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Nurses and physicians: a longitudinal analysis of mobility between jobs and labor supply

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Abstract We estimate a dynamic discrete choice model of registered nurses' labor supply. A distinguished feature of our model is that the random terms in the utility functions are correlated over time and jobs (habit or job persistence). Past options and not only the past optimal choices matter for the current choices. Given observed incentives and institutional constraints on offered hours, we find that nurses are mobile when they are young (less mobility than among physicians), but there is also a weak tendency of higher mobility again when they are approaching retirement age. Wage increases have a modest impact on labor supply. The overall elasticity for nurses is close to zero. These low elasticities shadow for stronger responses, shifting labor away from part-time jobs in the public and private sector toward full-time jobs in the private sector. A change in taxation away from the progressive tax system toward a flat tax of 28 % gives registered nurses a very modest incentive to shift their job to private hospitals. For physicians, the impact is stronger.

Keywords Nurses' labor supply · Multi-sector · Panel data

JEL Classification J22 · I10 · C35

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1 Introduction

The main motivation for the paper is that Norway's population is aging and the old-age dependency ratio, i.e., the ratio of the population aged 65+ to the population aged 20–64 is estimated to nearly double: from 32.7 % in 2011 to 62.2 % in 2050 (OECD 2013). This is in line with the average rise for the OECD area as a whole, although the increase in Norway is less dramatic than projected in most EU countries. In the EU21 countries, the ratio is projected to increase from 37.1 % in 2011 to 76.1 % in 2050.

This phenomenon implies that in the coming decades there will be many elderly people requiring care in hospitals and long-term care (OECD 2005). There will be a growing demand for nurses and medical doctors. This increase in demand can be covered with more nurses and medical doctors educated at Norwegian universities or migrating from abroad. The latter might be a difficult option, since most other OECD countries have the same need for people working in the health sector (OECD 2013).

In this paper, we focus on another option. We study how nurses respond to incentives to work longer hours, and we compare them with medical doctors. Almost 50 % of Norwegian nurses work part-time, and their working hours are among the lowest in the European Union (see OECD 2005). There might thus be room for increasing labor supply of nurses. Specifically, we wish to understand to what degree wages and taxes affect the labor supply of nurses. We do this by estimating a longitudinal discrete choice model on panel data for registered nurses. Andreassen et al. (2013) estimate a longitudinal discrete choice model on panel data for physicians. The contribution of the present paper is to estimate a similar model for nurses and to compare the results for nurses with the results for physicians published in Andreassen et al. (2013). Comparing these two groups is of great interest, because one usually thinks that they represent very different behavior in the labor market. In Norway, it is generally thought that one reason for nurses to choose their profession is that it gives flexibility with respect to working hours, something that can be important when raising a family. Doctors are, on the other hand, thought to be more motivated by prestige and money. We find that this thinking is to some extent supported by the data, with nurses having smaller wage elasticities than doctors and greater stability (habit persistence) than doctors when young.

In textbook labor supply models, individuals can choose any hours of work. The choice of hours is then determined by preferences and economic incentives only. This assumption of uniformly distributed hours available in the market is at odds with how working hours are organized in hospitals and primary care. The available choices for nurses, determined by the employers and the unions, are different types of working loads. Thus, available hours is not uniformly distributed. The most suitable framework for estimating labor supply, given these institutional constraints, is a discrete choice model, first introduced in Aaberge et al. (1995) and discussed in more detail in Dagsvik and Strøm (2006). Within this framework, the deterministic preferences in choice probabilities are weighted with the densities of hours offered in the market. In a survey, Creedy and Kalb (2005) coined this framework for weighted logit choice probabilities.

In the model estimated below, we allow for taste or habit persistence that may slow down mobility across jobs and working loads when wages and taxes are changed to stimulate labor supply. Habit formation and consequently habit persistence were

introduced in the modeling of consumer demand by Gorman (1967) and Pollak (1970), see also Deaton (1992) for lengthy discussions of habit persistence in demand models and Dynan (2000) for a more recent empirical work related to food expenditures. So far habit formation has been introduced in consumer demand model. To our knowledge, we are the first to include habit persistence attached to type of jobs in labor supply models.

The labor supply of RNs has been extensively investigated empirically during the last decades. Shields (2004) provides an excellent review of the studies. These previous models tend to be reduced form models, with a loose contact to structural decision models. Contractual arrangements are not explicitly accounted for, and hence offered hours are implicitly assumed to be uniformly distributed.

By allowing habit formation in labor supply models and non-uniformly distributed offered hours (contractual arrangements or institutional constraints), we should expect that labor supply is less elastic compared to models where these features are ignored. To test this conjecture, we have chosen to use data for the period 1997–1999. During these years, the Norwegian government gave a considerable boost to the wages of nurses. Also, the private sector responded by increasing wages. The annual disposable income in public hospitals and public health care increased by as much as 31–35 % from 1997 to 1999, both for part-timers and full-timers.[1] The increase in the private sector was of the same magnitude. Moreover, we simulate the labor supply effects of a replacement of the current tax system with a flat tax, which reduces the marginal tax rates substantially. The aim is to check labor supply responses when economic incentives to work more are really improved.

The main conclusion is that by cutting taxes and/or increasing wages, nurses move to jobs with higher working loads. However, the impact is not strong. Wage increases have the greatest effect on labor supply among nurses aged 35–50, while less progressive taxes stimulates in particular medical doctors to move to jobs with higher working loads in the private sector.

Another important result concerns the rationing or availability of jobs and thus hours offered by employers. Our model allows the estimation of the probabilities when individuals are offered different types of jobs. The results show that offered hours are more constrained for nurses than for physicians. Given observed incentives and institutional constraints, we find that nurses are more mobile when they are young (even if they are less mobile than young physicians), but there is also a weak tendency of higher mobility again when they are approaching retirement age.

On cross-sectional data from the same period as in the present paper, Di Tommaso et al. (2009) estimate a static discrete choice model of labor supply on nurses. The estimates indicate that overall labor supply is rather inelastic with an average elasticity of 0.33.[2] This average elasticity is similar to the ones reported in Shields (2004), but

[1] See Table 14 in "Appendix 2".

[2] A 10 % increase in the wage level for all nurses is estimated to yield a 3.3 % increase in the unconditional expectation of hours supplied in the population of nurses. Labor supply is aggregated across individuals and job types, and then the elasticities are calculated for this aggregate sum with respect to the wage rate in all job types. This aggregate elasticity is equivalent to taking the elasticity of the labor supply for every individual, and then calculating the weighted sum using the predicted choice probabilities of hours worked for each individual as weights.

much lower than the average elasticity (0.8) obtained on another set of Norwegian data and reported in Askildsen et al. (2003). In Hanel et al. (2014), the framework is similar to the one employed in Di Tommaso et al. (2009), with the exception that institutional constraints are not accounted for and the deterministic part of the utility function is quadratic. In Hanel et al. (2014), elasticities are somewhat on the high side, which is also driven by the decision of the nurse to enter or exit the profession.

Our paper shows that when estimating a dynamic model on job transitions data, accounting for habit persistence and institutional constraints, the labor supply of nurses becomes more inelastic than obtained in these previous papers, also significantly lower than in Di Tommaso et al. (2009).

In the next section, we give a brief but self-contained review of the model. Data is presented in Sect. 3. Estimates, elasticities and the result of a policy simulation are reported in the following three sections. Section 7 concludes.

2 Model

The model we employ allows for habit or job persistence. This implies correlation in utilities across time. Let $U_{jn}(t)$ be the utility of nurse n when working in job type j at time t. The utility function is assumed to be random because there are job attributes that affect preferences that we do not observe. Let $v_{jn}(t)$ be the systematic (deterministic) part of the utility function, and let $\varepsilon_{jn}(t)$ be the random term, assumed to be independent and identical extreme value distributed. The random term accounts for the job attributes that are not observed by the econometrician. Notice that this implies that the random terms vary across job types (and individuals).

Following Dagsvik (2002), we assume that

$$U_{jn}(t) = \max_j \left[U_{jn}(t-1) - \rho, v_{jn}(t) + \varepsilon_{jn}(t)\right] \tag{1}$$

The expected value of $U_{jn}(t)$ is given by

$$E\left[U_{jn}(t)\right] = ln\left[\sum_{r=t_0}^{t} \exp(v_{jn}(r) - (t-r)\rho)\right] \tag{2}$$

or

$$\exp\left\{E\left[U_{jn}(t)\right]\right\} = \sum_{r=t_0}^{t} \left[\exp\, v_{jn}(r) - (t-r)\rho\right] \tag{3}$$

To calculate correlation across utilities, it is convenient to calculate correlation of a monotone transformation of the utilities:

$$\text{corr}\left\{\exp\left[-U_{jn}(s)\right], \exp\left[-U_{jn}(t)\right]\right\} = \frac{\exp\left\{E\left[U_{jn}(s)\right]\right\}}{\exp\left\{E\left[U_{jn}(t)\right]\right\}} e^{-(t-s)\rho};\ \text{for } s \le t \tag{4}$$

We observe that if covariates are constant over time, the correlation from t to $t-1$ is approximately equal to $e^{-\rho}$. The coefficient ρ is a preference discount factor. If $\rho = 0$,

there is a complete strong taste or habit persistence and utilities are perfectly correlated across time. If $\rho = \infty$, there is no taste persistence at all and $U_{jn}(t) = v_{jn}(t) + \varepsilon_{jn}(t)$. The inclusion of taste or habit persistence is a behavioral assumption, and it implies that individuals' past options (and not only past optimal choices) matter for current choices. This implies that the current choice depends on all the utility functions associated with each alternative in the past, not only the optimal one. If $\rho = \infty$, the model degenerates to a standard multinomial logit model that can be estimated on panel data, see Train (2003).

From the model, we can derive transition probabilities, which will be estimated on panel data. We will assume that nurse n will choose the state that maximizes utility, given his or her choice set. Nurses can choose between 10 states, which vary with respect to type of institution (hospitals vs. primary care), sector (public vs. private), hours offered by the institutions in the healthcare sector (part-time vs. full-time) and also not working at all (0 h). Part time is defined as a number of hours of work less than 30. We will assume that the choice set is related to availability of jobs, characterized by offered hours. Thus, in our model, the nurses are not free to choose any hours they like to work. We will assume that

$$g_{jnt}(h_{jnt}) = \exp(d_{1j} z_{jnt});\ z_{jnt} = 1 \text{ if } h_{jnt} \leq 30; \\ = 0 \text{ otherwise, (part-time)} \tag{5a}$$

$$g_{jnt}(h_{jnt}) = \exp(d_{2j} z_{jnt});\ z_{jnt} = 1 \text{ if } h_{jnt} \geq 30; \\ = 0 \text{ otherwise, (full-time)} \tag{5b}$$

Note that the $g(.)$ function captures the rationing of full-time jobs, and d_{kj} are parameters to be estimated for each sector j and working loads k. The $g(.)$ functions capture the availability of full-time and part-time hours in the different jobs. For physicians, there are only a rationing of full time jobs, while for nurses, there is a rationing of part-time as well as full-time jobs.

Let Q_{ijnt} denote the probability that doctor or nurse n moves from state i in period $t-1$ to state j in period t, and Q_{iint} denotes the probability that doctor or nurse n stays in state i also in period t.

With the assumed probability distribution for ε_{jnt}, we get (Dagsvik (2002)):

$$Q_{ijnt} = \frac{V_{jnt}}{\sum_{r=t_0}^{t} \left\{ \left[\exp(-(t-r)\rho) \right] \sum_{k=0}^{9} V_{knr} \right\}};\ Q_{iint} = 1 - \sum_{\substack{j=0 \\ j \neq i}}^{9} Q_{ijnt};\ \forall i, j = 0, 1, \ldots, 9 \tag{6}$$

where $V_{jnt} = \exp(v_{jnt}) g_{jnt}(h_{jnt})$.

The different sectors that the nurse can choose are:

0 = not working[3]
1 = working part-time in a hospital in the private sector;
2 = working full-time in a hospital in the private sector;
3 = working part-time in primary care in the private sector;

[3] Implying that hours of work are zeros.

4 = working full-time in primary care in the private sector;
5 = working part-time in a hospital in the public sector;
6 = working full-time in a hospital in the public sector;
7 = working part-time in primary care in the public sector;
8 = working full-time in primary care in the public sector;
9 = working in other sectors.[4]

2.1 The deterministic part of the utility function

We will assume that the systematic or deterministic part of the utility function is given by:

$$\log v_{jnt} = \left(A + \sum_{s=1}^{4} a_s X_{snt}\right) \frac{(C_{jnt}10^{-5})^{\lambda} - 1}{\lambda} + \left(B + \sum_{s=5}^{7} b_s X_{snt}\right) \frac{(L_{jnt})^{\gamma} - 1}{\gamma} \tag{7}$$

Here, C_{jnt} is disposable annual income, and it is given by

$$C_{jnt} = f_t(w_{jnt}48h_{jnt} + SI_{nt}) + I_n t, \tag{8}$$

The hourly wage rate is w_{jnt}, $48h_{jnt}$ denotes weekly hours of work times number of working weeks per year (48), SI_{nt} is the wage income from secondary jobs and I_{nt} is non-labor income, including the after-tax income of a spouse, child benefits and other benefits. The functional form of f_t (.) depends on the characteristics of the tax function, T_t (.), which is a stepwise linear tax function at time t, see Tables 6, 7 and 8 "Appendix 1".

Annual leisure is denoted L_{jnt}. We assume 12 h a day for rest and sleep. Therefore, annual leisure in this definition is equal to the total number of hours in a year (8760) minus sleeping time in a year minus hours of work. Leisure includes therefore hours in the weekends and vacation time:

$$L_{jnt} = \frac{8760 - 12x365 - 48h_{jnt}}{8760} \tag{9}$$

Moreover, X_{1nt} is age and X_{2nt} is age squared. We account for the possibility that there is an impact on hours supplied when spouses are working in jobs where shift work is very common like in the health sector. We have thus included a dummy variable X_{3nt} which equals 1 if the nurse is married to a person in the health sector, and equal 0 otherwise. Other observed covariates that are included to account for observed heterogeneity are the dummy variables X_{4nt} that equals 1 if more than one job, and equal to 0 otherwise; X_{5nt} equals 1 if number of children <6; and X_{6nt} equals 1 if

[4] The classification of sectors is based on the standard used by Statistics Norway, which is based on the Statistical Classification of Economic Activities (NACE) used in the European Community. The sector "Other sectors" consists of all types of jobs that do not fall in under either hospital or healthcare services. It thereby includes nurses doing a wide variety of works outside the traditional healthcare sectors, such as administrative work in government and in the private sector or working in non-health sectors.

number of children {>6, <11}; and finally, X_{7nt} equals 1 if female, and equal to 0 otherwise.

To account for the possibility that habit persistence may increase with age (a lower preference discount parameter), we let the preference discount parameter ρ_{nt} depend on the age and age squared of the nurse:

$$\rho_{nt} = \rho_0 + \rho_1 X_{1nt} + \rho_2 X_{2nt} \tag{10}$$

The wage equation is estimated separately. Selection is accounted for. An important contribution is that we allow for correlation of wages across the various jobs. Once the wage equation is estimated, it is included in disable income, which is part of the utility function. The remaining parameters of the model is estimated through *simulated* maximum likelihood. The simulation is due to the fact that we have to integrate out the unobserved random terms of the wage equation. Details about the estimation procedure can be found in Andreassen et al. (2013)

In Dagsvik and Jia (2015), it is shown that this type of model is nonparametrically identified.

3 Data

The data used in this study are the result of merging register data from Statistics Norway with data on physicians and nurses collected by The Norwegian Association of Local and Regional Authorities (from the PAI[5] register). The register data from Statistics Norway consists of demographic, educational, income and labor market data. The income data is taken from tax returns, while the labor market data consist of employee data merged with data on employers. Tax functions are given in "Appendix 1".

The resulting panel data set covers *all* employed registered nurses in Norway in the period 1997–1999. "Appendix 2" shows the data for nurses and compares them with the data for physicians as reported in Andreassen et al. (2013). We only use observations of married individuals who did not change their marital status during the observation period. Table 9 in "Appendix 2" shows the sample selection. The final sample has 28,578 married nurses.

We have coded the data so that we ended up with 10 different sectors of work described above. Table 10 gives the distribution of physicians and nurses across sectors. Most nurses work in hospitals and primary care. Among working nurses, 59 % work part-time in 1999, while only 31 % of working physicians work part-time.

Our data only included hours worked per year, so weekly hours are calculated by dividing hours worked in a year by 48 (weeks in a year minus vacation). Table 11 shows the number of hours worked in the different sectors. Working hours for full-time jobs are longer in the private sector compared to in the public sector, while working hours for part-time jobs are longer in the public sectors. Table 12 reports also the distribution between short part-time and long part-time for nurses.

[5] The PAI register consists of data on workers in public enterprises, including physicians and nurses working in hospitals and health care.

Table 13 shows the mean of the explanatory variables for married physicians and married registered nurses. Women constitute around 27 % of physicians and 95 % of nurses. Thirteen percent of nurses are married with somebody in the health sector, and 43 % of physicians are married with somebody in the health sector. The percentage of nurses with an external job decreases from 7 % in 1997 to 6 % in 1999. For physicians, the percentages changes from 10 to 8 %.

Our model is based on the assumption that we can simulate the different levels of consumption and leisure which could be achieved by each individual in each sector if they chose to work there. Our calculations are based on estimated wage equations done independently for the 3 years 1997, 1998 and 1999. The resulting levels of possible consumption and leisure are reported in Tables 14 and 15, respectively. For the states which are observed chosen by an individual, we use observed leisure, while for other potential, but not chosen states, we use average leisure among those observed in the state. Consumption is determined by wage income, capital income, transfer income and the income of the spouse. All income variables were deflated by the consumer price index. Leisure is expressed as a percentage of available time. Available time includes time over the weekends and vacation time but excludes 12 h per day of sleeping and personal care time.

In "Appendix 3", Tables 16, 17, 18 and 19, we report the observed transitions across states. Although "stayers" are dominating, there are also a considerable amount of "movers".

"Appendix 4" reports the data and the estimates of the wage equation.

4 Estimates

In this section, we report the results for the labor supply of nurses alongside with the results for physicians estimated by Andreassen et al. (2013). We believe that it is useful to make a comparison between nurses and physicians because they are the two most important parts of the health workforce.

Estimation of the utility function is given in Table 1, which also contains the estimation of the difference between the parameters for nurses and physicians, with the corresponding standard errors and the level of statistical significance.

The exponents (λ for consumption and γ for leisure) in the utility function are both less than 1 which implies that the utility function is strictly concave. For both medical doctors and nurses, the marginal utility of consumption is declining in consumption. For nurses, the part of the utility that is related to leisure is not significantly different from a log-linear function.

The differences between physicians' and nurses' parameters are statistically significant. In particular, the exponent λ for consumption is higher for nurses, while the exponent γ for leisure is higher for physicians implying.

The marginal utility of consumption is a concave function of age with a peak around 40 years of age for nurses and 45 for medical doctors, see Fig. 1. Therefore, the marginal utility of consumption starts declining at a younger age for nurses than for physicians, again indicating that doctors are more concerned about monetary remuneration than nurses.

Table 1 Estimates of the utility function

Variables	Physicians		Nurses		Difference	
	Estimate	SE	Estimate	SE	Estimate	SE
Consumption						
Constant	−2.28**	0.823	−3.10**	0.4116	0.82	0.9201
Age, 1998	0.14**	0.0355	0.22**	0.0179	−0.07	0.0397
	–					
Age squared	0.0016**	0.0004	−0.0028**	0.0002	0.0012**	0.0004
Spouse in health sector	0.15**	0.0541	0.10*	0.0512	0.05	0.0745
More than one job	0.22**	0.0526	0.10**	0.0338	0.12*	0.0626
Last year of University (turnus)[a]	−0.71**	0.1933	–	–		
Exponent λ	0.31**	0.0651	0.55**	0.0335	−0.24**	0.0732
Leisure						
Constant	5.07**	0.3906	3.75**	0.2324	1.32**	0.4545
No. of children less than 7 years	0.09	0.096	1.04**	0.0644	−0.95**	0.1156
No. of children 7–18 years	0.24**	0.0729	0.20**	0.0441	0.04	0.0852
Female	0.1	0.1626	1.08**	0.1794	−0.98**	0.2421
Exponent γ	0.42*	0.1799	−0.08	0.0875	0.51*	0.2001
Habit persistence						
Constant	13.76**	1.4822	4.85**	0.467	8.91**	1.554
Age, 1998	−0.49**	0.0593	−0.13**	0.0202	−0.36**	0.0627
Age squared	0.0046**	0.0006	0.0013**	0.0002	0.0033**	0.0006
No. of observations	6564		28,578			
Log-likelihood	−10,993.10		−38,088.10			

* Statistically significant at 5 % level, ** statistically significant at 1 % level

[a] It is mandatory for all physicians to work their final year of studying medicine as an apprentice doctor in a given, often rural, location

For both nurses and physicians, the marginal utility of consumption is shifted upwards if the spouse also works in the health sectors. This implies that health workers married to health workers have stronger incentives to work longer hours in the health sector than other health workers.

The impact of having children below the age of 7 on the leisure term is not significantly different from zero for physicians but positive for nurses. Nurses with children below 7 value their leisure time more than physicians with children below 7. Thus, nurses with small children are less willing to work long hours compared to physicians. It is interesting to note that the impact of older children on the marginal utility of leisure is positive and similar for both nurses and physicians.

Our result that nurses value leisure more than physicians is reenforced by the estimate of the parameter of the dummy for females in the leisure term of the utility function. This parameter is not significantly different from zero for physicians, but it becomes significant and positive for nurses. The difference in this parameter for nurses and physicians is also statistically significant.

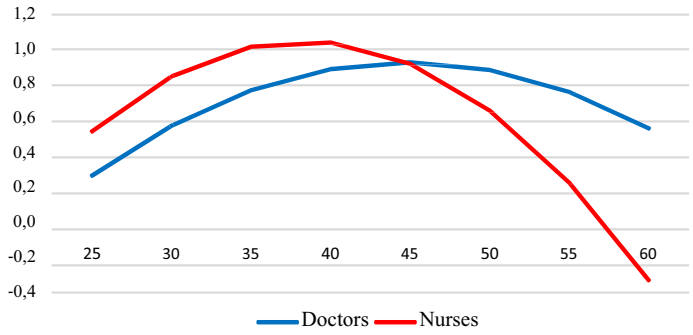

Fig. 1 Marginal utility of consumption and age

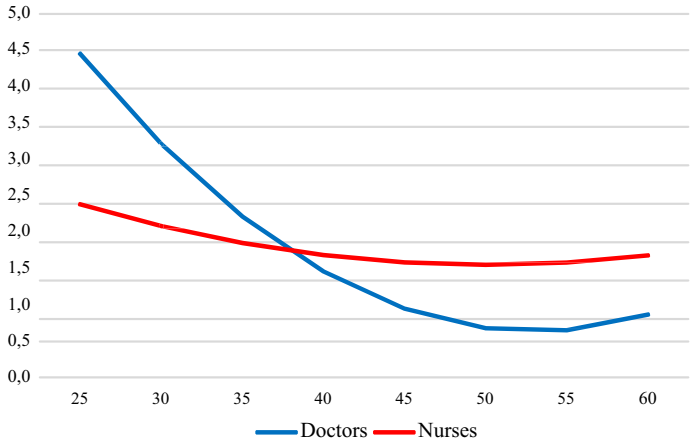

Fig. 2 Habit persistence and age

The estimate of the habit persistence parameters, $\rho's$, implies that if age is ignored, the utilities are less correlated across time for doctors than for nurses. Thus, physicians are more mobile than nurses. If we take into account the age (see Fig. 2), the young are more mobile than the old, given wages, taxes and other incentives. As shown in Fig. 2, this is particularly the case for medical doctors.

Mobility, as captured by the habit persistence parameters, is declining with age, more strongly for physicians than for nurses, and with a weak tendency of increasing again when the health workers are approaching retirement age.

Table 2 provides the estimates of the rationing function, i.e., the availability of jobs. For nurses, the values of the parameters for jobs' availability are higher in absolute values than for physicians, which means that rationing of jobs for nurses is stricter than for physicians. Thus, physicians have more options when it comes to working hours and sectors. For nurses, the estimates also imply that long part-time jobs are more available in the public sectors. Full-time jobs instead are more available in the private than in the public sector.

Table 2 Estimates of the rationing function (job availability)

Sector	Physicians	SE	Nurses	SE
1. Public sector, long part-time			4.69**	0.0311
2. Public hospital, full-time	0.25**	0.0024	6.03**	0.0427
3. Private hospital, long part-time			3.91**	0.1486
4. Private hospital, full-time	0.13**	0.0078	6.16**	0.1690
5. Public health care, long part-time			4.70**	0.0326
6. Public health care, full-time	0.21**	0.0038	5.98**	0.0450
7. Private health care, long part-time			3.66**	0.1387
8. Private health care, full-time	0.17**	0.0060	6.26**	0.1398
9. Other, long part-time			4.09**	0.0486
No. of observations	6,564		28,578	
Log-likelihood	−10,993.1		−38,088.1	

The rationing of part-time in the case of nurses concerns long part-time
* Statistically significant at 5 % level, ** statistically significant at 1 % level

The goodness of fit for this model is given in Figs. 3 and 4. With a few exceptions, in particular for private hospitals where the observations are few, the model fits the data pretty well.

5 Elasticities

In Table 3, we report the impact of an overall wage increase in all years from 1997 to 1999 on labor supply in 1999. In Table 4, we report similar elasticities based on some selected characteristics.

We observe that the labor supply of both nurses and doctor is rather inelastic (Table 3). An overall wage increase of 1 % increases labor supply in terms of total hours of work in 1999 by only 0.03–0.04 %. However, an overall wage increase is predicted to have a stronger impact on the distribution of physicians and nurses across job types. An overall wage increase is predicted to shift in particular physicians to full-time jobs in hospitals. An overall wage increase is predicted to increase the number of nurses working full-time in the private sector.

Table 4 shows the percentage changes in hours in 1999 when wages increase by 1 % in all years (1997–1999). Labor supply elasticities of physicians do not vary much according to age. However, the wage elasticities of nurses vary more, being higher if they are not working, than if they are working full-time or part-time. The elasticities for those not working are higher for nurses than for physicians. Having young children does not affect the labor supply of physicians (the coefficient is not significantly different from zero), but has a relatively strong effect on the wage elasticities of nurses. These results indicate that for nurses the work/not work decision is more important than for physicians (especially if they have young children), while income plays a greater role for physicians.

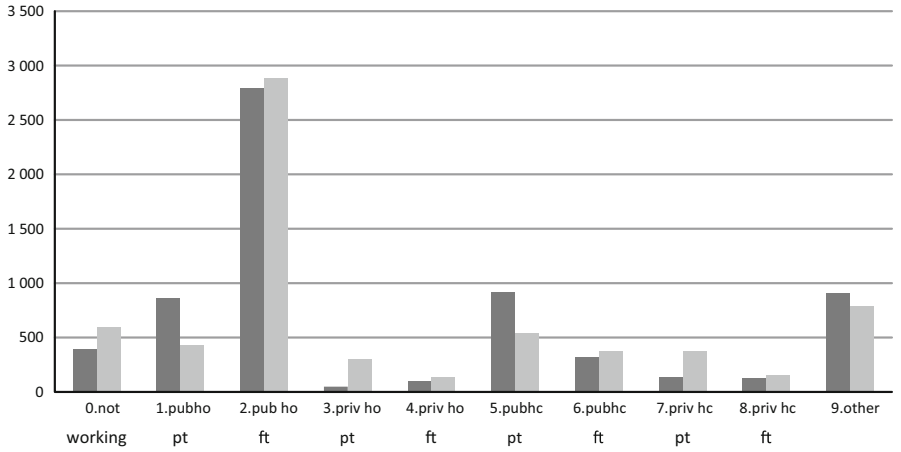

Fig. 3 Medical doctors, 1999. Goodness of fit. *Black* observed, *gray* model

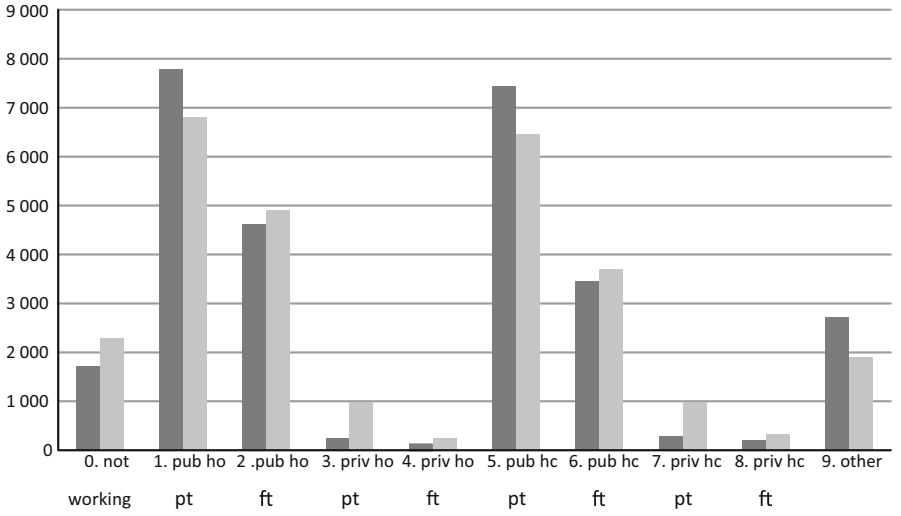

Fig. 4 Nurses,1999. Goodness of fit. *Black* observed, *gray* model

6 Policy simulation

In Table 5, we report the impact of change in taxation away from the current progressive tax system toward a flat tax of 28 %, which is a substantial change. The change in taxation is implemented for the whole period 1997–1999. This change in taxation gives the medical doctors an incentive to shift their work from part-time jobs to full-time jobs, in particular to jobs in the private sector. The reason for this is that wage levels and wage dispersion are much higher in the private than in the public sector. By moving to the private sector and by increasing their working loads, the medical doctor can keep more of their gross gain due to lower taxes. For nurses, the impact of

Table 3 Labor supply elasticities in 1999 based on the observed population

Sector	Physicians	Nurses
0. Not working	−0.30	−0.24
1. Public sector, part-time	0.02	0.00
2. Public hospital, full-time	0.03	0.03
3. Private hospital, part-time	0.04	0.03
4. Private hospital, full-time	0.26	0.14
5. Public health care, part-time	−0.03	0.00
6. Public health care, full-time	0.06	0.04
7. Private health care, part-time	−0.03	0.00
8. Private health care, full-time	0.14	0.10
9. Other	0.04	0.04
Weighted average of total hours	0.04	0.03

Percent change in number of worker and hours when wages increase by 1 % in all years 1997–1999

Table 4 Labor supply elasticities in 1999 based on selected combinations of observed characteristics

	30 years of age		40 years of age		50 years of age	
	Physicians	Nurses	Physicians	Nurses	Physicians	Nurses
Not working in 1997						
No children 18 or younger	0.11	0.18	0.12	0.18	0.10	0.11
Two young children (0–6 years)	0.11	0.24	0.12	0.24	0.10	0.14
Working part-time in hospital in 1997						
No children 18 or younger	0.11	0.01	0.12	0.01	0.09	0.01
Two young children (0–6 years)	0.11	0.02	0.12	0.02	0.09	0.01
Working full-time in hospital in 1997						
No children 18 or younger	0.11	0.01	0.11	0.01	0.08	0.01
Two young children (0–6 years)	0.11	0.04	0.11	0.04	0.08	0.03

Percent change in hours in 1999 when wages increase by 1 % in all years 1997–1999. Females with a husband who does not work in the health sector

lower taxes is much weaker. Most of them have lower income in potential new jobs, even in the private sector, than physicians, and therefore, they do not benefit that much from shifting jobs. Some of the nurses have so low potential income that the flat tax of 28 % increases their taxes. Moreover, their spouses get higher disposable income and this also has a negative impact on their labor supply. We therefore find that some quit working.

7 Conclusion

We have estimated a discrete choice model with random terms where we allow for these terms to be correlated over time and jobs (habit persistence). Past options and not only the past optimal choices matter for the current choices. Given observed incentives,

Table 5 Change in labor supply with the introduction of a flat tax

Sector	Physicians	Nurses
0. Not working	−1.53	0.71
1. Public sector, part-time	−1.73	−0.27
2. Public hospital, full-time	0.79	0.32
3. Private hospital, part-time	−2.84	−0.81
4. Private hospital, full-time	11.43	1.77
5. Public health care, part-time	−2.17	−0.25
6. Public health care, full-time	1.98	0.35
7. Private health care, part-time	−3.49	−0.89
8. Private health care, full-time	5.05	1.04
9. Other, part- and full-time	−0.54	−0.06
Weighted average of total hours	0.76	0.05

Percent change in number of worker and hours when a flat tax of 28 % is implemented for the whole period 1997–1999

we find that both nurses and in particular medical doctors are mobile when they are young, but there is a weak tendency of higher mobility again when physicians and nurses are approaching retirement age.

Wage increases have a modest impact on labor supply. The overall elasticity for both physicians and nurses is close to zero. These low elasticities shadow to some extent for stronger responses, shifting labor away from part-time jobs in the public and private sector toward full-time jobs in the private sector when wages are increased. This latter result accords well with facts. In recent years, the real wages in Norway have increased substantially and there are now more physicians and nurses working in private hospitals. The regulation of hours is more rigid in the public than in the private sector.

In our paper, nurses cannot choose any hours that they would like to work, given the job they occupy. They can choose between 10 different sectors with different working loads some in the private sector and some in the public sector, including not working, In order to work more, they have to shift job. The availability of the different types of jobs and working loads is estimated in the model, together with preferences. The availability of the different types of jobs captures the institutional constraints in the health sector, determined by employers and unions. These constraint and job persistence in preferences are the main reason for the weak impact of changes in economic incentives on job mobility and labor supply. So, we do not think that a wage change, e.g. 10 %, will move many people from part-time to full-time work. This is our main point and we refer to other papers (like Askildsen et al. 2003; Hanel et al. 2014), where institutional constraints and job persistence are ignored. It should also be noted that we use transition data to estimate our model, while the above papers use cross-sectional data. Our conclusion is thus that labor supply among nurses is rather inelastic. To increase labor supply in the population of nurses, longer shifts and therefore less part-time work would be more effective. In Norway, the unions have opposed such a change.

Our results indicate that a reform that removes some of the constraints related to the lack of full-time jobs for nurses may increase labor supply.

A change in taxation away from the progressive tax system toward a flat tax of 28 % gives medical doctors an incentive to shift their job to private hospitals. The reason for this is that the wage level and dispersion are much higher in the private than in the public sector. With a lower and flat tax rate, they can keep more of these private benefits. For nurses, the impact is much more modest. Their potential wage when moving is not that much higher than in the public sector, at least compared with the situation for physicians.

Appendix 1: Tax functions

See Tables 6, 7 and 8.

Table 6 Tax function, 1997

Nominal income (NOK) Y	Tax T (NOK)
0–18,198	0
18,198–24,709	0.25Y–4250
24,709–30,125	0.078Y
30,125–156,500	0.302Y–6748
156,500–233,000	0.358Y–15,512
233,000–262,500	0.453Y–37,647
262,500–	0.495Y–48,672

Table 7 Tax function, 1998

Nominal income (NOK) Y	Tax T (NOK)
0–18,198	0
18,198–24,709	0.25Y–4250
24,709–31,250	0.078Y
31,250–163,000	0.302Y–7000
163,000–248,000	0.358Y–16,128
248,000–272,000	0.453Y–39,688
272,000–	0.495Y–51,112

Table 8 Tax function, 1999

Nominal income (NOK) Y	Tax T (NOK)
0–21,800	0
21,800–31,105	0.25Y–5350
31,105–33,291	0.078Y
33,291–166,190	0.2992Y–7364
166,190–269,100	0.358Y–17,136
269,100–	0.493Y–53,465

Appendix 2: Data

In this appendix, the data and estimates for physicians are copied from Andreassen et al. (2013) (Tables 9, 10, 11, 12, 13, 14, 15).

Table 9 Sample selection

	Physicians	Nurses
Norwegian physicians and nurses in 2000, original data set	12,376	55,180
Dropped due to missing sector or missing gender	688	1122
Dropped if not a doctor or nurse in 1997, 1998 or 1999	2172	9,458
Dropped if not married throughout 1997 to 1999	2.934	16,022
Dropped if occupation not relevant	18	0
Total retained married physicians and married nurses	6564	28,578

Table 10 Number of married physicians and married nurses in the different sectors

	Physicians			Nurses		
	1997	1998	1999	1997	1998	1999
0. Not working	334	377	394	1051	1423	1717
1. Public hospital, part-time	857	792	862	7404	7595	7786
2. Public hospital, full-time	2750	2828	2786	4729	4870	4609
3. Private hospital, part-time	39	34	39	194	226	246
4. Private hospital, full-time	77	86	92	112	112	117
5. Public health care, part-time	785	830	912	7555	7376	7428
6. Public health care, full-time	402	355	318	3549	3517	3459
7. Private health care, part-time	118	135	131	242	242	293
8. Private health care, full-time	96	110	121	146	179	204
9. Other	1106	1017	909	3596	3038	2719
Total	6564	6564	6564	28, 578	28, 578	28, 578

Table 11 Average weekly hours across sectors

	Physicians			Nurses		
	1997	1998	1999	1997	1998	1999
1. Public hospital, part-time	20.0	19.1	18.7	21.8	21.4	20.9
2. Public hospital, full-time	40.0	39.9	39.3	39.9	39.9	39.2
3. Private hospital, part-time	19.1	20.2	18.5	18.7	18.9	18.7
4. Private hospital, full-ime	42.2	41.9	42.1	42.5	42.3	42.3
5. Public health care, part-time	16.7	15.7	15.6	21.4	21.1	20.9
6. Public health care, full-time	40.5	40.6	40.6	39.7	39.7	39.5
7. Private health care, part-time	14.6	13.2	13.9	19.0	18.3	18.4
8. Private health care, full-time	42.3	42.6	42.8	42.3	42.8	42.5
9. Other	29.3	26.7	26.2	28.9	27.7	27.6

Married physicians and married nurses

Table 12 Distribution between short part-time and long part-time among married nurses

	Short part-time (less than 20 h a week)			Long part-time 20–29 h a week		
	1997	1998	1999	1997	1998	1999
1. Public hospital, part-time	21.0	23.2	25.0	79.0	76.8	75.0
3. Private hospital, part-time	52.1	42.5	44.3	47.9	57.5	55.7
5. Public health care, part-time	24.3	25.8	27.3	75.7	74.2	72.7
7. Private health care, part-time	51.7	49.6	49.1	48.3	50.4	50.9
9. Other[a]	14.1	16.5	18.1	49.4	45.7	46.1

Percent
[a] Sector 9 includes full time

Table 13 Mean of the explanatory variables for married physicians and married registered nurses

	Physicians			Nurses		
	1997	1998	1999	1997	1998	1999
Female	0.27	0.27	0.27	0.94	0.94	0.94
Age	45	46	47	43	44	45
Age squared	2108	2199	2292	1902	1988	2077
No. of children younger than 7 years	0.68	0.58	0.49	0.61	0.52	0.44
No. of children 7–18 years of age	1.01	1.03	1.04	0.95	0.97	0.98
Spouse working in health sector	0.43	0.43	0.43	0.13	0.13	0.13
Has a side job	0.10	0.09	0.08	0.07	0.06	0.06
Works "turnus" (internship)[a]	0.03	0.01	0.00	–	–	–
Number observations	6564	6564	6564	28,578	28,578	28,578

[a] It is mandatory for all physicians to work their final year of studying medicine as an apprentice doctor in a given, often rural, location

Table 14 Mean consumption for married physicians and married nurses by sector

	Physicians			Nurses		
	1997	1998	1999	1997	1998	1999
0. Not working	234,008	208,758	230,922	154,233	207,313	228,687
1. Public hospital, part-time	376,104	347,365	366,002	247,612	308,821	330,624
2. Public hospital, full-time	457,517	444,162	467,571	310,696	379,912	408,697
3. Private hospital, part-time	375,572	370,105	370,429	253,758	308,453	337,562
4. Private hospital, full-time	514,895	497,835	556,823	315,138	382,632	415,413
5. Public health care, part-time	334,460	308,563	332,590	245,368	306,601	330,230
6. Public health care, full-time	448,288	439,211	467,161	310,529	379,140	407,684
7. Private health care, part-time	325,550	304,015	330,991	247,038	305,830	326,544
8. Private health care, full-time	446,135	446,595	497,167	309,615	373,088	407,585
9. Other	399,800	368,367	394,853	273,183	333,602	359,893

Norwegian kroner

Table 15 Mean leisure for married physicians and married nurses by sector

	Physicians			Nurses		
	1997 (%)	1998 (%)	1999 (%)	1997 (%)	1998 (%)	1999 (%)
0. Not working	100.0	100.0	100.0	100.0	100.0	100.0
1. Public hospital, part-time	78.1	79.1	79.4	75.9	76.4	76.9
2. Public hospital, full-time	56.2	56.2	56.9	56.3	56.3	57.0
3. Private hospital, part-time	79.1	77.9	79.8	79.5	79.3	79.5
4. Private hospital, full-time	53.7	54.1	53.9	53.4	53.7	53.6
5. Public health care, part-time	81.7	82.9	82.9	76.5	76.7	77.0
6. Public health care, full-time	55.6	55.5	55.5	56.5	56.5	56.7
7. Private health care, part-time	84.0	85.6	84.7	79.2	79.9	79.8
8. Private health care, full-time	53.7	53.3	53.1	53.7	53.1	53.4
9. Other	68.0	70.7	71.3	68.4	69.5	69.7

Percent of available time

Appendix 3: Observed transition rates for nurses, transition rates for physicians are given in Andreassen et al. (2013)

See Tables 16, 17, 18 and 19.

Table 16 Transitions of married nurses from 1997 to 1998

	Hospitals					Primary care					Total
	Not working	Public		Private		Public		Private		Other	
	0.	Part time 1.	Full time 2.	Part time 3.	Full time 4.	Part time 5.	Full time 6.	Part time 7.	Full time 8.	9.	
0. Not working	**624**	124	37	6	0	126	7	8	2	117	1051
1. Public hospitals, part-time	245	**5646**	878	17	11	270	61	29	11	236	7404
2. Public hospitals, full-time	39	922	**3552**	9	4	53	52	3	6	89	4729
3. Private hospitals, part-time	9	12	4	**124**	16	18	5	2	0	4	194
4. Private hospitals, full-time	3	4	4	32	**59**	4	2	1	1	2	112
5. Public primary care, part-time	295	237	91	24	12	**5846**	721	28	14	287	7555
6. Public primary care, full-time	47	59	40	4	3	762	**2512**	5	6	111	3549
7. Private primary care, part-time	11	21	10	5	1	26	5	**121**	30	12	242
8. Private primary care, full-time	4	2	5	0	2	4	4	23	**100**	2	146
9. Other	146	568	249	5	4	267	148	22	9	**2178**	3596
Total	1423	7595	4870	226	112	7376	3517	242	179	3038	28, 578

Number of individuals. The column to the left gives the states in 1997. Bold value indicates that the individual does not change state

Table 17 Transitions of married nurses from 1998 to 1999

	Hospitals					Primary care					Total
	Not working	Public		Private		Public		Private		Other	
	0.	Part time 1.	Full time 2.	Part time 3.	Full time 4.	Part time 5.	Full time 6.	Part time 7.	Full time 8.	9.	
0. Not working	**872**	133	35	9	3	186	12	13	2	158	1423
1. Public hospitals, part-time	296	**5852**	729	23	7	327	78	35	11	237	7595
2. Public hospitals, full-time	45	1043	**3506**	6	8	81	74	6	14	87	4870
3. Private hospitals, part-time	5	22	6	**140**	16	19	10	0	0	8	226
4. Private hospitals, full-time	1	2	6	27	**71**	3	1	0	1	0	112
5. Public primary care, part-time	310	297	91	26	5	**5685**	652	37	17	256	7376
6. Public primary care, full-time	45	50	93	7	5	764	**2433**	7	16	97	3517
7. Private primary care, part-time	9	19	2	1	0	30	9	**137**	18	17	242
8. Private primary care, full-time	1	3	4	0	0	6	8	35	**118**	4	179
9. Other	133	365	137	7	2	327	182	23	7	**1855**	3038
Total	1717	7786	4609	246	117	7428	3459	293	204	2719	28, 578

Number of individuals. The column to the left gives the states in 1998. Bold value indicates that the individual does not change state

Table 18 Transitions of married nurses from 1997 to 1998

	Hospitals					Primary care					Total
	Not working	Public		Private		Public		Private		Other	
	0.	Part time 1.	Full time 2.	Part time 3.	Full time 4.	Part time 5.	Full time 6.	Part time 7.	Full time 8.	9.	
0. Not working	**0.59**	0.12	0.04	0.01	0.00	0.12	0.01	0.01	0.00	0.11	1.00
1. Public hospitals, part-time	0.03	**0.76**	0.12	0.00	0.00	0.04	0.01	0.00	0.00	0.03	1.00
2. Public hospitals, full-time	0.01	0.20	**0.75**	0.00	0.00	0.01	0.01	0.00	0.00	0.02	1.00
3. Private hospitals, part-time	0.05	0.06	0.02	**0.64**	0.08	0.09	0.03	0.01	0.00	0.02	1.00
4. Private hospitals, full-time	0.03	0.04	0.04	0.29	**0.53**	0.04	0.02	0.01	0.01	0.02	1.00
5. Public primary care, part-time	0.04	0.03	0.01	0.00	0.00	**0.77**	0.10	0.00	0.00	0.04	1.00
6. Public primary care, full-time	0.01	0.02	0.01	0.00	0.00	0.21	**0.71**	0.00	0.00	0.03	1.00
7. Private primary care, part-time	0.05	0.09	0.04	0.02	0.00	0.11	0.02	**0.50**	0.12	0.05	1.00
8. Private primary care, full-time	0.03	0.01	0.03	0.00	0.01	0.03	0.03	0.16	**0.68**	0.01	1.00
9. Other	0.04	0.16	0.07	0.00	0.00	0.07	0.04	0.01	0.00	**0.61**	1.00

Shares. The column to the left gives the states in 1997. Bold value indicates that the individual does not change state

Table 19 Transitions of married nurses from 1998 to 1999

	Hospitals					Primary care					Total
	Not working	Public		Private		Public		Private		Other	
	0.	Part time 1.	Full time 2.	Part time 3.	Full time 4.	Part time 5.	Full time 6.	Part time 7.	Full time 8.	9.	
0. Not working	**0.61**	0.09	0.02	0.01	0.00	0.13	0.01	0.01	0.00	0.11	1.00
1. Public hospitals, part-time	0.04	**0.77**	0.10	0.00	0.00	0.04	0.01	0.00	0.00	0.03	1.00
2. Public hospitals, full-time	0.01	0.21	**0.72**	0.00	0.00	0.02	0.02	0.00	0.00	0.02	1.00
3. Private hospitals, part-time	0.02	0.10	0.03	**0.62**	0.07	0.08	0.04	0.00	0.00	0.04	1.00
4. Private hospitals, full-time	0.01	0.02	0.05	0.24	**0.63**	0.03	0.01	0.00	0.01	0.00	1.00
5. Public primary care, part-time	0.04	0.04	0.01	0.00	0.00	**0.77**	0.09	0.01	0.00	0.03	1.00
6. Public primary care, full-time	0.01	0.01	0.03	0.00	0.00	0.22	**0.69**	0.00	0.00	0.03	1.00
7. Private primary care, part-time	0.04	0.08	0.01	0.00	0.00	0.12	0.04	**0.57**	0.07	0.07	1.00
8. Private primary care, full-time	0.01	0.02	0.02	0.00	0.00	0.03	0.04	0.20	**0.66**	0.02	1.00
9. Other	0.04	0.12	0.05	0.00	0.00	0.11	0.06	0.01	0.00	**0.61**	1.00

Shares. The column to the left gives the states in 1998. Bold value indicates that the individual does not change state

Appendix 4: Wage equations and selection effects for nurses, for physicians see Andreassen et al. (2013)

We estimate wage equations for all individuals for the 3 years 1997, 1998 and 1999. The wage equations for physicians are documented in Andreassen et al. (2013). The wage equations for nurses are documented below. We take sample selection into account by including the predicted choice probabilities as explanatory variables in the wage equations. These probabilities were the predictions resulting from a simple multinomial logit estimation of sector choice. We show the mean of the explanatory variables used in the estimation of the choice probabilities in Table 20. The estimates of the choice probabilities are given in Table 21, and the resulting average predicted probabilities are given in Tables 22, along with the means of the other variables used in the wage equations. The logit estimations were done on all nurses in a given year, while the wage equations were estimated on all working nurses with observations of wage income (Table 23). The estimates of the wage equations are given in Table 24. The wage equations for all nine work sectors have been estimated simultaneously using maximum likelihood, allowing for correlation between the different wages. The parameters σ_1 to σ_9 are the variance parameters mentioned in the main paper, and the parameters κ_1 to κ_9 are the parameters allowing for correlation between sectors. As shown in tables, these correlation factors are not found to be significant, indicating that there is not much residual correlation between the different wages after correcting for the other explanatory variables. In general, being a woman reduces wages, while wages increase with age. Table 25 shows the mean and predicted hourly wages for nurses and derived from predictions using the estimated wage equations reported above. Table 26 shows the predicted wages for physicians based on the wage equations documented in Andreassen et al. (2013). The wages for doctors are higher and vary more than the wages of nurses.

Table 20 Mean of the explanatory variables for the logit estimation

	1997	1998	1999
Female	0.93	0.93	0.92
Birthyear	1940	1940	1941
Married	0.70	0.66	0.66
No. of children younger than 7 years	0.60	0.52	0.43
No. of children 7–18 years of age	0.72	0.72	0.71
Less than 16 years of education	0.83	0.81	0.75
Sixteen or more years of education	0.14	0.16	0.21
Missing education	0.03	0.04	0.04
Spouse working in health sector	0.09	0.09	0.09
Income of spouse, NOK	76,689	79,613	83,498
Number observations	44,600	47,793	51,874

All nurses

Table 21 Logit estimates of choice of sector and hours (job type)

	1997 Coeff.	SE	1998 Coeff.	SE	1999 Coeff.	SE
1. Public hospital, part-time						
Female	−0.14	0.1342	−0.06	0.1173	−0.12	0.0996
Birthyear	−0.07***	0.0031	−0.08***	0.0027	−0.09***	0.0023
Married	0.46***	0.0840	0.33***	0.0624	0.45***	0.0574
No. of children younger than 7 years	−0.41***	0.0340	−0.44***	0.0313	−0.46***	0.0308
No. of children 7–18 years of age	−0.01	0.0313	0.18***	0.0283	0.28***	0.0273
Sixteen or more years of education	0.22**	0.0922	0.12	0.0717	0.27***	0.0603
Missing education	−0.98***	0.1002	−1.28***	0.0847	−1.81***	0.0724
Spouse working in health sector	0.39***	0.1110	0.40***	0.0952	0.42***	0.0888
Income of spouse (1/1,000,000)	−0.16	0.4830	−0.10	0.2480	−0.16	0.2150
Constant	135.1***	6.0983	153.0***	5.1505	168.0***	4.5298
2. Public hospital, full-time						
Female	−1.04***	0.1324	−1.17***	0.1147	−1.04***	0.0982
Birthyear	−0.06***	0.0032	−0.07***	0.0027	−0.07***	0.0024
Married	0.49***	0.0880	0.04	0.0649	0.17***	0.0602
No. of children younger than 7 years	−0.90***	0.0364	−1.02***	0.0345	−1.12***	0.0353
No. of children 7–18 years of age	−0.33***	0.0329	−0.15***	0.0298	−0.01	0.0288
Sixteen or more years of education	0.90***	0.0918	0.64***	0.0716	0.32***	0.0616
Missing education	−1.40***	0.1087	−1.69***	0.0932	−1.96***	0.0779
Spouse working in health sector	0.75***	0.1127	0.67***	0.0967	0.77***	0.0903
Income of spouse (1/1,000,000)	−3.48***	0.5320	0.06	0.2580	−0.16	0.2270
Constant	122.1***	6.1379	144.2***	5.2216	146.1***	4.6024
3. Private hospital, part-time						
Female	−0.24	0.2705	−0.03	0.2713	−0.14	0.2318
Birthyear	−0.08***	0.0076	−0.10***	0.0070	−0.09***	0.0061
Married	0.48**	0.2033	0.73***	0.1640	0.80***	0.1529
No. of children younger than 7 years	−0.60***	0.0796	−0.67***	0.0779	−0.67***	0.0794
No. of children 7–18 years of age	−0.21***	0.0744	−0.01	0.0654	0.12	0.0603
Sixteen or more years of education	0.41**	0.1884	0.24	0.1628	0.34***	0.1285
Missing education	−1.86***	0.4239	−1.91***	0.3672	−2.33***	0.3446
Spouse working in health sector	0.48**	0.2288	0.38	0.2105	0.36	0.2001
Income of spouse (1/1,000,000)	−0.31	1.1800	0.07	0.6080	−0.16	0.5380
Constant	154.4***	14.7357	196.1***	13.4715	182.4***	11.8952
4. Private hospital, full-time						
Female	−0.73***	0.2622	−0.92***	0.2436	−0.76***	0.2589
Birthyear	−0.09***	0.0086	−0.09***	0.0081	−0.08***	0.0083
Married	0.66**	0.2575	0.31	0.2066	0.41*	0.2165
No. of children younger than 7 years	−0.84***	0.0967	−1.03***	0.1127	−0.95***	0.1316
No. of children 7–18 years of age	−0.59***	0.1071	−0.24***	0.0922	0.07	0.0858
Sixteen or more years of education	0.63***	0.2126	0.72***	0.1766	0.49***	0.1697

Table 21 continued

	1997 Coeff.	SE	1998 Coeff.	SE	1999 Coeff.	SE
Missing education	−1.90***	0.4644	−2.36***	0.5132	−2.48***	0.5131
Spouse working in health sector	0.47	0.2848	0.64	0.2536	0.65	0.2559
Income of spouse (1/1,000,000)	−2.50	1.7800	−1.19	0.9210	0.15	0.7550
Constant	177.4***	16.6418	173.5***	15.6853	147.2***	16.0066
5. Public health care, part-time						
Female	0.17	0.1386	0.02	0.1204	0.16	0.1040
Birthyear	−0.03***	0.0031	−0.05***	0.0027	−0.06***	0.0023
Married	1.05***	0.0855	0.51***	0.0632	0.60***	0.0580
No. of children younger than 7 years	−0.21***	0.0345	−0.25***	0.0317	−0.26***	0.0311
No. of children 7–18 years of age	0.12***	0.0313	0.26***	0.0284	0.35***	0.0274
Sixteen or more years of education	0.05	0.0932	−0.11	0.0731	0.15**	0.0612
Missing education	−1.08***	0.1046	−1.32***	0.0885	−1.71***	0.0748
Spouse working in health sector	0.05	0.1127	0.10	0.0969	0.12	0.0907
Income of spouse (1/1,000,000)	−3.69***	0.5030	−0.13	0.2470	−0.35	0.2160
Constant	63.6***	6.1181	97.5***	5.1858	118.5***	4.5636
6. Public health care, full-time						
Female	−0.77***	0.1376	−0.94***	0.1196	−0.92***	0.1026
Age	−0.05***	0.0033	−0.06***	0.0029	−0.06***	0.0026
Married	1.22***	0.0935	0.34***	0.0694	0.48***	0.0646
No. of children younger than 7 years	−0.75***	0.0389	−0.78***	0.0368	−0.84***	0.0373
No. of children 7–18 years of age	−0.12***	0.0337	0.08***	0.0306	0.22***	0.0294
Sixteen or more years of education	0.77***	0.0945	0.59***	0.0744	0.38***	0.0644
Missing education	−1.11***	0.1186	−1.47***	0.1056	−1.71***	0.0883
Spouse working in health sector	0.37***	0.1172	0.38***	0.1013	0.46***	0.0947
Income of spouse (1/1,000,000)	−5.97***	0.5730	0.08	0.2680	−0.02	0.2350
Constant	90.7***	6.4986	111.4***	5.5906	119.3***	4.9660
7. Private health care, part-time						
Female	−0.69***	0.2334	−0.33	0.2314	−0.45**	0.1954
Age	−0.05***	0.0073	−0.06***	0.0064	−0.06***	0.0057
Married	0.35*	0.1901	0.11	0.1533	0.33**	0.1377
No. of children younger than 7 years	−0.46***	0.0777	−0.58***	0.0788	−0.42***	0.0733
No. of children 7–18 years of age	−0.02	0.0656	0.23***	0.0579	0.37***	0.0523
Sixteen or more years of education	0.11	0.1899	−0.10	0.1684	0.06	0.1301
Missing education	−1.71***	0.3938	−1.60***	0.3039	−1.98***	0.2706
Spouse working in health sector	0.59***	0.2015	0.85***	0.1786	0.63***	0.1697
Income of spouse (1/1,000,000)	0.74	0.9870	0.03	0.5920	−0.60	0.5180
Constant	105.2***	14.1402	120.2***	12.4772	109.9***	11.0013

Table 21 continued

	1997 Coeff.	SE	1998 Coeff.	SE	1999 Coeff.	SE
8. Private health care, full-time						
Female	−0.68**	0.2916	−0.90***	0.2500	−0.80***	0.2178
Age	−0.06***	0.0092	−0.07***	0.0083	−0.06***	0.0072
Married	0.85***	0.2566	0.88***	0.2056	0.61***	0.1844
No. of children younger than 7 years	−0.99***	0.1213	−0.77***	0.1068	−0.72***	0.1052
No. of children 7–18 years of age	−0.28***	0.0886	0.07	0.0732	0.25***	0.0664
Sixteen or more years of education	0.91***	0.1930	0.80***	0.1605	0.52***	0.1450
Missing education	−1.43***	0.4663	−1.98***	0.5128	−2.11***	0.3908
Spouse working in health sector	0.74***	0.2445	0.44	0.2253	0.84***	0.1944
Income of spouse (1/1,000,000)	−0.80	1.3700	−0.16	0.6930	0.17	0.5880
Constant	124.0***	17.7236	133.2***	16.0365	118.0***	13.9972
9. Other sectors, both part-time and full-time						
Female	−0.69***	0.1381	−0.79***	0.1210	−0.73***	0.1049
Age	−0.06***	0.0034	−0.08***	0.0030	−0.08***	0.0027
Married	0.59***	0.0905	0.37***	0.0702	0.44***	0.0665
No. of children younger than 7 years	−0.49***	0.0370	−0.49***	0.0350	−0.51***	0.0355
No. of children 7–18 years of age	−0.02	0.0332	0.18***	0.0307	0.29***	0.0299
Sixteen or more years of education	0.68***	0.0946	0.62***	0.0755	0.65***	0.0649
Missing education	−1.13***	0.1182	−1.27***	0.1047	−1.79***	0.0980
Spouse working in health sector	−0.07	0.1196	0.05	0.1053	0.31***	0.0983
Income of spouse (1/1,000,000)	−0.18	0.5140	0.08	0.2740	−0.08	0.2460
Constant	116.0***	6.5752	147.7***	5.8142	155.0***	5.2587
Number observations Log-likelihood		44600		47793		51874
Log-likelihood		−76350.39		−82394.08		−89426.97
LR chi2(81)		5762.69		6189.43		7190.48
Pseudo R2		0.04		0.04		0.04

Nurses 1997–1999. The base outcome is not working. The base category is a male, unmarried nurse with a registered education of less than 16 years and no children under 19 years of age (and, since unmarried, with no spouse working in the health sector)
*** Statistically significant parameter at 1 % confidence interval
** Statistically significant parameter at 5 % confidence interval
* Statistically significant parameter at 10 % confidence interval

Table 22 Sample selection for logit estimation and estimation of wage equations

	1997	1998	1999
All nurses, used in logit estimation	44,600	47,793	51,874
Not working	−1731	−2460	−3148
Missing wage income	−2	−3	−3
Working nurses, used in wage equation	42,867	45,330	48,723

Table 23 Mean of the explanatory variables for the wage equations

	1997	1998	1999
Female	0.93	0.92	0.92
Birthyear	1940	1940	1940
Less than 16 years of education	0.83	0.81	0.75
Sixteen or more years of education	0.14	0.16	0.22
Missing education	0.03	0.03	0.03
Least central municipalities (kommuner)	0.11	0.11	0.11
Less central and central municipalities	0.39	0.39	0.38
Especially central municipalities	0.50	0.50	0.51
Probability of working at job type 1	0.255	0.263	0.273
Probability of working at job type 2	0.174	0.176	0.167
Probability of working at job type 3	0.007	0.008	0.008
Probability of working at job type 4	0.004	0.004	0.004
Probability of working at job type 5	0.216	0.215	0.221
Probability of working at job type 6	0.111	0.112	0.110
Probability of working at job type 7	0.008	0.008	0.010
Probability of working at job type 8	0.004	0.005	0.006
Probability of working at job type 9	0.121	0.105	0.096
Number observations	42,867	45,330	48,723

Table 24 Estimated coefficients of the wage equations for nurses 1997–1999

	1997		1998		1999	
	Coeff.	SE	Coeff.	SE	Coeff.	SE
1. Public hospital part-time						
Female	−0.042***	0.0089	−0.085***	0.0102	−0.098***	0.0063
Age	0.004***	0.0003	0.006***	0.0003	0.007***	0.0002
Sixteen or more years of education	0.049***	0.0055	0.078***	0.0049	0.036***	0.0027
Missing education	0.003	0.0086	0.036***	0.0083	0.097***	0.0070
Least central municipalities (kommuner)	−0.035***	0.0068	−0.026***	0.0066	−0.014***	0.0047
Less central and central municipalities	−0.032***	0.0032	−0.029***	0.0030	−0.024***	0.0022
$\mathrm{Ln}(\mathrm{Pr}_1)$	0.036***	0.0113	0.102***	0.0134	0.171***	0.0103
Constant	−3.138***	0.4831	−5.789***	0.4746	−8.793***	0.3805
σ_1	0.107***	0.0009	0.104***	0.0008	0.077***	0.0006
2. Public hospital full-time						
Female	−0.033***	0.0034	−0.032***	0.0039	−0.039***	0.0032
Age	0.005***	0.0001	0.005***	0.0001	0.006***	0.0001
Sixteen or more years of education	0.050***	0.0028	0.056***	0.0031	0.048***	0.0024
Missing education	−0.021***	0.0062	−0.036***	0.0073	−0.002	0.0056
Least central municipalities (kommuner)	−0.007	0.0048	−0.001	0.0055	−0.024***	0.0049
Less central and central municipalities	−0.018***	0.0022	−0.008***	0.0026	−0.030***	0.0021
$\mathrm{Ln}(\mathrm{Pr}_2)$	−0.010***	0.0028	−0.001	0.0033	−0.025***	0.0027
Constant	−4.349***	0.2085	−5.523***	0.2344	−6.360***	0.1918
σ_2	0.060***	0.0006	0.072***	0.0006	0.060***	0.0005

Table 24 continued

	1997		1998		1999	
	Coeff.	SE	Coeff.	SE	Coeff.	SE
3. Private hospital part-time						
Female	0.048	0.0861	0.162*	0.0888	0.005	0.0751
Age	−0.003	0.0029	−0.003	0.0027	0.003	0.0021
Sixteen or more years of education	0.153***	0.0567	0.123**	0.0480	−0.005	0.0378
Missing education	−0.332**	0.1346	−0.080	0.1174	0.031	0.1367
Least central municipalities (kommuner)	−0.109	0.0789	0.085	0.0829	−0.028	0.0664
Less central and central municipalities	−0.024	0.0444	−0.087**	0.0397	0.003	0.0430
$\mathrm{Ln}(\mathrm{Pr}_3)$	−0.134	0.0983	−0.137*	0.0835	−0.102	0.0892
Constant	10.367**	5.1329	10.559**	4.8613	−1.508	3.6956
σ_3	0.193***	0.0094	0.183***	0.0080	0.193***	0.0079
4. Private hospital full-time						
Female	−0.099***	0.0321	−0.077**	0.0311	−0.113***	0.0425
Age	0.006***	0.0013	0.006***	0.0011	0.003***	0.0012
Sixteen or more years of education	0.010	0.0274	−0.051**	0.0252	−0.015	0.0277
Missing education	−0.015	0.0632	−0.071	0.0866	0.060	0.1113
Least central municipalities (kommuner)	−0.074	0.0639	−0.032	0.0622	−0.017	0.0540
Less central and central municipalities	0.026	0.0292	0.003	0.0281	−0.028	0.0335
$\mathrm{Ln}(\mathrm{Pr}_4)$	0.035	0.0233	0.062**	0.0262	0.052	0.0490
Constant	−6.745***	2.4493	−5.818***	2.0685	−0.968	2.2885
σ_4	0.081***	0.0045	0.084***	0.0047	0.100***	0.0060

Table 24 continued

	1997		1998		1999	
	Coeff.	SE	Coeff.	SE	Coeff.	SE
5. Public health care part-time						
Female	−0.034***	0.0088	−0.042***	0.0086	−0.042***	0.0069
Age	0.001***	0.0001	0.002***	0.0001	0.002***	0.0001
Sixteen or more years of education	0.020***	0.0049	0.038***	0.0049	0.016***	0.0032
Missing education	−0.001	0.0080	0.009	0.0083	0.039***	0.0068
Least central municipalities (kommuner)	−0.013***	0.0037	−0.021***	0.0038	−0.017***	0.0031
Less central and central municipalities	−0.016***	0.0030	−0.025***	0.0030	−0.017***	0.0024
$\text{Ln}(\text{Pr}_5)$	0.015***	0.0048	0.020***	0.0055	0.032***	0.0046
Constant	2.143***	0.2612	1.675***	0.2631	1.829***	0.2067
σ_5	0.087***	0.0008	0.092***	0.0008	0.077***	0.0006
6. Public health care full-time						
Female	−0.013***	0.0047	−0.011**	0.0050	−0.013***	0.0042
Age	0.002***	0.0002	0.002***	0.0002	0.002***	0.0001
Sixteen or more years of education	0.015***	0.0036	0.025***	0.0038	0.022***	0.0026
Missing education	0.007	0.0068	−0.007	0.0075	0.001	0.0056
Least central municipalities (kommuner)	−0.002	0.0033	−0.005	0.0033	−0.021***	0.0028
Less central and central municipalities	−0.009***	0.0028	−0.010***	0.0028	−0.024***	0.0024
$\text{Ln}(\text{Pr}_6)$	0.004	0.0058	0.007	0.0082	0.010	0.0063
Constant	1.346***	0.3292	1.387***	0.3674	1.748***	0.2937
σ_6	0.056***	0.0007	0.058***	0.0007	0.050***	0.0006

Table 24 continued

	1997		1998		1999	
	Coeff.	SE	Coeff.	SE	Coeff.	SE
7. Private health care part-time						
Female	−0.110	0.0816	−0.024	0.0781	−0.093	0.0585
Age	−0.003	0.0021	0.001	0.0020	0.000	0.0017
Sixteen or more years of education	−0.014	0.0786	−0.007	0.0637	−0.033	0.0498
Missing education	−0.257	0.1578	−0.106	0.1115	0.020	0.0995
Least central municipalities (kommuner)	−0.183**	0.0813	−0.186**	0.0768	−0.201***	0.0620
Less central and central municipalities	−0.089*	0.0459	−0.075*	0.0452	−0.121***	0.0373
$\ln(Pr_7)$	−0.111	0.0969	−0.067	0.0887	0.018	0.0881
Constant	11.041***	4.1361	3.296	3.9584	5.404	3.5252
σ_7	0.230***	0.0102	0.239***	0.0102	0.220***	0.0085
8. Private health care full-time						
Female	−0.146***	0.0434	−0.162***	0.0465	−0.102**	0.0415
Age	0.001	0.0014	0.002	0.0017	0.005***	0.0016
Sixteen or more years of education	0.015	0.0309	0.051	0.0385	0.060**	0.0273
Missing education	0.072	0.0862	0.094	0.1062	−0.115	0.0883
Least central municipalities (kommuner)	−0.037	0.0477	−0.111**	0.0499	−0.061	0.0426
Less central and central municipalities	−0.076***	0.0296	−0.066**	0.0325	−0.073***	0.0255
$\ln(Pr_8)$	0.061	0.0374	0.015	0.0510	−0.048	0.0512
Constant	4.203	2.8733	1.867	3.4974	−5.876*	3.2886
σ_8	0.101***	0.0060	0.126***	0.0068	0.111***	0.0055

Table 24 continued

	1997		1998		1999	
	Coeff.	SE	Coeff.	SE	Coeff.	SE
9. Other sectors, both part-time and full-time						
Female	−0.067***	0.0080	−0.044***	0.0084	−0.035***	0.0083
Age	0.004***	0.0002	0.005***	0.0003	0.006***	0.0003
Sixteen or more years of education	0.030***	0.0058	0.007	0.0079	−0.037***	0.0083
Missing education	−0.028**	0.0113	−0.008	0.0116	0.040***	0.0125
Least central municipalities (kommuner)	−0.006	0.0071	−0.004	0.0074	−0.011*	0.0064
Less central and central municipalities	−0.022***	0.0041	−0.015***	0.0047	−0.017***	0.0043
Ln(Pr_9)	0.026**	0.0120	0.098***	0.0180	0.172***	0.0204
Constant	−1.999***	0.4042	−4.331***	0.5424	−6.097***	0.4995
σ_9	0.091***	0.0011	0.098***	0.0012	0.087***	0.0011
κ_1	0.000	0.0021	0.000	0.0020	0.000	0.0015
κ_2	0.000	0.0020	0.000	0.0021	0.000	0.0021
κ_3	−0.033	0.0485	0.006	0.0438	−0.015	0.0359
κ_4	0.004	0.0231	−0.001	0.0206	0.002	0.0228
κ_5	0.000	0.0017	−0.001	0.0017	0.000	0.0014
κ_6	0.000	0.0018	0.000	0.0017	0.000	0.0016
κ_7	0.012	0.0488	0.006	0.0390	−0.012	0.0305
κ_8	0.006	0.0267	−0.005	0.0279	−0.007	0.0236
κ_9	−0.001	0.0027	0.000	0.0031	−0.001	0.0030
Number observations		42867		45330		48723
Log-likelihood		−188149.7		−204877.1		−211026.2

The base category is a male nurse with a registered education of <16 years years and living in an especially centralized region
*** Statistically significant parameter at 1% confidence interval
** Statistically significant parameter at 5% confidence interval
* Statistically significant parameter at 10% confidence interval

Table 25 Mean and median predicted hourly wages for nurses

	1997			1998			1997		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Mean
1. Public hospital part-time									
Observed	125	63.02	113	134	66.78	122	132	59.66	122
Predicted	116	7.00	116	126	8.22	126	126	7.11	126
2. Public hospital full-time									
Observed	115	15.56	115	123	19.18	125	128	17.06	130
Predicted	115	6.81	115	125	8.68	124	128	9.12	128
3. Private hospital part-time									
Observed	161	112.12	132	154	66.48	129	158	71.09	137
Predicted	150	17.07	148	148	15.99	146	153	15.67	152
4. Private hospital full-time									
Observed	112	19.57	111	121	19.9	123	127	24.65	130
Predicted	112	7.55	111	123	8.22	121	130	8.38	129
5. Public health care part-time									
Observed	121	49.37	115	129	51.19	124	130	44.06	126
Predicted	117	4.67	117	126	5.77	126	127	4.86	127
6. Public health care full-time									
Observed	115	13.77	117	124	15.55	126	128	14.09	129
Predicted	117	3.57	117	126	4.21	126	129	4.06	129
7. Private health care part-time									
Observed	144	77.24	118	145	65.4	129	144	70.44	129
Predicted	140	18.65	138	149	18.55	148	145	16.8	144
8. Private health care full-time									
Observed	111	21.73	114	112	25.66	115	121	27.19	121
Predicted	113	8.23	113	116	10.25	115	122	9.61	121
9. Other sectors, both part-time and full-time									
Observed	119	47.15	115	128	53.78	122	129	48.7	125
Predicted	116	6.51	116	125	7.77	125	127	7.86	127

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Table 26 Mean and median predicted hourly wages for physicians

	1997			1998			1999		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
1. Public hospital part-time									
Observed	203	136.53	166	205	166.6	172	191	145.88	169
Predicted	186	33.23	180	182	30.74	176	174	27.15	168
2. Public hospital full-time									
Observed	186	48.98	176	190	47.7	181	183	37.44	181
Predicted	180	16.94	179	185	16.44	184	181	14.88	180
3. Private hospital part-time									
Observed	201	132.19	173	214	79.5	188	198	81.92	173
Predicted	187	18.69	189	212	59.92	203	191	24.34	187
4. Private hospital full-time									
Observed	226	65.78	217	228	77.49	206	243	83.62	221
Predicted	223	27	223	226	24.76	227	242	30.55	238
5. Public health care part-time									
Observed	156	59	157	162	71.74	166	160	57.43	166
Predicted	158	11.55	158	166	12.84	166	165	13.34	164
6. Public health care full-time									
Observed	160	30.63	166	167	37.82	172	169	34.16	172
Predicted	166	10.51	166	174	15.9	173	175	11.89	175
7. Private health care part-time									
Observed	168	50.18	160	188	148.4	169	192	120.98	169
Predicted	164	10.35	163	186	20.11	185	183	17.82	182
8. Private health care full-time									
Observed	155	63.54	147	167	70.56	158	188	89.08	174
Predicted	157	20.71	151	172	27.81	172	191	35.47	184
9. Other sectors, both part-time and full-time									
Observed	168	67	166	167	59.88	169	169	62.31	169
Predicted	168	17.62	166	169	16.3	168	171	16.7	170

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