SERVICE MOTIVES AND PROFIT INCENTIVES AMONG PHYSICIANS

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UNIVERSITY OF OSLO
HEALTH ECONOMICS RESEARCH PROGRAMME
Working paper 2007: 4

HERO

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HERO 2007

Acknowledgements: We acknowledge the Research Council of Norway through the Health Economics Research Program at the University of Oslo (HERO) for their financial support. For their comments, we thank conference and seminar participants at Boston University, European University Institute, University of Milan, and the Workshop on Health Economics, Oslo 2006. We also thank Trond Olsen for his suggestions.

Health Economics Research Programme at the University of Oslo
Financial support from The Research Council of Norway is acknowledged.
ISSN 1501-9071 (print version.), ISSN 1890-1735 (online), ISBN 82-7756-176-8

Abstract

We model physicians as health care professionals who care about their services and monetary rewards. These preferences are heterogeneous. Different physicians trade off the monetary and service motives differently, and therefore respond differently to incentive schemes. Our model is set up for the Norwegian health care system. First, each private practice physician has a patient list, which may have more or less patients than he desires. The physician is paid a fee-for-service reimbursement and a capitation per listed patient. Second, a municipality may obligate the physician to perform 7.5 hours per week of community services. Our data are on an unbalanced panel of 435 physicians, with 412 physicians for the year 2002, and 400 for 2004. A physician's amount of gross wealth and gross debt in previous periods are used as proxy for preferences for community service. First, for the current period, accumulated wealth and debt are predetermined. Second, wealth and debt capture lifestyle preferences because they correlate with the planned future income and spending.

The main results show that both gross debt and gross wealth have negative effects on physicians' supply of community health services. Gross debt and wealth have no effect on fee-for-service income per listed person in the physician's practice, and positive effects on the total income from fee-for-service; hence, the higher income from fee-for-service is due to a longer patient list. Patient shortage has no significant effect on physicians' supply of community services, a positive effect on the fee-for-service income per listed person, and no effect on the total income from fee-for service. These results confirm physician preference heterogeneity.

1. Introduction

Economic theory is largely based on a hypothesis of self-interest. To a large extent, it is argued, many social phenomena may be explained as outcomes of interactions of selfish economic agents. Nevertheless, the selfish economic agent hypothesis is a simplifying assumption. Economists do recognize that even their own behaviors are not entirely consistent with self-interest, and that many social phenomena cannot be easily explained by it.

The self-interest hypothesis is probably unpalatable when it is applied to the health care market. There are serious frictions in the health care market due to hidden information and hidden action. One wonders why the complete collapse of the health market had not already occurred if physicians and health care professionals were completely guided by their selfish goals. In fact, Arrow (1963), in his seminal discussion of the medical market, already has called for a broader perspective. He also points out as a matter of fact that health care professionals are strongly influenced by ethical conduct, standards of care and service motives.

In this paper we model physicians as health care professionals who care about their community services. Their preferences are a combination of community service and monetary rewards. Furthermore, we let these preferences be heterogeneous; different physicians trade off the monetary and service motives differently. Heterogeneity is an important assumption because preferences on monetary and service motives determine how physicians react to incentive schemes. Those physicians who care more about monetary rewards react more strongly to financial incentives than those who do not.

We set up a theoretical model for physician services in Norway. Various components of the model are set up to reflect the Norwegian health care system. There are two important elements in the description of the private practice physicians in Norway. First, each private practice physician has a list of patients under his care, and this list may have more or less than the number of patients he desires. The physician is paid a fee-for-service reimbursement together with a capitation per patient in his practice list.

Second, each physician is obligated to perform some community service in the municipality where he works. In fact, a municipality has the power to request 7.5 hours per week of community service from a physician. Physicians are paid an hourly wage for their community services. This hourly wage is quite low compared to the equivalent earning a physician can make in private practice. This is the basis for our assumption that physicians are motivated by their preferences for community services to the municipalities. Despite a smaller financial reward, some physicians actually work more than the legally required amount of community service.

We have data on an unbalanced panel of 435 physicians, with 412 physicians for the year 2002, and 400 for 2004. The information includes physician personal characteristics, their community involvements, and private practices. Our estimations identify the effect of physician characteristics on their private practice styles as well as their community services. We look at services provided by physicians to their patients. Are they affected by whether the physicians think that they have enough patients in their lists? Does patient shortage affect physicians' supply of community health service?

We use a physician's amount of wealth and debt in previous periods as proxy for the physician's preferences for community service. First, for the current period, accumulated wealth and debt are predetermined. Second, wealth and debt likely capture lifestyle preferences because they correlate with the planned future income and spending. The actual implementation will use gross wealth and gross debt in the regressions. The higher gross debt, the higher is the future income required to pay for the interest. This likely means that the physician is less interested in providing community service, which is financially less rewarding.

In our study, physicians' community health service supply decisions are censored because municipalities may impose upon physicians up to 7.5 hours of work per week. When the dependent variable is censored, a linear regression model will give inconsistent estimates. Instead, we estimate a random-effects tobit model on physicians' community service supply. For estimating the effects of indicators of service motive on the physicians' private practice service supply, we use a standard random-effects model, which controls for unobserved heterogeneity in our panel data.

The main results show that both gross debt and gross wealth have negative effects on physicians' supply of community health service. Gross debt and wealth have no effect on fee-for-service income per listed person in the physician's practice, and positive effects on the total income from fee-for-service; hence, the higher income from fee-for-service is due to a longer patient list. Patient shortage has no significant effect on physicians' supply of community

services, a positive effect on the fee-for-service income per listed person, and no effect on the total income from fee-for service.

The paper proceeds as follows. Section 2 describes the study setting and reviews the literature. We set up a model in section 3, and derive a set of hypotheses. Section 4 presents the data and descriptive statistics. In Section 5 the strategy for empirical analysis is explained and results are presented. Concluding remarks are given in Section 6.

2. Study setting and literature review

We use data from Norway in this study. Norway is a country of about 4.5 million inhabitants. Norwegians' health care is covered by a national health service, which is mainly tax-financed. Hospitals are publicly owned, and in-patient care is free to users. Outpatient consultations with primary care physicians and specialists are offered respectively with a co-payment of about US$25 and US$40 in 2006. Since the implementation of the Regular General Practitioner Scheme in 2001, each inhabitant of Norway has been listed with a General Practitioner (GP), or primary care physician. About 90% of GPs are self-employed, private physicians contracting with municipalities, with the remaining GPs employed by the municipalities. Each GP has a list of patients. In 2004 the average list-size was between 1250 and 1300 people. Besides providing primary care, GPs act as gatekeepers. A referral by a GP is required for consultations with health care specialists. The national insurance covers all expenditures if co-payments for physician services and medicines within a year exceed a deductible of about US$250.

The Regular General Practitioner Scheme of 2001 required each inhabitant to submit to the National Insurance Administration up to three preferred physicians. GPs submitted to the Administration the maximum number of patients they were willing to include in the practice list. A matching process respecting patient and GP preferences formed the GP patient lists. For many physicians the maximum number of patients they were willing to accept exceeded the number of people who showed interest in being listed with them. The administration then allocated inhabitants who did not submit any physician preference (30 percent of the adult population) to these GPs. After this second round of assignments, about 30 percent of the GPs still ended up with at least 100 patients less than the number of patients they were willing to take. In the paper we say that these GPs experience a shortage or deficit of patients.

Private practice general practitioners have three sources of revenue. First, there is a fee-for-service payment; a GP provides various services to patients in return for a fee from the national insurance. Second, for each consultation, a GP receives a co-payment from the patient. Third, a GP receives a capitation fee from the municipality in which he serves. The capitation amount is based on the number of patients listed with the practice without any risk adjustment. Each of the three components constitutes about one third of the income of an average practice.

In Norway preventive health care at childcare centers and schools, and regularly medical care at nursing homes and prisons are served by GPs working in part-time positions in the community health service. These community health services are remunerated according to a fixed salary scheme that is negotiated between the state and the Norwegian Medical Association. The community service remunerations are in terms of hourly wages and tend to be lower than the

equivalent rates in private practice. GPs are also entitled to a "practice compensation" to cover costs in their practice while working for the municipality, and it is paid on an hourly basis. In Godager and Lurås (2005) the remuneration rate for community service is estimated to be between 38% and 66% of the equivalent private practice rate. This range is due to variations in cost reductions in GPs' private practice while working for the municipality. According to current regulations, a municipality can require GPs to perform up to 7.5 hours of community services per week. A municipality is obliged to strive for an equitable distribution of community health workload among the GPs if they choose to enforce the regulation.

Several papers have studied the impact of economic incentives since the health system reform in Norway. Iversen (2005) studies whether patient shortage will lead a GP to increase services provided to patients in the practice. The study shows that GPs with patient shortage in fact compensate for their lower capitation payment by earning more fee-for-service incomes. Carlsen and Norheim (2003) investigate whether the patient list system has influenced general practitioners' self-perception as gatekeepers. They find that GPs generally have become less concerned with the gatekeeper role. Rather, GPs believe that they should provide better services to keep patients from switching to other physicians.

In Lurås (2005) a nationally representative sample of Norwegians are surveyed about satisfaction with their GPs. She finds that if a patient's GP has a patient shortage, then she is likely to be dissatisfied in most quality dimensions except waiting time. Iversen and Lurås (2006) add to this result by supplementing the earlier study by registrar data. They find that

patients of those GPs with patient shortage tend to switch GPs more often, even though these GPs already provide more services.

Using cross sectional data from 2002, Godager and Lurås (2006) study the effect of patient shortage on GPs' supply of community health service. From tobit regressions, they find that GPs experiencing a patient shortage contract for more hours of community health service. The shorter GP's patient list, the higher is this supply. The dataset in Godager and Lurås (2006) is the same as the 2002 part of the data in this paper.

We are unaware of any paper that studies the relationship between physician indebtedness and physicians' service decisions. There are, however, some papers that study the effect of study loans on physicians' occupational choices. Fox (2003) finds that physicians who have had large study loans are less likely to enter academic medicine, which is financially less rewarding. Bazzoli (1985) and Thornton (2000) find that medical students' magnitude and types of loans have an impact on physician specialty choices. Culler and Bazzoli (1985) study factors that affect resident physicians taking a second job; when making moonlighting decisions, residents are influenced by debt and other economic factors.

3. The model

We present a model of physician decision on private practice and community services. A physician has a private practice, where he provides services for patients who are enrolled with him. The physician also spends some time to work for the municipality. We call this community

service. While the private practice is usually within the physician's specialty or general medicine, community services at the municipality typically are related to nursing home care, prisons, vaccination for school children, administrative work, and related community medicines. The contract between the physician and the municipality stipulates that a minimum number of hours of community service may be required.

The physician receives two kinds of payments for treating patients at his private practice. First is the patient list component of the revenue. The physician receives a capitation payment, a lump sum per patient who has elected to be in the doctor's practice. Second is the fee-for-service component of the revenue. The physician receives a payment based on the service that is provided to a patient.[2] Community services are also remunerated, and they are paid on an hourly basis.

The payment for a unit of private practice service, s, is denoted by α; the community service has an hourly remuneration rate β. While the fee-for-service rate α is based on the quantity of services, we will interpret α as an equivalent hourly rate, so that the private-practice and community-service remuneration rates are comparable. Alternatively, we may interpret s as hours of private practice. The remuneration rate for community service is lower than private service, so we assume that $\alpha > \beta$. The last component of payment is the capitation rate per patient enrolled in a physician practice; this is denoted by γ.

[2] Physicians also receive co-payments from patients for office consultations, but we will ignore this revenue source here.

Let n denote the number of patients who are enrolled in the physician practice, and s the service that the physician supplies to a patient. Let a denote the amount of community service the physician provides at a municipality. The physician decides on these three variables subject to various constraints to be explained below.

The physician incurs a total cost of $C(ns + a)$ when he serves n patients, each with service s, and when he supplies a units of community service. The cost function includes both the physician's time cost and other necessary input costs for providing s services to each of n patients, and the community service a. For convenience, we have chosen to let cost be a function of the sum of private and community services. The function C is increasing and convex. We will also assume that it is twice differentiable, and that the marginal cost (first order derivative) increases without bound. The physician derives utility $\theta V(a)$ from community service a. The function V is an increasing and concave function, and θ is a positive parameter. We postulate that the physician is motivated to provide community service, and this motivation is captured by the utility $\theta V(a)$. Later, we discuss how we proxy for the preference parameter θ.

For simplicity, we have assumed that the physician's concern for patients in his private practices is purely motivated by profits. This may not seem entirely consistent with the assumption that physicians derive a utility from serving the community besides the monetary remuneration. In the appendix, we have examined the robustness of the model. There we allow the physician to derive a utility for serving patients in his private practice, and show that the predictions by the model remain valid.

There are two constraints that restrict the physician's choice of the number of patients in his practice, as well as the service for each patient. First, we let D be the maximum number of patients that the physician can have. This maximum demand D is assumed to be exogenously given. In a short period of time, the physician cannot influence the total number of patients willing to be listed with him. Nevertheless, the physician may decide to serve less than D patients. Therefore, the first constraint for the physician is $n \leq D$.

In the absence of this constraint, a physician may want to enroll more patients. If indeed the physician does want a larger patient list, the constraint will become binding, and $n = D$, and we say that the physician has a shortage of patient or is rationed. We will not impose a minimum community service constraint now. The basic model will be used later for studying this possibility.

The second constraint concerns the physician's service intensity. We assume that the service per patient, s, is limited to a range $[S_1,S_2]$, with $S_1 < S_2$. This range of services describes the physician's control on patients, or the extent of physician agency. Superior medical knowledge and experience allow the physician to dictate to some extent the services patients receive. Variations in services, however, are subject to some limits. We bound these variations by an interval. We assume that S_1 and S_2 are exogenous. Within this range, the physician is able to dictate the service to the patient: $S_1 \leq s \leq S_2$.

Given the payment parameters, fee-for-service rate α, community service rate β, and capitation rate γ, if the physician has n patients in his practice, and provides s services to each patient, as well as community service a, his payoff is

$$U(s,n,a) \equiv \alpha sn+\beta a + \gamma n + \theta V(a) - C(ns+a). \tag{1}$$

The utility function in (1) contains the financial rewards from private practice and community service (the first three terms), an enjoyment from serving the municipalities, and the cost of services. We will later proxy the community service preferences.

The physician's list of patients must be less than D, and his service intensity must be within the range $[S_1,S_2]$. The physician's behavior is described by his choice of n, s and a that maximize his utility in (1) subject to the constraints $n \le D$ and $S_1 \le s \le S_2$.

We begin by considering cases when the constraint $n \le D$ does not bind. Here, the physician is not rationed and can choose the optimal number of patients for his practice without worrying that insufficient patients will elect to join. The first-order condition of U with respect to n is

$$\frac{\partial U}{\partial n} = s\left[\alpha - C'(ns+a) + \frac{\gamma}{s}\right] = 0 \tag{2}$$

when the constraint $n \le D$ does not bind. Now consider the first-order derivative of U with respect to service s:

$$\frac{\partial U}{\partial s} = n\left[\alpha - C'(ns+a)\right] < 0. \tag{3}$$

From the first order condition (2), the first-order derivative with respect to s in (3) must be negative. This implies that the optimal value of s is S_1, the lower bound on the range of service.

Having an extra patient entitles the physician to obtain the capitation payment. The physician cares about total service *ns*. By reducing *s* and raising *n* to keep *ns* constant, the physician already raises his payoff due to the capitation payment. The result is that when there is no patient shortage, the physician tends to provide less service and enrolls more patients.

We have not included a utility component in the physician's service in the private practice. Such a utility may tend to raise the value of s in the above calculation. Nevertheless, the tendency to increase n due to the capitation payment remains robust for many specifications of such a utility.

Next, we differentiate the objective function *U* with respect to community service *a*:

$$\frac{\partial U}{\partial a} = \beta + \theta V'(a) - C'(ns + a) . \tag{4}$$

From (3), and the assumption that $\alpha > \beta$, the expression in (4) must be strictly negative when θ is sufficiently small. Community service has a lower remuneration ($\alpha > \beta$). If the physician does not value community service sufficiently, he chooses the minimal level.

Now we consider the case when the constraint $n \le D$ binds. Here the first-order derivative of *U* with respect to *n* is positive at $n = D$:

$$\frac{\partial U}{\partial n} = s\left[\alpha - C'(Ds + a) + \frac{\gamma}{s}\right] > 0 .$$

The first-order derivative with respect to *s* is

$$\frac{\partial U}{\partial s} = D\left[\alpha - C'(Ds + a)\right].$$

If D is small, then the first-order derivative evaluated at $s = S_1$ will likely be positive and the optimal s is strictly bigger than S_1 . In fact, the first-order derivative may remain positive for all service levels, so that we may have a corner solution $s = S_2$. In such an equilibrium the community service a will be decreasing in D. For an interior solution, s is in $[S_1,S_2]$, and will be given by setting the above first-order derivative to zero. Finally, the first-order derivative (4) applies, and for an equilibrium where $a > 0$, it will be set at zero.

When the constraint $n \le D$ binds, and when the physician picks a service per patient in the interior of $[S_1,S_2]$, we can use the first order conditions:

$$\left[\alpha - C'(Ds + a)\right] = 0$$
$$\beta + \theta V'(a) - C'(Ds + a) = 0$$

to obtain comparative static result. For brevity, we do not present the derivations here. At the service intensity interior solution, the equilibrium community service a is increasing in the preference parameter θ, but does not vary with the rationed list size D while the equilibrium service s is decreasing in D. [3]

A physician having stronger preferences for community services will cut back more on private practice. This is because community services raise the marginal cost of supplying services to patients. Finally, a higher value of θ implies a larger supply of community service.

[3] Use the two first-order conditions to eliminate the term C' to get $\alpha = \beta + \theta V'(a)$. Hence, given an interior solution of s a change of community service a is only related to θ .

To summarize, we list several predictions of our model:

1. Physicians who have patient shortage tend to supply more service per patient; conversely, physicians who have no patient shortage tend to supply less service per patient.
2. Physicians' community service does not depend on the list size when they face a patient shortage and when the optimal service per patient is an interior solution.
3. With both patient shortage and constrained service per patient, the physicians' community service is decreasing in the rationed list size.
4. The stronger physicians' preferences for community service, the larger is the amount of community service they supply and the shorter the preferred list of patients.

4. Data and descriptives

A survey of 35 Norwegian municipalities and two districts of the city of Oslo forms the basis of the data for analysis. This survey was initiated by us and put together by municipality administrative staff. The data contain information of physicians who participated in community health services at the said municipalities and districts for the years 2002 and 2004.

The municipalities and Oslo districts in the survey were randomly selected within groups stratified according to geography and a measure of centrality according to the classification by Statistics Norway (Norwegian Official Statistics, 1999).[4] The stratification aims to obtain a representative sample of Norwegian municipalities. In 2002, all municipalities responded to the survey, while in 2004, four municipalities failed to respond (with a corresponding response rate

[4] The classification assigns each municipality to one of four groups based on travel time from the municipality to the nearest densely populated area.

of 89%). The four municipalities that did not respond were small, and so were the numbers of physicians in these municipalities relative to the total.

The survey data were merged with registrar data from the Norwegian primary physician database, which describes characteristics of each GP and each GP's patient list.[5] GP characteristics include age, gender, number of children according to age groups, taxable income, wealth and debt. The GP practice characteristics include preferred number of patients, actual number of patients listed according to gender and age, and the total of fees received from national insurance.

Primary care physicians who did not provide any community service were not in the survey. The municipalities simply did not register these physicians in their administrative files. So those physicians in the registrar data who did not appear in the survey were assigned zero hours of community service in the corresponding municipalities or Oslo districts.

For confidentiality and privacy protection, each physician in the survey was informed and given the opportunity to withdraw participation from the survey. No such request was received and the merged data from the 2002 survey was made available for research four months after data collection. The merged data from the 2004 survey was available for the researchers eight months after data collection.

[5] The Norwegian primary physician database is administered by the Norwegian Social Science Data Service (NSD) and provides information of individual GPs.

The data set is an unbalanced panel of 484 physicians. There were 466 physicians for the year 2002, and 440 in the year 2004. We exclude GPs who contract with more than one municipality (6 physicians each year) because we are unable to disaggregate their total practice income into the municipality sources. We also exclude salaried GPs (28 physicians in 2002 and 22 physicians in 2004) because their economic incentives are different from the private GPs who contract with a municipality. We also exclude those GPs who were both salaried and contracted with more than one municipality (1 physician each year not in the previous exclusions). In the primary physician registrar, information of *Annual income from fees from national insurance* or *Gross debt* and *Gross wealth* was missing for 19 physicians in 2002 and for 11 physicians in 2004. Our analysis is then based on data of a total of legitimate 812 observations (412 in 2002 and 400 in 2004) of 435 GPs.

Table 1 presents descriptive statistics of the full panel. The last two columns decompose the total variation into 'between physician' (b) and 'within physician' (w) variation.[6] On average a physician works 4.88 hours per week of community health services, with a maximum of 22.5 hours per week. The between variation as a proportion of total variation is 71 percent and accordingly, the within variation is 29 percent of the total variation. About 14 percent of the GPs work more than the 7.5 hours per week, which is the legal requirement that a municipality may impose on GPs. On average a GP's preferred list size (1393) is slightly larger than the actual list size (1316). While 22 percent of the GPs experience a shortage of patients, 8 percent have a list larger than they prefer.

[6] While 'between physician variation' measures the variation in physician averages, 'within physician variation' measures the variation around the average of the two periods for each physician.

Table 1 Descriptive statistics for the panel

Variable	Definition	Mean	Std. Dev.	Min	Max	b	w
Total-hour	Total hours per week in community health service	4.88	4.27	0	22.5	0.71	0.29
Volunt-hour	Binary variable set to 1 if Total-hour>7.5, otherwise 0	0.14	0.35	0	1	0.65	0.35
Prefer-list	The GP's preferred list size	1393	378	100	2500	0.76	0.24
List	Actual list size	1316	383	98	2798	0.79	0.21
Prop-female	Proportion of females on list	0.51	0.10	0.25	0.86	0.92	0.08
Prop-old	Proportion of 70 and older on list	0.11	0.06	0.00	0.37	0.88	0.12
Shortage	Binary variable set to 1 if (Prefer-list – list)>100, otherwise 0	0.22	0.41	0	1	0.54	0.46
Many	Binary variable set to 1 if (Prefer-list – list)<-100, otherwise 0	0.08	0.28	0	1	0.50	0.50
Total-FFS	Annual income (NOK) from fees from national insurance	558102	285717	875	2702649	0.70	0.30
FFS-NI	Annual income (NOK) from fees from National insurance per listed person	440.38	251.24	0.84	3677.85	0.47	0.53
Gr-debt	Gross debt in million NOK	1.15	1.08	0	6.86	1.00	0.00
Gr-wealth	Gross wealth in million NOK	1.21	0.92	0	8.21	1.00	0.00
Net-wealth	Net wealth in million NOK	0.06	1.36	-5.32	4.79	1.00	0.00
Gen-Med	Binary variable set to 1 if GP specialist in general medicine, otherwise 0	0.59	0.49	0	1	1.00	0.00
Comm-Med	Binary variable set to 1 if GP specialist in community medicine, otherwise 0	0.06	0.24	0	1	1.00	0.00
Age	GP's age	46.66	8.74	27	69	1.00	0.00
Male	Binary variable set to 1 if GP is a male, otherwise 0	0.74	0.44	0	1	1.00	0.00
Married	Binary variable set to 1 if GP is a married, otherwise 0	0.78	0.41	0	1	0.89	0.11
Child-under 6	Number of own children under 6 years old	0.27	0.60	0	3	0.62	0.38
Child-6-18	Number of own children between 6 and 18 years	0.87	1.10	0	5	0.74	0.26
Low-Central	Binary variable set to 1 if municipality has lowest level of centrality; otherwise 0	0.04	0.20	0	1	1.00	0.00
Med-Central	Binary variable set to 1 if municipality has second lowest level of centrality; otherwise 0	0.07	0.26	0	1	1.00	0.00
High-1-Central	Binary variable set to 1 if municipality has second highest level of centrality; otherwise 0	0.19	0.39	0	1	1.00	0.00
High-Central	Binary variable set to 1 if municipality has highest level of centrality; otherwise 0	0.70	0.46	0	1	1.00	0.00

As described previously, a GP's total practice income consists of capitation fees (NOK 299 per person[7] listed in 2003), patient co-payments and service fees from the national insurance. The last two components are proportional to the volume of services provided. We do not have reliable data on patient co-payments. Therefore, we use the annual income from national insurance fees as a proxy. From Table 1 this fee has a mean of NOK 558102 per physician per year.

Table 1 also displays the average physician debt and wealth. Gross wealth (*Gr-wealth*) is defined as the sum of real capital (including housing value) and financial assets (bank deposits and other financial assets). Gross debt (*Gr-debt*) is personal debt including mortgage balance. Net wealth (*Net-wealth*) is the difference between gross wealth and gross debt. The mean gross debt is 1.15 million NOK, while the mean gross wealth is 1.21 million NOK. Together these figures imply a positive average net wealth. The variation in the debt and wealth figures is considerable. Because we only have data on wealth and debt for the year 2002, the within physician variation is zero for these variables. The mean age of the GPs is 47 years, and 74 per cent of them are men. Seventy-eight per cent is married and the GPs have on average 0.27 children below six years of age. About 6 percent of physicians are specialists in community medicine, while 59 percent have earned a specialist degree in general medicine. From Table 1, 4 percent of the GPs practice in a municipality with the lowest level of centrality, while 70 percent practice in a municipality with the highest level of centrality.

[7] 1 USD was approximately 6.30 NOK

Wealth and debt are measured at the individual level. It is likely that a GP's decisions are influenced not only by his own wealth and debt, but also by wealth and debt registered in the name of the spouse. We would prefer to have access to the household wealth and debt. Since these figures are not available to us, we use household composition variables as controls (*Male, Married, Child-under 6*).

Table 2 contains the descriptive statistics of physicians' involvement in community health services. We categorize the information according to whether the physicians work more or less than 7.5 hours, the obligation that municipalities may impose upon them. Those physicians who work more than 7.5 hours may have chosen to do so voluntarily. Those physicians who work voluntary hours have shorter preferred lists and actual lists. However, the two groups of physicians share similar characteristics with respect to gender and elderly proportion in their patient lists. The proportion of GPs with patient shortage is higher among those who work voluntary hours of community health service than those who do not. GPs who work less than 7.5 hours have both higher gross debt and gross wealth, but those who work more than 7.5 hours have a higher net wealth. Finally, those who work voluntary hours at municipalities are more likely to be specialists in community medicine.

In our theoretical model, a physician's preferences for community service is $\theta V(a)$ from community service a. The parameter θ captures the intensity of such preferences. In our empirical implementation, we use the amount of a physician's debt and wealth in previous periods to proxy for his preferences for community service. Gross wealth and gross debt are

independent variables in the regressions.[8] Physicians who have higher levels of gross wealth are likely to have a more affluent lifestyle. Physicians who have higher levels of gross debt require more income to pay for finance charges and interests. So we associate weaker preferences for community services with higher physician gross wealth and debt.

Table 2 Descriptive statistics according to physician community health service

	Volunt-hour = 0 (No. obs. = 700)				*Volunt-hour* = 1 (No. obs. = 112)			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Total-hour	3.60	2.62	0	7.5	12.83	4.02	8	22.5
Prefer-list	1412	377	100	2500	1274	362	300	2000
List	1336	385	98	2798	1187	349	212	2045
Prop-female	0.51	0.10	0.28	0.86	0.50	0.10	0.25	0.76
Prop-old	0.10	0.06	0.00	0.35	0.12	0.07	0.00	0.37
Shortage	0.21	0.41	0	1	0.28	0.45	0	0
Many	0.09	0.29	0	1	0.03	0.16	0	0
Total-FFS	562691	293449	875	2702649	529421	230673	32892	1344763
FFS-NI	435.65	255.99	0.84	3677.85	469.99	217.95	26.33	1527.60
Gr-debt	1.19	1.10	0	6.86	0.89	0.85	0	3.35
Gr-wealth	1.24	0.96	0	8.21	1.02	0.56	0.03	2.67
Net-wealth	0.06	1.41	-5.32	4.79	0.13	1.06	-2.37	2.36
Gen-Med	0.58	0.49	0	1	0.63	0.49	0	1
Comm-Med	0.04	0.20	0	1	0.20	0.40	0	1
Age	46.49	9.00	27.00	69.00	47.71	6.79	33	61
Male	0.73	0.45	0	1	0.79	0.41	0	1
Married	0.76	0.43	0	1	0.79	0.41	0	1
Child-under 6	0.28	0.60	0	3	0.21	0.59	0	3
Child-6-18	0.90	1.06	0	4	0.87	1.10	0	5
Low-Central	0.03	0.17	0	1	0.11	0.31	0	1
Med-Central	0.07	0.25	0	1	0.10	0.30	0	1
High-1-Central	0.19	0.39	0	1	0.19	0.39	0	1
High-Central	0.71	0.45	0	1	0.61	0.49	0	1

[8] Since Net wealth = Gross wealth – Gross debt, we could have used any two of the three measures in the regressions. We also have access to data on interest payment. The coefficient of correlation between Gross debt and interest payment is 0.93, so interest payment does not add any information.

5. Empirical specification and results

We would like to know what determines GPs' community services. In our study, GPs' labor supply decisions on community service are censored because municipalities may impose upon physicians that they work up to 7.5 hours per week. Furthermore, in our data, we observe cases in which GPs work less than 7.5 hours. So we must allow the censoring threshold to vary between GPs. When the dependent variable is censored, a linear regression model will give inconsistent estimates (Tobin, 1958). Many tobit models have been developed to take account of a censored dependent variable, and such models are frequently used in labor econometrics (Moffit, 1999).

Let $\tilde{y}_{it}$ denote the number of hours of community service GP *i* prefers to work in time period *t*; we regard $\tilde{y}_{it}$ as a latent variable. We let $\tilde{y}_{it}$ be normally distributed with mean μ and variance $\sigma_{\tilde{y}}^2$. Further let y_{it} denote the actual number of hours of community service GP *i* has provided in time period *t*. When y_{it} is less than 7.5, we do not know if this is a result of the physician's choice or the municipality's imposition, and can only infer that $\tilde{y}_{it} \le y_{it}$. In this case we say that the physician's community service supply has been censored. For $y_{it} > 7.5$ we assume that the community service provided is the GP's own choice. We assign the individual specific thresholds in period *t*, c_{it}, according to the following rule:

$c_{it} = 0$ when $y_{it} > 7.5$, and $c_{it} = y_{it}$ when $y_{it} \in [0, 7.5]$. Letting I_{it} denote an indicator variable equal to 1 if y_{it} is censored, and 0 otherwise, we now specify our censored regression model:

$$y_{it} = (1 - I_{it})(\beta' x_{it} + u_i + \varepsilon_{it}) + I_{it} c_{it},$$

where β is a vector of parameters, and x_{it} a vector of explanatory variables. The variable u_i denotes random effects and is assumed to be i.i.d $N(0,\sigma_u)$ while ε_{it} 's are residuals and are assumed to be i.i.d $N(0,\sigma_\varepsilon)$ and independent of u_i. The estimation is by maximum likelihood in STATA 9. The main results of the estimation are in Table 3.

Table 3 The estimated effect of physician characteristics on hours of community health service. Random-effects tobit model.

	Total-hour
Prop-female	-1.99 (4.16)
Prop-old	6.88 (5.22)
Shortage	0.65 (0.66)
Many	-2.13 (1.22)
Gr-debt	-0.83** (0.32)
Gr-wealth	-1.68** (0.45)
Gen-Med	0.88 (0.64)
Comm-Med	4.98** (1.02)
Male	0.34 (1.01)
Married	-0.14 (0.67)
Child-under 6	-0.46 (0.50)
Med-Central	-0.94 (1.57)
High-1-Central	-4.14** (1.36)
High-Central	-4.23** (1.26)
Constant	6.40 (2.96)
P	0.68
No. left-censored observations	700
No. of observations	812
No. GPs	435
No. observations per GP	Min: 1 Avg: 1.9 Max: 2

Estimates with '**' indicates that the parameter is significantly different from zero at the one percent level for a two-tailed test.

From Table 3, both *Gr-debt* and *Gr-wealth* have negative and statistically significant effects on GPs' total number of hours of community health service. The magnitude of the effect is large: An increase of 1 million NOK each in *Gr-debt* and *Gr-wealth* (which results in no change in net wealth) is expected to decrease the labor supply by 2.5 hours, about 51 per cent of the mean number of hours worked. Being a specialist in community medicine (*Comm-Med*) contributes positively to community service, while a higher degree of centrality has a negative effect. Patient shortage (*Shortage*) has a statistically insignificant effect on GPs' supply of community service.

From Table 3 physicians who practice in municipalities with a high level of centrality are less engaged in community health services compared to their colleagues in the least centrally located municipalities. This result indicates that municipality characteristics represent important constraints and culture with impact on physicians' decisions. We could control for these characteristics at the municipality level by fixed effects. Nevertheless, some municipalities have only a few physicians. Because of the lack of variations for some municipalities, regressions yield statistically insignificant results. So for our purpose we have decided to continue with the four centrality variables to capture municipality characteristics.

We use a parameter to measure the latent, physician-specific heterogeneity in the supply of community health service. This parameter, ρ, is defined as the ratio of the variance of the physician-specific effect to the variance of the 'gross disturbance' $u_i + \varepsilon_{it}$, i.e., $\rho = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_\varepsilon^2}$. The parameter has the alternative interpretation of the coefficient of correlation between two 'gross disturbances' from the same physician in different years. The value of ρ=0.68 indicates that the

unobserved heterogeneity is significant. Accounting for physician heterogeneity in community health service supply is important for the estimation.

We perform a Hausman test to check whether the 7.5 hours threshold is effective. Consider the two possibilities:

H_0 : Data are generated by a standard labor market with supply censored at zero hours.

H_A: Data are generated by a labor market with supply censored whenever $y_i \leq 7.5$.

The idea behind the test is this:

(1) use an estimator that is consistent whether or not the hypothesis is true (i.e, whether or not physicians work voluntarily when they work less then 7.5 hours.)

(2) use an estimator that is efficient (and consistent) under H_0, but inconsistent otherwise;

(3) use a Hausman test to study if the estimated coefficients are systematically different. If they are systematically different, we reject H_0.

In step (1) we run the tobit regression just presented. In step (2) we run a regression with a censoring threshold at zero. In step 3, the Hausman test rejects the hypothesis of no systematic differences in coefficients. The conclusion is that a standard labor supply tobit model with a threshold equal to zero is inconsistent.

We are also interested in estimating the impact of the indicators of service motive on the provision of services in the physicians' private practices. Again, since we have panel data, we are

able to account for unobserved heterogeneity in the estimation. We fit a standard model[9] of the form:

$$z_{it} = \gamma' \mathbf{x}_{it} + \alpha_i + v_{it} \qquad (i = 1, ..., 435; \quad t = 1, 2),$$

where z_{it} is the dependent variable for GP *i* in time period *t*, and $\mathbf{x}_{it}$ a vector of explanatory variables. We will use the national insurance total income from fees, both average (with respect to list size) and total, as the dependent variables. The variable α_i is a GP-specific random variable that captures unobserved GP heterogeneity; this effect is constant over time. Finally, v_{it} denotes the residuals. We assume that:

(a) $E(v_{i,t}) = 0$,
(b) $Var(v_{i,t}) = \sigma_i^2$
(c) $Cov(v_{i,t}, v_{i,s}) = 0$
(d) $E(\alpha_i) = 0$
(e) $Var(\alpha_i) = \sigma_\alpha^2$
(f) $Cov(\alpha_i, v_{i,t}) = 0$

If the random effects model is valid, we must have $Cov(\alpha_i, x_{i,t}) = 0$. We test this restriction by a standard Hausman-test.[10] From Table 4 we see that the Hausman-statistic is not statistically significant and hence, we proceed with the random effects model.

[9] See for instance Cameron and Trivedi (2005), Ch. 21.

[10] If the restriction is rejected, the fixed effects model is selected. In the fixed-effects model α_i cancels; hence, the model is robust. When they are valid, the random effects estimators are more efficient than the fixed effects estimators. In addition, we are able to test the effect of time-invariant variables.

Table 4 The estimated effect of physician characteristics on the total and perlisted-patient fee-for-service incomes. Random-effects model with robust standard errors.

	FFS-NI	*Total-FFS*
Prop-female	385.37 (267.38)	519729** (159357)
Prop-old	69.85 (275.14)	347937 (187914)
Shortage	111.85** (30.95)	-37100 (19216)
Many	-6.27 (22.17)	65054* (29245)
Gr-debt	13.40 (11.60)	57315** (14470)
Gr-wealth	33.40 (20.40)	53923** (16153)
Gen-Med	42.38* (20.70)	82316** (27347)
Comm-Med	18.70 (44.19)	-78797 (41561)
Male	105.40* (52.31)	160168** (39935)
Married	12.17 (26.68)	21456 (25456)
Child-under 6	-16.67 (13.41)	-16833 (18170)
Med-Central	-78.79 (64.73)	28331 (56686)
High-1-Central	-62.24 (65.88)	110018 (53721)
High-Central	-128.58* (60.34)	48216 (45313)
Constant	153.70 (177.48)	-109292 (110952)
ρ	0.36	0.76
No. of observations	812	812
No. GPs	435	435
No. observations per GP	Min: 1 Avg: 1.9 Max: 2	Min: 1 Avg: 1.9 Max: 2
Hausman Test	CHISQ(6) = 12.45 p-value = 0.052	CHISQ(6) = 8.11 p-value = 0.23

Estimates with '*' ('**') indicate that the parameter is significantly different from zero at the five (one) percent level for a two-tailed test.

Table 4 shows the effects of explanatory variables on the revenue from fee-for-service per listed person and the total revenue from fee-for-service. *Patient Shortage* has a positive and statistically significant effect on the fee-for-service income per listed person, but not on the total income. Hence, we cannot reject the hypothesis that more services to patients listed compensates for patient shortage. Also, from Table 4 neither *Gr-debt* nor *Gr-wealth* has an effect on service provision per listed person. However, there is a positive effect of these variables on the total

income from fee-for-service. Together these results imply that the additional income comes from a larger patient list. Simultaneous increases in *Gr-wealth* of 1 million NOK and in *Gr-debt* of 1 million NOK are predicted to increase fee-for-service income by NOK 111,238, or 20 percent of the average annual fee-for-service income from national insurance among physicians in our sample.

Being a specialist in general medicine (*Gen-Med*) has a positive effect on both total and per-patient fee-for-service income. This is likely due to the fact that specialists in general medicine receive an additional fee per consultation from the national insurance. Also, from Table 4, a GP being male increases both the number of services per listed patient and the total fee-for-service income. The higher total income for male GPs is due to both higher service intensity and longer lists.

We have also estimated the impact on preferred list size of gross wealth and gross debt by a regression model with random effects. Both variables are found to have a positive and statistically significant effect on preferred list size. Hence, this result supports prediction four of Section 3. We also find that being a specialist in general medicine, being male and being located in a municipality with a high level of centrality all contribute to a greater preferred list size. Being a specialist in community medicine and married both contribute to a small preferred list size.

6. Concluding remarks

It is widely believed that many professionals hold high standards in how they should perform. Financial incentives are important, but not sufficient to determine their behaviors. Physicians are highly skilled professionals who have undertaken long trainings and maintain a commitment to the well-being of their patients. It is natural to expect that their behaviors are driven by a complex set of motives. In this paper, we have set out to investigate this set of motives for physicians in Norway.

We have shown that physicians respond to incentives in a heterogeneous way. Despite their lower remunerations, community services are undertaken by a significant fraction of physicians beyond the minimum required amount. We model this by postulating that GPs deriving utility from both financial returns and treating patients and performing tasks in the community health service. We proxy the preferences for community services with gross wealth and gross debt, and find them to be both statistical and quantitatively significant. Those GPs with lower gross wealth and gross debt tend to perform more community services; lower gross wealth and gross debt likely capture a more modest lifestyle and a stronger commitment to altruism.

Policy implications of our study are important. Financial incentives cannot be expected to affect all physicians in a homogeneous way. Physicians likely respond to any set of incentives in complex ways. In our study, lifestyles, proxied by physicians' gross wealth and gross debt, affect how they choose to supply community services. Much research is needed to identify other factors that contribute to their decisions.

Appendix: Physician deriving utility from serving patients in private practices

We now modify the utility function to check the robustness of results. We first let the utility function in (1) be modified to the following:

$$(1.A) \qquad U(s,n,a) \equiv W(n,s) + \alpha sn + \beta a + \gamma n + \theta V(a) - C(ns+a).$$

Here the new term $W(n,s)$ is the utility from providing care to n patients at the intensity of s services per patient. We assume that W is increasing and concave. We further specialize the function into two cases: (i) W takes the form $nW(s)$, and (ii) W takes the form $W(ns)$. Case (i) says that the physician derives a utility $W(s)$ per private patient, and when there are n patients, the total utility is simply n times the per-patient utility. Case (ii) says that the physician derives a utility that is based on the aggregate services to all patients. Case (i) seems plausible, and we study it in some details. The analysis for Case (ii) is straightforward, and we will omit it.

We study the case when the quantity constraint $n \le D$ does not bind. The first-order condition with respect to n for the maximization of the modified utility function is

$$\left[\alpha s + W(s) + \gamma - sC'(ns+a)\right] = 0.$$

Dividing throughout by s, we get

$$\left[\alpha + \frac{W(s)}{s} - C'(ns+a)\right] = -\frac{\gamma}{s} < 0.$$

Next we consider the first-order derivative of the modified utility function with respect to s:

$$n\left[\alpha + W'(s) - C'(ns + a)\right] < 0$$

where the inequality follows from the concavity of W ($W'(s) < W(s)/s$) and the preceding inequality (from the first-order condition with respect to n). Hence, the physician optimally chooses to lower the service per patient while choosing more patients.

In Case (i), the physician's altruistic preferences towards private patients is increasing in the services per patient, but at a decreasing rate. So a higher utility level may be achieved by simply adding more patients to the practice; more patients in the practice also mean more capitation income. For a general altruistic utility $W(n,s)$, there may be a tendency for the service to rise above the minimum. This does not alter the fundamental incentive for increasing the patient list due to the capitation payment γ.

In a second variation of the utility modification, we can think of θ as a parameter that indicates a physician's tradeoff between monetary profit and private and community services. In this case, we modify the objective function accordingly:

$$(1.B) \qquad U(s,n,a) \equiv \alpha sn + \beta a + \gamma n + \theta\left[V(a) + W(s)\right] - C(ns + a)$$

Again the benevolent physician experiences some benefit from performing tasks in the community health service, $V(a)$, and further experience some benefit from providing services in the private practice $W(s)$. A physician having an objective function specified in (1.B) has an altruistic attitude to providing services to the individuals who are actually listed in the practice, but this altruistic attitude is independent of list size.

We assume that $W(s)$ is strictly concave and for simplicity we also assume that $W(s)$ possesses properties that ensure that the physician chooses a service intensity in the interior of $[S_1,S_2]$. We study the case when the constraint $n \le D$ does not bind.

The first-order condition with respect to n for the maximization of (1.B) is

$$\left[\alpha s + \gamma - C'(ns + a)s\right] = 0$$

This can be expressed as:

$$\left[\alpha - C'(ns + a)\right]s = -\frac{\gamma}{s} < 0$$

Next we consider the first-order condition with respect to s :

$$\left[\theta W'(s) + \alpha n - C'(ns + a)n\right] = 0$$

This can be expressed:

$$\left[\alpha - C'(ns + a)\right]n = -\frac{\theta W'(s)}{n} < 0 .$$

From these two first order conditions we get:

$$\frac{\theta W'(s)}{n^2} = \frac{\gamma}{s^2} .$$

The marginal benefit from service intensity is set proportional to the marginal benefit from the list size. In this version of the model, there is a tradeoff between service intensity and list size. Since the physician derives some utility from providing services in the private practice, he balances the incentive from the capitation payment γ from a longer list and low service intensity with the incentive to have high service intensity due to the service motives implicit in the $W(s)$ function.

By totally differentiating the system of equations implied by the three first-order conditions, we find that the comparative statics with respect to the altruism indicator are: $\frac{dn}{d\theta} < 0, \frac{ds}{d\theta} > 0$ and $\frac{da}{d\theta} > 0$. The results of the model specification implied by the objective function (1.B) are similar to those in section 3.

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