

A PANEL DATA STUDY OF PHYSICIANS' LABOR
SUPPLY: THE CASE OF NORWAY

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Abstract

Physicians are key personnel in a sector which is important due to its size as well as the quality of service it provides. We estimate the labor supply of physicians employed at hospitals in Norway, using personnel register data merged with other public records. A dynamic labor supply equation is estimated using a sample of 1303 physicians observed over the period 1993-97. The methods of estimation are GMM and system GMM. We reject the static model in favor of a dynamic model and obtain a long-run wage elasticity of about 0.55. This is considerably higher than previously estimated for physicians, in particular for those who are not self-employed.

JEL Code: I10, J22, J44.

Keywords: physicians, labor supply, dynamic panel data.

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1. Introduction

The purpose of this paper is to estimate the labor supply of physicians in Norway. Thus we provide insight into the behavior of key personnel in a sector that is important due to the quality of service it provides, as well as the fraction of GDP that is spent on health expenditures. There are relatively few studies of the labor market for the medical profession, and those that exist tend to focus on physicians in private practice. Our addition to previous research is a study of the labor supply of physicians employed by Norwegian hospitals. Besides its relevance for labor markets in the health sector *per se*, a study of physicians may provide insight into the behavior of high-income employees in general.

A significant amount of the research on physician behavior relates to physician-induced demand for services, e.g., Hay and Leahy (1982), Headen (1990), McGuire and Pauly (1991). There is also a literature on physician practice patterns, including Gaynor and Pauly (1990), Lee (1990), Ferrall et al. (1998). The relatively few papers on supply include Sloan (1975) and Noether (1986). A relatively recent application is Rizzo and Blumenthal (1994), who focus on the impact of wage and non-wage income for a sample of self-employed US physicians. They find an uncompensated wage elasticity for male doctors of 0.23, with a compensated substitution elasticity of 0.44. Showalter and Thurston (1997) focus on tax effects on labor supply for physicians, as an example of the response of high-income individuals. A key finding is that self-employed physicians are sensitive to the marginal tax rate, with a supply elasticity of 0.33, whereas the effect is small and insignificant for employee physicians.

In this study we estimate the labor supply of 1303 physicians employed at Norwegian hospitals over a five-year period: 1993-97. The data are constructed by combining information on wages and hours worked from a personnel register with administrative individual information. We focus on labor supply conditional on working. Even though the strongest

effect of wages are at the extensive margin (Heckman 1993), this may be less of an issue for physicians.¹ Since physicians belong to the group of high-income individuals, the question remains whether there is a positive labor supply response to wage increases at all, or if the income effect dominates the substitution effect. As noted above, previous results find that the wage elasticities of physicians who are not self-employed are modest.

The general literature on labor supply is vast. In their recent overview, Blundell and MaCurdy (1999) point out that some confusion exists as to what kind of wage elasticities are estimated when different studies are compared – the researcher should be explicit as to whether inter- or intratemporal substitution effects are modeled. Following the seminal work by Heckman and MaCurdy (1980) and MaCurdy (1981), a branch of the labor supply literature has developed which considers life cycle effects. Estimation of life cycle models is facilitated by the availability of panel data, see the survey in Laisney et al. (1996). The purpose of this study is not to estimate a full life cycle labor supply model; specifically we do not consider intertemporal substitution effects. Having access to panel data, we formulate a model that does not require myopic agents, and therefore uses a framework that is consistent with a life cycle model.

We proceed with an account of relevant features of the Norwegian health sector and health labor markets in the next section. Section 3 describes our empirical approach, while Section 4 gives an overview of the data. Section 5 presents our results and Section 6 concludes.

2. Background

At \$2362 per capita in 2000, Norwegian total health expenditures are above the OECD average (\$1967), but way below the US (\$4631) and Switzerland (\$3222). The health sector is

¹ In a companion paper, Askildsen et al. (2002), nurses' labor supply is estimated using data from the same sources, with a focus on the selectivity that follows from participation decisions.

predominantly public, with governmental expenditures in 2000 amounting to 85.2%, as compared to the OECD average of 71.5%. Despite the expenditure level, the physician density (2.7 per 1000 in 1998) is at the OECD average, a fact that may be partly explained by the cost driving effects of a scattered population.²

With few exceptions, Norwegian hospitals are owned and run by the public authorities, typically by counties. However, a recent (2002) reform transferred ownership of all publicly owned hospitals to the central government. An important exception are two large hospitals in the capital, Oslo. These hospitals were run by the central government before 2002. In the Norwegian nomenclature, hospitals are grouped according to functions and responsibilities. Local hospitals with surgical, medical, and gynecological wards; County hospitals (the term refers to functions and not to ownership) with more specialties, e.g. neurological wards; and “Central hospitals” with a longer list of capacities. Finally, there are five “regional hospitals” with the highest level of specialties, including one in Oslo owned by the central government.

Centralized negotiations and powerful unions characterize the Norwegian labor market. This is also the case for physicians, who are represented by The Norwegian Medical Association, whose members include 94% of the physician population. As of 2002, about 55% of Norwegian physicians were employed by hospitals. Self-employed physicians are largely dependent on National Insurance reimbursements, which are negotiated centrally, as are the tariffs for physicians employed by hospitals or other public services. Still there is room for local variation among hospitals, for example in the scheduling of overtime work. Until the reform in 2002 which transferred ownership to the central government, the physicians’ association’s main counterpart in wage negotiations pertaining to hospitals was The Norwegian Association of Local and Regional Authorities. In addition, wages for those

² Source: OECD Health Statistics, <http://www.oecd.org>. It should be noted that according to the Norwegian Medical Association, the OECD estimate of Norwegian physician density is too low.

employed by the state were negotiated with representatives for the central authorities. At the local level, physicians follow schedules that typically involve a certain amount of “extended hours”, i.e. the work schedule involves more than “normal” hours per week, with compensation. This “planned over-time” varies across hospitals and is not necessarily renegotiated when the central tariffs change. In addition, there may be demand for over-time due to vacancies, sick-absence etc. Thus, even though hospital physicians are public servants, there is variation in wages as well as in hours demanded and supplied.

3. Econometric approach

3.1 Economic model

We formulate a labor supply equation that is consistent with a life cycle model, where the period labor supply is the outcome of a two-stage budgeting process, see Blundell and MaCurdy (1999), Blundell and Walker (1986).³ Assume that physicians have period t utility functions, $u(c_t, l_t, \Psi_t)$ over a composite consumption good (c_t , the numeraire) and leisure (l_t). Ψ_t is a vector of “taste shifter” characteristics that may affect consumption decisions. Physicians maximize the life time sum of discounted utility subject to period t budget constraints

$$(1) \quad c_t + w_t l_t = w_t \tau + y_t^n - s_t,$$

where w denotes the wage rate, τ is the time constraint, s is net saving, and y^n is non-labor income, net of asset income. Letting A_t denote period t assets (as measured at the end of the period) and r_t period t interest rate, savings are given by

³ An alternative approach is to model marginal-utility-of-wealth-constant (Frisch) labor supply, see MaCurdy (1981) and MaCurdy and Blundell (1999).

$$(2) \quad s_t = A_t - (1 + r_t)A_{t-1}.$$

In the first stage of the maximization, wealth is allocated over the life cycle to keep the marginal utility of wealth constant. In the second stage, for each period t utility is maximized subject to current prices and the wealth (full income) allocated to that period in the first stage. This gives period t labor supply ($h_t \equiv \tau - l_t$) as $h_t = h(w_t, Y_t, \Psi_t)$, where $Y_t = y_t^n - s_t$. In the empirical specification we use a frequently applied formulation,

$$(3) \quad h_t = (w_t)^\alpha \exp(\varphi Y_t + \eta \Psi_t).$$

It is easy to verify, by using Roy's identity, that (3) is consistent with the additive indirect utility function

$$(4) \quad v(w_t, Y_t, \Psi_t) = \frac{w_t^{\alpha+1}}{\alpha+1} - \frac{\exp(-\varphi Y_t)}{\varphi \exp(\eta \Psi_t)}.$$

Equation (3) is the uncompensated (Marshallian) labor supply function, and α is the wage elasticity. Using the Slutsky equation, the income compensated (Hicksian) response to a wage change may be derived as $h_t \left(\frac{\alpha}{w_t} - \varphi h_t \right)$. Standard consumer theory places no restrictions on α , but implies that Hicksian supply be non-negative (i.e., that the demand for leisure be non-positive) in the wage rate. This condition holds if $\alpha \geq \varphi w_t h_t$.

3.2 Econometric specification and estimation

In the econometric specification we introduce individual subscripts and allow for unobservables by writing $\eta\Psi_{it} = \beta X_{it} + \mu_i + \varepsilon_{it}$, where X_{it} are observable characteristics. μ_i is an individual specific effect and may be correlated with X_{it} and/or Y_{it} . The remainder ε_{it} is assumed to be white noise. As noted in Section 2, wages are negotiated centrally each year but that does not necessarily mean that a physician is able to adjust his work schedule immediately following a wage change. We incorporate this element in the model by assuming that physician i 's *desired* supply of hours is given by (3), denoted by an asterisk. In natural logs,

$$(5) \quad \ln h_{it}^* = \beta_0 + \alpha \ln w_{it} + \varphi Y_{it} + \beta X_{it} + \mu_i + \varepsilon_{it}.$$

We then impose a simple partial adjustment mechanism,

$$(6) \quad \ln h_{it} - \ln h_{i,t-1} = \theta(\ln h_{it}^* - \ln h_{i,t-1}), 0 < \theta \leq 1,$$

where a lack of asterisk indicates realized hours. Combining (5) and (6) gives the estimable equation

$$(7) \quad \ln h_{it} = \tilde{\beta}_0 + \gamma \ln h_{i,t-1} + \tilde{\alpha} \ln w_{it} + \tilde{\varphi} Y_{it} + \tilde{\beta} X_{it} + f_i + e_{it},$$

with $\gamma = 1 - \theta$, $\tilde{\beta}_0 = \theta\beta_0$, $\tilde{\alpha} = \theta\alpha$, $\tilde{\varphi} = \theta\varphi$, $f_i = \theta\mu_i$, $e_{it} = \theta\varepsilon_{it}$. The parameters of (5) are easily recovered by dividing $\tilde{\alpha}$, $\tilde{\varphi}$, and $\tilde{\beta}$ by $1 - \gamma$. We also note that a ‘‘standard’’ model with all

adjustment taking place within each period is nested in our set-up. This corresponds to the case where $\gamma = 0$, and is a testable hypothesis.

For estimation, we note that Y_{it} includes A_{it} , which is an outcome of the choice process and is therefore endogenous. Previous values are predetermined and are therefore valid instruments. If y_{it}^n includes spouse income (as it will in this application), presumably the couple's labor supply decisions are not independent. Then this element is endogenous, too, and must be instrumented.⁴ Due to the way the data are constructed, wage is also endogenous. Equation (7) is a dynamic linear panel data model and may be estimated by GMM-methods that have now become standard. First, the equation is first-differenced to get rid of the fixed effect f_i , which may be correlated with some of the right hand side variables. With T time periods, the estimating equation becomes

$$(8) \quad \Delta \ln h_{it} = \gamma \Delta \ln h_{i,t-1} + \tilde{\alpha} \Delta \ln w_{it} + \tilde{\varphi} \Delta Y_{it} + \tilde{\beta} \Delta X_{it} + \Delta e_{it}, t = 2, \dots, T,$$

where Δ is the difference operator: $\Delta \ln h_{i,t} = \ln h_{i,t} - \ln h_{i,t-1}$ etc. In this equation, $\Delta \ln h_{i,t-1} = \ln h_{i,t-1} - \ln h_{i,t-2}$ is correlated with $\Delta e_{it} = e_{it} - e_{i,t-1}$, but $\ln h_{i,t-s}$ and $\Delta \ln h_{i,t-s}$ are uncorrelated with Δe_{it} and are valid instruments for $s \geq 2$ (serial correlation has been ruled out by assumption).

Arellano and Bond's (1991) GMM estimator, which will be employed here, exploits all possible moment restrictions in levels for each period $t \geq 3$. The number of available restrictions increases with t :

$$\begin{aligned} t = 3: E(\Delta e_{i3} \ln h_{i1}) &= 0, \\ t = 4: E(\Delta e_{i4} \ln h_{i1}) &= 0, E(\Delta e_{i4} \ln h_{i2}) = 0 \\ t = 5: E(\Delta e_{i5} \ln h_{i1}) &= 0, E(\Delta e_{i5} \ln h_{i2}) = 0, E(\Delta e_{i5} \ln h_{i3}) = 0, \text{ etc.} \end{aligned}$$

⁴ In the estimation, the elements of Y_{it} will be entered as separate variables.

The validity of the over-identifying restrictions may be tested using a Sargan test. If the ε_{it} (and thus e_{it}) are serially uncorrelated, then the residuals in the first-differenced model are first-order-correlated, but should not show any second-order serial correlation. These restrictions may be tested, see Arellano and Bond (1991). More recently, Arellano and Bover (1995) and Blundell and Bond (1998) show that the efficiency of the Arellano and Bond (1991) GMM estimator may be dramatically improved by using an extended system GMM estimator that uses lagged differences as instruments for equations in levels, in addition to lagged levels of the instruments for equations in first differences. In this paper, we report both the “ordinary” GMM and “system” GMM results.

4. 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 wage and hours information on public servants employed by counties or municipalities. Thus employees of the main bulk of hospitals (county-owned) are represented. The NALRA data have been merged with individual specific as well as hospital specific information from Statistics Norway. The data sources are public registers, e.g. wealth data are extracted from tax records.

Sixty four hospitals report information to the NALRA register. This is the majority of Norwegian hospitals, the most important exceptions being the National Hospital (Rikshospitalet) and the National Cancer Hospital (Radiumhospitalet), both run by the central government. However, some hospitals did not report sufficiently detailed hours information to the register for some (12 hospitals) or all (12 hospitals) the years in the analysis period, 1993-1997. Thus 40 hospitals are represented in the sample. We restrict the sample to male physicians less than 67 years of age, who worked at one of these hospitals for at least three

consecutive years – the last requirement is necessary for first-differencing and instrumenting. The final sample then includes 1303 physicians.⁵

Table 1 Variable definitions

Lnh	Log of monthly hours
Lnw	Log of hourly wage
Saving	Net wealth of physician and spouse (t) – net wealth of physician and spouse (t-1)
Other income	Spouse income + child benefits
Hour35.5	Dummy=1 if the physician is on a contract implying 35.5 hours per week, 0 otherwise
Experience	Years with income above basic counting unit in pension system (NoK 37033 in 1993)
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
Chief consultant physician	Dummy=1 if chief consultant physician, 0 otherwise
Consultant physician	Dummy=1 if consultant physician, 0 otherwise
Married	Dummy=1 if married, 0 otherwise
Children<3	Dummy=1 if having children less than 3 years of age, 0 otherwise

The variables used in the analysis are the empirical counterparts to $\ln h_{it}$, $\ln w_{it}$, s_{it} , y_{it} , and X_{it} , and are defined more concisely in Table 1. The specification of X_{it} contains family information, and also job and hospital characteristics. In addition to the exclusion restrictions discussed in the previous section, experience and two demand related variables (hospital occupancy rate and average hospitalization time) are used as instruments. Details regarding the construction of wage and hours variables can be found in the appendix. It should be noted that the wage and hours data in the NALRA register are collected in October each year,

⁵ It is well established that there are gender differences in labor market behavior. We only have data on 378 female physicians. Regressions based on this sub-sample yielded imprecise results, and we have chosen to focus on the sample of males in this paper.

Table 2 Descriptive statistics

	1993	1994	1995	1996	1997
Hours per month	180.75 (24.42)	181.49 (25.26)	176.08 (30.06)	172.06 (29.47)	173.52 (33.34)
Hourly wage	186.29 (21.77)	187.42 (28.45)	191.49 (31.79)	220.89 (39.64)	220.71 (34.34)
Other income (1000 NoK)	137.47 (115.47)	138.29 (118.03)	145.86 (120.93)	156.69 (131.05)	161.98 (142.58)
Net wealth (1000 NoK)	82.35 (1114.13)	127.35 (1932.54)	179.87 (2153.63)	194.66 (2396.23)	247.66 (2628.01)
Savings (1000 NoK)	-	2.23 (48.94)	6.58 (43.25)	5.03 (34.73)	3.60 (36.42)
Hour35.5	0.73 (0.44)	0.72 (0.45)	0.71 (0.46)	0.68 (0.47)	0.67 (0.47)
Experience	20.53 (6.11)	20.81 (6.43)	21.28 (6.83)	22.29 (8.77)	23.42 (6.78)
Age	46.67 (8.55)	46.87 (8.70)	47.34 (8.96)	48.34 (8.77)	49.47 (8.59)
Married	0.82 (0.38)	0.82 (0.39)	0.81 (0.39)	0.82 (0.38)	0.82 (0.39)
Children < 3	0.15 (0.36)	0.13 (0.34)	0.12 (0.33)	0.11 (0.32)	0.10 (0.30)
Consultant physician	0.61 (0.49)	0.61 (0.49)	0.62 (0.49)	0.65 (0.48)	0.63 (0.48)
Chief consultant physician	0.20 (0.40)	0.18 (0.39)	0.18 (0.39)	0.19 (0.39)	0.24 (0.43)
Central hospital	0.62 (0.49)	0.63 (0.48)	0.64 (0.48)	0.65 (0.48)	0.67 (0.47)
County hospital	0.18 (0.38)	0.18 (0.38)	0.17 (0.37)	0.18 (0.39)	0.17 (0.38)
Occupancy rate	88.91 (8.59)	86.63 (9.03)	87.83 (8.49)	87.83 (8.55)	87.56 (9.52)
Hospital beds	367.46 (255.21)	385.88 (272.07)	402.53 (283.97)	406.74 (277.77)	401.59 (259.02)
Length of stay	299.93 (30.47)	304.39 (31.71)	302.17 (27.79)	307.81 (32.53)	314.19 (33.67)
Number of observations	1028	1216	1304	1105	995

whereas other individual characteristics are observed yearly, and hospital characteristics are yearly averages.

Sample statistics for each year are reported in Table 2. The mean age is about 46.7 years in 1993 and about 49.5 years in 1997, reflecting that the panel is unbalanced. The marriage rate is relatively stable (about 82 percent) over the five years, while the proportion with children less than three years of age varied from 10 to 15 percent. The average number of hours worked per month decreased from 181.5 in 1994 to 172.1 in 1996. We also note that the average wage rate increased sharply in 1996, following a particularly favorable settlement for physicians employed at hospitals in the central negotiations. Non-labor income (mostly spouse earnings) has increased steadily over the sample period from 137.5 thousand NoK in 1993 to 162.0 thousand NoK in 1997. Net wealth has also increased steadily over the sample period from 82.4 thousand NoK in 1993 to 247.7 thousand NoK in 1997. These physicians had an average of 20 to 23 years of experience over the sample period. Sixty one to sixty three percent of these were consultant physicians, while 18 to 24 percent of them were chief consultant physicians. Sixty two to sixty seven percent of the hospitals were central hospitals, while 17 to 18 percent were county hospitals. The occupancy rate varied between 86 and 89, while the total number of hospital beds varied between 367 and 407. The average length of stay varied between 300 and 314.

5. Regression results

Table 3 presents results for the dynamic labor supply equation. The Arellano-Bond (1991) GMM estimator and the Blundell-Bond (1998) system GMM system estimator are reported.⁶ Columns 1-2 of Table 3 report the GMM results without external instruments, while columns

⁶ The results were obtained using code written by Doornik et al. (2001) in the Ox language, see Doornik (1999).

3-4 report the GMM results using the additional instruments described in the data section and at the bottom of Table 3. The reported standard errors have the finite sample correction suggested by Windmeijer (2000) to deal with the potential finite sample bias of GMM. The reader is reminded that in our specification, the wage coefficients are elasticities, and that all the coefficients are short run.

We first note that the specification tests are satisfactory. The tests regarding serial correlation reject the absence of first order, but not second order serial correlation, and the Sargan tests do not reject the over-identifying restrictions. The system GMM results in columns (2) and (4) are quite similar, both rejecting that the lagged hours coefficient is zero. We interpret this as a rejection of a static model in favor of a dynamic model.

The short run wage elasticities using the system GMM estimator are in the 0.303 and 0.342 range. These are on the high end when compared to previous cross-section results for physicians labor supply. The corresponding long run wage elasticities for system GMM are 0.55 and 0.58, with standard errors 0.20 and 0.15, respectively. Savings and other income are not significant for all GMM estimators. Consultant and chief physicians work less than the reference group. This is also the case for physicians with small children, indicating that family responsibilities may play a role even for male physicians. Doctors employed at large hospitals (measured by number of beds) work more than others, but that effect is partly offset by the negative effect of working at a regional hospital as compared to the reference group of smaller local hospitals. We also note the negative constant term, which in a differenced model implies a negative time trend. Thus the positive wage effect at the individual level is compatible with the negative trend in aggregate hours seen in Table 2.

A possible objection to our modeling might be that taxes are not taken explicitly into consideration. However, with wages measured in logs, the effect of a constant marginal tax is picked up by the constant term. Individual differences in the tax rate that are fixed over time

Table 3 Labor supply estimates

	(1)		(2)		(3)		(4)	
	GMM		GMM-SYS		GMM		GMM-SYS	
	Coef	Std.Error	Coef	Std.Error	Coef	Std.Error	Coef	Std.Error
Lnh(-1)	0.238	0.167	0.450***	0.078	0.179	0.156	0.408***	0.073
Lnw	0.390*	0.203	0.303***	0.099	0.543***	0.186	0.342***	0.093
Saving	-0.001	0.001	0.001	0.001	-0.001	0.001	0.000	0.001
Other income	-0.007	0.007	0.001	0.001	-0.003	0.005	0.001	0.001
Hour_35.5	-0.057**	0.027	-0.014	0.013	-0.075***	0.025	-0.016	0.012
Married	0.129	0.125	-0.023	0.016	0.067	0.095	-0.029*	0.015
Child<3	-0.033	0.022	-0.018*	0.011	-0.040**	0.019	-0.023**	0.011
Consultant physician	-0.046	0.037	-0.034*	0.019	-0.075**	0.032	-0.039**	0.016
Chief consultant phys.	-0.051	0.047	-0.044	0.027	-0.085**	0.042	-0.048**	0.023
Hospital beds	0.021***	0.008	0.009***	0.002	0.021***	0.007	0.008***	0.002
Centr/Regional hosp	-0.211***	0.067	-0.040***	0.013	-0.199***	0.063	-0.040***	0.013
County hospital	-0.112**	0.052	-0.003	0.013	-0.096**	0.046	-0.004	0.013
Constant	-0.041***	0.010	1.316**	0.634	-0.046***	0.008	1.340***	0.519
T1995			-0.047***	0.006			-0.046***	0.006
T1996	-0.026	0.031	-0.107***	0.017	-0.047	0.029	-0.113***	0.016
T1997	0.060***	0.013	-0.077***	0.018	0.061***	0.012	-0.086***	0.017
AR(1) test		-3.290		-5.017		-3.509		-4.953
(p-value)		(0.001)		(0.000)		(0.000)		(0.000)
AR(2) test		0.638		1.583		0.354		1.413
(p-value)		(0.524)		(0.113)		(0.724)		(0.158)
Sargan test		25.71		36.29		35.05		46.37
(p-value)		(0.176)		(0.236)		(0.111)		(0.139)
Observations		3038		4341		3038		4341

Number of individuals: 1303

All results are based on a 2-step GMM. Standard errors use the Windmeijer's finite sample correction.

(1), (2): No additional instruments. (3), (4): Experience, length of stay, occupancy rate are used as additional instruments.

are swept away by first-differencing, along with the constant term. Moreover, most physicians in our sample have a yearly income implying the highest marginal tax rate (about 59%) for all years⁷. Since there has been no change in the relevant tax rates during this period, the marginal tax rate is constant for most physicians over the sample period. Excluding physicians with yearly income implying lower tax rates for some years had practically no effect on the estimated wage elasticities.

Even though the institutional setting is different, a comparison to Rizzo and Blumenthal (1994) and Showalter and Thurston (1997) seems relevant. Both these studies find considerably lower wage elasticities than those reported here. Using the same functional form as in the present study, Rizzo and Blumenthal, who consider self-employed physicians, find an uncompensated wage elasticity for men of 0.23, and an income compensated elasticity of 0.44. Somewhat surprisingly, we do not find any statistically significant income effects. Hence, we do not compute the income compensated elasticities. The lack of significance could be due to too little variation over time, but could also reflect differences between self-employed and employee physicians. Showalter and Thurston focus on responses to variations in marginal tax rather than wage elasticities *per se*, but a key finding is that whereas self-employed physicians are sensitive to the marginal tax rate, employee physicians have no discernible sensitivity at all. The according wage elasticities are 0.33 and 0.10, respectively.⁸ One reason that we estimate elasticities closer to 0.6 could be that the work schedules possibly are more flexible for the employee physicians in our sample. We have also estimated a static model (not reported) which is rejected by our dynamic specification. In this model the estimated wage elasticity (0.25) was closer to those reported in previous studies. Thus it cannot be ruled out that our higher estimated elasticities are not only resulting from

⁷ Only 37 physicians had yearly incomes corresponding to marginal tax rates lower than 59 percent. 4 physicians had lower marginal tax rates for all years, 19 physicians only the first year, while 8 physicians had lower marginal tax rates only for the last year.

⁸ The elasticities are with respect to $(1 - \text{marginal tax rate})$ but in their formulation the wage elasticity is identical.

institutional differences, but also from our access to panel data that allows for a richer dynamic specification.

6. Concluding remarks

The literature on the behavior of physicians holding jobs at hospitals is scarce. In this study we have estimated the labor supply of Norwegian hospital physicians, who constitute a majority of the profession in that country. We have used a matched panel data set which we think provide fairly accurate information on wages and hours. Simply stated, our main conclusion is that physicians who work at hospitals behave similarly to other employees. Compared to previous findings, the physicians in our sample seem fairly responsive to wage changes. In part, this may result from the institutional setting: these physicians are ordinary wage earners, and their earnings – even though they clearly are in the upper part of the wage distribution – are lower than for many self-employed doctors. Thus they need not be anywhere near the backward-bending part of the labor supply curve. But having access to panel data and being able to control for unobserved heterogeneity, as well as estimating a dynamic model, may explain why our wage elasticity estimates differ from the previous cross-section estimates. For planners of public policy, our results are interesting from at least two perspectives. First, if physician services are in short supply, physicians actually do respond to wage increases. Second, if increasing health expenditures are a worry, policymakers should be aware that the fiscal effect of increasing physicians' wages might be magnified by the labor supply response.

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Data appendix

In this appendix we explain how wages, hours and savings are constructed. The total number of hours supplied by each physician is not directly reported in our data (the NALRA register). The amount of regular hours is given, while work outside normal hours have to be calculated on the basis of different overtime payments. Our data contains information on the total sum of two types of overtime compensation: compensation for planned (contractual) overtime (fixed overtime compensation) and compensation for ordinary overtime (variable overtime compensation). Ordinary overtime is typically used due to vacancies and sick-absence. Before 1996, compensation for this kind of overtime was the same irrespective of working hours. Assistant physicians received 100 % overtime bonus, while ward and leading physicians received only 50 %. Since 1996, all physicians received 100 percent compensation for the first 11 hours per week and 200 percent compensation for additional overtime (here additional overtime include both planned and ordinary overtime). Using the total amount of overtime payments and the hourly compensation, it is straightforward to calculate the number of ordinary overtime hours.

In addition to ordinary overtime, physicians can make an agreement with the hospital to set an amount of hours that the physician is required to supply. Before 1996 the physicians were compensated at a fixed rate for this kind of contractual overtime. From 1996 the overtime bonus was made dependent on the amount of hours offered. The physicians receive 50 percent compensation for the first five hours per week, 100 percent from 6 to 11 hours and 200 percent compensation for more than 11 hours per week. Knowing the exact amount each physician receives as fixed overtime pay makes it a straightforward task to calculate the number of planned overtime hours worked. However, the amount reported in our data could include other kinds of regular compensation as well. Typically this is compensation for other types of extended working hours (like meetings or administrative work outside normal hours)

and this overtime might be compensated differently compared to what we have called planned overtime. Since we only have the total amount of fixed overtime payments, and therefore are unable to single out different types of overtime, we treat all overtime in the same way. To the extent that this possible measurement error is individual specific, first differencing eliminates it.

The hourly wage is calculated by adding the monthly basic income, compensation for ordinary and contractual overtime, and then dividing this income by the total number of hours worked. Finally the wage is discounted by a price index.

Physicians engaged in shift work have a contractual regular working hours of 35.5 hours per week, whereas others work 37.5 hours per week. To correct for this we have included a dummy variable (Hour35.5) in the regressions that takes the value 1 if the physician is on a contract implying 35.5 hours per week, 0 otherwise.

Saving is constructed as net family wealth (wealth of the physician and his wife) at time (t) minus net family wealth at time ($t-1$). Information on net wealth is taken from public tax registers, and includes real estate, bonds, shares, options and other securities, checking accounts, savings and deposits accounts, personal loans, credits, etc. Net wealth might be undervalued, since the taxable value of real estate is considerably lower than the marked value. Assuming that the under valuation of net wealth is constant over this short time span, first differencing eliminates this problem.

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