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by

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Abstract:
It is not uncommon that publicly employed physicians also have income from work outside the hospital, often termed moonlighting. There is little empirical evidence of such activity. In this paper we investigate which factors that may influence physicians' choice of work between the public hospital sector and elsewhere. An exceptionally high wage increase in 1996 for one group of hospital physicians (assistant physicians) serves as a natural experiment, and we analyse whether wages in general and this reform in particular have affected physicians' external earnings. For assistant physicians we find that higher wages at public hospitals affect negatively both the decisions to earn income externally, and level of income once active. For consultant physicians, on the other hand, there was no such response to the wage increase. Several hospital specific factors representing job specific work characteristics also matter for physicians' decisions to moonlight.

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1. Introduction

In predominantly public health care systems as in the Scandinavian countries and in the UK, it is considered a potential problem that physicians take up jobs and earn income from external sources. In addition to a main employment contract with a public hospital, it is not uncommon that physicians earn considerable additional income from work outside the hospital. Such activity is often termed moonlighting. This constitutes a problem if it effects hospital production negatively due to lack of key personnel, or if it implies giving access to treatment for diagnoses or patients of low priority. Countries with a National Health Care System often suffer from unacceptably long waiting lists, often claimed to be related to lack of key health personnel. Thus, for the public health care institutions, on the margin moonlighting may affect their cost efficiency as well as objectives concerning treatment levels and prioritisation among patient groups. So as to attract physicians to the public hospitals and induce them to supply additional effort at these institutions rather than to external activities, wage policy and manning restrictions to control workload are integral parts of a public health care policy. In this paper we will analyse how wage settlements and measures for workload affect physicians' decisions to earn income from other sources than a public hospital which is their main employer. The institutional framework is the Norwegian national health care system, where wage policies and wage bargaining between the physicians' union and hospital owners seem to have been used actively for affecting allocation of resources among different health care producers.

Based on available statistics (OECD 2005), the density of physicians and nurses in Norway is at or above average OECD level. Unacceptable waiting lists in the public health care sector and alleged shortage of key health personnel may indicate that health care personnel are inefficiently used. A specific problem may be

that physicians work too short hours for their main employer. Thus, during the 1990ies a growing concern emerged that physicians devoted to much time to work outside the hospitals. However, hospital employment increased during this period. Some evidence has been provided indicating that this increase in number of physicians has contributed little to increasing number of patients treated (Bratlid 2000). A lower than expected level of patient treatment may be due to extra work outside the hospital, using physician resources that could otherwise have been used at public hospitals.

We investigate which factors determine physicians' decision to moonlight and earn income as self-employed outside the hospital[1]. When physicians have additional employment beyond ordinary hospital work, the reason may be found in good income prospects through alternative employment, for example due to a large demand for services in the private and independent part of the health care sector. Alternatively, it may result from problematic working conditions at the hospitals. There is a cost to the public hospitals when physicians devote their efforts to supplementary employment, since this labour could alternatively be used working for the main employer, either by being more productive during normal working hours, or by working overtime. Wage policy is one of the instruments used by the government to attract key health personnel, and in particular to induce physicians to allocate additional work effort to hospitals.[2]

To mitigate a trend among publicly employed physicians to work outside the hospitals, and induce more work at the hospitals, a substantial wage increase was granted in 1996. The wage settlement was particularly favourable for assistant

[1] Another source of external income is from part-time positions. Unfortunately, we have no information on part-time work outside the hospital in our data set.
[2] Planned overtime work is in general not legal. However, physicians are exempted from this regulation, and can plan for considerable overtime work.

physicians, but also consultant physicians got a large increase in wages. Higher wages might in isolation contribute to reduced demand for physicians. Two factors work in the opposite direction. Firstly, the health personnel labour market was probably out of equilibrium in the sense of being supplier rationed for physicians as well as nurses. Secondly, the following year (1997), in order to induce higher activities within the public hospitals, the government decided to introduce an activity based finance system, expectedly increasing demand for physicians at any given wage level. During the three years preceding this wage increase, wages were rather stable, although wage rates may have varied differently among groups of physicians.

The wage settlement in 1996 creates a natural experiment enabling us to see whether wages in general affect the decisions to moonlight, and the level of moonlighting once participating. Since the wage increase was much higher for assistant physicians than for consulting physicians we also focus on possible differences in moonlighting activity between the two groups. Our data cover the period 1993-1997, that is, three years before and two years after the wage settlement.[3] The data also include information about relevant working conditions like capacity utilisation, health care personnel per patient and type of hospital, considered equally important for choice of work effort at the hospitals. We have information about individual specific observable characteristics, like age and family situation, which according to standard labour market theory are held to be important for labour supply. Use of panel data enables us in addition to control for unobservable individual characteristics, as well as time variant selection into moonlighting.

There are relatively few studies investigating labour supply of physicians. Relevant papers include Rizzo and Blumenthal (1994) and Showalter and Thurston

[3] Wage settlement was in effect as of May 1996. Wage rates are observed in October each year.

(1997) on US data, and Baltagi, Bratberg and Holmås (2003) and Sæther (2003) using Norwegian data. The Norwegian studies find positive wage elasticities for employee physicians. The US studies also estimate positive elasticities for physicians working as self-employed but with less clear results for employee physicians. Moonlighting in general has attracted interest in the literature but there are very few papers that address this phenomenon in the health care sector. Biglaiser and Ma (2003) show that moonlighting may be welfare improving, while Iversen (1997) and Barros and Martinez-Giralt (2002) are other relevant papers investigating welfare effects of interactions between public and private sectors. A paper that considers relative wage effects both theoretically and empirical is Conway and Kimmel (1998). They find that moonlighting as an option leads to relatively high wage elasticities.

Thus, this study offers new empirical evidence on physicians' income generating activities beyond their main job at a hospital. The paper is organized as follows. In the next section we provide an institutional outline and a theoretical background for how wages and job characteristics may effect decisions on working hours of physicians. Data are presented in section 3, and a discussion of our empirical approach is given in section 4. In section 5 results are discussed, while section 6 offers some concluding remarks.

2. Institutional and theoretical background.

Norway has around 14.000 trained physicians (OECD 2005), of which more than half work at publicly owned hospitals. During the period of investigation, a hospital belonged to one of 19 counties[4]. According to scope and complexity of treatment offered, they are grouped into regional (university) hospitals, central hospitals, county

[4] As of 2002, ownership of hospitals was transferred to the state.

hospitals and local hospitals. It is common and in accordance with employee regulations that hospital physicians have jobs outside of the hospitals, quite often in ambulatory service or as a private specialist. The reverse is also possible, that a private specialist has part time employment at a hospital.[5] Physicians are exempted from regulations banning planned overtime, enabling the hospital and its employed physicians to plan for overtime work within the main hospital job.

Almost 100% of physicians are members of the national physicians' union, which bargains wages and work conditions on behalf of its members. The union also bargains on behalf of private specialists, basically on public refunds for treatment of patients referred to them through the public health care system. Wage rates are bargained every year at a central level, with room for local bargaining as well. Individual and local adjustments of wages take place through this local wage bargaining. There is also room for some local discretion at county and hospital level in fitting employees into wage brackets. Thus, there will be variation in wage levels across regions and hospitals, as well as over time and between types of physicians.

As previously mentioned, there are indications of some shortage of physicians working in the dominantly public part of the hospital sector. Policy during recent years has been aimed at attracting physicians to work at hospitals, and to induce them to work longer hours at the hospitals. This was one intention of the government side when accepting a generous wage settlement for hospital physicians in 1996. There may, however, be several factors explaining both the shortage of physicians at public hospitals, and problems in extracting sufficient hours of work from them. In addition to wage differentials, unfavourable working conditions at the public hospitals, for example related to stress from too high capacity utilization and burdensome patients,

[5] These will be excluded from our analysis.

may induce physicians to supply additional hours externally instead of work overtime for the main employer. It is interesting to look at the relative importance of wages and work environment for decisions to moonlight. For hospital owners, the outcome may have policy consequences, in the sense that monetary remuneration and improved working conditions may supplement each other as incentive mechanisms for attracting physicians to specific activities and work places.

We will use a standard utility maximization approach to represent the physicians' choice of hours of work. Although wages are bargained by the union and counties (with some additional employer discretion) it should from the above be clear that each physician may individually, within limits, determine how many hours she wants to work at different work places, for example a public hospital or a private practice.

Consider the following model, representative of a physician with several possible income sources. Wages and job specific work characteristics matter for choice of additional working hours beyond contracted normal time, l^c. Utility depends on consumption (income y) and leisure, which we with time normalised to 1 write as $(1- \Sigma_i l^i)$. A vector Φ represents work attributes, which are either favourable or unpleasant. The index $i = c, o, m$ indicates a specific job or income source, either contracted hours at a hospital, l^c, overtime l^o, or additional jobs outside the hospital, l^m.[6] For ease of exposition, we ignore income from non-labour sources. The utility or disutility of work characteristics, element x^i for job i, may be constant or variable in hours of work supplied[7]. We let job characteristics in the utility function be represented by the function $\theta^h \varphi(l^h)$ for hospital work (normal time and overtime) and by $\theta^m \varphi(l^m)$ for external jobs (moonlighting), where θ^j, $j=h,m$, is a job-specific shift

[6] Without loss of generality, we investigate only one outside job opportunity (or several identical).
[7] There may of course be more than one characteristic for each job, however, ignoring that possibility can de done without loss of generality.

parameter. Individual characteristics (gender, age, marital status etc.) are represented by a vector Ψ. We then write the utility function of a representative physician as

(1) $$U = u(y, (1- \Sigma_i l^i), \theta^h \varphi(l^h), \theta^m \varphi(l^m), \Psi)$$

With w^i as the wage rate for job i, the budget constraint is

(2) $$y = \Sigma_i w^i l^i, \qquad i = c, o, m$$

Assuming that less than a 100% position as well as overtime are possible, the physician chooses number of hours at the hospital, which include contracted hours, l^c, and overtime, l^o, or external work, l^m, so as to maximise (1) given (2). Letting $L = \Sigma_i l^i$, the resultant Kuhn-Tucker first order conditions are

(3a) $$\left[w^c - \frac{\partial u(\bullet)}{\partial(1-L)} - \frac{\partial u(\bullet)}{\partial \theta^h \phi(l^h)} \right] = 0, \qquad l^c > 0$$

(3b) $$\left[w^o - \frac{\partial u(\bullet)}{\partial(1-L)} - \frac{\partial u(\bullet)}{\partial \theta^h \phi(l^h)} \right] l^o = 0, \quad l^o \geq 0$$

(3c) $$\left[w^m - \frac{\partial u(\bullet)}{\partial(1-L)} - \frac{\partial u(\bullet)}{\partial \theta^m \phi(l^m)} \right] l^m = 0, \quad l^m \geq 0$$

By definition of a main job we assume that always $l^c > 0$, implying equality of bracket in (3), and since we assume that the physician can choose to work less than 100%, there is an interior solution for l^c. We see from (3a,b,c) that a physician may choose to substitute time at the main job for moonlighting, either by adjusting ordinary contracted working hours, or by overtime. Furthermore, interior solutions with

different wage levels externally and internally are possible, since work characteristics may compensate. On the other hand, supplementary work (overtime or moonlighting) may not at all be relevant due to their wage levels and job characteristics. Lastly, from (3b,c) we see that an increase in overtime wages or improved working conditions at the hospital may induce a physician to start working overtime and stop moonlighting, i.e. set $l^m = 0$.

Straightforward comparative statics[8] on (3) will provide the usual indeterminate wage effect from changes in wage level w^i on hours of work in job i. The magnitude of the wage effect depends also on how concerned the physicians are with work characteristics, like stress or fringe benefits. Consider a work place burden like stress (for example too may beds occupied and therefore a very high workload during the work day), such that the marginal effect of increased work is negative, then the effect of a wage increase on work hours will be moderated compared to a situation where these burdens did not exist. Furthermore, limiting ourselves to a situation where the physician is moonlighting in addition to the contracted working hours, $l^o > 0$, the effect of a wage increase at the hospital, $\Delta w^c > 0$, is to reduce supply of hours moonlighting, $\Delta l^m < 0$. Lastly, the effect of a further improvement of working conditions, i.e. an increase in θ^i when at the outset $\phi'(l^i) \geq 0$, affects l^i positively[9]. Symmetrically, for work characteristics representing a disutility, l^i is reduced if conditions are worsened.

Thus, physicians will adjust their labour supply in the hospital and externally according to wage levels and income prospects both places, as well as according to

[8] Note that some comparative static results may depend on sign of second order differentials, which may sometimes be hard to determine. However, some simplifying and unproblematic assumptions will enable signing effects unambiguously.

[9] We assume $\frac{\partial u(\bullet)}{\partial \theta^i \phi(l^i)} \geq 0$ and $\frac{\partial^2 u(\bullet)}{\partial \left(\theta^i \phi(l^i)\right)^2} = 0$.

work characteristics like stress or fringe benefits. Changes in wage levels and work conditions will affect the degree to which physicians, on the margin, take up jobs outside of the hospitals. In the empirical section, we will use different estimators to determine the decision to have additional income from sources outside of the hospital (moonlight). Independent variables include hospital wages and proxies for hospital work characteristics, in addition to individual and hospital specific variables. In particular it is of interest to trace effects on out-of-hospital income from a natural experiment in 1996, when hospital wages were increased quite considerably, with an expected fall in participation and income from moonlighting.

3. Data and variables

Our main data source is a personnel register administered by the Norwegian Association of Local and Regional Authorities (NALRA), providing individual specific information on wages and working hours of public servants employed by counties and municipalities. Employees of the main bulk of Norwegian hospitals are represented. The NALRA data have been merged with individual as well as hospital specific information from Statistics Norway. All data sources are public registers. Data on income from self-employment are extracted from tax records. We use a panel data set covering the period 1993 to 1997

During this period, sixty-four hospitals reported to the NALRA register, which constitutes a majority of Norwegian hospitals.[10] However, for three hospitals information on occupancy rate and length of stay was not available, reducing the sample to physicians within 61 hospitals. We further restrict the sample to include

[10] The most important exceptions are the National Hospital (Rikshospitalet) and the National Cancer Hospital (Radiumhospitalet), both opreated by the central government. Later (2002) the government has taken over responsibility for all hospitals.

only physicians holding a seventy-five percent position or more in a hospital. The final sample then includes 5868 physicians.

(Table 1 about here)

The variables used in the analysis are defined in Table 1, while in Table 2 yearly summary statistics are reported. Focusing first on hospital wages, we see that the wage settlement in 1996 resulted in an increase in the mean hourly basic wage from about NOK 138 in 1995 to NOK 155 in 1996 (a 11 percent increase), while it stayed fairly constant from 1993 to 1995. Notice also that the proportion of physicians working as assistant physicians is relatively stable over the whole period, varying between 0.36 and 0.39. Turning to income from self-employment, we notice that while there has been a weak reduction in the mean income from 1993 to 1996 (from about NOK 26000 to NOK 24000), there was a marked reduction in income from self-employment in 1997[11] (NOK 20900). However, conditioning on physicians with a positive income from self-employment, we do not find the same clear time pattern. On the contrary, after a relatively large drop in mean income from 1993/1994 to 1995, there has been an increase from 1995 to 1997. This indicates that in 1997 the proportion of physicians with income from self-employment has fallen. Looking at table 2, we see that this is exactly what has happened. While the proportion of physicians with income from self-employment was between 0.32 and 0.34 from 1993 to 1996, this proportion dropped to 0.29 in 1997.

(Table 2 about here)

[11] Since the wage settlement came into effect in June/July 1996, and since the adjustment to the wage increase probably take some time, it is not surprising that we don't see any effect in 1996.

Looking at the variables measuring working conditions at the hospitals, we see that the occupancy rate varied between 85 and 88 percent. From 1993 to 1997 there has been an increase in number of physicians per bed from 0.34 to 0.44, and nurses per bed have increased from 1.13 to 1.38. Costs per hospital bed showed a marked increase during 1996 and 1997, potentially caused by the wage increase.

Since the wage settlement in 1996 was particularly generous for assistant physicians, it might be interesting to see whether the moonlighting activity for assistant physicians differ from that of consultant physicians. Tables 3 and 4 present descriptive statistics for the two groups. First we note that assistant physicians in our sample certainly had a larger wage increase than consultant physicians; from 1995 to 1996 the average wage for assistant physicians increased by approximately 19.5 percent while the wage increase for consultant physicians were more moderate (about 8.5 percent). Dividing the sample into two groups of physicians further indicates that only assistant physicians responded to the wage increase by a reduction in self-employment. On average assistant physicians reduced income from self-employment by 17.8 percent from 1996 to 1997. Much of this reduction can probably be explained by a large drop from 1996 to 1997 in the proportion of assistant physicians earning income as self-employed. For consultant physicians, on the other hand, there are no clear indications of any adjustment of their moonlighting activity due to the wage increase.

(Tables 3 and 4 about here)

4. Econometric method

To investigate how hospital wages and work conditions affect moonlighting, we use a two stage panel data sample selection model where we first estimate a "participation" equation and then an income equation. There are several reasons why we think this model is appropriate. Firstly, theory and descriptive statistics indicate that the effect of hospital wages on moonlighting will work both through the participation decision and magnitude of work once participating. To be able to say something about how wages affect also the decision to engage in moonlighting, a two stage model is required. Next, since the majority of the physicians do not earn income outside of the hospitals it is likely that there is selection into moonlighting. Another potential problem is the presence of unobserved heterogeneity in the income equation. To deal with both unobserved heterogeneity and selection, panel data are required. If the selection process were time invariant, standard estimators like the fixed effect estimator would solve the problem. However, this is not likely to be the case, and in the rest of this section we describe a panel data estimator that takes account of both unobserved heterogeneity among the physicians, and sample selection into the sub-group consisting of moonlighters.

Consider the following panel data model:

(4) $$y_{it}^{*} = x_{it}\beta + \alpha_i + \varepsilon_{it};$$

(5) $$d_{it}^{*} = z_{it}\gamma + \eta_i + u_{it}$$

(6) $$d_{it} = 1 \text{ if } d_{it}^{*} > 0,\ 0 \text{ otherwise}$$

(7) $$y_{it} = y_{it}^{*} \cdot d_{it}$$

Here, i ($i = 1,...,N$) denotes the physicians and t ($t = 1,...,T$) the time periods. Equation (4) represents the true model for determination of income from outside sources, while (5) models the individual choice to participate in external income generating activities. Physician *i's* income as self-employed in period *t*, the latent variable y_{it}^{*}, is only observable for those who choose to work outside the hospitals. This choice depends on the outcome of the indicator variable d_{it}, since the latent variable d_{it}^{*} is unobservable. The coefficients β and γ are the unknown parameters we wish to estimate while α_i and η_i are unobservable time-invariant individual-specific effects. Covariates x_{it} and z_{it} are vectors of explanatory variables which may contain common elements, and all variables in z_{it} and x_{it} are assumed to be strictly exogenous. The ε_{it} and u_{it} are unobserved disturbances. The sample selection problem arises because the external income y_{it} is only observable for physicians with $d_{it} = 1$. Applying for example OLS only on the observations for physicians who moonlight will lead to biased estimates of the β vector.

To correct for sample selection and unobserved heterogeneity in the external income equation we follow a two-step approach proposed by Kyriazidou (1997)[12], see also Askildsen, Baltagi and Holmås (2003) for an application on nurses' labour supply. This estimator relies on pairwise differences over time applied to equation (4) for individuals satisfying $d_{it} = d_{is} = 1, s \neq t$. The estimator is flexible in the sense that the individual effects, α_i and η_i, are allowed to be correlated with the explanatory variables (x_{it} and z_{it}) and the error terms (ε_{it} and u_{it}). No distributional assumptions are made concerning the error terms.

[12] Several other sample selection panel data estimators exists, see for example Vella (1998) for an overview.

Following Kyriazidou (1997) and Dustman and Rochina-Barrachinna (2000), the sample selection effect for each time period may be defined as

$$\lambda_{its} \equiv E\left(\varepsilon_{it} \mid \widetilde{z}_{it}, \widetilde{z}_{is}, \alpha_i, \eta_i, u_{it} \le z_{it}\gamma - \eta_i, u_{is} \le z_{is}\gamma - \eta_i\right)$$

$$= \Lambda(z_{it}\gamma - \eta_i, z_{is}\gamma - \eta_i; F\left(\varepsilon_{it}, u_{it}, u_{is} \mid \widetilde{z}_{it}, \widetilde{z}_{is}, \alpha_i, \eta_i\right))$$

$$\lambda_{ist} \equiv E\left(\varepsilon_{is} \mid \widetilde{z}_{it}, \widetilde{z}_{is}, \alpha_i, \eta_i, u_{is} \le z_{is}\gamma - \eta_i, u_{it} \le z_{it}\gamma - \eta_i\right)$$

$$= \Lambda(z_{is}\gamma - \eta_i, z_{it}\gamma - \eta_i; F\left(\varepsilon_{is}, u_{is}, u_{it} \mid \widetilde{z}_{it}, \widetilde{z}_{is}, \alpha_i, \eta_i\right))$$

where $\widetilde{z}_{it} = \left(x_{it}, z_{it}\right)$, $\widetilde{z}_{is} = \left(x_{is}, z_{is}\right)$, $\Lambda(\cdot)$ is an unknown function and $F(\cdot)$ is an unknown joint conditional distribution function of the errors. Taking first differences, we can rewrite the main equation (4) in any time period *t* and *s* as

$$(8) \qquad y_{it} - y_{is} = \left(x_{it} - x_{is}\right)\beta + \left(\alpha_i - \alpha_i\right) + \left(\lambda_{its} - \lambda_{ist}\right) + v_{its}$$

where $v_{its} \equiv \left(\varepsilon_{it} - \varepsilon_{is}\right) - \left(\lambda_{its} - \lambda_{ist}\right)$ is a new error term. Obviously, this error term satisfies $E\left(v_{its} \mid d_{it} = d_{is} = 1, \varsigma_i\right) = 0$ by construction. If the sample selection effect is the same over periods, first-differencing (8) will eliminate both the individual-specific component and the selection effect. Under rather weak distributional assumptions[13], the sample selection effect λ_{its} and λ_{ist} will be the same as long as $z_{it}\gamma = z_{is}\gamma$. Thus, applying first-differences will eliminate both the individual time invariant effect and the selection effect. Notice that since first-differences are taken on an individual basis, the functional form of Λ may vary across physicians.

Since *z* includes continuous variables, $z_{it}\gamma$ and $z_{is}\gamma$ will differ for most physicians in our sample. However, differencing across observations when the values

[13] See Kyriazidou (1997) for a discussion of the necessary assumptions.

of $z_{it}\gamma$ and $z_{is}\gamma$ are close, will also approximately eliminate the unobserved expectation. Thus, to make the estimator operational, Kyriazidou (1997) suggests the following procedure. In the first step, get consistent estimates of the parameters in the selection equation. Here, we estimate a conditional logit model using only the physicians who change status over time. In the next step we use these estimates to construct weights which finally are included in a weighted least square regression. The estimator is

$$\hat{\beta}_n = \left[\sum_{i=1}^{n} \hat{\psi}_{in}(x_{it} - x_{is})'(x_{it} - x_{is}) d_{it} d_{is}\right]^{-1} \times \left[\sum_{i=1}^{n} \hat{\psi}_{in}(x_{it} - x_{is})'(y_{it} - y_{is}) d_{it} d_{is}\right], \tag{9}$$

where $\hat{\psi}_{in}$ are "kernel" weights, declining to zero as the difference $|z_{it}\hat{\gamma}_n - z_{it}\hat{\gamma}_n|$ increases:

$$\hat{\psi}_{in} = \frac{1}{h_n} K\left(\frac{(z_{it} - z_{is})\hat{\gamma}_n}{h_n}\right) \tag{10}$$

K is a "kernel density" function, and h_n is a sequence of "bandwidths" that tends to zero as $n \to \infty$.

5. Empirical results

The following main issues are considered: Firstly, does the wage level at the hospital influence physicians' decisions to moonlight and earn income as self-employed outside of the hospitals? We investigate this question by estimating the effect of

variation in hourly hospital wages on external income. An important advantage of our data set and time period is that it includes a generous wage settlement in 1996, providing sufficient exogenous variation in the wage variable both over time and between groups of physicians. Note that the wage settlement was much more generous for assistant physicians than for consultant physicians. We are not only interested in investigating what factors that affect the magnitude of self-employment, but also what affects the participation decision. In the analysis it is therefore essential to separate the participation decision from the magnitude of the activity. Secondly, are the incidence and magnitude of self-employment among hospital physicians affected by hospital specific factors, like indicators of workload?

To shed some light on these questions, we use the sample selection model outlined in the previous section. First we estimate a conditional logit model. The results for this participation equation are reported in Table 5, column 4. As identifying variables we use dummy variables measuring the degree of centrality of the municipality where the physicians live. The estimates from the logit model are then used to construct "kernel weights". We use a normal density for the kernel, and the bandwidth is set to $h_n = h \cdot n^{-1/5}$ where $h = 1$[14]. Finally, these weights are used in a weighted least square regression where we apply the Huber/White estimator for the variance (to take account of the weights). The results from estimating this income equation are given in the last column of table 5. For comparison, in columns 1 and 2 of Table 5 we also report results from OLS and fixed effect regressions[15]. The large differences between the estimates of the OLS and fixed effect models clearly indicates

[14] We have experimented with different values of *h* but this had very little effect on the final estimates.
[15] The OLS model gives unbiased estimates only when no sample selection or unobserved heterogeneity exists. The estimates from the fixed effect model are unbiased if the sample selection process is time constant.

the presence of unobserved heterogeneity, and we therefore focus on the results from the fixed effect and the sample selection models.

(Table 5 about here)

Focusing first on the difference in moonlighting activity between assistant and consulting physicians both the fixed effect model and the sample selection model show that, ceteris paribus, *assistant physicians* have higher income from self-employment than consultant physicians. However, given that the physicians have decided to earn external income, the levels of incomes for the two groups are not very different, and the estimated effect is significant at the 10% level only. The size (measured in *hospital beds*) or type of hospital (*local compared to regional and central hospitals*) does not seem to influence much on the physician' moonlighting activity. The only exception is that physicians working at central hospitals are less likely to have income from self-employment than others. On the other hand, family characteristics (whether the physician is *married* or have *children younger than 3*) have an effect on how much the physicians work outside the hospital, but not on whether they have external income or not. Married physicians earn less from self-employment than others, while the opposite is the case for physicians having children younger than 3 years of age.

Turning now to our main variables of interest, we observe from the sample selection model that the *hourly wage* rate has a negative and significant effect on the participation decision and on magnitude of external income from self-employment, but only so for assistant physicians. The descriptive statistics in section 3 indicated that most of the wage effect worked through the participation decision and this seems to be confirmed from these results. In the fixed effect model the coefficient on the

interaction “Wage*assistant physician” is 0.4256 while in the two-stage model this coefficient is only 0.0712.

Lastly we look at the effects of job characteristics. The occupancy rate, number of health personnel (nurses and physicians) per bed and costs per bed provide information about work-load at the hospitals. Thus, they are reasonable proxies for job characteristics that increase or decrease job related stress, and thus they represent important work condition variables. More *physicians per bed* reduce income from non-hospital jobs but do not affect the participation decision. It is reasonable to assume that physician staffing indicates the work load which a given physicians faces on the margin. Thus, more physicians per bed are less stressful and considered a more attractive job characteristic. The quite clear picture of a positive effect from more *nurses per bed* is perhaps more surprising. It may be the case that nurses to a small degree can substitute for physicians. Another problem in interpreting this variable is that the increase in number of nurses went hand-in-hand with an even larger reduction in number of auxiliary nurses. Thus, during this period more nurses per bed do not necessarily reflect improved working conditions for physicians, since it is unclear how the total effect of the two simultaneous events turned out for nursing services. The *occupancy rate* works in the expected direction. There is a positive and significant effect on external wage income, as well as on the participation decision from the selection models. Occupancy is a variable with very clear interpretation in terms of work-load, and it gives as such good support for the simple theoretical and empirical formulation of the model. In hospitals with high *costs per bed*, physicians are less likely to have income from self-employment, and they will have lower external income once participating.

We interpret the results held together that hospital wages have a clear effect on assistant physician's decision to work as self-employed. However, among consultant physicians we find no indications that hospital wages have affected the moonlighting activity. The physicians' job characteristics are important for their decisions to moonlight and work as self-employed, beyond their full time job at the hospital.

6. Concluding remarks.

We find a significantly negative effect of wages on assistant physicians' income from self-employment. Thus, wage policy and efforts to affect working conditions are viable instruments for controlling activity in public hospitals.

The wage effect works both trough the decision to moonlight, and wages affect level of activity for those who have income from external sources. Our results indicate that a model that is able to correct for unobserved heterogeneity as well as sample selection is warranted so as to be able to isolate effects from a particular reform, here a generous wage increase taking place one specific year but with long-lasting effects. Work conditions at the hospitals are also important for incentives to earn income externally. When work environment gets more stressful, as measured by capacity utilization and number of peers available, physicians tend to earn more externally.

Admittedly, the variables included to proxy for work characteristics may also capture general demand for health care services. Also for physicians in public hospitals, a high demand will affect their job opportunities in private practices. As seen from the physicians' point of view, possible demand effects, and reactions to unpleasant work conditions, will work in the same direction. Whether a high work-load and stressful work situation stem from high demand or from bad organization of

work, it may induce the physician to allocate additional hours of work outside the public hospital, since a private unit will generally be able on the margin to offer higher payment. For policy, the consequences will be different. If difficult work conditions at the public hospitals result from shortage of physicians, which is again due to high demand for health care services compared to capacity, there seems to be a better argument for alleviating the problem through wage compensation, given that labour is available elsewhere. However, if the tendency for moonlighting has its origin in poor organization, and corresponding stressful working conditions, wage policy may still work, through compensating wage differentials, but a better policy may be to reorganise production conditions and improve internal organization of work.

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Table 1 Variable definitions.

Income from self-employment	Yearly income from self-employment (in 100 NoK.)
Hourly wage	Hourly wage in the hospital
Non-labour income	Spouse income + capital income
Age	Physicians age
Male	Dummy variable which equal one if the physician is a male
Married	Dummy variable which equal one if the physician is married
Children<3	Dummy=1 if having children less than 3 years of age, 0 otherwise
Assistant physician	Dummy=1 if assistant physician, 0 if consultant physician
Nurses per physician	Number of nurses per physician
Physician per bed	Number of physicians per hospital bed
Length of stay	Total inpatients days/number of patients (in 100)
Occupancy rate	Total inpatient days*100/effective beds*365
Hospital beds	Total number of beds set-up and staffed for use (in 100)
Central hospital	Dummy=1 if working at central or regional hospital, 0 otherwise
County hospital	Dummy=1 if working in a county hospital, 0 otherwise
Centrality 1	Dummy variables which equal one if the physician is living in a municipality classified as “most central”
Centrality 2	Dummy variables which equal one if the physician is living in a municipality classified as “central”

Table 2. Descriptive statistics.

	1993	1994	1995	1996	1997
Income as self-employed	260.76 (712.82)	251.74 (719.51)	233.23 (63.882)	239.26 (629.50)	209.26 (614.60)
Income if income>0	764.42 (1051.22)	774.95 (1090.35)	689.75 (944.67)	725.24 (921.47)	725.33 (958.91)
Proportion with income	0.33	0.32	0.34	0.33	0.29
Hourly wage	140.60 (18.63)	139.47 (18.17)	138.15 (18.10)	155.20 (14.42)	154.97 (15.91)
Assistant physician	0.37	0.37	0.38	0.36	0.39
Non-labour income	170.83 (239.17)	169.74 (181.15)	165.63 (159.57)	192.07 (189.66)	195.79 (209.63)
Age	43.21 (8.49)	43.47 (8.60)	43.48 (8.81)	43.43 (8.98)	43.31 (9.16)
Male	0.78	0.76	0.75	0.72	0.71
Married	0.77	0.76	0.76	0.74	0.74
Child_y3	0.20	0.18	0.18	0.19	0.20
Occupancy rate	87.81 (8.21)	85.28 (8.94)	86.65 (7.71)	86.91 (7.76)	85.73 (8.38)
Physicians per bed	0.34 (0.07)	0.36 (0.07)	0.39 (0.09)	0.42 (0.09)	0.44 (0.09)
Nurses per bed	1.13 (0.18)	1.20 (0.18)	1.27 (0.19)	1.33 (0.19)	1.38 (0.20)
Costs per bed	999.34 (105.72)	926.30 (109.35)	946.56 (130.57)	1089.58 (145.35)	1157.85 (167.15)
Number of beds	436.43 (292.92)	440.91 (290.26)	444.44 (293.02)	435.73 (285.49)	446.40 (295.37)
County hospital	0.15	0.14	0.14	0.14	0.14
Central hospital	0.71	0.72	0.72	0.72	0.73
Central 1	0.62	0.60	0.61	0.60	0.62
Central 2	0.22	0.25	0.25	0.25	0.24
Observations	3166	3183	3398	3407	3584

Table 3. Income from self-employment and hospital wages, assistant physicians.

	1993	1994	1995	1996	1997
Income as self-employed	278.52 (669.52)	264.29 (662.86)	242.54 (583.57)	244.08 (600.41)	176.34 (496.38)
Income if income>0	766.57 (927.68)	792.83 (971.74)	662.18 (807.81)	684.71 (842.85)	625.90 (770.73)
Hourly wage	119.66 (9.30)	119.20 (9.10)	118.12 (9.34)	141.27 (11.67)	140.21 (11.96)
Proportion with income	0.36	0.34	0.36	0.35	0.28

Table 4. Income from self-employment and hospital wages, consultant physicians.

	1993	1994	1995	1996	1997
Income as self-employed	250.24 (737.23)	250.22 (751.51)	227.64 (669.88)	236.51 (645.68)	230.41 (673.47)
Income if income>0	763.00 (1125.65)	764.47 (1154.79)	708.63 (1028.08)	751.51 (968.73)	786.79 (1054.54)
Hourly wage	153.49 (8.75)	152.19 (8.71)	150.87 (8.67)	163.58 (8.79)	164.99 (9.47)
Proportion with income	0.33	0.32	0.32	0.31	0.29

Table 5. External income; OLS, fixed effect and sample selection models.

	OLS	Fixed effect	Sample selection model	
	Income equation	Income equation	Participation equation	Income equation
Hourly wage	-0.4101***	0.0555	0.0029	-0.0195
	(0.0737)	(0.0676)	(0.0072)	(0.0361)
Wage*assistant physician	0.0230	-0.4256***	-0.0275***	-0.0712***
	(0.0860)	(0.0637)	(0.0063)	(0.0055)
Married	-2.6771**	-7.1104***	-0.2900	-10.0821***
	(1.3381)	(2.1612)	(0.2088)	(3.6984)
Non-labour income	0.0000	0.0001***	-0.0001	0.0004**
	(0.0000)	(0.00003)	(0.0002)	(0.0002)
Age	3.2945***			
	(0.6862)			
Age2	-0.0346***			
	(0.0073)			
Male	18.7495***			
	(1.2781)			
Child_y3	-1.9154	2.2993*	-0.0858	3.3073***
	(1.4377)	(1.3058)	(0.1224)	(0.8857)
Assistant physician	-6.4161	57.1753***	3.4029***	2.0440*
	(12.5843)	(9.4839)	(0.9637)	(1.2656)
Occupancy rate	0.4935***	0.0276	0.0162**	0.0897*
	(0.0720)	(0.0747)	(0.0073)	(0.0509)
Physicians per bed	-32.8911***	-24.2610**	0.2427	-25.4798***
	(9.8185)	(9.8089)	(0.9505)	(7.4727)
Nurses per bed	1.3791	12.6482***	0.7894**	13.3603***
	(4.2655)	(4.3113)	(0.4007)	(3.9333)
Costs per bed	0.0003	-0.0055	-0.0009**	-0.0084**
	(0.0056)	(0.0051)	(0.0005)	(0.0039)
Number of beds	-0.0011	0.0044	0.0006	-0.0002
	(0.0029)	(0.0046)	(0.0004)	(0.0033)
County hospital	4.3544**	0.9902	-0.3980	0.9515
	(1.9655)	(3.4137)	(0.3038)	(1.6710)
Central hospital	10.8530***	-1.1385	-0.7200***	1.1877
	(1.9359)	(3.3135)	(0.2946)	(2.0976)
Central 1			0.5743**	
			(0.2840)	
Central 2			0.3788*	
			(0.2120)	
y94	0.7243	-0.4680	-0.2794***	0.8118
	(1.7303)	(1.0740)	(0.1046)	(0.7740)
y95	-1.1087	-1.9355*	-0.2649**	-0.0001
	(1.7543)	(1.1672)	(0.1121)	(0.9249)
y96	7.4189***	1.8307	-0.1181	2.3517*
	(1.9347)	(1.4963)	(0.1503)	(1.3126)
y97	5.9350***	-1.4971	-0.7307***	2.5550
	(2.0516)	(1.7361)	(0.1734)	(1.6207)
Constant	-44.3905**	12.7106		0.0325
	(19.3730)	(12.7394)		(0.6742)

*Note: *, **, *** denote significant at 10%, 5% and 1% level respectively*

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