary care, c) private health practice and d) other non-health work. Those who earned less than the minimum amount to qualify for pension entitlements (1G=NOK 39,340), are categorized as e) not working. Self-employment is allocated to the non-health sector.

*Hourly wages*

The earnings measure used is hourly wage. I calculated hourly wages for the subsample with a full-time job for the whole year by dividing the annual income by the normal working hours for the job type concerned. Intuitively there is reason to believe that there is a selection into the different job types, driven by unobserved factors like preferences and productivity. When I predict hourly wages for each individual, also in the job categories where they do not work, I take this selection into consideration. I apply a Heckman two-step procedure when estimating the wage equations as presented in Table A4, and find a significant selection effect. I repeat this procedure for each job category. Table A4 only reports the wage equation for the hospital sector. I exclude the equations for the other sectors, as they are parallel. The hours 'observed' are calculated by dividing the annual income by the hourly wage for the job category chosen by the individual.

*Experience*

In many empirical studies a labor market experience is proxied by *potential* experience, i.e. age-education-7 (Age of primary school enrolment). This is a problematic upper bound for experience which is more upwardly biased for women, who tend to be more loosely connected to the labor market, at least in connection with maternity leave. This is highly relevant for the nurse profession. I have therefore used the 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, which was established in 1967. Individual ‘pension entitlements’ in this scheme are linked to their income histories. I have also tested the traditional experience measure but found the measure based on ‘pension entitlements’ to be more suitable.

*Table A4 Wage equation from a Heckman selection model*

| | | Coef. | Std. Err | z |
|---|---|---|---|---|
| | Dependent variable: Wage per hour in the hospital sector | | | |
| **Female** | **Female=1** | -0.033 | 0.006 | -5.84 |
| **Regiona** | **Oslo/Akershus** | 0.043 | 0.010 | 4.53 |
| **Regionc** | **West** | -0.015 | 0.005 | -3.11 |
| **Regiond** | **Middle** | -0.006 | 0.006 | -1.03 |
| **Regione** | **North** | -0.013 | 0.005 | -2.35 |
| **Age** | **Age** | 0.122 | 0.047 | 2.62 |
| **age2** | **Age^2/10** | -0.353 | 0.164 | -2.16 |
| **age3** | **Age^3/1000** | 0.435 | 0.249 | 1.75 |
| **age4** | **Age^4/100000** | -0.194 | 0.139 | -1.39 |
| **erf95** | **Years of work experience last 20 years** | -0.018 | 0.011 | -1.61 |
| **erf952** | **Experience^2/10** | 0.408 | 0.176 | 2.32 |
| **erf953** | **Experience^3/1000** | -2.519 | 1.118 | -2.25 |
| **erf954** | **Experience^4/100000** | 5.081 | 2.434 | 2.09 |
| **Cnordic** | **From Nordic country except Norway=1** | 0.039 | 0.008 | 4.82 |
| **coecd_no** | **From OECD area except the Nordic countries=1** | 0.006 | 0.010 | 0.56 |
| **Cglobal** | **Non-OECD background=1** | 0.019 | 0.012 | 1.61 |
| **kommsen1** | **Centrality index 1 =1** | 0.019 | 0.007 | 2.58 |
| **kommsen2** | **Centrality index 2 =1** | 0.013 | 0.006 | 2.11 |
| **kommsen3** | **Centrality index 3 =1** | 0.013 | 0.005 | 2.65 |
| **kommsen4** | **Centrality index 4 =1** | 0.061 | 0.019 | 3.19 |
| **kommsen5** | **Centrality index 5 =1** | 0.021 | 0.009 | 2.39 |
| **kommsen6** | **Centrality index 6 =1** | -0.012 | 0.005 | -2.4 |
| **Constant** | | 3.442 | 0.475 | 7.24 |

***Table A4 continued- Selection into the hospital sector***

| Select | | | | |
|---|---|---|---|---|
| **Female** | **Female=1** | -0.657 | 0.033 | -19.96 |
| **Regiona** | **Oslo/Akershus** | -0.889 | 0.037 | -24.02 |
| **Regionc** | **West** | 0.062 | 0.032 | 1.9 |
| **Regiond** | **Middle** | -0.057 | 0.036 | -1.58 |
| **Regione** | **North** | 0.219 | 0.034 | 6.42 |
| **Cnordic** | **From Nordic country except Norway=1** | 0.014 | 0.050 | 0.29 |
| **coecd_no** | **From OECD area except the Nordic countries=1** | -0.008 | 0.065 | -0.13 |
| **Cglobal** | **Non-OECD background=1** | 0.188 | 0.077 | 2.42 |
| **Age** | **Age** | -0.684 | 0.288 | -2.38 |
| **age2** | **Age^2/10** | 1.817 | 1.022 | 1.78 |
| **age3** | **Age^3/1000** | -1.948 | 1.569 | -1.24 |
| **age4** | **Age^4/100000** | 0.652 | 0.882 | 0.74 |
| **erf95** | **Years of work experience last 20 years** | 0.094 | 0.064 | 1.47 |
| **erf952** | **Experience^2/10** | 0.117 | 1.048 | 0.11 |
| **erf953** | **Experience^3/1000** | -6.147 | 6.783 | -0.91 |
| **erf954** | **Experience^4/100000** | 23.834 | 14.933 | 1.6 |
| **Married** | **Married=1** | -0.494 | 0.020 | -24.2 |
| **b950_5** | **No. of children Aged 0-5** | -0.293 | 0.018 | -16.35 |
| **kommsen1** | **Centrality index 1 =1** | 0.059 | 0.051 | 1.17 |
| **kommsen2** | **Centrality index 2 =1** | 0.161 | 0.044 | 3.62 |
| **kommsen3** | **Centrality index 3 =1** | 0.096 | 0.033 | 2.87 |
| **kommsen4** | **Centrality index 4 =1** | -0.234 | 0.115 | -2.04 |
| **kommsen5** | **Centrality index 5 =1** | -0.021 | 0.057 | -0.36 |
| **kommsen6** | **Centrality index 6 =1** | 0.045 | 0.031 | 1.45 |
| **Constant** | | 8.723 | 2.922 | 2.99 |
| **/athrho** | | -0.574 | 0.093 | -6.18 |
| **/lnsigma** | | -2.113 | 0.030 | -69.86 |
| **Rho** | | -0.518 | 0.068 | |
| **Sigma** | | 0.121 | 0.004 | |
| **Lambda** | | -0.063 | 0.010 | |

| | | | |
|---|---|---|---|
| **Number of obs** | 24,171 | **Log likelihood** | -6,934.4 |
| **Censored obs** | 17,827 | **Wald chi2(22) =** | 996.11 |
| **Uncensored obs** | 6,344 | **Prob >chi2 =** | 0 |

# Appendix 3. Taxes

## *Income tax*

***Table A5 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 28 percent.

# Appendix 4. Predicted choices of the discrete choice model without the health care provider indicator in the opportunity index.

***Table A6. Extended model - Married females. Predicted changes in sector choices and working hours in policy simulations. (Without $v_3$).***

| | **Predicted** | | **Predictions with a 10% increase in hospital wages** | | **Predictions with a 10% increase in prim. care wages** | | **Predictions with a 10% increase in both wages** | | **Predictions with a 10% increase in non-health wages** | | **Predictions with a 10% increase in all wages** | | **Predictions with NOK 50,000 in transfers** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* |
| *Prob (Sector choice)* | | | | | | | | | | | | | | |
| Hospital | 0.378 | *0.020* | 0.381 | *0.021* | 0.376 | 0.019 | 0.379 | *0.020* | 0.376 | *0.019* | 0.377 | *0.019* | 0.376 | *0.017* |
| Primary care | 0.304 | *0.014* | 0.303 | *0.015* | 0.308 | 0.011 | 0.307 | *0.012* | 0.303 | *0.015* | 0.305 | *0.013* | 0.308 | *0.010* |
| Non-health | 0.317 | *0.010* | 0.316 | *0.009* | 0.316 | 0.009 | 0.314 | *0.009* | 0.321 | *0.012* | 0.317 | *0.010* | 0.316 | *0.009* |
| | | | *1.000* | | *1.000* | | *1.000* | | *1.000* | | *1.000* | | *1.000* | |
| *Pr (Sector) * Mean hours in sector* | | | | | | | | | | | | | | |
| Hospital hours | 10.9 | *0.7* | 10.9 | *0.7* | 10.8 | 0.6 | 10.9 | *0.7* | 10.8 | *0.6* | 10.8 | *0.6* | 10.7 | *0.5* |
| Primary care hours | 8.3 | *0.5* | 8.2 | *0.5* | 8.4 | 0.5 | 8.3 | *0.5* | 8.2 | *0.5* | 8.3 | *0.5* | 8.3 | *0.5* |
| Non-health hours | 8.6 | *0.5* | 8.6 | *0.5* | 8.6 | 0.5 | 8.5 | *0.5* | 8.7 | *0.6* | 8.6 | *0.5* | 8.5 | *0.5* |
| *Sum over [Pr (Sector) *Mean hours in sector]* | | | | | | | | | | | | | | |
| Total | 27.8 | *0.7* | 27.8 | *0.6* | 27.8 | 0.6 | 27.7 | *0.6* | 27.8 | *0.6* | 27.7 | *0.6* | 27.6 | *0.5* |
| *Wage elasticities* | *(New pred. hours-Old pred. hours)/Old pred. hours*10* | | | | | | | | | | | | | |
| All hours | | | -0.006 | *0.008* | -0.004 | 0.007 | -0.010 | *0.014* | -0.005 | *0.009* | -0.014 | *0.022* | -0.064 | *0.083* |
| Hospital hours | | | 0.062 | *0.053* | -0.056 | 0.058 | 0.006 | *0.014* | -0.050 | *0.056* | -0.042 | *0.061* | -0.144 | *0.180* |
| Primary care hours | | | -0.050 | *0.053* | 0.124 | 0.164 | 0.073 | *0.109* | -0.050 | *0.056* | 0.024 | *0.055* | 0.083 | *0.161* |
| Non-health hours | | | -0.050 | *0.053* | -0.056 | 0.058 | -0.105 | *0.107* | 0.095 | *0.095* | -0.011 | *0.022* | -0.089 | *0.112* |

Standard deviation in italics. * Significantly different from zero at a 10% level. ** Significantly different from zero at a 5% level.

***Table A7. Single nurses. Predicted changes in sector choices and working hours in policy simulations. (Without $v_3$).***

| | **Predicted** | | **Predictions with a 10% increase in hospital wages** | | **Predictions with a 10% increase in prim. care wages** | | **Predictions with a 10% increase in both wages** | | **Predictions with a 10% increase in non-health wages** | | **Predictions with a 10% increase in all wages** | | **Predictions with NOK 50,000 in transfers** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* |
| *Prob (Job type choice)* | | | | | | | | | | | | | | |
| Hospital | 0.579 | *0.114* | 0.603 | *0.119* | 0.565 | *0.114* | 0.590 | *0.118* | 0.567 | *0.114* | 0.578 | *0.117* | 0.582 | *0.124* |
| Primary care | 0.182 | *0.056* | 0.172 | *0.059* | 0.202 | *0.057* | 0.191 | *0.059* | 0.177 | *0.055* | 0.187 | *0.057* | 0.198 | *0.061* |
| Non-health | 0.239 | *0.062* | 0.225 | *0.063* | 0.233 | *0.059* | 0.219 | *0.060* | 0.256 | *0.066* | 0.235 | *0.063* | 0.220 | *0.064* |
| | 1.000 | | 1.000 | | 1.000 | | 1.000 | | *1.000* | | 1.000 | | 1.000 | |
| *Pr (Job type) * Mean hours in job type* | | | | | | | | | | | | | | |
| Hospital | 19.1 | *3.8* | 19.5 | *3.9* | 18.6 | *3.7* | 19.1 | *3.8* | 18.6 | *3.7* | 18.7 | *3.8* | 17.9 | *3.7* |
| Primary care | 6.0 | *1.7* | 5.6 | *1.8* | 6.6 | *1.8* | 6.2 | *1.8* | 5.8 | *1.7* | 6.1 | *1.8* | 6.1 | *1.9* |
| Non-health | 7.7 | *2.0* | 7.2 | *2.0* | 7.5 | *1.9* | 7.0 | *1.9* | 8.1 | *2.2* | 7.4 | *2.0* | 6.7 | *2.0* |
| *Sum over [Pr (Job type) *Mean hours in job type]* | | | | | | | | | | | | | | |
| Total | 32.7 | *1.6* | 32.4 | *1.4* | 32.6 | *1.5* | 32.3 | *1.4* | 32.6 | *1.5* | 32.2 | *1.3* | 30.8 | *0.6* |
| *Wage elasticities* | *(New pred. hours-Old pred. hours)/Old pred. hours*10* | | | | | | | | | | | | | |
| All | | | -0.094* | *0.053* | -0.027* | *0.015* | -0.116** | *0.059* | -0.040 | *0.025* | -0.149** | *0.073* | | |
| Hospital | | | 0.258* | *0.142* | -0.248* | *0.140* | 0.020 | *0.037* | -0.223 | *0.137* | -0.182 | *0.129* | | |
| Primary care | | | -0.629* | *0.372* | 1.034* | *0.558* | 0.339 | *0.236* | -0.223 | *0.137* | 0.129 | *0.108* | | |
| Non-health | | | -0.629* | *0.372* | -0.248* | *0.140* | -0.843* | *0.437* | 0.551* | *0.304* | -0.330* | *0.190* | | |

Standard deviation in italics. * Significantly different from zero at a 10% level. ** Significantly different from zero at a 5% level.

## Appendix 5. The predicted costs of a simulated wage increase.

***Table A8. Extended model - Married females with basic model (A). Predicted cost changes in policy simulations.***

| N=25242 | Predicted | | Predictions with a 10% increase in hospital wages | | Predictions with a 10% increase in prim. care wages | | Predictions with a 10% increase in both wages | | Predictions with a 10% increase in non-health wages | | Predictions with a 10% increase in all wages | | Predictions with NOK 50,000 in transfers | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* |
| *Predicted total net wage cost per sector. In million NOK per year: 48 weeks, 7,782 individuals* | | | | | | | | | | | | | | |
| Hospital | 2 831 | *313* | 2 879 | *323* | 2 529 | *268* | 2 830 | *305* | 2 550 | *273* | 2 805 | *295* | 2 484 | *240* |
| Primary care | 1 511 | *190* | 1 343 | *176* | 1 568 | *187* | 1 533 | *189* | 1 361 | *172* | 1 520 | *187* | 1 400 | *167* |
| Non-health | 940 | *116* | 919 | *113* | 924 | *111* | 903 | *109* | 1 080 | *141* | 1 037 | *128* | 924 | *111* |
| All sectors | 5 282 | *259* | 5 140 | *253* | 5 021 | *243* | 5 266 | *250* | 4 991 | *254* | 5 362 | *258* | 4 807 | *209* |
| *Difference in net wage costs in million NOK between predictions before and after the wage increase.* | | | | | | | | | | | | | | |
| Hospital | | | 47 | | -302 | | -1 | | -281 | | -26 | | -348 | |
| Primary care | | | -168 | | 57 | | 22 | | -150 | | 9 | | -111 | |
| Non-health | | | -22 | | -16 | | -37 | | 139 | | 96 | | -17 | |
| All sectors | | | -142 | | -261 | | -16 | | -292 | | 79 | | -475 | |

*Table A9. Single nurses with basic model (A). Predicted cost changes in policy simulations.*

| N=7782 | Predicted | | Predictions with a 10% increase in hospital wages | | Predictions with a 10% increase in prim. care wages | | Predictions with a 10% increase in both wages | | Predictions with a 10% increase in non-health wages | | Predictions with a 10% increase in all wages | | Predictions with NOK 50,000 in transfers | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* | *Mean* | *St.dev.* |
| *Predicted total net wage cost per sector. In million NOK per year: 48 weeks, 7,782 individuals* | | | | | | | | | | | | | | |
| Hospital | 1 279 | *189* | 1 304 | *196* | 1 107 | *156* | 1 248 | *180* | 1 139 | *164* | 1 227 | *173* | 1 005 | *134* |
| Primary care | 331 | *74* | 304 | *82* | 424 | *76* | 390 | *83* | 325 | *74* | 383 | *82* | 371 | *80* |
| Non-health | 207 | *38* | 188 | *35* | 197 | *34* | 180 | *32* | 259 | *52* | 226 | *42* | 185 | *35* |
| All sectors | 1 817 | *149* | 1 797 | *140* | 1 727 | *128* | 1 817 | *132* | 1 724 | *137* | 1 836 | *133* | 1 561 | *86* |
| *Difference in net wage costs in million NOK between predictions before and after wage increase.* | | | | | | | | | | | | | | |
| Hospital | | | 26 | | -172 | | -31 | | -139 | | -52 | | -273 | |
| Primary care | | | -27 | | 92 | | 58 | | -6 | | 52 | | 40 | |
| Non-health | | | -18 | | -10 | | -27 | | 53 | | 19 | | -22 | |
| All sectors | | | -20 | | -90 | | 1 | | -93 | | 19 | | -256 | |

# Chapter 4
# Nurses' labor supply with endogenous choice of care level and shift type. A nested discrete choice model with nonlinear income.

**Abstract**

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 and level of care in the evaluation of such policies may lead to biased estimates of the wage elasticities. 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. International studies have also documented that hospital jobs often involve relatively unpleasant characteristics such as a high degree of stress and job hazards.

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 high quality 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

One segment of the literature addressing "shortages" of health personnel focuses on the wage impact on labor supply. 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. Intuitively there is reason to believe that shift workers respond differently to a wage increase than those working daytime hours. For one thing, the burden involved in working more may increase more rapidly for shift workers who often work nighttime. For another thing, changes in the wage level of daytime jobs may cause shift-workers to switch to those.

A very small number of existing labor supply studies take these differences between shift labor and regular daytime labor into account. Askildsen et.al. (2003) claim that it is important to correct for shift work, as omitting such institutional features will bias the wage effect. "The reason is twofold. If shift hours are considered burdensome, a wage compensation is required (Moore and Viscusi, 1990). If this compensation is insufficient, lower labor supply is offered, and the estimated wage effect will be downwardly biased. It may also be the case that shift workers just consider it too demanding to work long hours, and respond less to wage changes than those working on ordinary daytime contracts." Shift work is, however, only one important factor when choosing a nursing job. There are for instance many differences between a hospital and a primary care job such as patient characteristics, types of nursing tasks, preventive versus curative focus, teamwork opportunities, stress levels and travel distance.

Focusing on wage as a policy instrument, this paper is an attempt to explicitly include both the choice between shift work and daytime hours and between hospital and primary care jobs, in a labor supply model of registered nurses (RNs). 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.” 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. As mentioned above there are many differences between a hospital and a primary care job, and 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. Sæther (2004) showed that the singles are somewhat more responsive to wage changes than the married, and it is thus reasonable to analyze the wage responses of singles and married separately. Also to limit the effect of spouses's income on the hours of work I have chosen to focus on the singles. An extension of the analysis to include married females and male RNs is left for future work.

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

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

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

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

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,

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

*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

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

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 $\varepsilon_{ijk}$ 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 $\varepsilon_{ijk}$ 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*.

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

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,

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

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

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

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

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

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

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

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

$\mu_2$ 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

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

where $\mu = \mu_2 / \mu_1$ is possible to identify. $\mu_1$ takes care of the uncertainty in the choice between a hospital and a primary care job. $\mu$ is a measure of degree of dependence in unobserved utility among the alternatives in the upper nest. The statistic 1- $\mu^2$ is a measure used as an indication of correlation, in the sense that as $\mu$ rises, indicating less correlation, this statistics drops. (McFadden, 1978). A value of $\mu$=1 indicates complete independence within the nests, i.e. no correlation. When $\mu$=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 $\mu$ must be within a particular range for the model to be consistent with the utility-maximizing behavior. If $\mu$ 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

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

with $\theta$ 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

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

8760 is the number of total annual hours, while $\alpha$ , $\lambda$ , and the $\beta's$ are unknown parameters. For the utility function to be quasi-concave, we require $\lambda$ <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 *($\alpha$, $\lambda$, $\beta_{0j}$, $\beta_1$, $\beta_{2j}$, $\tau$ , $\mu$ , $\theta$ )* are estimated using a maximum-likelihood procedure. Note that $\mu_2$ is not identified, and is absorbed in $\alpha$ and $\beta_j$.

## 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 the estimate of $\lambda$ yields a quasi-concave utility function. Parameters attached to the income term in the utility function *(16)* are estimated with a $\lambda$ of –1.68 and an $\alpha$ - 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 $\beta_0$ in the leisure term is positive and significant, which means that more hours of leisure increases the utility. Somewhat surprisingly $\beta_1$ 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 $\beta_{2A}$ of 10.20 and a $\beta_{2B}$ of 7.93. $\mu$ , the degree of independence in unobserved utility among the upper nests, is estimated to 0.71, but it is not significantly different from 1, and the model is thus not necessarily better than the standard multinominal logit model. Remember however, that this parameter is weighted by the centrality of residency, $\tau$ . The parameter $\theta$ 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*** | | | |
| $\beta_0$ | Constant - 'leisure element' | 5.651 | 1.358 | [.000] |
| $\beta_1$ | Age | -0.118 | 0.031 | [.000] |
| $\beta_{2A}$ | Shift Work in hospitals | 10.200 | 0.890 | [.000] |
| $\beta_{2B}$ | Shift Work in primary care | 7.926 | 0.941 | [.000] |
| $\alpha$ | Constant - 'consumption element' | 0.836 | 0.212 | [.000] |
| $\lambda$ | Exponent - 'consumption element' | -1.677 | 0.231 | [.000] |
| $\mu$ | Degree of independence in unobserved utility among the alternatives | 0.709 | 0.266 | [.008] |
| | ***Opportunity density**** | | | |
| $\tau$ | 1 if living in a central area, 0 otherwise | 1.150 | 0.067 | [.000] |
| $\theta$ | 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.***

| N=4042 | Observed<br>**Means** | ***Std.dev.*** | Predicted<br>**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. The simulated wage changes is also illustrated by Figures 1-3. 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.

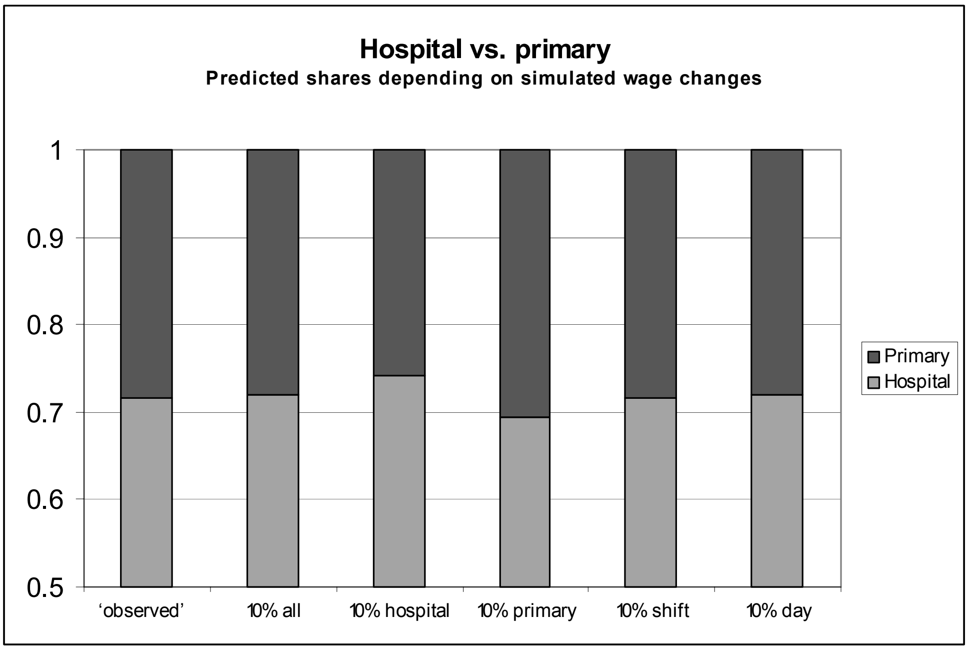


*Figure 1. Predicted shares for hospital and primary care jobs depending on simulated wage changes.*

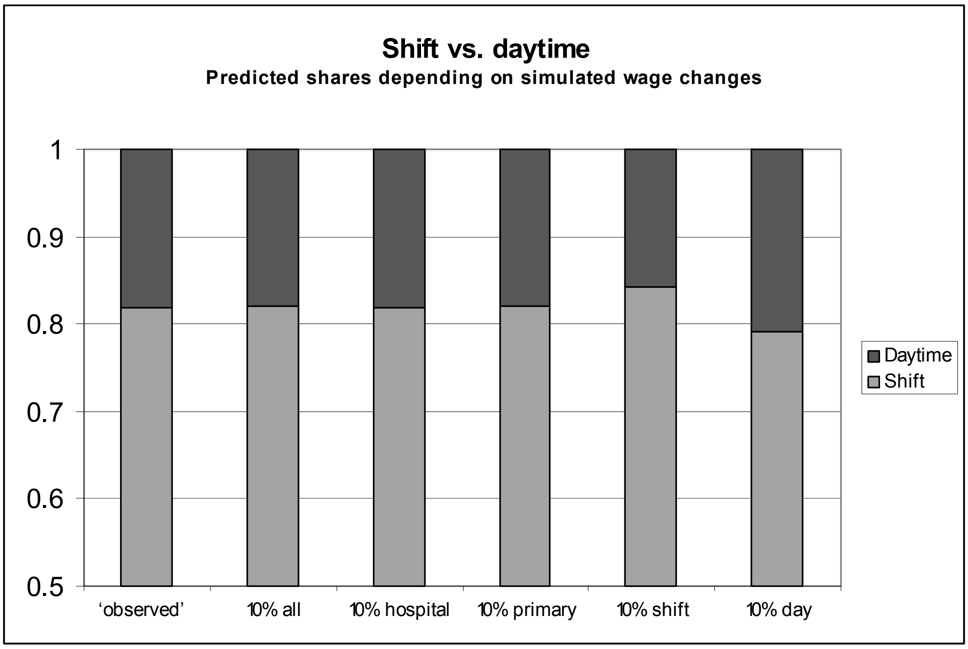


*Figure 2. Predicted shares for shift and day jobs depending on simulated wage changes.*

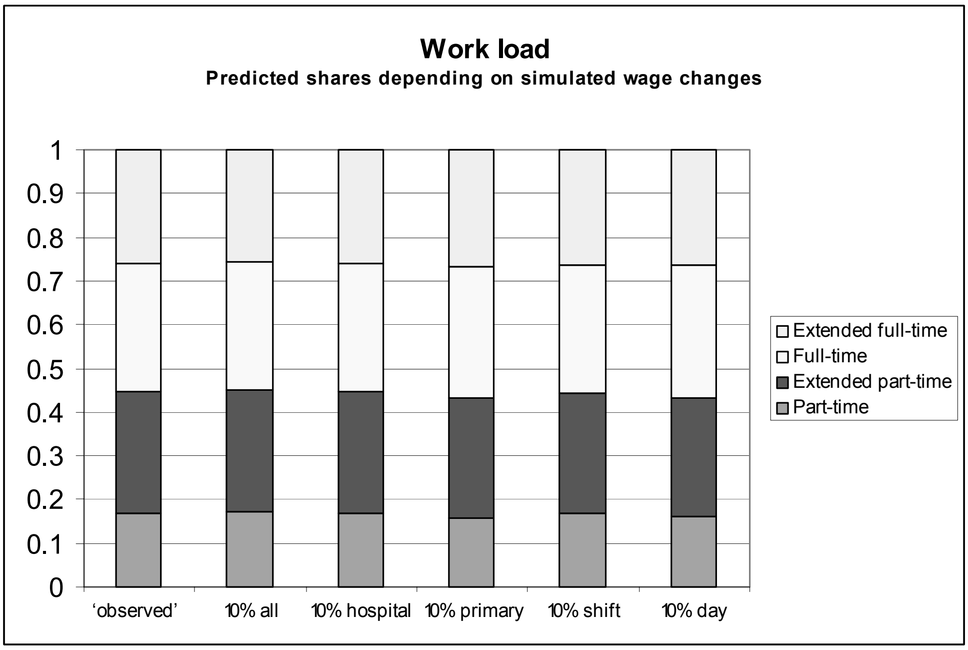


***Figure 3. Predicted shares for the four categories of hours depending on simulated wage changes.***

*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.

My conclusion is thus that 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.

## 6. References

Aaberge, R., Dagsvik, J. R., Strøm, S.,1995. Labor supply responses and welfare effects of tax reforms. Scandinavian Journal of Economics 97: 635-59.

Aaberge, R., Colombino, U., Strøm, S., 1999, Labour Supply in Italy: An Empirical Analysis of Joint Household Decisions, with Taxes and Quantity Constraints. Journal of Applied Econometrics 14: 403-422.

Antonazzo, E., Scott, A., Skatun, D., Elliott, R.F., 2003, The labour market for nursing: a review of the labour supply literature. Health Economics. Vol. 12, pp. 465-478.

Askildsen, J., Baltagi, B., Holmås T.H., 2003, Wage Policy in the Health Care Sector: A Panel Data Analysis of Nurses' Labour Supply, Health Economics, vol. 12 , pp. 705-719.

Ben-Akiva, M., Lerman, S.R., 1985. Discrete Choice Analysis. Cambridge, MIT Press.

Box, G E P, Cox, D R, 1964. An Analysis of Transformations. Journal of the Royal Statistical Society, 211-243, discussion 244-252.

Costa, G., 1996, The Impact of Shift and Night Work on Health. Applied Ergonomics, Vol 27. No. 1, pp. 9-16.

European Observatory on Health Care Systems, 2000, Health Care Systems in Transition, Norway. Copenhagen: WHO Regional office for Europe.

The International Coucil of Nurses (ICN), 2000, Nurses and Shift work, Position Statements.

Kostiuk, P. F., 1990, Compensating Differentials for Shift Work. The Journal of Political Economy, Vol. 98, No. 5, pp. 1054-1075.

Lanfranchi, J., Ohlsson, H., Skalli, A., 2002, Compensating Wage Differentials and Shift Work Preferences. Economics letters 74, 393-398.

MaCurdy, T., Green, D., Paarsch, H., 1990, Assessing Empirical Approaches for Analyzing Taxes and Labor Supply, Journal of Human Resources 25, 415-490.

McFadden, D., 1978, Modeling the Choice of Residential Location. In Karlqvist, A., Lundqvist, L., Snickars, F., Weibull, J. (eds.), Spatial Interaction Theory and Planning Models, North-Holland, Amsterdam, pp. 105-142.

Moore, M.J., Viscusi, W.K., 1990. Compensating mechanisms for Job Risks. Princeton University press, Princeton NJ.

Ohida, T., 2001, Night-shift work related problems in young female nurses in Japan. Journal of Occupational Health, 43, 150-156.

Phillips, V.L., 1995, Nurses´ Labor Supply: Participation, Hours of Work, and Discontinuities in the Supply Function. Journal of Health Economics, 14, 567-582.

Rosen, S., 1986, The Theory of Equalizing Differences. In: Ashenfelter, O., Layard, R. (Eds.). Handbook of Labor Economics, Vol. 1. North-Holland, Amsterdam, pp. 641-692, Chapter 12.

Schumacher, E.J, Hirsch, B.T., 1997, Compensating Differentials and Unmeasured Ability in the Labor Market for Nurses: Why do Hospitals Pay More? Industrial and Labor Relations Review, Vol. 50, No. 4, July 1997, pp. 557-79.

Statistics Norway, 2001, Specialist Health Service 1990-2000. General Hospitals, Psychiatric Institutions, etc. Kongsvinger.

Sæther, E.M., 2004, Will Increased Wage Increase the Nurses' Working Hours in the Health Care Sector? HERO Working Paper No. 2004:7. Health Economics Research Programme, University of Oslo.

Train, K., 2003, Discrete Choice Methods with Simulation. Cambridge University Press, Cambridge.

Van Soest, A., 1995, Discrete Choice Models of Family Labor Supply. Journal of Human Resources 30, 63-88.

van den Noord, P., Hagen, T.P., Iversen, T., 1998, The Norwegian Health Care System. Economics Department Working Papers no. 198. Paris: OECD.

## 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 Shift | | Daytime | | Primary care 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<br>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.

# Chapter 5
# Compensating differentials for nurses

**Abstract**
When entering the job market registered nurses (RNs) face job alternatives with differences in wages and other job attributes. Previous studies of the nursing labor market have shown large earnings differences between similar hospital and non-hospital RNs. Corresponding differences are found in some of the analyses of shift and regular daytime workers.

In the first part of this paper I analyze the wage differentials in the Norwegian public health sector, applying a switching regression model. I find no hospital premium for the shift RNs and a slightly negative hospital premium for the daytime RNs, but it is not significant for the hospital job choice. I find a positive shift premium. The wage rate is 19% higher for the shift working hospital RNs and 18% for the sample of primary care workers. The shift premium is only weakly significant for the shift work choice for the sample of hospital RNs, and not for the primary care RNs. I identify some selection effects.

In the second part of the paper I focus on the shift compensation only, and present a structural labor supply model with a random utility function. This is done to identify the expected compensating variation necessary for the nurses to remain on the same utility level when they are “forced” from a day job to a shift job. The expected compensating variations are derived by Monte Carlo simulations and presented for different categories of hours. I find that on average the offered combination of higher wages, shorter working hours and increased flexibility overcompensates for the health and social strains related to shift work.

## 1. Introduction

When entering the job market registered nurses (RNs) face job alternatives with differences in wages and other job attributes. Previous studies of the nursing labor market have shown large earnings differences between similar hospital and non-hospital RNs, and corresponding differences are found in some of the analyses of shift and regular daytime work.

I will analyze the wage differentials in the public health sector using two different methodological approaches. In the first part of this paper I analyze the wage differentials with a switching regression model similar to the set-up presented in Lanfranchi et al. (2002). I examine the existence of wage differentials between RNs working in hospitals and primary care institutions, and between shift and daytime workers. I control for the shift dimension when I focus on the hospital premium, and for the care level when I analyze the shift premium.

In an attempt to better capture the impact of preferences and choice I introduce a structural labor supply model with a random utility function in the second part of this paper. I limit the analysis to the shift compensation and shift choice, as the hospital premium is found to be insignificant. The RNs maximize utility, given a nonlinear budget set that incorporates taxes. The individual's labor supply decision can be considered as a choice from a set of discrete alternatives (job packages). These job packages are characterized by attributes such as hours of work, sector specific wages, shift type, and other job-type specific aspects. The approach is inspired by i.a. Aaberge, Dagsvik and Strøm (1995) and van Soest (1995). I use the structural framework to identify the expected compensation necessary for the nurses to remain on the same utility level when they are "forced" from a daytime job to a shift job. Using Monte Carlo simulations I present the distributions of the expected compensating variations for different categories of hours. The model may also be looked upon as a framework to inform public employers when deciding what size of wage compensation to offer.

Rosen (1986) gives an introduction to the literature on compensating variations.
"The theory of equalizing differences refers to observed wage differentials required to equalize the total monetary and non-monetary advantages or disadvantages among work activities and among workers themselves." These ideas go back to the writings of Adam

Smith. As presented by Rosen, the evidence of compensating variations related to a broad scope of working conditions, is mixed.

It is a well–known fact that the inability to observe workers' full labor market productivity can bias estimates of compensating wage differentials derived from cross-sectional labor market data. Hwang et al. (1992) demonstrate that the bias is a function of three factors: (i) the average share of total hourly remuneration taken in the form of wages, (ii) the proportion of wage dispersion due to the differing tastes of workers, and (iii) the degree of unobserved productivity heterogeneity. Their results provide the key for determining the likely size of the bias when estimating compensating wage differentials with real data.

Many nursing services must be accessible on a twenty-four hour basis, making shift work a necessity. This opens up an opportunity to combine work and family life, which is often especially appreciated during the years with small children. However, while shift work may bring some wanted flexibility to nurses' work schedule and additional income, it often introduces additional hardship on nurses providing services in complex environments and demanding interpersonal situations.

The health strain of shift work is well documented. As far back as in 1713, Bernardino Ramazzini (Costa, 1996) pointed out the harmfulness of shift work, in particular night work. He wrote of the bakers, who 'work at night, so when the others sleep they stay awake, while trying to sleep during the day like animals who escape the light: hence, in the same town there are men living in antithetic life in comparison with the others'. The medical interest for such a problem started between the two world wars and has increased over the past decades.

A broad overview of concerns related to shift work is presented by Costa (1996). Shift work, particularly night work, can have a negative impact on the health and well-being of workers, particularly in four spheres: a) biological: due to the disturbance of normal circadian rhythms of psychophysiological functions, beginning with the sleep/wake cycle; b) working: coming from fluctuations in work performance and efficiency over the 24 hour span, with consequent errors and accidents; c) social: dealing with difficulties in maintaining the usual relationships both at family and social level, with consequent negative influences on marital relations, care of children and social contacts; d) medical: deterioration of health, which can manifest itself in disturbances of sleeping and eating habits and, in the long run, in more severe disorders that deal prevalently with the gastrointestinal, neuropsychical and, probably, cardiovascular functions. Costa especially stresses that shift and night work may have specific adverse effects on women's health in relation to the hormonal and reproductive function." In a study on young female nurses, Ohida et al. (2001) find a significant association between working night shifts and the use of alcoholic beverages to help induce sleep, as well as daytime drowsiness.

Lanfranchi et al. (2002) report a significant shift premium. The wage rate for shift workers is 16% higher than for daytime workers. This premium compensates workers who do not self-select into shift work. They find that the shift premium is significant for shift work choice, and conclude that for their sample the shift choice is a result of wage differentials rather than shift preferences.

One study focusing on RNs is Schumacher and Hirsch (1997). They find that on US data the shift premium to evening shift RNs is close to 4 percent, while for night shift RNs it is almost 12 percent. They find a small insignificant premium for working rotating or split shifts over day shifts. Even though shift premiums are significant wage determinants, they account for just under 10 percent of the cross-sectional wage differential between hospitals and health practitioners' offices, and little of the differential between hospitals and nursing homes.

Lehrer et al. (1991) refer to the differences in job attributes between hospital and non-hospital settings. If hospital jobs involve relatively unpleasant characteristics such as a high degree of stress and job hazards, then in order to attract nurses of a given quality, hospitals must pay a compensating differential. In this paper I do not, however, compare hospital RNs with colleagues working in a practitioner's office, but with nurses working shifts at nursing homes and in home nursing. They may have an equal need for compensation to care for a less prestigious patient group often with less qualified colleagues and poorer staffing than is the case at the hospitals.

An understanding of the hospital premium is important, especially given what is expected to be a large shift of medical care delivery away from hospitals towards outpatient settings. Schumacher and Hirsch (1997) argue that a plausible explanation for the hospital premium is that "hospitals demand, attract, and retain higher quality nurses than do employers in the non-hospital sector, and these skills are not reflected fully in measured variables". They report a hospital RN advantage of roughly 20 percent based on a cross-sectional analysis. When they extend their analysis to a longitudinal analysis they find that one third to half of the advantage is due to unmeasured worker ability. The remainder is likely to reflect compensating differentials for hospital disamenities. Older studies include Link (1988) who finds that there was a hospital premium of around 13 percent in 1984 (but does not find a premium with 1977 data). Booton and Lane (1985) use data from a 1981 survey of Utah RNs and find that the hospital premium is largest for associate degree RNs (21 percent) and smallest for diploma RNs (15 percent). Lehrer et al. (1991), using a sample of Illinois RNs, note the large difference in earnings between hospital and non-hospital RNs. Although it is not the focus of their paper, they suggest that the premium may reflect a compensating differential.

While there seems to be a hospital premium in the US health care sector, the setting is quite different in a National health sector in a Scandinavian country with a tradition for centralized wage bargaining and a monopsonistic buyer. The nurses union and NALRA bargain the wage nationally[5]. However, there is some room for local adaptations of the wage policy. Hospitals and municipalities that have severe staff shortages or a high rate of turnover, offer higher wages than nationally agreed upon as well as other benefits in order to become a more attractive workplace.

Shift hours in Norway are compensated with both an hourly wage premium and shorter mandated working hours for a full-time position. Health workers may choose shift work because of compensating wage differentials, but it is also possible that they have preferences for shift work. Compared to other studies of compensating variation, my study has the advantage of focusing on differentials within a single occupation, so that preferences and abilities are more homogeneous than for broader groups of workers. I find a positive shift premium, but no positive hospital premium. Actually, the hospital premium for the sample of daytime working RNs is slightly negative. The shift premium influences the shift choice for the hospital RNs. I also identify some selection effects.

[5] In many European countries, compensating wage differentials are set by industry-wide collective bargaining and are adopted by non-unionized firms in the same industry. Hamermesh (1999) points to the fact that these bargained differentials are wider than the mostly market-generated premia that exist in the United States.

As there is no hospital premium, I focus on the shift dimension in the application of the random utility model. I find that for most RNs the offered combination of a shift wage premium, shorter working hours and the flexibility of hours, overcompensates the negative effects of shift work.

This paper is organized as follows: In section 2 the data and setting is presented. In section 3 a switching regression model with endogenous switching is established and the results presented. In section 4 a strategy for estimating compensated variation in a random utility model is presented. Section 5 discusses the results from the two approaches and concludes.

## 2. Data

The public health care providers are the dominant employers of Norwegian registered nurses. In 2002, 91.4 percent of those working within health and social services were public employees. The Norwegian Association of Local and Regional Authorities (NALRA), organize employers in municipalities and counties who own the public institutions, with the exception of some national hospitals. There were 77,819 registered nurses in 2002, of whom 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 or vocational rehabilitation or 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).

This study uses a sample of 11,542 female registered nurses employed by NALRA institutions in 2000. Being prior to the national hospital ownership reform, the counties demanded RNs for their hospitals, and the municipalities needed personnel for their health centers, nursing homes and home nursing. The attraction of limiting the analysis to NALRA employees is the information on hours of work and shift type. The data is only reported for one month by October 1st. The NALRA register data is matched with annual labor income and other administrative data registers delivered by Statistics Norway. The set includes information about work experience and various sociodemographic variables, like the age of children and spouse's income. I exclude nurses with other jobs than the NALRA job, and those not employed during the whole year.

I focus on the occupational sub-category specified as “Registered Nurses” in the NALRA register, which is a group that normally has not undertaken any postgraduate training. I thus exclude midwifes and registered nurses working as nursing specialists or ward administrators. By restricting the analysis to the “ordinary” RNs I avoid the comparisons of groups with different formal qualifications and different management tasks. Daytime work, however, is strongly related to management tasks, and by omitting this personnel category from the analysis the sample of daytime RNs becomes relatively small compared to the shift worker sample. This may bias the results in that RNs incorporate a specialization and/or a management premium when choosing daytime work. The decision to exclude specialized nurses and health administrators allows me to focus on the hospital premium and the shift premium, but the alternative of including the other personnel categories is highly relevant in further research.

Registered nurses dominate the hospital nursing services whereas auxiliary nurses play a more important role in nursing homes and in home nursing. At the local health centers and municipal casualty clinics the nursing staff consists mostly of RNs. Hospital nurses are generally confronted with more complicated and acute cases than nurses at the primary care level. However they normally work in teams with other RNs, and the patients are younger and with better prospects than those in nursing homes. In the nursing homes the RNs lead teams of auxiliary nurses and nurse assistants. Nurse assistants are personnel without any health qualification. In home nursing you work more independently but deal with more trivial health problems related to aging.

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. Kostiuk (1990) and Lanfranchi et al. (2002) apply a similar shift measure.

The alternatives available for NALRA nurses are hospital jobs with shift work, hospital jobs with daytime hours, primary care jobs with shift work and primary care jobs with daytime hours. The sample is almost equally divided between hospital and primary care jobs. Shift work is far more common than daytime work. See Table 1 for an overview of observed choices and hourly wages. Appendix 1 provides summary statistics for key individual level variables.

***Table 1 Observed job alternative and hourly wage.***

| | *Number of* | *Hourly wages* | | | |
|---|---|---|---|---|---|
| | *workers* | *Mean* | *St.dev.* | *Min.* | *Max.* |
| Hospital daytime | 803 | 146.5 | 12.9 | 121.2 | 184.3 |
| Hospital shift work | 5,154 | 172.2 | 20.1 | 126.3 | 225.2 |
| Primary care daytime | 589 | 146.8 | 13.5 | 120.2 | 188.8 |
| Primary care shift work | 4,996 | 172.7 | 19.4 | 128.7 | 225.5 |
| Total sample | 11,542 | | | | |

Hourly wage is the applied earnings measure, calculated by dividing annual earnings reported to the tax authorities by the reported hours from the NALRA register. The reason why I do not apply the reported NALRA hourly wage, but instead construct the wages from annual income reports, is that only a small share of the NALRA institutions reports the wage completely. Shift compensation and other benefits are often unreported. From the RNs with complete data I can, however, observe that none of the RNs has a wage outside the wage interval NOK 120 – NOK 230. I thus omit the constructed wages outside this interval, a total of 1,404. These observations probably represent wrongly reported full-year participation or RNs who have changed their workload during the year, making the hours reported by October 1 misleading.

The observed mean wage is higher in shift work (NOK 172) than daytime work (NOK 147), but there seems to be almost no difference between the mean in hospital and primary care jobs. Remember that these wages are not yet corrected for individual characteristics. Hospital nurses are generally younger than primary care nurses, they work in more urban areas and have fewer children. Similarly, shift workers are younger than daytime workers. Corrections for these observed variables will be addressed below.

## 3. A switching regression model

### 3.1 The model

Lanfranchi et al. (2002) demonstrate how the estimation of a shift premium and shift choice fits well into the framework of switching regression models with endogenous switching. I follow their strategy but extend the focus to four types of job premiums for registered nurses in the public sector:

a) *the shift premium for hospital nurses,*
b) *the shift premium for primary care nurses,*
c) *the hospital premium for shift working nurses, and*
d) *the hospital premium for nurses working regular daytime.*

I undertake four separate rounds of analysis, but I introduce the model with a notation suitable for the estimation of a shift premium. The estimation of a hospital premium is parallel. By categorizing the sample into different sub-categories I am able to apply the relatively simple set-up from Lanfranchi et al. but still use the richness of the data. I also avoid the pooling of samples as it seems reasonable to expect that the shift premium is different from hospital to primary care nurses, and similarly that the hospital premium is different for nurses working shifts and those working regular daytime. See i.a. Lanfranchi et al. (2002) for a discussion of the problems that arise with pooling of the data.

The starting point is:

shift wages: $w_s = \beta_s X + u_s$ *(1a)*

day wages: $w_d = \beta_d X + u_d$ *(1b)*

shift choice: $S^* = \eta Z + \delta\left(w_s - w_d\right) + v$ *(1c)* where $w_s$ and $w_d$ are log hourly wages, the vector *X* includes standard wage equation variables, while $u_s$ and $u_d$ are error terms in the wage equations. The subscript *s* and *d* refer to shift work and regular daytime work.

There may be selectivity into shift work. Let $S^*$ be a latent variable for shift work with the corresponding binary variable S. S = 1 if $S^* \geq 0$ and S = 0 if $S^* < 0$. Z is a vector of variables influencing shift choice (including potential instruments), and *v* an error term. The term $w_s - w_d$ captures the shift premium.

The error terms may be correlated giving rise to selectivity bias. Following Lanfranchi et al. (2001), let $\sigma_{u_s v}$ and $\sigma_{u_d v}$ represent the covariances between the error term in the choice equation, *v,* and the error terms in the wage equations, $u_s$ and $u_d$ The covariance $\sigma_{u_s v}$ can be expected to be positive while $\sigma_{u_d v}$ can be expected to be negative. Suppose that we study a worker with abilities not captured by the exogenous variables in the shift work wage equation. These abilities are reflected in a higher wage. This in turn will give rise to a positive error term $u_s$. In addition, suppose that because of this higher wage the person becomes more likely to choose shift work than what is captured by the explanatory variables in the shift choice equation. We will then have a positive error term *v.* Moreover, the covariance $\sigma_{u_s v}$ will be positive. There will, in other words, be a positive selection into shift work. On the other hand, a positive selection into daytime work would imply that $\sigma_{u_d v}$ is negative.

The reduced form of the choice equation is:

$$S^* = \eta Z + \delta\left(\beta_s - \beta_d\right) X + \delta(u_s - u_d) + v \qquad (2)$$

which can be reparametrized to $S^* = \tilde{\eta}\tilde{Z} + \tilde{v}$. Following Maddala (1983), we can compute the conditional expected wages:

$$E\left(w_s \mid S = 1\right) = \beta_s X + \sigma_{u_s v} \frac{\phi\left(\tilde{\eta}\tilde{Z}\right)}{1 - \Phi\left(\tilde{\eta}\tilde{Z}\right)} \qquad (3a)$$

$$E\left(w_s \mid S=0\right)=\beta_d X+\sigma_{u_d v}\frac{\phi\left(\tilde{\eta}\tilde{Z}\right)}{1-\Phi\left(\tilde{\eta}\tilde{Z}\right)} \qquad (3b)$$

where including $+\sigma_{u_s v}\left(\phi/\Phi\right)$ and $-\sigma_{u_d v}\left(\phi/\Phi\right)$ in the respective wage equation will control for selectivity. $\phi$ and $\Phi$ are the density and distribution functions of the standard normal evaluated at $\tilde{\eta}\tilde{Z}$. If we estimate the wage equation (1a) and (1b) without controlling for selectivity we will get biased estimates if the covariances are nonzero. Most likely, we will tend to underestimate the shift premium.

The wage equations (1a) and (1b) and the choice equation (1c) is a switching regression model with endogenous switching. We can use it to estimate whether there are shift premiums and whether the shift premiums affect shift choice.

The next steps are firstly, to estimate the reduced form (2) using a probit to get $\hat{\tilde{\eta}}$. I then compute $\phi\left(\hat{\tilde{\eta}}\hat{\tilde{Z}}\right)$ and $\Phi\left(\hat{\tilde{\eta}}\hat{\tilde{Z}}\right)$. Secondly, I estimate the wage (3a) and (3b), including selection terms, to get $\hat{\beta}_s$ and $\hat{\beta}_d$, $\hat{\sigma}_{u_s v}$, $\hat{\sigma}_{u_d v}$, and compute the estimated expected wage premium $\left(\hat{w}_s-\hat{w}_d\right)=\left(\hat{\beta}_s-\hat{\beta}_d\right)X$. I then estimate the structural form (1c) using probit to get $\hat{\delta}$. If $\hat{\sigma}_{u_s v}$ and $\hat{\sigma}_{u_d v}$ are significant in the wage equations, the correction for sample selection is needed. The above procedure is then repeated for case *b) – d).* The results are presented in Tables 2 and 3 in Appendix 2 where they are presented in pairs by shift choice (*a* and *b*) and hospital choice (*c* and *d*).

**3.2 Wages, shift premiums, and shift choice.**

I will first present the results for the model of shift choice and the shift premium. The results are reported separately for the two samples; the hospital RNs (*a*) and the primary care RNs (*b*).

*Reduced form choice.* I start by estimating the reduced form probit for shift choice (2) for the subset of hospital workers. Table A2.i column 1 in Appendix 2.1 reports marginal effects of the reduced form, whereas the next columns report standard errors and t-values. I will later discuss the parameters in the shift choice function to the structural form choice equation.

While Kostiuk (1990) and Lanfranchi et al. (2002) had access to data from different sectors with variations in contract terms, shift bonuses and shift rates for the different industries, I do not have any similar variation in data as all RNs get the same public sector contract. I must relate the shift choice to family life like marital status and children. Shift work gives less leisure time with your spouse and we should therefore expect that married nurses are less likely to choose shift work. On the other hand, shift work means increased flexibility to be there for your children and their activities in daytime. It is thus likely that parents of small children are more likely to choose shift work.

None of the family characteristics are likely to have any direct influence on the wage. There is a possible indirect effect as having smaller children leads many nurses to reduce their workload or withdraw from the labor market temporarily thereby getting lower job tenure, which influences their salary. In many empirical studies the labor market experience is proxied by *potential* experience, i.e. age-education-7[6]. This is a problematic upper bound for experience that is more upwardly biased for women, who tend to be more loosely connected to the labor market, at least in connection with maternity leave. In this study I have, however, controlled for the number of years with an income qualifying for pension entitlement during the last 23 years as a measure of experience. The measure is constructed on earnings histories available from the Norwegian National Insurance Scheme, which was established in 1967. Individual 'pension entitlements' in this scheme are linked to their income histories.

Wage equations. The results from the reduced form probit can be used to control for sample selection when estimating wage equations for shift workers and daytime workers. The wage equations are presented in Table A3.i in Appendix 2.1. The first two sets of results (column 1-3 and 4-6) are for the sample of hospital RNs. For the shift workers neither age nor experience is significant. The only dummy for country origin that is significant is the one for non-OECD countries. The county dummies are significant and with one exception they are negative compared to the reference of the capital Oslo. This is as expected as the reference group

[6] The RNs in this sample started in the primary school when aged 7. Today the children start school the year they get 6.

working for Oslo municipality has a separate wage contract with a somewhat higher wage. The dummies for municipal centrality are not significant, with the exception of one that is weakly significant for an intermediary centrality. For the daytime workers in the sample of hospital RNs there is a significant age effect where the wage is reduced by age. According to the agreed contract with the labor union, experience is one of the strongest criteria for increased wage. It is thus surprising that age has a negative sign in the wage equation. One possible explanation is that younger nurses are more willing to work overtime, somewhat increasing their average salary. Most dummies for county of residency are significant and negative.

Although weakly significant, the selection term coefficients suggest a positive selection into shift work and no significant selection into daytime work. The RNs select themselves into shift work because of preferences or comparative advantages. This differs from the findings of Kostiuk (1990) who finds no effect of self-selection of workers into shift work, and Lanfranchie et al. (2002) who find that shift workers seem to prefer to avoid shift work. The shift wage premium, which is (weakly) significant for the choice of shift work in the structural probit results (Table A2.i column 4), increases the preference for shift work. I find no selection into daytime work, in contrast to the findings of Kostiuk and Lanfranchie et al.

The estimated wage equations are somewhat different for the sample of primary care nurses. Experience, county dummies and one centrality dummy for the second highest centrality level are significant for the shift working primary care nurses. None of the explanatory variables are significant for the daytime workers. This accentuates the homogeneity of the sample with little variation in wages. For the shift working primary care RNs there is a negative selection into shift work, as opposed to the shift-selection term for the hospital RNs. There is no significant selection into daytime jobs. In the structural probit model (in Table A2.i column 10) there is no significant effect of the shift wage premium on shift choice for the sample of primary care RNs.

*Structural form choice equations.* Table A2.i column 4 and 10 presents the marginal effects in the structural form (1c) for the sample of hospital and primary care nurses respectively. The corresponding standard errors and t-values are also reported. As already mentioned, the shift premium is weakly significant for the shift choice for the hospital RNs and not significant for the primary care RNs. The top rows of Table A2.i report the results for variables only appearing in the choice equation. Both the dummy for marital status and the number of children below 6 years of age are significant, and the signs are as expected for the sample of hospital RNs. The number of children from 6 to 11 years of age is only weakly significant. None of the three selection variables are significant for the sample of primary care RNs. The lack of variable significance for the latter group is not easily interpreted but hospital RNs are generally younger than primary care RNs and a smaller percentage is married.

The bottom rows report the results for variables also appearing in the wage equations. For the hospital RNs, age becomes weakly significant, as well as experience. The probability of selecting a shift job is estimated to decrease by age and experience.

Whereas it is less likely for a RN from one of the other Nordic countries to choose a shift job, it is more likely for RNs from other countries. For the hospital sample, the county dummies are mostly positive and significant for the shift choice, but not for the primary care sample. The centrality dummies are not significant.

The two wage equations for shift and daytime workers can be used to compute the shift premium for each person in the sample. The average shift premium for the sample of hospital nurses is 19.3%, while the shift premium for the sample of primary care nurses is 18.1%. The shift premiums are sharply determined with t-values of 293.3 and 330.0.

### 3.3 Wages, hospital premiums, and hospital choice.

I now shift the focus to the analysis of hospital versus primary care choice and the hospital premium. Tables A2.ii and A3.ii in Appendix 2.2 presents the results for two samples; the RNs working shifts (*c*), and the RNs working regular daytime hours (*d*).

*Reduced form choice*. I start by estimating the reduced form probit for hospital choice (2) in the subset of shift working RNs. Table A2.ii column 1 reports marginal effects of the reduced form. Marital status and children may be correlated with hospital choice in several ways. Given the stress and demanding environment at a hospital many RNs prefer to switch to a primary care job that is easier to combine with family life when they get children. There is also an indirect geographical effect as many RNs move out of the city centers to the suburbs and rural areas when they become parents. With most hospitals centrally located, they are able to reduce their travel time if they take a job in a nursing home or in home nursing.

*Wage equations*. The wage equations for the sample selection models with hospital choice are presented in Table A3.ii in Appendix 2.2. The first two sets of results (column 1-3 and 4-6) are for the sample of shift RNs. In contrast to the primary care workers, age, experience or country background is not significant in the wage equation for the hospital workers. Most geographical dummies are strongly significant and negative, meaning that they earn less than the RNs working in Oslo, the capital. There is a positive and significant selection into both hospital and primary care jobs for the sample of shift working RNs.

Few of the variables are significant in the two wage equations for the sample of daytime working RNs. Age and experience and some of the county dummies are significant for the hospital workers. There is no selection effect for the hospital workers. For the primary care workers there is a weakly significant positive selection effect.

*Structural form choice equations.* Table A2.ii column 4 and 10 presents the marginal effects in the structural form (1c) for hospital choice for the samples of shift and daytime RNs respectively. The hospital premiums are not significant for the hospital choice for any of the two samples. For the sample of shift working RNs, marital status and the number of children from 6 to 11 years of age is significant for the choice of a hospital job. For the sample of RNs working regular daytime only the number of children from 6 to 11 years of age is (weakly) significant.

The results for the explanatory variables also used in the wage equations are as follows. For the sample of shift working RNs, age is a negative and significant variable in the structural form equation of hospital choice, whereas experience is not. The opposite is the case for the daytime working RNs. Of the shift working nurses, those with a non-OECD background are less likely to choose a hospital job. Of the day-working nurses, those from the other Nordic countries are more likely to choose a hospital job, but this effect is only weakly significant. Most of the geographical dummies are strongly significant and negative for both samples meaning that they are less likely to work in a hospital job than the reference group in the capital.

The average hospital premium for the sample of shift working nurses is -0.04%, while the hospital premium for the sample of daytime working nurses is –1.7%. The hospital premium for the nurses working shifts are, however, not significantly different from zero with a t-value of 1.37. The t-value is 18.73 for the nurses working daytime.

*A summary of results so far*

Before I present the random utility model, I will summarize the results so far. The first finding is that there is a highly significant shift premium of 19.3% for the sample of hospital RNs and 18.1% for the primary care RNs. However, the shift premium is only weakly significant for the shift work choice for the sample of hospital RNs, and not for the primary care RNs. There seems to be a positive selection into shift work for the nurses working in hospitals, but a negative selection into shift work for the nurses in primary care jobs. There is no selection effect into the daytime jobs.

I find no hospital premium for the shift RNs, and a slightly negative hospital premium of –1.7% for the daytime working RNs, but it is not significant for the hospital job choice. There is a positive selection into hospital and primary care jobs for the sample of shift RNs. There is no selection into hospital jobs and a positive selection into primary care jobs for the day-working RNs.

The selection equation *(1c)* may be looked upon as a simplified choice model where the individual wage rate determines the selection of job type. The random utility model presented in the next section takes choices one step further to integrate choice and a richer specification of preferences in the modeling. I will restrict the analysis to the shift choice and shift compensation as the hospital premium seems to be of minimum significance in the Norwegian public health sector.

## 4. Compensating variation in random utility models

### 4.1 A random utility model

In order to calculate the compensating differentials in utility terms, I present 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 shift type, leisure and income combination from a finite set of alternatives. Conditioning on their participation in the public health care sector, the nurses are facing a choice between a shift job or a day job (i = s,d). As explained above I omit the analysis of the hospital premium in this part of the paper.

Because the analyst does not know the nurses' preferences, I will assume a random utility model

$$U\left(C,h,i\right)=V\left(C\left(h\right),h\right)+e\left(C,h,i\right), \quad (4)$$

where $U$ is the utility when the nurse works $h$ hours with shift type $i$ (shift job or a day job). $C$ is disposable income. $V$ is the deterministic element in the utility function and $\varepsilon$ is a stochastic term with an iid extreme value distribution with an expected mean of 0 and a variance of $\sigma_*^2\pi^2/6$. The random term $\varepsilon$ also captures the unobserved job characteristics associated with the workload and shift type.

The budget constraint, for a job with shift type *i,* is

$$C=f(hw)+I;\ h=H_{ik},\ w=W_i(H_{ik}), \quad (5)$$

where $H_{ik}$ ($i=d,s,\ k=1,\dots,9$) are the specific hours of work for the alternative with shift type $i$ and hours of work $k$, and $W_i(H_{ik})$ the pre-tax hourly wage for the job-package with shift type $i$ when the individual is working $H_{ik}$ hours. The wage is a piecewise linear relation capturing the agreed terms of overtime compensation. Note that for the same job, wage rates may differ across nurses by personal characteristics like experience, residency and country background. In addition, for the same nurse, wage rates may differ with shift type. For all individuals a pre-tax hourly wage is estimated for each shift type applying a Heckman two-step selection correction procedure. The $f(.)$ function represents the net-of-tax labor income while $I$ is the family income other than the nurse's own earnings (capital income after tax, spouses income after tax, and transfers)[7].

Each category of hours is centered on a common choice of working hours, e.g. 50%, 75% and 100% of a full-time position. There are also categories for extended full-time, covering nurses in full-time positions working overtime, or people with jobs at more than one hospital where the workload totals more than 100%. As the nurses working shifts face different contractual arrangements than those working daytime, the hours are shorter for this group[8].

I assume that the nurses make their choices by maximizing utility, given the job-packages available in the market. Let *B(i,h)* denote the set of feasible jobs with hours of work $H_{ik}$ equal to *h,* with shift type *i*. Let $g_i(h)$ be the frequency of jobs in *B(i,h),* which is related to the institutional availability of full-time jobs. It follows from above that the utility function can be written as

$$\tilde{U}_{ik} = U\left(f\left(H_{ik}W_i\left(H_{ik}\right)\right)+I, H_{ik}, i, k\right) = V\left(f\left(H_{ik}W_i\left(H_{ik}\right)\right)+I, H_{ik}\right)+\tilde{\varepsilon}_{ik} \tag{6}$$

where

$$\tilde{\varepsilon}_{ik} = \varepsilon\left(f\left(\left(H_{ik}W_i\left(H_{ik}\right)\right)+I, H_{ik}, i, k\right)\right) \tag{7}$$

Since hours of work and consumption are given when the job-package is given, the agent's choice problem is a discrete one, namely to find the job-package that maximizes utility. Let $P(i,h)$ denote the probability of the agent choosing a job-package with shift type *i* and hours of work *h*. This is the same as choosing a job-package (any job-package) within *B(i,h).* When the random error terms $\{\tilde{\varepsilon}_{ik}\}$ are iid extreme value distributed, the probability $P(i,h)$ can be expressed as

[7] A non-trivial assumption made is that the spouse's hours of work is exogenous, as there is reason to believe that the spouse's choice of working hours will correlate, either negatively, e.g. if one of the parents must look after the children, or positively as they have preferences for spending their leisure time together.

$P(i,h) =$ *P(choosing any job-package within B(i,h))*

$$= P(\tilde{U}_{ik} = \max_{i,k} \tilde{U}_{ik} \mid i,k \in B(i,h))$$

$$= \frac{\exp(\psi(i,h;w,I))g_i(h)}{\sum_{x,y \in B} \exp(\psi(x,y;w,I)g_i(x)}, \qquad (8)$$

where $B$ is the set of feasible combinations of shift type and hours of work, and

$$\psi(i,h;w,I) = v_{ik}\left(f\left(H_{ik}W_i\left(H_{ik}\right)\right) + I, H_{ik}\right) = V_{ik} / \sigma. \qquad (9)$$

Due to the assumption of extreme value distributed utilities it follows that the choice probabilities are multinomial logits. By setting $g_i(h) = 1$ in *(8)* we get the standard multinomial logit. The interpretation of the "opportunity density extended" version of the standard multinomial logit, given in *(8),* is that the attractiveness of a choice measured by $\exp(\psi)$ is weighted by a function saying how available this choice is in the market. The weight is determined by

$$g_i(h) = \exp(\varsigma k_i) \qquad (10)$$

where $k_i$ = 1 if the main job is full-time with shift type *i* (35.5 hours per week if shift, 37.5 hours per week if daytime), and $k_i$ = 0 otherwise. For more details about this methodology I refer to Aaberge, Colombino and Strøm (1999).

The deterministic part of the preferences is represented by the following "Box-Cox" type utility function:

---

[8] The hours per week in the categories, based on the observed means, are Hi ={11.5, 17.9, 21.6, 26.3, 28.2, 30.6, 35.4, 36.6, 40.7} if the nurse work shifts and Hi ={12.2, 18.9, 22.8, 27.8, 29.8, 32.3, 37.4, 38.6, 42.9} if the nurse does not work shifts.

$$v_{ik} = \kappa \frac{(C_{ik} - C_0)^{\lambda} - 1}{\lambda} + \rho(X)\frac{(L_{ik} - L_0)^{\gamma} - 1}{\gamma} \tag{11}$$

where

$$C_{ik} - C_0 = 10^{-6}\left(C_{ik} - 50000\right)$$

$$L_{ik} - L_0 = \left(8760 - (12 * 365) - H_{ik}\right)/8760\,. \tag{12}$$

$$\rho(X) = \rho_0 + \sum_{q=1}^{5} \rho_q X_q$$

The first element represents the utility from consumption and the second element the utility of leisure time. See Aaberge, Dagsvik and Strøm (1995) and Aaberge, Colombino and Strøm (1999) for an empirical analysis applying this specification. One advantage of this specification is that it is flexible enough to yield both negative (backward bending labor supply curve) and positive wage elasticities.

A minimum consumption of NOK 50,000 is introduced in the consumption element. 8,760 is the total number of annual hours, from which 12 hours per day for sleep and rest is subtracted in the leisure element. $\kappa$ , $\lambda$ , $\gamma$ and the $\rho's$ are unknown parameters. For the utility function to be quasi-concave, we require $\lambda$ <1 and $\gamma$ <1. Note that if $\lambda \to 0$ and $\gamma \to 0$, the utility function converges to a log-linear function.

An alternative specification is to use a semi-parametric approach like van Soest (1995), where the deterministic part of the preferences is represented by a polynomial.
Due to the calculation of the compensating variation (CV) below I stay with the Box-Cox formulation.

The characteristics are: $X_1$ = Age of the nurse/10. $X_2$ = Number of children below six years of age. $X_3$ = Number of children between 6 and 11 years of age. $X_4$ = 1 if the person is born in Norway, 0 otherwise. $X_5$ = 1 if the person is married, 0 otherwise.

The parameters (κ, λ, γ, $\rho_0, \rho_q, \varsigma$) are estimated in a maximum-likelihood procedure. Note that σ is not identified and is absorbed in $\kappa$ and $\rho$'s.

*Compensating variation*

We are interested in the value in utility terms of a change of shift type from daytime job *d* to the shift job *s,* for a specific workload. We measure the utility with the expected value of the compensating variation $z_h$.

First we define $z_h$ in

$$U(C(w_{dh}), L_{dh}) = U(C(w_{sh}) - z_h, L_{sh}) \qquad (13)$$

or

$$v(C(w_{dh}), L_{dh}) + \varepsilon_{dh} = v(C(w_{sh}) - z_h, L_{sh}) + \varepsilon_{sh} \qquad (14)$$

If the shift alternative is more attractive than the day job for a given workload measured in percentage of a full-time position, $z_h$ is a measure of the over-compensation of the shift job.

Given the choice of a Box-Cox function from (11), we can insert it into (14). For a specific category of hours (*k=1,...,9*) we have

$$\begin{aligned} &\kappa \frac{(C_{dk} - C_0)^{\lambda} - 1}{\lambda} + \rho(X) \frac{(L_{dk} - L_0)^{\gamma} - 1}{\gamma} + \varepsilon_{dk} = \\ &\kappa \frac{(C_{sk} - z_k - C_0)^{\lambda} - 1}{\lambda} + \rho(X) \frac{(L_{sk} - L_0)^{\gamma} - 1}{\gamma} + \varepsilon_{sk} \end{aligned} \qquad (15)$$

I will try to identify the size of $z_k$ using a Monte Carlo simulation. However, to simplify this process I first rearrange *(15)* to the following expression

$$\tilde{\kappa}\left[C\left(w_{sk}\right)-z_k-C_0\right]^{\lambda}=$$
$$\tilde{\kappa}\left[C\left(w_{dk}\right)-C_0\right]^{\lambda}+\tilde{\rho}\left(x\right)\left[\frac{L_{dk}-L_0}{\gamma}-\frac{L_{sk}-L_0}{\gamma}\right]+\left(\varepsilon_{dk}-\varepsilon_{sk}\right) \tag{16}$$

where $\tilde{\kappa}=\frac{\kappa}{\lambda}$, $\tilde{\rho}\left(x\right)=\frac{\rho\left(x\right)}{\lambda}$

I also introduce the denotation $K_k$ to simplify the presentation of *(16):*

$$K_k=\tilde{\kappa}\left[C\left(w_{dk}\right)-C_0\right]^{\lambda}+\tilde{\rho}\left(x\right)\left[\frac{L_{dk}-L_0}{\gamma}-\frac{L_{sk}-L_0}{\gamma}\right] \tag{17}$$

$K_k$ is deterministic and can be calculated for each individual when we have estimated the parameters of the model. (16) may now be represented as

$$\tilde{\kappa}\left[C\left(w_{sk}\right)-z_k-C_0\right]^{\lambda}=K_k+\left(\varepsilon_{dk}-\varepsilon_{sk}\right) \tag{18}$$

We know that the difference between two extreme value variables is logistic distributed. Thus, if $\varepsilon_{dk}$ and $\varepsilon_{sk}$ are iid extreme values, then $\varepsilon^*_{dsk}=\varepsilon_{dk}-\varepsilon_{sk}$ follows the logistic distribution. The next step is to simulate $z_k$ using a Monte Carlo simulation where I take 50 draws from the logistic distribution for each category of hours for each individual. For each draw of $\varepsilon^*_{dsk}$, I calculate $\hat{z}_k$. I have to apply the following rule in the calculation:

$$\tilde{\kappa}\left[C\left(w_{sk}\right)-\hat{z}_k-C_0\right]^{\lambda}=\max\left(0,K_k+\hat{\varepsilon}^*_{dsk}\right) \tag{19}$$

This is to avoid that the consumption you give up as measured by $\hat{z}_k$ gives you a lower consumption than the minimum level of $C_0$. The result is two formulas to calculate $\hat{z}_k$:

If $K_k+\hat{\varepsilon}^*_{dsk}\leq 0$ then $\hat{z}_k=C(w_{sk})-C_0$ *(20)*

If $K_k + \hat{\varepsilon}^*_{dsk} > 0$ then

$$\hat{z}_k = \left[C(w_{sk}) - C_0\right] - \left\{\left[C(w_{dk}) - C_0\right]^{\lambda} + \frac{\tilde{\rho}(x)}{\tilde{\kappa}}\left[\frac{L_{dk} - L_0}{\gamma} - \frac{L_{sk} - L_0}{\gamma}\right] + \frac{1}{\tilde{\kappa}}\hat{\varepsilon}^*_{dsk}\right\}^{\frac{1}{\lambda}} \qquad (21)$$

The next step is to find the average for each category of hours for each individual. I calculate

$$CV_{kn} = \sum_{t=1}^{50} \hat{z}_{knt} \qquad (22)$$

for each individual *n*, and each category of hours *k*. The last step is to calculate the mean per category of hours over the individuals.

$$\overline{CV_k} = \frac{1}{N}\sum_{n=1}^{N} CV_{kn} \qquad (23)$$

Given that the utility function can be given a cardinal interpretation I may present the mean and the standard deviation of $CV_k$ and plot the distribution for each category of hours. If I restrict the utility function to be ordinal, I can only report the number of nurses who have a $CV_{kn} > 0$ and $CV_{kn} \leq 0$.

### 4.2 Estimation and results

*Job-specific wages and disposable income*

The first step in the estimation procedure is to derive predicted hourly wages not only for the shift type and care level they actually work in, but also for the other alternatives. The wages are individual specific depending on personal characteristics like age, experience, country background and residency, and are estimated by a Heckman selection correction procedure. Overtime hours are compensated in accordance with the agreed terms. As the wages were discussed in detail in Section 3, I will only refer to Table A4 in Appendix 3. Above, I used a two-step Heckman procedure with a Probit model for covering the probabilistic structure of choice. Here, the latter is logistic, but the outcome on the wages of a Logit instead of a Probit is minimal (Dagsvik et al. (1987)).

A disposable income is calculated for each job package, defined by care level, shift type and categories of hours. I use the predicted hourly wages, and actual non-linear tax rates to calculate labor income after tax, and add the actual capital income, social security benefits and spouse's income. The first column in Table A8 presents the difference in disposable income for a shift job versus a day job for the nine categories of hours. The mean shift premium is positive and higher in hospitals as shown in Section 3.2, but for all alternative hours there are some individuals who have a negative shift premium. The mean difference is NOK 19,000 for a full-time position in the hospital sector or approximately 4% of the disposable income for the day alternative. This is illustrated for the case of full-time jobs by the histogram of the difference in disposable income in favor of the shift jobs in Figure A1, Quadrant 1.

*Estimation of structural parameters*

Based on the knowledge of disposable income and leisure measured by hours of work for all alternative job packages for each individual, I estimate the structural model. The parameters are estimated separately for the samples of hospital and primary care nurses. Remember that for the same percentage of a full-time job the nurses work shorter hours if they work in a shift job. I have restricted the sample to those with a non-work income between NOK 100,000 and NOK 500,000 in order to limit the impact of outliers in the analysis.

From Table A5 we observe that almost all parameters are sharply determined and that $\lambda$ and $\gamma$ are estimated to yield a quasi-concave utility function. For the hospital nurses the income term in the utility function (11) is estimated with $\lambda$ to be 0.285, and $\alpha$ to 2.828 such that increased income increases the deterministic utility.

The $\gamma$ in the leisure component is estimated to -0.320. $\beta_0$ is positive with a value of 6.567, meaning that the average individual has an increased utility of jobs with shorter working hours. The other $\beta s$ are, however, negative. This means that the RNs tend to choose jobs with less part-time work the older they are, and that the same goes for nurses with children aged between 6 and 11 and married nurses. The number of children below 6 years of age is not significant. The *g*-function in (8) with a dummy representing a full-time position is represented with the significant parameter $\varsigma$ of 1.064.

The parameters estimated for the primary care nurses follows the same pattern as for the hospital RNs with the exception of some of the $\beta s$. Age is not significant, but age squared is significant and has a negative sign. Surprisingly $\beta_3$, the parameter for the number of children below 6 years of age is negative, as well as the parameters for the number of children between 6 and 11 years, marital status, and whether you are born in Norway.

*Deterministic utility*

The second group of columns in Table A6 presents the difference in deterministic utility between the shift job and the daytime job. It is worth noting that the mean difference is positive in favor of the shift jobs for all categories of hours. This is illustrated for the case of full-time jobs by the histogram of the difference in deterministic utility in favor of the shift jobs in Figure A1, Quadrant 2.

*Compensating variation*

The results from the Monte Carlo simulations are presented in the third group of columns in Table A6. The compensating variation is presented for the variable $\overline{CV_k}$ for the nine alternative categories of hours. For all alternatives the mean is positive, with the exception of the jobs with shortest working hours, the category of 32.5% of a full-time position, which has a negative mean. However, a positive $\overline{CV_k}$ means that the RNs on average are so satisfied with their shift jobs, being rewarded with higher wages, shorter working hours and increased flexibility, that they actually would accept a lower wage than they are offered today and still be better or equally well off with a shift job. For a full-time job the $\overline{CV_k}$ equals NOK 26,000 or 5.7% of the annual disposable income for the household. The minimum value for the simulated $\overline{CV_k}$ is -63,680 NOK and the maximum is NOK 96,500. For the full-time alternative 90 % has $\overline{CV_7} > 0$ meaning that the majority gains from having a shift job, or in other words that the RNs could accept a reduction in the shift compensation and still prefer the shift alternative. For half-time jobs the percentage with $\overline{CV_4} > 0$ is 62% of the RNs, while for those working in a one third of a full-time position, we have that $\overline{CV_1} > 0$ for 29% for the hospital RNs and 27% for the primary care RNs.

Generally the differences between shift jobs and daytime jobs are smaller in primary care both when focusing on the shift premium measured in disposable income, and compensating variation expressed by $\overline{CV_k}$. For all categories of hours a histogram for $\overline{CV_k}$ and the share with a positive $\overline{CV_k}$ are presented in Figure A2 and A3. In Figure A4 and A5 the $\overline{CV_k}$ is plotted by age for 50%, 75% and 100% positions for hospital and primary care jobs. The compensation needed seems to be rather stable across age groups.

I have not conditioned on the RNs' actual choices in the calculation of the $\overline{CV_k}$. I still consider the calculations as a relevant approximation of the compensation necessary. The statistical derivation of a more correct expression, contingent on their actual choices is technically more complex and an obvious topic for further research.

## 5. Conclusions

In the first part of this paper I applied a switching regression model to identify the compensating differentials for registered nurses. The first finding was that there is a significant shift premium of 19.3% for the sample of hospital RNs and 18.1% for the primary care RNs. However, the shift premium is only weakly significant for the shift work choice for the sample of hospital RNs, and not significant for the primary care RNs. There seems to be a positive selection into shift work for the nurses working in hospitals, but a negative selection into shift work for the nurses in primary care jobs. There is no selection effect into the daytime jobs.

In contrast to the previous published results I found no hospital premium for the shift RNs, and a slightly negative hospital premium of –1.7% for the daytime working RNs. The negative hospital premium is not significant for the hospital job choice. There is a positive selection into hospital and primary care jobs for the sample of shift RNs. There is no selection into hospital jobs and a positive selection into primary care jobs for the dayworking RNs.

In the second part of the paper I focused on the shift premium and shift choice as the hospital premium seems to be of minimum significance in the Norwegian public health sector. I presented a structural labor supply model with a random utility function to identify the expected compensation necessary for the nurses to remain on the same utility level when they are “forced” from a day job to a shift job. The expected compensating variations were derived by Monte Carlo simulations and the distribution presented for different categories of hours. I found that on average the offered combination of higher wages, shorter working hours and increased flexibility overcompensated for the health and social strain related to shift work. The simulations indicated that the average nurse would choose a shift job even if the shift compensation was reduced by 5% of the disposable income.

It is widely known that a focusing only on wage differentials may be misleading when evaluating compensating mechanisms, as the other attributes of a nursing job, such as job flexibility and working hours, also compensate the negative effects of shift work. A structural labor supply model with a random utility function makes it possible to better include the non-pecuniary characteristics of jobs in the analysis, and thus to better inform the policy makers who are trying to find an optimal compensation package in a public health sector with a strained budget.

## 6. References


Aaberge, R., Colombino, U., Strøm, S., 1999, Labour Supply in Italy: An Empirical Analysis of Joint Household Decisions, with Taxes and Quantity Constraints. Journal of Applied Econometrics 14: 403-422.

Aaberge, R., Dagsvik, J. K., Strøm, S., 1995, Labor Supply Responses and Welfare Effects of Tax Reforms. Scandinavian Journal of Economics 97: 635-59.

Booton, L.A., Lane, J.I., 1985, Hospital Market Structure and the Return to Nursing Education. Vol. 96, No. 1 (January), pp. 61, 64.

Costa, G., 1996, The Impact of Shift and Night Work on Health. Applied Ergonomics 27: 9-16.

Dagsvik, J. K., 1987, A Modification of Heckman's Two Stage Estimation Procedure that is Applicable when the Budget Set is Convex. Discussion paper No. 28. Statistics Norway.

Dagsvik, J. K, Laisney, F., Strøm, S., Østervold, J., 1988, Female Labor Supply in France, Annales d'Economic et de Statistique, Vol. 11, 5-40.

European Observatory on Health Care Systems, 2000, Health Care Systems in Transition, Norway. Copenhagen: WHO Regional office for Europe.

Hamermesh, D., 1999, The Timing of Work over Time, The Economic Journal, 109 (January), 37-66.

Hwang, H., Reed, W.R., Hubbard, C., 1992, Compensating Wage Differentials and Unobserved Productivity. Journal of Political Economy, Vol. 100, No. 4 (August), pp. 835-58.

The International Council of Nurses (ICN), 2000, Nurses and Shift work, Position Statements.

Kostiuk, P. F., 1990, Compensating Differentials for Shift Work. Journal of Political Economy, Vol. 98, No. 5, pt. 1 (October), pp. 1054-75.

Lanfranchi, J., Ohlsson, H., Skalli, A., 2001, Compensating Wage Differentials and Shift Work Preferences: Evidence from France, ERMES (2001). Working paper No 55, Department of Economics, Göteborg University.

Lanfranchi, J., Ohlsson, H., Skalli, A., 2002, Compensating Wage Differentials and Shift Work Preferences. Economics letters 74, 393-398.

Lehrer, E. L., White, W.D., Young, W.B., 1991, The Three Avenues to a Registered Nurse License: A Comparative Analysis. Journal of Human Resources, Vol. 26, No. 2 (Spring), pp. 262-79.

Link, C. R.,1988, Returns to Nursing Education: 1970-84. Journal of Human Resources, Vol. 23, No.3 (Summer), pp. 372-87.

Maddala, G., 1983, Limited Dependent and Qualitative Variables in Econometrics. Cambridge University Press, Cambridge.

Ohida, T., 2001, Night-Shift Work Related Problems of Young Female Nurses in Japan. Journal of Occupational Health, 43, 150-156.

Rosen, S., 1986, The Theory of Equalizing Differences. In: O. Ashenfelter and R. Layard, Editors, Handbook of Labor Economics Vol. 1, North-Holland, Amsterdam (1986), pp. 641–692 Chapter 12.

Schumacher, E. J., Hirsch, B.T., 1997, Compensating Differentials and Unmeasured Ability in the Labour Market for Nurses: Why do Hospitals Pay More? Industrial and Labor Relations Review, Vol. 50, No.4, July 1997, pp 557-79.

Train, K., 2003, Discrete Choice Methods with Simulation. Cambridge University Press, Cambridge.

van den Noord, P., Hagen, T.P., Iversen, T., 1998, The Norwegian Health Care System. Economics Department Working Papers no. 198. Paris: OECD.

van Soest, A., 1995, Discrete Choice Models of Family Labor Supply. Journal of Human Resources 30, 63-88.

# Appendix 1 Key variables

### *Table A1 Key variables*

| Female registered nurses in 2000 | Mean | Std Dev |
|---|---|---|
| N | 11,542 | |
| Age | 40.2 | 10.2 |
| Born in Norway=1 | 0.92 | 0.27 |
| Single | 0.29 | 0.45 |
| Married | 0.60 | 0.49 |
| Number of children | 2.0 | 1.0 |
| | | |
| Lives in a central area (Cat. 6&7 out of 7) | 0.70 | 0.46 |
| Years since graduation | 13.3 | 11.0 |
| Number of years employed (income >1G) since 1967 | 10.9 | 7.6 |
| Hours per year | 1,363 | 347 |
| Work shifts | 0.88 | 0.33 |
| % Position | 0.81 | 0.21 |
| Income from work, NOK | 237,914 | 56,953 |
| Social security benefits, NOK | 21,037 | 28,229 |
| Total income, NOK | 264,990 | 68,815 |
| Income after tax | 196,376 | 50,422 |
| | | |
| Age of spouse (N=7,753) | 45.7 | 9.6 |
| Total annual income, spouse | 403,774 | 416,579 |
| Annual income after tax, spouse | 277,146 | 328,507 |

## Appendix 2.1. A switching regression model to identify the shift premium

***Table A2.i Shift choice, probit models, marginal effects. (Case a and b)***

| | Case a) Shift work choice if hospital RNs | | | | | | Case b) Shift work choice if primary care RNs | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Reduced form | | | Structural form | | | Reduced form | | | Structural form | | |
| **Variable** | **dF/dx** | ***Std. E.*** | ***t-values*** | **dF/dx** | ***Std. E.*** | ***t-values*** | **dF/dx** | ***Std. E.*** | ***t-values*** | **dF/dx** | ***Std. E.*** | ***t-values*** |
| Shift premium | | | | 3.555 | *1.951* | *1.78* | | | | 1.917 | *2.762* | *0.7* |
| Married | -0.020 | *0.009* | *-2.24* | -0.036 | *0.012* | *-2.82* | 0.002 | *0.009* | *0.2* | -0.001 | *0.010* | *-0.08* |
| No. of children <6 years of age | 0.027 | *0.010* | *2.75* | 0.048 | *0.015* | *3.09* | 0.024 | *0.009* | *2.52* | -0.014 | *0.056* | *-0.26* |
| No. of children aged 6-11 | 0.008 | *0.007* | *1.16* | 0.015 | *0.008* | *1.86* | 0.005 | *0.007* | *0.77* | -0.003 | *0.014* | *-0.24* |
| Age | -0.047 | *0.112* | *-0.42* | -0.893 | *0.477* | *-1.83* | 0.202 | *0.116* | *1.75* | -0.013 | *0.331* | *-0.04* |
| Age^2/100 | 0.168 | *0.399* | *0.42* | 2.992 | *1.599* | *1.83* | -0.736 | *0.408* | *-1.8* | 0.093 | *1.263* | *0.07* |
| Age^3/1000 | -0.259 | *0.616* | *-0.42* | -4.338 | *2.319* | *-1.83* | 1.166 | *0.625* | *1.86* | -0.224 | *2.098* | *-0.11* |
| Age^4/10000 | 0.144 | *0.349* | *0.41* | 2.288 | *1.226* | *1.82* | -0.672 | *0.351* | *-1.91* | 0.168 | *1.260* | *0.13* |
| Experience | -0.027 | *0.017* | *-1.59* | -0.079 | *0.033* | *-2.31* | -0.054 | *0.017* | *-3.07* | -0.092 | *0.057* | *-1.62* |
| Experience^2/100 | 0.062 | *0.258* | *0.24* | 0.746 | *0.453* | *1.61* | 0.465 | *0.266* | *1.74* | 0.778 | *0.524* | *1.49* |
| Experience^3/1000 | 0.156 | *1.524* | *0.1* | -3.875 | *2.671* | *-1.43* | -1.610 | *1.569* | *-1.02* | -2.444 | *1.980* | *-1.24* |
| Experience^4/10000 | -0.598 | *3.032* | *-0.2* | 8.017 | *5.584* | *1.41* | 1.655 | *3.117* | *0.53* | 2.107 | *3.188* | *0.66* |
| Born in a Nordic country excl. Norway | -0.051 | *0.023* | *-2.5* | -0.095 | *0.038* | *-3.03* | -0.018 | *0.025* | *-0.75* | -0.051 | *0.060* | *-0.98* |
| Born in an OECD country excl. Nordic | 0.033 | *0.020* | *1.44* | 0.083 | *0.014* | *2.19* | -0.042 | *0.033* | *-1.45* | 0.031 | *0.079* | *0.33* |
| Born in a non-OECD country | 0.040 | *0.020* | *1.64* | 0.074 | *0.015* | *2.39* | 0.047 | *0.020* | *1.79* | 0.056 | *0.021* | *1.88* |
| Place of residency (C3=Oslo) | | | | | | | | | | | | |
| County 1 Østfold | 0.076 | *0.009* | *5.3* | 0.091 | *0.008* | *4.44* | 0.059 | *0.029* | *1.44* | 0.089 | *0.032* | *1.25* |
| County 2 Akershus | 0.038 | *0.013* | *2.49* | 0.050 | *0.012* | *3.07* | 0.028 | *0.042* | *0.59* | 0.091 | *0.047* | *0.83* |
| County 4 Hedmark | 0.075 | *0.010* | *4.23* | 0.046 | *0.026* | *1.36* | 0.057 | *0.029* | *1.37* | 0.091 | *0.030* | *1.12* |
| County 5 Oppland | 0.089 | *0.007* | *5.81* | 0.101 | *0.006* | *3.95* | 0.075 | *0.020* | *2.12* | 0.091 | *0.020* | *1.77* |
| County 6 Buskerud | 0.079 | *0.008* | *5.71* | -0.351 | *0.424* | *-1.09* | 0.023 | *0.045* | *0.46* | 0.018 | *0.048* | *0.34* |
| County 7 Vestfold | 0.071 | *0.010* | *4.3* | 0.077 | *0.009* | *4.62* | 0.042 | *0.037* | *0.91* | 0.090 | *0.036* | *0.94* |
| County 8 Telemark | 0.075 | *0.010* | *4.34* | 0.042 | *0.029* | *1.19* | 0.038 | *0.038* | *0.8* | 0.078 | *0.041* | *0.97* |
| County 9 Aust-Agder | 0.068 | *0.011* | *3.75* | -0.027 | *0.088* | *-0.34* | 0.027 | *0.043* | *0.56* | 0.078 | *0.045* | *0.85* |
| County 10 Vest-Agder | 0.082 | *0.007* | *6.93* | 0.049 | *0.026* | *1.48* | 0.059 | *0.028* | *1.46* | 0.073 | *0.027* | *1.57* |
| County 11 Rogaland | 0.071 | *0.008* | *5.65* | 0.051 | *0.016* | *2.48* | 0.045 | *0.036* | *1.01* | 0.082 | *0.046* | *1.09* |
| County 12 Hordaland | 0.051 | *0.010* | *4.18* | -0.023 | *0.055* | *-0.44* | 0.056 | *0.032* | *1.33* | 0.101 | *0.043* | *1.07* |
| County 13 Sogn og Fjordane | 0.053 | *0.018* | *2.12* | -0.295 | *0.316* | *-1.25* | 0.061 | *0.027* | *1.5* | 0.075 | *0.025* | *1.58* |
| County 14 Møre og Romsdal | 0.056 | *0.015* | *2.8* | 0.027 | *0.027* | *0.89* | 0.065 | *0.029* | *1.58* | 0.083 | *0.031* | *1.61* |
| County 15 Sør-Trøndelag | 0.081 | *0.007* | *7.41* | 0.103 | *0.009* | *4.23* | 0.022 | *0.045* | *0.45* | 0.087 | *0.047* | *0.79* |
| County 16 Nord-Trøndelag | 0.085 | *0.007* | *6.15* | 0.059 | *0.021* | *1.96* | 0.070 | *0.023* | *1.89* | 0.082 | *0.022* | *1.88* |
| County 17 Nordland | 0.063 | *0.013* | *3.29* | 0.055 | *0.015* | *2.66* | 0.051 | *0.033* | *1.16* | 0.093 | *0.038* | *1.05* |
| County 18 Troms | 0.052 | *0.021* | *1.76* | 0.085 | *0.011* | *2.45* | 0.028 | *0.042* | *0.59* | 0.089 | *0.049* | *0.84* |
| County 19 Finnmark | 0.056 | *0.023* | *1.67* | 0.091 | *0.007* | *2.34* | 0.031 | *0.043* | *0.62* | 0.037 | *0.042* | *0.73* |
| Municipal Centrality (7=Most central) | | | | | | | | | | | | |
| Municipal Centrality 1 | 0.038 | *0.018* | *1.77* | -0.001 | *0.036* | *-0.04* | -0.027 | *0.016* | *-1.78* | 0.010 | *0.050* | *0.2* |
| Municipal Centrality 2 | -0.013 | *0.025* | *-0.55* | 0.000 | *0.024* | *0* | 0.012 | *0.021* | *0.54* | -0.031 | *0.075* | *-0.45* |
| Municipal Centrality 3 | -0.003 | *0.023* | *-0.15* | 0.038 | *0.025* | *1.28* | -0.001 | *0.019* | *-0.06* | 0.047 | *0.059* | *0.66* |
| Municipal Centrality 4 | -0.003 | *0.043* | *-0.08* | -0.803 | *0.274* | *-1.77* | 0.021 | *0.017* | *1.15* | 0.013 | *0.022* | *0.55* |
| Municipal Centrality 5 | 0.026 | *0.017* | *1.4* | -0.069 | *0.075* | *-1.09* | -0.041 | *0.023* | *-1.99* | -0.003 | *0.052* | *-0.06* |
| Municipal Centrality 6 | 0.000 | *0.016* | *0.02* | -0.015 | *0.019* | *-0.8* | -0.002 | *0.015* | *-0.15* | 0.040 | *0.055* | *0.65* |
| Log likelihood | -2,007.2 | | | -2,005.6 | | | -1,774.6 | | | -1,774.3 | | |
| chi squared | 696.53 | | | 699.78 | | | 214.24 | | | 214.72 | | |
| Significance level | 0.000 | | | 0.000 | | | 0.000 | | | 0.000 | | |
| pseudo R2 | 0.1479 | | | 0.1485 | | | 0.0569 | | | 0.0571 | | |
| Number of observations | 5,957 | | | 5,957 | | | 5,585 | | | 5,585 | | |

(*) dF/dx is for discrete change of dummy variable from 0 to 1

***Table A3.i Wage equations, sample selection models. Shift RNs and daytime RNs (Case a and b).***

| | Case a) Wage equations if hospital RNs | | | | | | Case b) Wage equations if primary care RNs | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Shift workers | | | Daytime workers | | | Shift workers | | | Daytime workers | | |
| | Coef. | *Std. E.* | *t-values* | Coef. | *Std. E.* | *t-values* | Coef. | *Std. E.* | *t-values* | Coef. | *Std. E.* | *t-values* |
| Age | 0.015 | *0.039* | *0.37* | -0.215 | *0.107* | *-2.02* | 0.026 | *0.048* | *0.54* | 0.082 | *0.167* | *0.49* |
| Age^2/100 | 0.013 | *0.147* | *0.09* | 0.779 | *0.368* | *2.11* | -0.058 | *0.175* | *-0.33* | -0.238 | *0.593* | *-0.4* |
| Age^3/1000 | -0.102 | *0.238* | *-0.43* | -1.204 | *0.554* | *-2.17* | 0.039 | *0.275* | *0.14* | 0.289 | *0.913* | *0.32* |
| Age^4/10000 | 0.095 | *0.140* | *0.68* | 0.673 | *0.305* | *2.2* | 0.002 | *0.158* | *0.01* | -0.123 | *0.513* | *-0.24* |
| Experience | 0.004 | *0.005* | *0.73* | -0.007 | *0.021* | *-0.35* | 0.018 | *0.006* | *2.94* | -0.043 | *0.030* | *-1.42* |
| Experience^2/100 | 0.037 | *0.087* | *0.43* | 0.238 | *0.272* | *0.88* | -0.100 | *0.092* | *-1.1* | 0.402 | *0.349* | *1.15* |
| Experience^3/1000 | -0.469 | *0.555* | *-0.84* | -1.733 | *1.502* | *-1.15* | 0.177 | *0.566* | *0.31* | -1.350 | *1.792* | *-0.75* |
| Experience^4/10000 | 1.139 | *1.171* | *0.97* | 3.848 | *2.860* | *1.35* | 0.095 | *1.176* | *0.08* | 1.255 | *3.299* | *0.38* |
| Born in a Nordic country excl. Norway | 0.005 | *0.008* | *0.6* | 0.006 | *0.016* | *0.35* | 0.015 | *0.009* | *1.63* | -0.012 | *0.023* | *-0.54* |
| Born in an OECD country excl. Nordic | 0.017 | *0.011* | *1.54* | 0.040 | *0.026* | *1.58* | -0.005 | *0.012* | *-0.41* | 0.001 | *0.028* | *0.05* |
| Born in a non-OECD country | 0.022 | *0.011* | *2.1* | 0.032 | *0.027* | *1.21* | 0.006 | *0.012* | *0.48* | 0.062 | *0.047* | *1.33* |
| Place of residency (C3=Oslo) | | | | | | | | | | | | |
| County 1 Østfold | -0.040 | *0.010* | *-4.13* | -0.051 | *0.031* | *-1.65* | -0.125 | *0.055* | *-2.29* | -0.017 | *0.095* | *-0.18* |
| County 2 Akershus | -0.032 | *0.008* | *-3.98* | -0.036 | *0.016* | *-2.3* | -0.100 | *0.054* | *-1.85* | -0.002 | *0.090* | *-0.03* |
| County 4 Hedmark | -0.026 | *0.012* | *-2.14* | -0.069 | *0.035* | *-1.98* | -0.132 | *0.055* | *-2.42* | -0.013 | *0.095* | *-0.14* |
| County 5 Oppland | -0.041 | *0.013* | *-3.22* | -0.046 | *0.044* | *-1.04* | -0.141 | *0.055* | *-2.55* | -0.012 | *0.102* | *-0.11* |
| County 6 Buskerud | 0.023 | *0.011* | *2.15* | -0.098 | *0.031* | *-3.12* | -0.069 | *0.054* | *-1.28* | -0.052 | *0.090* | *-0.57* |
| County 7 Vestfold | -0.045 | *0.011* | *-4.15* | -0.063 | *0.030* | *-2.07* | -0.116 | *0.055* | *-2.12* | -0.008 | *0.092* | *-0.09* |
| County 8 Telemark | -0.019 | *0.011* | *-1.64* | -0.062 | *0.033* | *-1.86* | -0.104 | *0.054* | *-1.91* | -0.022 | *0.092* | *-0.24* |
| County 9 Aust-Agder | -0.026 | *0.012* | *-2.19* | -0.084 | *0.031* | *-2.7* | -0.122 | *0.055* | *-2.23* | -0.043 | *0.091* | *-0.48* |
| County 10 Vest-Agder | -0.018 | *0.010* | *-1.7* | -0.067 | *0.031* | *-2.12* | -0.113 | *0.055* | *-2.07* | -0.029 | *0.095* | *-0.31* |
| County 11 Rogaland | -0.010 | *0.008* | *-1.21* | -0.042 | *0.025* | *-1.66* | -0.092 | *0.054* | *-1.7* | -0.010 | *0.091* | *-0.11* |
| County 12 Hordaland | -0.034 | *0.007* | *-4.74* | -0.071 | *0.017* | *-4.08* | -0.123 | *0.054* | *-2.27* | -0.003 | *0.092* | *-0.03* |
| County 13 Sogn og Fjordane | -0.018 | *0.014* | *-1.28* | -0.102 | *0.029* | *-3.47* | -0.114 | *0.055* | *-2.07* | -0.023 | *0.096* | *-0.24* |
| County 14 Møre og Romsdal | -0.018 | *0.010* | *-1.7* | -0.045 | *0.026* | *-1.73* | -0.124 | *0.055* | *-2.26* | -0.030 | *0.096* | *-0.31* |
| County 15 Sør-Trøndelag | -0.027 | *0.009* | *-3.04* | -0.033 | *0.029* | *-1.16* | -0.137 | *0.054* | *-2.52* | -0.045 | *0.090* | *-0.51* |
| County 16 Nord-Trøndelag | -0.015 | *0.012* | *-1.27* | -0.066 | *0.036* | *-1.83* | -0.134 | *0.055* | *-2.44* | -0.028 | *0.099* | *-0.29* |
| County 17 Nordland | -0.053 | *0.011* | *-4.97* | -0.076 | *0.028* | *-2.67* | -0.118 | *0.054* | *-2.17* | -0.008 | *0.094* | *-0.09* |
| County 18 Troms | -0.057 | *0.015* | *-3.69* | -0.043 | *0.034* | *-1.27* | -0.125 | *0.054* | *-2.31* | -0.032 | *0.090* | *-0.35* |
| County 19 Finnmark | -0.089 | *0.017* | *-5.26* | -0.062 | *0.046* | *-1.36* | -0.104 | *0.055* | *-1.88* | -0.069 | *0.093* | *-0.74* |
| Municipal Centrality (7=Most central) | | | | | | | | | | | | |
| Municipal Centrality 1 | -0.006 | *0.008* | *-0.73* | -0.029 | *0.030* | *-0.96* | -0.006 | *0.007* | *-0.9* | -0.008 | *0.017* | *-0.48* |
| Municipal Centrality 2 | 0.002 | *0.009* | *0.24* | 0.008 | *0.021* | *0.39* | -0.007 | *0.009* | *-0.87* | -0.018 | *0.027* | *-0.67* |
| Municipal Centrality 3 | -0.007 | *0.008* | *-0.85* | 0.007 | *0.021* | *0.33* | -0.008 | *0.007* | *-1.05* | 0.021 | *0.022* | *0.98* |
| Municipal Centrality 4 | -0.014 | *0.014* | *-1.02* | -0.133 | *0.053* | *-2.5* | 0.002 | *0.009* | *0.19* | 0.017 | *0.023* | *0.74* |
| Municipal Centrality 5 | 0.013 | *0.008* | *1.67* | -0.018 | *0.019* | *-0.92* | 0.014 | *0.009* | *1.56* | 0.001 | *0.025* | *0.02* |
| Municipal Centrality 6 | 0.004 | *0.006* | *0.72* | 0.000 | *0.015* | *-0.03* | -0.012 | *0.006* | *-1.96* | 0.011 | *0.015* | *0.74* |
| Selection term | 0.057 | *0.032* | *1.76* | 0.022 | *0.048* | *0.45* | -0.136 | *0.066* | *-2.04* | -0.118 | *0.087* | *-1.36* |
| Constant | 4.755 | *0.381* | *12.48* | 7.107 | *1.116* | *6.37* | 4.840 | *0.486* | *9.97* | 4.366 | *1.568* | *2.78* |
| sigma ui | | | | | | | | | | | | |
| R2 | 0.1429 | | | 0.1369 | | | 0.0716 | | | 0.0816 | | |
| RSS | | | | | | | | | | | | |
| Number of observations | 4,863 | | | 758 | | | 4,652 | | | 550 | | |

## Appendix 2.2. A switching regression model to identify the hospital premium

***Table A2.ii Hospital choice, probit models, marginal effects (Case c and d).***

| | **Case c) Hospital choice if shift RNs** | | | | | | **Case d) Hospital choice if daytime RNs** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Reduced form** | | | **Structural form** | | | **Reduced form** | | | **Structural form** | | |
| **Variable** | **dF/dx** | ***Std. E.*** | ***t-values*** | **dF/dx** | ***Std. E.*** | ***t-values*** | **dF/dx** | ***Std. E.*** | ***t-values*** | **dF/dx** | ***Std. E.*** | ***t-values*** |
| Hospital premium | | | | -0.915 | *0.756* | *-1.21* | | | | -4.368 | *4.305* | *-1.02* |
| Married | -0.049 | *0.012* | *-4.02* | -0.056 | *0.013* | *-4.17* | 0.017 | *0.035* | *0.48* | 0.027 | *0.037* | *0.74* |
| No. of children <6 years of age | 0.000 | *0.013* | *-0.03* | 0.000 | *0.013* | *-0.02* | 0.017 | *0.039* | *0.42* | 0.027 | *0.041* | *0.67* |
| No. of children aged 6-11 | -0.046 | *0.010* | *-4.72* | -0.052 | *0.011* | *-4.8* | -0.054 | *0.028* | *-1.95* | -0.088 | *0.044* | *-2.02* |
| Age | -0.815 | *0.139* | *-5.85* | -0.858 | *0.144* | *-5.97* | -0.293 | *0.490* | *-0.6* | -0.905 | *0.780* | *-1.16* |
| Age^2/100 | 2.857 | *0.511* | *5.59* | 3.052 | *0.536* | *5.7* | 1.027 | *1.706* | *0.6* | 3.025 | *2.616* | *1.16* |
| Age^3/1000 | -4.361 | *0.810* | *-5.39* | -4.707 | *0.859* | *-5.48* | -1.578 | *2.578* | *-0.61* | -4.348 | *3.770* | *-1.16* |
| Age^4/10000 | 2.422 | *0.469* | *5.16* | 2.637 | *0.502* | *5.25* | 0.888 | *1.430* | *0.62* | 2.272 | *1.985* | *1.15* |
| Experience | -0.004 | *0.018* | *-0.24* | -0.013 | *0.020* | *-0.68* | -0.167 | *0.083* | *-2.01* | -0.179 | *0.085* | *-2.11* |
| Experience^2/100 | 0.309 | *0.310* | *1* | 0.461 | *0.334* | *1.38* | 2.808 | *1.188* | *2.36* | 3.718 | *1.505* | *2.48* |
| Experience^3/1000 | -2.823 | *1.952* | *-1.45* | -3.743 | *2.096* | *-1.79* | -15.701 | *6.715* | *-2.34* | -24.005 | *10.674* | *-2.26* |
| Experience^4/10000 | 7.120 | *4.055* | *1.76* | 8.929 | *4.324* | *2.07* | 28.749 | *12.928* | *2.22* | 49.125 | *24.043* | *2.05* |
| Born in a Nordic country excl. Norway | 0.029 | *0.030* | *0.97* | 0.025 | *0.031* | *0.82* | 0.117 | *0.070* | *1.55* | 0.151 | *0.074* | *1.85* |
| Born in an OECD country excl. Nordic | 0.016 | *0.037* | *0.43* | 0.039 | *0.041* | *0.95* | -0.160 | *0.109* | *-1.48* | -0.080 | *0.135* | *-0.6* |
| Born in a non-OECD country | -0.136 | *0.036* | *-3.69* | -0.132 | *0.036* | *-3.56* | -0.013 | *0.151* | *-0.09* | 0.022 | *0.152* | *0.15* |
| Place of residency (C3=Oslo) | | | | | | | | | | | | |
| County 1 Østfold | -0.534 | *0.014* | *-17.3* | -0.518 | *0.021* | *-11.93* | -0.612 | *0.036* | *-7.44* | -0.573 | *0.064* | *-4.65* |
| County 2 Akershus | -0.530 | *0.014* | *-17.64* | -0.514 | *0.021* | *-11.8* | -0.611 | *0.039* | *-8.2* | -0.626 | *0.036* | *-7.58* |
| County 4 Hedmark | -0.535 | *0.011* | *-17.59* | -0.520 | *0.019* | *-10.59* | -0.614 | *0.031* | *-7.43* | -0.611 | *0.031* | *-7.44* |
| County 5 Oppland | -0.532 | *0.012* | *-17.22* | -0.518 | *0.019* | *-11.75* | -0.616 | *0.028* | *-7.23* | -0.555 | *0.100* | *-2.72* |
| County 6 Buskerud | -0.518 | *0.014* | *-16.6* | -0.496 | *0.025* | *-9.38* | -0.634 | *0.028* | *-8.94* | -0.646 | *0.025* | *-7.17* |
| County 7 Vestfold | -0.509 | *0.016* | *-15.1* | -0.493 | *0.022* | *-11.29* | -0.616 | *0.036* | *-7.29* | -0.628 | *0.032* | *-6.75* |
| County 8 Telemark | -0.507 | *0.015* | *-15* | -0.488 | *0.025* | *-9.72* | -0.627 | *0.027* | *-7.85* | -0.625 | *0.027* | *-7.9* |
| County 9 Aust-Agder | -0.506 | *0.015* | *-14.68* | -0.484 | *0.027* | *-8.51* | -0.623 | *0.029* | *-7.88* | -0.630 | *0.025* | *-7.2* |
| County 10 Vest-Agder | -0.494 | *0.018* | *-14.97* | -0.469 | *0.030* | *-9.11* | -0.562 | *0.049* | *-6.5* | -0.513 | *0.080* | *-4.17* |
| County 11 Rogaland | -0.558 | *0.014* | *-19.12* | -0.540 | *0.023* | *-11.98* | -0.654 | *0.031* | *-9.51* | -0.644 | *0.034* | *-8.92* |
| County 12 Hordaland | -0.531 | *0.018* | *-16.95* | -0.504 | *0.031* | *-9.74* | -0.548 | *0.056* | *-6.68* | -0.590 | *0.060* | *-5.57* |
| County 13 Sogn og Fjordane | -0.521 | *0.012* | *-15.03* | -0.506 | *0.020* | *-9.82* | -0.593 | *0.042* | *-5.91* | -0.609 | *0.035* | *-5.54* |
| County 14 Møre og Romsdal | -0.584 | *0.011* | *-20.12* | -0.569 | *0.018* | *-11.81* | -0.659 | *0.030* | *-8.25* | -0.617 | *0.066* | *-4.18* |
| County 15 Sør-Trøndelag | -0.435 | *0.025* | *-12.02* | -0.380 | *0.057* | *-5.09* | -0.577 | *0.048* | *-7.1* | -0.485 | *0.124* | *-2.85* |
| County 16 Nord-Trøndelag | -0.526 | *0.014* | *-16.78* | -0.504 | *0.027* | *-9.01* | -0.584 | *0.044* | *-6.4* | -0.501 | *0.122* | *-2.68* |
| County 17 Nordland | -0.545 | *0.013* | *-17.69* | -0.536 | *0.016* | *-14.28* | -0.628 | *0.034* | *-7.52* | -0.644 | *0.030* | *-6.3* |
| County 18 Troms | -0.567 | *0.007* | *-22.63* | -0.563 | *0.008* | *-18.06* | -0.654 | *0.020* | *-9.63* | -0.650 | *0.021* | *-9.48* |
| County 19 Finnmark | -0.514 | *0.012* | *-13.21* | -0.513 | *0.012* | *-13.26* | -0.502 | *0.085* | *-3.69* | -0.403 | *0.164* | *-1.97* |
| Municipal Centrality (7=Most central) | | | | | | | | | | | | |
| Municipal Centrality 1 | -0.217 | *0.021* | *-9.62* | -0.216 | *0.021* | *-9.5* | -0.462 | *0.054* | *-6.65* | -0.563 | *0.089* | *-3.66* |
| Municipal Centrality 2 | 0.042 | *0.028* | *1.48* | 0.049 | *0.029* | *1.69* | 0.152 | *0.072* | *1.9* | 0.240 | *0.096* | *1.96* |
| Municipal Centrality 3 | 0.088 | *0.025* | *3.45* | 0.090 | *0.025* | *3.5* | 0.193 | *0.060* | *2.8* | 0.143 | *0.083* | *1.58* |
| Municipal Centrality 4 | -0.336 | *0.026* | *-10.19* | -0.352 | *0.028* | *-9.48* | -0.493 | *0.073* | *-4.32* | -0.633 | *0.029* | *-1.86* |
| Municipal Centrality 5 | -0.035 | *0.026* | *-1.34* | -0.030 | *0.026* | *-1.13* | -0.214 | *0.072* | *-2.96* | -0.386 | *0.160* | *-2.02* |
| Municipal Centrality 6 | 0.016 | *0.020* | *0.82* | 0.031 | *0.023* | *1.33* | 0.069 | *0.056* | *1.21* | -0.002 | *0.092* | *-0.02* |
| Log likelihood | -5,992.8 | | | -5,992.1 | | | -747.42 | | | -746.88 | | |
| chi squared | 2,082.8 | | | 2,084.2 | | | 401.9 | | | 402.9 | | |
| significance level | 0.000 | | | 0.000 | | | 0.000 | | | 0.000 | | |
| pseudo R2 | 0.148 | | | 0.1482 | | | 0.2119 | | | 0.2124 | | |
| Number of observations | 10,150 | | | 10,150 | | | 1,392 | | | 1,392 | | |

(*) dF/dx is for discrete change of dummy variable from 0 to 1

### *Table A3.ii Wage equations, sample selection models. Hospital RNs and primary care RNs. (Case c and d)*

| | Case c) Wage equations if shift RNs | | | | | | Case d) Wage equations if daytime RNs | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hospital workers | | | Primary care workers | | | Hospital workers | | | Primary care workers | | |
| | Coef. | *Std.E.* | *t-values* | Coef. | *Std.E.* | *t-values* | Coef. | *Std.E.* | *t-values* | Coef. | *Std.E.* | *t-values* |
| Age | -0.058 | *0.043* | *-1.34* | -0.135 | *0.052* | *-2.58* | -0.214 | *0.107* | *-2* | -0.118 | *0.127* | *-0.93* |
| Age^2/100 | 0.262 | *0.160* | *1.64* | 0.481 | *0.186* | *2.59* | 0.773 | *0.370* | *2.09* | 0.470 | *0.441* | *1.07* |
| Age^3/1000 | -0.474 | *0.255* | *-1.86* | -0.745 | *0.286* | *-2.61* | -1.196 | *0.555* | *-2.15* | -0.799 | *0.666* | *-1.2* |
| Age^4/10000 | 0.297 | *0.149* | *1.99* | 0.421 | *0.161* | *2.61* | 0.669 | *0.306* | *2.18* | 0.485 | *0.370* | *1.31* |
| Experience | 0.006 | *0.005* | *1.17* | 0.015 | *0.005* | *2.79* | -0.010 | *0.021* | *-0.5* | -0.032 | *0.023* | *-1.4* |
| Experience^2/100 | 0.041 | *0.086* | *0.47* | -0.083 | *0.090* | *-0.92* | 0.256 | *0.294* | *0.87* | 0.453 | *0.340* | *1.33* |
| Experience^3/1000 | -0.589 | *0.553* | *-1.07* | 0.040 | *0.564* | *0.07* | -1.793 | *1.627* | *-1.1* | -2.162 | *1.930* | *-1.12* |
| Experience^4/10000 | 1.532 | *1.170* | *1.31* | 0.489 | *1.168* | *0.42* | 3.946 | *3.070* | *1.29* | 3.436 | *3.698* | *0.93* |
| Born in a Nordic country excl. Norway | 0.011 | *0.008* | *1.38* | 0.020 | *0.009* | *2.14* | 0.002 | *0.015* | *0.12* | 0.011 | *0.023* | *0.48* |
| Born in an OECD country excl. Nordic | 0.015 | *0.011* | *1.39* | -0.009 | *0.011* | *-0.75* | 0.044 | *0.025* | *1.77* | 0.004 | *0.026* | *0.16* |
| Born in a non-OECD country | 0.008 | *0.011* | *0.79* | -0.015 | *0.012* | *-1.24* | 0.036 | *0.025* | *1.47* | 0.026 | *0.037* | *0.69* |
| Place of residency (C3=Oslo) | | | | | | | | | | | | |
| County 1 Østfold | -0.099 | *0.015* | *-6.46* | -0.335 | *0.064* | *-5.25* | -0.040 | *0.035* | *-1.16* | -0.210 | *0.127* | *-1.65* |
| County 2 Akershus | -0.084 | *0.015* | *-5.63* | -0.323 | *0.064* | *-5.05* | -0.033 | *0.031* | *-1.08* | -0.161 | *0.124* | *-1.29* |
| County 4 Hedmark | -0.095 | *0.019* | *-5.09* | -0.359 | *0.065* | *-5.5* | -0.058 | *0.043* | *-1.35* | -0.209 | *0.130* | *-1.61* |
| County 5 Oppland | -0.108 | *0.017* | *-6.32* | -0.352 | *0.065* | *-5.45* | -0.031 | *0.044* | *-0.69* | -0.239 | *0.132* | *-1.81* |
| County 6 Buskerud | -0.035 | *0.015* | *-2.29* | -0.290 | *0.064* | *-4.55* | -0.087 | *0.040* | *-2.16* | -0.225 | *0.132* | *-1.71* |
| County 7 Vestfold | -0.097 | *0.015* | *-6.5* | -0.319 | *0.063* | *-5.06* | -0.053 | *0.037* | *-1.45* | -0.184 | *0.128* | *-1.43* |
| County 8 Telemark | -0.072 | *0.015* | *-4.72* | -0.311 | *0.063* | *-4.92* | -0.052 | *0.045* | *-1.16* | -0.210 | *0.133* | *-1.58* |
| County 9 Aust-Agder | -0.081 | *0.016* | *-4.89* | -0.337 | *0.064* | *-5.29* | -0.074 | *0.041* | *-1.82* | -0.216 | *0.131* | *-1.64* |
| County 10 Vest-Agder | -0.068 | *0.013* | *-5.33* | -0.298 | *0.062* | *-4.81* | -0.055 | *0.026* | *-2.08* | -0.201 | *0.119* | *-1.69* |
| County 11 Rogaland | -0.071 | *0.015* | *-4.61* | -0.317 | *0.065* | *-4.92* | -0.033 | *0.038* | *-0.87* | -0.198 | *0.131* | *-1.51* |
| County 12 Hordaland | -0.081 | *0.013* | *-6.39* | -0.321 | *0.063* | *-5.13* | -0.066 | *0.022* | *-2.96* | -0.162 | *0.116* | *-1.4* |
| County 13 Sogn og Fjordane | -0.077 | *0.019* | *-3.93* | -0.333 | *0.065* | *-5.12* | -0.096 | *0.039* | *-2.44* | -0.216 | *0.127* | *-1.7* |
| County 14 Møre og Romsdal | -0.092 | *0.021* | *-4.46* | -0.368 | *0.067* | *-5.5* | -0.040 | *0.045* | *-0.87* | -0.238 | *0.133* | *-1.79* |
| County 15 Sør-Trøndelag | -0.062 | *0.009* | *-6.72* | -0.300 | *0.060* | *-5.05* | -0.022 | *0.026* | *-0.85* | -0.186 | *0.119* | *-1.56* |
| County 16 Nord-Trøndelag | -0.078 | *0.016* | *-4.85* | -0.341 | *0.064* | *-5.33* | -0.053 | *0.033* | *-1.6* | -0.228 | *0.124* | *-1.84* |
| County 17 Nordland | -0.116 | *0.018* | *-6.55* | -0.343 | *0.065* | *-5.29* | -0.069 | *0.042* | *-1.64* | -0.195 | *0.129* | *-1.51* |
| County 18 Troms | -0.156 | *0.029* | *-5.4* | -0.414 | *0.070* | *-5.91* | -0.038 | *0.060* | *-0.64* | -0.228 | *0.141* | *-1.62* |
| County 19 Finnmark | -0.150 | *0.022* | *-6.9* | -0.334 | *0.066* | *-5.1* | -0.057 | *0.046* | *-1.22* | -0.206 | *0.119* | *-1.74* |
| Municipal Centrality (7=Most central) | | | | | | | | | | | | |
| Municipal Centrality 1 | -0.033 | *0.010* | *-3.34* | -0.058 | *0.009* | *-6.28* | -0.024 | *0.042* | *-0.58* | -0.048 | *0.034* | *-1.42* |
| Municipal Centrality 2 | 0.007 | *0.009* | *0.79* | 0.004 | *0.009* | *0.49* | 0.007 | *0.023* | *0.3* | 0.003 | *0.031* | *0.09* |
| Municipal Centrality 3 | 0.000 | *0.008* | *0.05* | 0.009 | *0.008* | *1.15* | 0.007 | *0.025* | *0.28* | 0.049 | *0.026* | *1.87* |
| Municipal Centrality 4 | -0.054 | *0.017* | *-3.15* | -0.068 | *0.014* | *-4.85* | -0.132 | *0.063* | *-2.11* | -0.058 | *0.041* | *-1.43* |
| Municipal Centrality 5 | 0.007 | *0.008* | *0.84* | -0.004 | *0.008* | *-0.5* | -0.015 | *0.022* | *-0.71* | -0.005 | *0.024* | *-0.19* |
| Municipal Centrality 6 | 0.004 | *0.006* | *0.69* | -0.010 | *0.006* | *-1.73* | -0.001 | *0.016* | *-0.05* | 0.024 | *0.016* | *1.54* |
| Selection term | 0.071 | *0.019* | *3.79* | -0.159 | *0.024* | *-6.58* | 0.000 | *0.040* | *0.01* | -0.090 | *0.051* | *-1.76* |
| Constant | 5.533 | *0.428* | *12.94* | 6.964 | *0.579* | *12.03* | 7.145 | *1.121* | *6.38* | 6.368 | *1.363* | *4.67* |

Notes. The dependent variable is the log hourly wage rate.

# Appendix 3 A random utility model

## *Table A4 Predicted hourly wages*

| Heckman selection model two-step estimates Hourly wage | Hospital RNs Shift | | | Day | | | Primary care RNs Shift | | | Day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Coef.** | **Std. E.** | ***t-values*** | **Coef.** | **Std. E.** | ***t-values*** | **Coef.** | **Std. E.** | ***t-values*** | **Coef.** | **Std. E.** | ***t-values*** |
| Age | -0.039 | 0.091 | -0.440 | -0.261 | 0.127 | -2.060 | 0.140 | 0.081 | 1.720 | -0.070 | 0.120 | -0.580 |
| Age^2/100 | 0.198 | 0.337 | 0.590 | 0.926 | 0.439 | 2.110 | -0.476 | 0.293 | -1.630 | 0.311 | 0.419 | 0.740 |
| Age^3/1000 | -0.376 | 0.541 | -0.690 | -1.410 | 0.658 | -2.140 | 0.707 | 0.460 | 1.540 | -0.571 | 0.635 | -0.900 |
| Age^4/10000 | 0.246 | 0.318 | 0.770 | 0.778 | 0.363 | 2.140 | -0.385 | 0.264 | -1.460 | 0.366 | 0.353 | 1.040 |
| Experience | 0.012 | 0.012 | 0.990 | -0.006 | 0.022 | -0.260 | 0.004 | 0.011 | 0.400 | -0.010 | 0.019 | -0.530 |
| Experience^2/100 | -0.083 | 0.201 | -0.410 | 0.260 | 0.311 | 0.840 | 0.058 | 0.175 | 0.330 | 0.109 | 0.281 | 0.390 |
| Experience^3/1000 | 0.321 | 1.292 | 0.250 | -2.053 | 1.743 | -1.180 | -0.617 | 1.090 | -0.570 | -0.270 | 1.616 | -0.170 |
| Experience^4/10000 | -0.606 | 2.733 | -0.220 | 4.750 | 3.354 | 1.420 | 1.484 | 2.254 | 0.660 | -0.013 | 3.163 | 0.000 |
| Born in a Nordic country excl. Norway | -0.005 | 0.019 | -0.250 | 0.001 | 0.016 | 0.040 | 0.003 | 0.018 | 0.170 | -0.003 | 0.021 | -0.120 |
| Born in an OECD country excl. Nordic | -0.009 | 0.025 | -0.360 | 0.035 | 0.029 | 1.210 | -0.018 | 0.021 | -0.830 | 0.022 | 0.023 | 0.940 |
| Born in a non-OECD country | 0.009 | 0.023 | 0.390 | 0.053 | 0.031 | 1.690 | -0.001 | 0.021 | -0.070 | 0.022 | 0.037 | 0.600 |
| County 1 Østfold | -0.021 | 0.022 | -0.940 | -0.033 | 0.023 | -1.450 | 0.138 | 0.119 | 1.160 | -0.073 | 0.109 | -0.670 |
| County 2 Akershus | -0.026 | 0.018 | -1.420 | -0.026 | 0.016 | -1.560 | 0.171 | 0.125 | 1.370 | -0.029 | 0.109 | -0.260 |
| County 4 Hedmark | -0.014 | 0.026 | -0.560 | -0.041 | 0.029 | -1.410 | 0.151 | 0.126 | 1.200 | -0.065 | 0.107 | -0.610 |
| County 5 Oppland | -0.028 | 0.025 | -1.110 | -0.015 | 0.032 | -0.480 | 0.158 | 0.128 | 1.230 | -0.091 | 0.109 | -0.830 |
| County 6 Buskerud | 0.017 | 0.019 | 0.890 | -0.097 | 0.022 | -4.380 | 0.192 | 0.123 | 1.560 | -0.076 | 0.111 | -0.690 |
| County 7 Vestfold | -0.043 | 0.022 | -1.980 | -0.046 | 0.025 | -1.840 | 0.142 | 0.120 | 1.190 | -0.045 | 0.109 | -0.410 |
| County 8 Telemark | -0.010 | 0.024 | -0.420 | -0.048 | 0.028 | -1.700 | 0.166 | 0.124 | 1.330 | -0.056 | 0.103 | -0.540 |
| County 9 Aust-Agder | -0.035 | 0.025 | -1.420 | -0.071 | 0.026 | -2.700 | 0.140 | 0.123 | 1.140 | -0.070 | 0.113 | -0.620 |
| County 10 Vest-Agder | -0.028 | 0.017 | -1.660 | -0.051 | 0.018 | -2.750 | 0.167 | 0.124 | 1.340 | -0.086 | 0.113 | -0.770 |
| County 11 Rogaland | 0.002 | 0.018 | 0.130 | -0.023 | 0.018 | -1.320 | 0.179 | 0.123 | 1.460 | -0.048 | 0.107 | -0.450 |
| County 12 Hordaland | -0.025 | 0.016 | -1.570 | -0.066 | 0.014 | -4.840 | 0.155 | 0.124 | 1.250 | -0.051 | 0.108 | -0.480 |
| County 13 Sogn og Fjordane | 0.001 | 0.032 | 0.020 | -0.073 | 0.034 | -2.120 | 0.169 | 0.125 | 1.350 | -0.084 | 0.115 | -0.730 |
| County 14 Møre og Romsdal | -0.019 | 0.022 | -0.860 | -0.036 | 0.026 | -1.360 | 0.159 | 0.124 | 1.280 | -0.091 | 0.115 | -0.790 |
| County 15 Sør-Trøndelag | -0.033 | 0.015 | -2.250 | -0.011 | 0.017 | -0.660 | 0.146 | 0.130 | 1.120 | -0.069 | 0.113 | -0.610 |
| County 16 Nord-Trøndelag | -0.023 | 0.020 | -1.110 | -0.037 | 0.026 | -1.430 | 0.159 | 0.127 | 1.250 | -0.100 | 0.110 | -0.910 |
| County 17 Nordland | -0.042 | 0.023 | -1.820 | -0.063 | 0.028 | -2.250 | 0.164 | 0.126 | 1.300 | -0.055 | 0.112 | -0.500 |
| County 18 Troms | -0.022 | 0.039 | -0.570 | -0.027 | 0.038 | -0.730 | 0.156 | 0.128 | 1.220 | -0.058 | 0.111 | -0.530 |
| County 19 Finnmark | -0.076 | 0.038 | -2.000 | -0.037 | 0.054 | -0.700 | 0.181 | 0.131 | 1.380 | -0.099 | 0.116 | -0.850 |
| Municipal Centrality 1 | -0.006 | 0.017 | -0.370 | -0.028 | 0.033 | -0.850 | -0.011 | 0.011 | -1.010 | 0.007 | 0.013 | 0.530 |
| Municipal Centrality 2 | 0.017 | 0.020 | 0.830 | -0.002 | 0.025 | -0.090 | 0.004 | 0.016 | 0.250 | -0.022 | 0.026 | -0.830 |
| Municipal Centrality 3 | -0.009 | 0.018 | -0.520 | 0.008 | 0.024 | 0.350 | -0.005 | 0.014 | -0.330 | 0.023 | 0.021 | 1.110 |
| Municipal Centrality 4 | 0.004 | 0.032 | 0.130 | -0.145 | 0.059 | -2.460 | -0.002 | 0.015 | -0.110 | 0.002 | 0.020 | 0.110 |
| Municipal Centrality 5 | 0.011 | 0.018 | 0.640 | -0.015 | 0.022 | -0.700 | 0.013 | 0.015 | 0.850 | 0.024 | 0.017 | 1.450 |
| Municipal Centrality 6 | 0.004 | 0.013 | 0.340 | -0.001 | 0.018 | -0.080 | -0.002 | 0.012 | -0.170 | 0.015 | 0.014 | 1.020 |
| Constant | 5.288 | 0.877 | 6.030 | 7.630 | 1.325 | 5.760 | 3.419 | 0.857 | 3.990 | 5.598 | 1.250 | 4.480 |

***Table 4 continued. Selection term.***

| Selection term | Hospital RNs Shift Coef. | Std. E. | *t-values* | Day Coef. | Std. E. | *t-values* | Primary care RNs Shift Coef. | Std. E. | *t-values* | Day Coef. | Std. E. | *t-values* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Married | -0.038 | 0.069 | -0.550 | -0.127 | 0.204 | -0.620 | -0.130 | 0.068 | -1.930 | -0.130 | 0.244 | -0.530 |
| No. Of children <6 years of age | -0.268 | 0.070 | -3.830 | -0.512 | 0.191 | -2.680 | -0.295 | 0.061 | -4.810 | -0.242 | 0.215 | -1.120 |
| No. of children aged 6-11 | -0.204 | 0.055 | -3.720 | -0.049 | 0.157 | -0.310 | -0.092 | 0.048 | -1.920 | -0.215 | 0.168 | -1.280 |
| Age | -0.953 | 0.816 | -1.170 | -0.620 | 2.434 | -0.250 | 2.080 | 0.726 | 2.870 | -6.314 | 6.847 | -0.920 |
| Age^2/100 | 3.489 | 3.052 | 1.140 | 1.325 | 8.658 | 0.150 | -7.587 | 2.639 | -2.880 | 25.187 | 25.276 | 1.000 |
| Age^3/1000 | -5.656 | 4.936 | -1.150 | -0.947 | 13.353 | -0.070 | 11.892 | 4.148 | 2.870 | -43.515 | 40.831 | -1.070 |
| Age^4/10000 | 3.397 | 2.919 | 1.160 | 0.012 | 7.549 | 0.000 | -6.783 | 2.385 | -2.840 | 27.510 | 24.367 | 1.130 |
| Experience | 0.097 | 0.099 | 0.980 | 0.036 | 0.401 | 0.090 | -0.172 | 0.101 | -1.690 | -0.662 | 0.647 | -1.020 |
| Experience^2/100 | -1.297 | 1.703 | -0.760 | 3.682 | 6.056 | 0.610 | 3.411 | 1.679 | 2.030 | 9.495 | 8.939 | 1.060 |
| Experience^3/1000 | 7.982 | 10.889 | 0.730 | -36.004 | 35.556 | -1.010 | -23.131 | 10.498 | -2.200 | -56.503 | 49.691 | -1.140 |
| Experience^4/10000 | -18.205 | 22.889 | -0.800 | 90.620 | 70.561 | 1.280 | 50.235 | 21.744 | 2.310 | 116.649 | 95.175 | 1.230 |
| Born in a Nordic country excl. Norway | -0.231 | 0.131 | -1.770 | 0.100 | 0.326 | 0.310 | -0.154 | 0.148 | -1.040 | -0.161 | 0.536 | -0.300 |
| Born in an OECD country excl. Nordic | -0.369 | 0.160 | -2.300 | -0.600 | 0.492 | -1.220 | -0.069 | 0.192 | -0.360 | 4.964 | . | . |
| Born in a non-OECD country | -0.144 | 0.173 | -0.830 | 5.439 | . | . | -0.278 | 0.153 | -1.820 | 5.306 | . | . |
| County 1 Østfold | 0.705 | 0.196 | 3.590 | 0.452 | 0.609 | 0.740 | 2.008 | 0.332 | 6.040 | 1.931 | 0.816 | 2.370 |
| County 2 Akershus | 0.185 | 0.140 | 1.330 | 0.356 | 0.358 | 0.990 | 2.396 | 0.334 | 7.160 | 1.895 | 0.751 | 2.520 |
| County 4 Hedmark | 0.502 | 0.228 | 2.210 | 5.853 | . | . | 2.465 | 0.351 | 7.030 | 1.546 | 0.796 | 1.940 |
| County 5 Oppland | 0.644 | 0.230 | 2.800 | 5.297 | . | . | 2.679 | 0.355 | 7.550 | 1.877 | 0.852 | 2.200 |
| County 6 Buskerud | 0.081 | 0.148 | 0.550 | -0.660 | 0.382 | -1.730 | 2.246 | 0.337 | 6.670 | 2.557 | 0.825 | 3.100 |
| County 7 Vestfold | 0.211 | 0.179 | 1.180 | 0.407 | 0.600 | 0.680 | 2.044 | 0.342 | 5.970 | 1.775 | 0.830 | 2.140 |
| County 8 Telemark | 0.390 | 0.202 | 1.940 | 0.171 | 0.635 | 0.270 | 2.300 | 0.351 | 6.540 | 1.484 | 0.778 | 1.910 |
| County 9 Aust-Agder | 0.008 | 0.189 | 0.040 | 0.315 | 0.651 | 0.480 | 2.239 | 0.354 | 6.320 | 7.280 | . | . |
| County 10 Vest-Agder | 0.042 | 0.129 | 0.330 | 0.211 | 0.400 | 0.530 | 2.362 | 0.337 | 7.000 | 7.178 | . | . |
| County 11 Rogaland | 0.466 | 0.139 | 3.370 | 0.674 | 0.516 | 1.310 | 2.324 | 0.326 | 7.140 | 1.757 | 0.740 | 2.370 |
| County 12 Hordaland | 0.303 | 0.119 | 2.540 | -0.108 | 0.256 | -0.420 | 2.372 | 0.327 | 7.260 | 1.805 | 0.747 | 2.420 |
| County 13 Sogn og Fjordane | 0.697 | 0.414 | 1.680 | 5.841 | . | . | 2.404 | 0.359 | 6.690 | 7.453 | . | . |
| County 14 Møre og Romsdal | 0.123 | 0.184 | 0.670 | 0.310 | 0.587 | 0.530 | 2.378 | 0.338 | 7.040 | 7.450 | . | . |
| County 15 Sør-Trøndelag | 0.076 | 0.111 | 0.680 | 0.694 | 0.530 | 1.310 | 2.789 | 0.358 | 7.780 | 7.075 | . | . |
| County 16 Nord-Trøndelag | 0.066 | 0.161 | 0.410 | 5.765 | . | . | 2.557 | 0.350 | 7.320 | 2.199 | 0.843 | 2.610 |
| County 17 Nordland | 0.389 | 0.196 | 1.990 | 0.309 | 0.633 | 0.490 | 2.482 | 0.343 | 7.230 | 2.517 | 0.848 | 2.970 |
| County 18 Troms | 5.177 | . | . | 4.938 | . | . | 2.593 | 0.337 | 7.700 | 2.382 | 0.845 | 2.820 |
| County 19 Finnmark | 0.492 | 0.427 | 1.150 | 5.320 | . | . | 2.794 | 0.448 | 6.240 | 7.363 | . | . |
| Municipal Centrality 1 | 0.052 | 0.157 | 0.330 | -0.103 | 0.705 | -0.150 | -0.010 | 0.108 | -0.090 | -0.288 | 0.323 | -0.890 |
| Municipal Centrality 2 | 0.341 | 0.193 | 1.770 | -0.683 | 0.581 | -1.180 | 0.237 | 0.175 | 1.360 | -0.622 | 0.589 | -1.060 |
| Municipal Centrality 3 | -0.070 | 0.156 | -0.450 | 0.018 | 0.555 | 0.030 | 0.069 | 0.135 | 0.510 | -0.422 | 0.571 | -0.740 |
| Municipal Centrality 4 | 0.623 | 0.421 | 1.480 | -0.343 | 0.788 | -0.430 | -0.170 | 0.134 | -1.270 | 5.272 | . | . |
| Municipal Centrality 5 | 0.028 | 0.150 | 0.180 | -0.031 | 0.595 | -0.050 | 0.180 | 0.160 | 1.130 | -0.304 | 0.407 | -0.750 |
| Municipal Centrality 6 | 0.011 | 0.124 | 0.090 | -0.115 | 0.447 | -0.260 | 0.216 | 0.103 | 2.110 | 0.012 | 0.335 | 0.030 |
| _cons | 11.210 | 7.910 | 1.420 | 10.180 | 24.799 | 0.410 | -21.034 | 7.223 | -2.910 | 59.179 | 67.985 | 0.870 |
| Mills lambda | 0.244 | 0.111 | 2.200 | 0.099 | 0.058 | 1.690 | 0.203 | 0.079 | 2.560 | -0.015 | 0.049 | -0.290 |
| rho | 1* | | | 1* | | | 1* | | | -0.170 | | |
| Number of observations | 5,154 | | | 803 | | | 4,996 | | | 589 | | |
| Wald chi2 | 216.16 | | | 115.45 | | | 226.10 | | | 68.35 | | |
| Prob >chi2 | 0.000 | | | 0.000 | | | 0.000 | | | 0.242 | | |

Note: two-step estimate of rho = rho is being truncated to 1

** For the hours above 100%, which means 35.5 hours per week for shift workers and 37.5 hours per week for daytime workers, the hourly wage is increased by 50%.*
*** Marital status and number of children are used as selection variables to correct for the selection into the respective job-types. Mills lambda is the selection correction.*

***Table A5 Estimated parameters in the RUM model***

| | | Shift vs. daytime work for hospital nurses | | | Shift vs. daytime work for primary care nurses workers | | |
|---|---|---|---|---|---|---|---|
| | | ***Est.*** | ***St. E.*** | ***t-values*** | ***Est.*** | ***St. E.*** | ***t-values*** |
| | ***Utility function*** | | | | | | |
| $\beta_0$ | Constant 'leisure element' | 6.567 | 0.884 | 7.427 | 3.688 | 0.788 | 4.681 |
| $\beta_1$ | Age/10 | -0.325 | 0.062 | -5.243 | 0.371 | 0.267 | 1.389 |
| $\beta_2$ | Age/10 squared | | | | -0.068 | 0.030 | -2.282 |
| $\beta 3$ | No. of children < 6 years of age | -0.098 | 0.087 | -1.123 | -0.175 | 0.068 | -2.575 |
| $\beta 4$ | No. of children 5< years of age<12 | -0.269 | 0.074 | -3.656 | -0.252 | 0.054 | -4.688 |
| $\beta 5$ | Born in Norway | | | | -0.240 | 0.100 | -2.408 |
| $\beta 5$ | Married | -0.601 | 0.114 | -5.289 | -0.225 | 0.076 | -2.976 |
| $\gamma$ | Exponent 'leisure element' | -0.320 | 0.148 | -2.161 | -0.677 | 0.139 | -4.887 |
| $\alpha$ | Constant 'consumption element' | 2.828 | 0.489 | 5.787 | 2.236 | 0.384 | 5.825 |
| $\lambda$ | Exponent 'consumption element' | 0.285 | 0.148 | 1.922 | 0.405 | 0.149 | 2.725 |
| | ***Opportunity density**** | | | | | | |
| $\varsigma$ | 1 if the job is full-time, 0 otherwise | 1.064 | 0.082 | 12.976 | 0.758 | 0.091 | 8.311 |
| | Number of observations | 3,354 | | | 3,928 | | |
| | Log likelihood | -8,835.5 | | | -10,136.5 | | |
| | McFadden's Rho | 0.089 | | | 0.107 | | |

***Table A6 Differences in consumption, deterministic utility and compensating variation in the RUM-model***

**Hospital**

| *Categories* | Difference in disposable income, NOK | | | | Difference in deterministic utility | | | | $CV_k$ per year, NOK | | | | Share with positive |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *of hours* % of full-time | Shift job - Daytime job | | | | Shift job - Daytime job | | | | Compensating variation | | | | $CV_k$ |
| | **Mean** | **Std D** | **Min** | **Max** | **Mean** | **Std D** | **Min** | **Max** | **Mean** | **Std D** | **Min** | **Max** | **Mean** |
| **32.5 %** | 7 329 | *2 400* | -2 125 | 17 264 | 0.148 | *0.040* | 0.025 | 0.405 | -12 278 | *21 294* | -101 625 | 66 453 | 0.29 |
| **50 %** | 11 404 | *3 735* | -3 306 | 26 868 | 0.226 | *0.055* | 0.052 | 0.563 | 4 023 | *17 774* | -69 672 | 79 375 | 0.62 |
| **60 %** | 13 175 | *4 345* | -3 984 | 32 008 | 0.265 | *0.060* | 0.073 | 0.632 | 7 412 | *18 613* | -61 594 | 85 266 | 0.68 |
| **75 %** | 15 294 | *5 015* | -4 433 | 36 784 | 0.319 | *0.064* | 0.111 | 0.697 | 12 671 | *19 585* | -68 375 | 75 203 | 0.76 |
| **80 %** | 16 392 | *5 368* | -4 752 | 38 688 | 0.344 | *0.067* | 0.127 | 0.733 | 15 240 | *19 655* | -80 141 | 88 516 | 0.80 |
| **86 %** | 17 771 | *5 819* | -5 152 | 41 864 | 0.378 | *0.071* | 0.150 | 0.782 | 18 764 | *20 181* | -76 563 | 100 922 | 0.83 |
| **100 %** | 19 063 | *6 283* | -5 968 | 48 024 | 0.439 | *0.073* | 0.206 | 0.874 | 26 317 | *20 907* | -63 680 | 96 500 | 0.90 |
| **103 %** | 18 480 | *6 362* | -6 195 | 48 496 | 0.446 | *0.073* | 0.221 | 0.888 | 26 610 | *21 198* | -48 797 | 114 828 | 0.90 |
| **115 %** | 20 525 | *6 524* | -5 066 | 51 024 | 0.518 | *0.071* | 0.303 | 0.951 | 34 841 | *21 802* | -47 164 | 116 922 | 0.94 |

*N=3354*

**Primary care**

| *Categories* | Difference in disposable income, NOK | | | | Difference in deterministic utility | | | | $CV_k$ per year, NOK | | | | Share with positive |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *of hours* % of full-time | Shift job - Daytime job | | | | Shift job - Daytime job | | | | Compensating variation | | | | $CV_k$ |
| | **Mean** | **Std D** | **Min** | **Max** | **Mean** | **Std D** | **Min** | **Max** | **Mean** | **Std D** | **Min** | **Max** | **Mean** |
| **32.5 %** | 5 767 | *2 286* | -6 419 | 13 354 | 0.121 | *0.033* | -0.033 | 0.258 | -13 896 | *22 184* | -105 078 | 57 000 | 0.27 |
| **50 %** | 8 974 | *3 557* | -9 988 | 20 780 | 0.191 | *0.045* | -0.028 | 0.377 | 2 276 | *18 612* | -87 266 | 65 797 | 0.57 |
| **60 %** | 10 315 | *4 114* | -12 036 | 24 264 | 0.229 | *0.050* | -0.017 | 0.438 | 6 006 | *19 273* | -96 641 | 95 391 | 0.64 |
| **75 %** | 12 033 | *4 769* | -13 394 | 27 864 | 0.286 | *0.054* | 0.019 | 0.505 | 11 925 | *20 035* | -74 188 | 76 328 | 0.74 |
| **80 %** | 12 898 | *5 112* | -14 358 | 29 868 | 0.313 | *0.057* | 0.032 | 0.542 | 14 524 | *19 753* | -66 953 | 86 563 | 0.78 |
| **86 %** | 13 983 | *5 542* | -15 566 | 32 384 | 0.350 | *0.060* | 0.051 | 0.591 | 18 478 | *20 571* | -70 406 | 90 484 | 0.82 |
| **100 %** | 14 937 | *5 907* | -18 028 | 35 304 | 0.424 | *0.061* | 0.105 | 0.689 | 27 414 | *21 188* | -56 922 | 116 031 | 0.90 |
| **103 %** | 14 188 | *5 906* | -18 772 | 35 232 | 0.434 | *0.060* | 0.128 | 0.701 | 28 128 | *21 427* | -47 672 | 95 000 | 0.90 |
| **115 %** | 16 299 | *6 174* | -16 672 | 36 768 | 0.530 | *0.061* | 0.223 | 0.776 | 39 192 | *21 920* | -42 875 | 134 313 | 0.96 |

*N=3928*

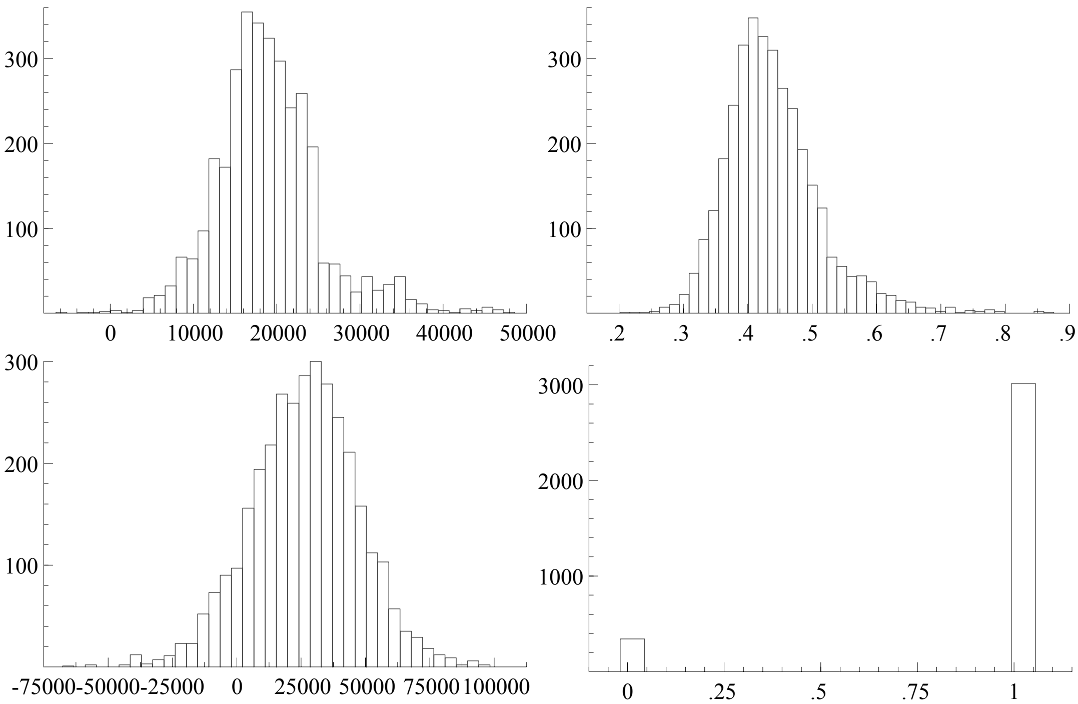


***Figure A1 Hospital nurses – Full-time***

Clockwise:

Quadrant 1: The difference in disposable income for full-time jobs (shift job – daytime job).

Quadrant 2: The difference in deterministic utility for full-time jobs (shift job – daytime job).

Quadrant 3: Compensating variation ($CV_7$) for full-time jobs (shift job – daytime job).

Quadrant 4: Share with positive and negative $CV_7$, for a for full-time job.

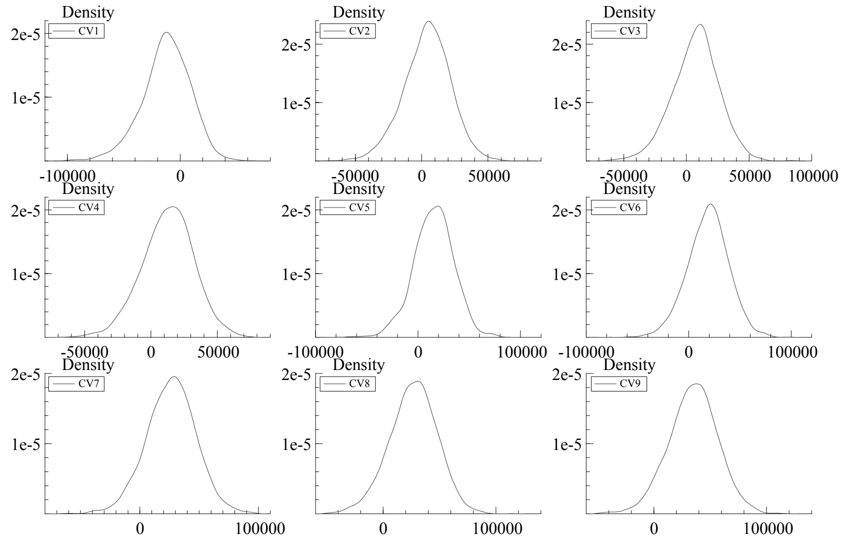


***Figure A2. Shift compensation for hospital nurses***

*The mean of the compensating variation,* $CV_k$*, by categories of hours.*

*(2: 50%, 4: 75% and 7: 100% position).*

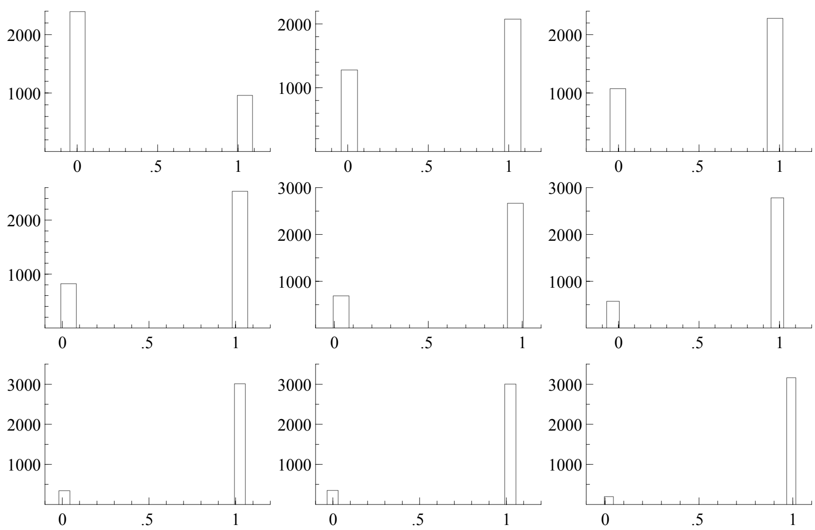


***Figure A3. Shift compensation for hospital nurses***

*The share of the nurses with* $CV_k$ *>0, by category of hours.*

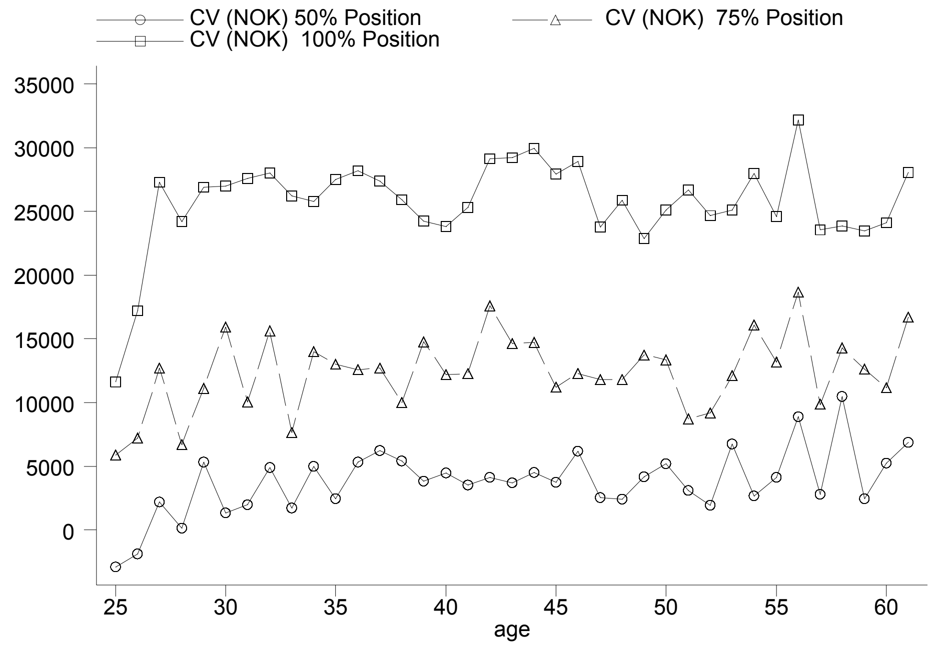


***Figure A4. Shift compensation for hospital nurses.***

*The mean of the compensating variation,* $CV_k$*, by age. 50%, 75% and 100% position.*

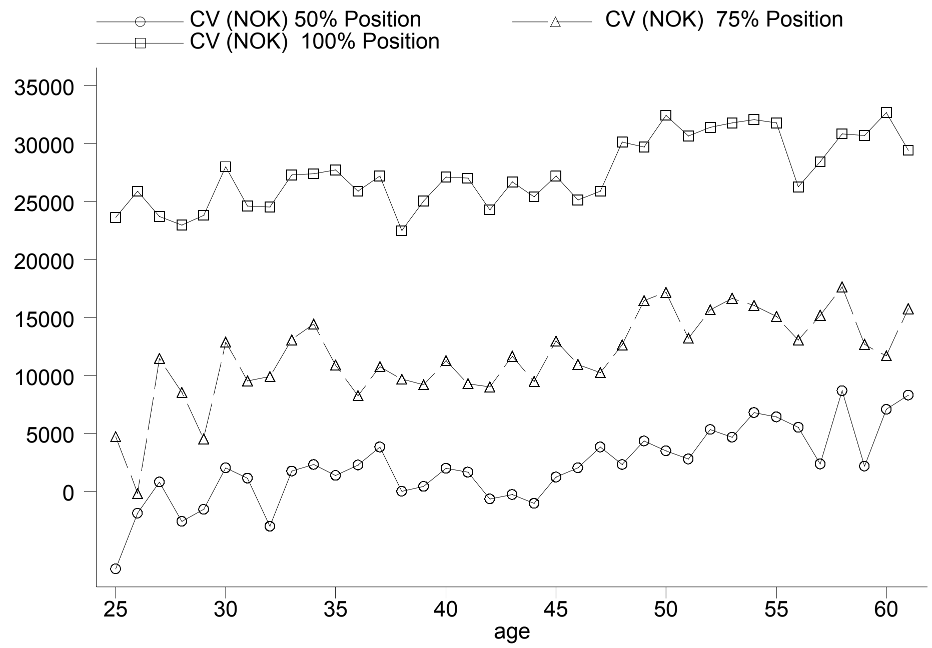


***Figure A5. Shift compensation for primary care nurses***

*The mean of the compensating variation,* $CV_k$*, by age. 50%, 75% and 100% position.*

# Errata

| Page | Correction from first print |
|---|---|
| *6, last para* | Hospital *operational* expenses (text inserted) |
| *20, second para* | *Please observe that the figure is just a cross-sectional snapshot, and should be interpreted with caution.* (text inserted). |
| *21, first para* | *a* peak (not its) |
| *46, third para* | *The analyst has incomplete knowledge or information about variables entering the choice set B, and one way to take account of this incomplete knowledge is to specify probability distributions for these variables.* (text inserted and revised). |
| *64, 65* | *small* replaced with *modest* |
| *71, 3 para* | *private hourly wages* (not income) |
| *109, table* | *The parameter* $\gamma$ *is included* (not included by mistake) |
| *113, para 4* | *Table 7 (*not Table 6*)* |
| *153, last para* | *, but it is not significantly different from 1, and the model is thus not necessarily better than the standard multinominal logit model*. (text inserted) |
| 196, third para last sentence | *ordinal* (not cardinal) |