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Service motives and profit incentives among physicians

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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 h/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. 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 a negative effect on the total income from fee for service. These results support physician preference heterogeneity.

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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 between 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.

The literature on physician response to incentives is very large, and a major area in the entire health economics field.[1] The focus of this literature is often on the magnitude of empirical outcomes of an incentive innovation. For example, if the US Medicare system changes its fee structure, will physicians who experience an income loss perform more coronary artery bypass grafting procedures (Yip 1998)? Or, do obstetricians perform more cesarean sections when they are in financially less rewarding markets (Gruber and Owings 1996)? It is of course important to study the direct effect of financial incentives on medical treatment. Physicians, however, perform services that may not generate the most monetary rewards for them. Arrow's "broader" perspective calls for studying effects of incentives on the many tasks that physicians perform.

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 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 h/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

[1] We cite only two papers here, but health economists will agree with us about this assertion.

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 assemble a data set 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 is gross debt, the higher 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 h 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. 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 a negative effect on the total income from fee for service.

Our results suggest that policies may affect physicians differentially. A mandatory increase in the hours of community service municipalities may impose on physicians likely will be binding on the majority of physicians, but may not be so for those physicians with lower gross wealth and debt. On the other hand, an increase in the remuneration of community services may relax this constraint for the majority of physicians, but have little effect on those with lower gross wealth and debt.

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

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 inpatient care is free to users. Outpatient consultations with primary care physicians and specialists are offered respectively with a copayment 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 1,250 and 1,300 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 copayments 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% of the adult population) to these GPs. As of June 2001, after this second round of assignments, about 30% of the GPs still had 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 GPs 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 copayment 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 listed patients with the GP 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 part-time in municipalities. Such 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 h 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. In nearly all municipalities at least one GP works more that 7.5 h of community work, so it seems that those who work less than 7.5 h would not have preferred to work more, but may well have preferred to work less.

Community service is provided in normal work hours and does not substitute for leisure. A physician may have to be absent from his private practice one day a week to provide services at nursing homes and childcare centers. We have found a negative correlation between the private practice list size and community service hours; this is consistent with community services using up physicians' time that would otherwise be available for private practice. Generally, physicians should find it more rewarding to build reputation through superior services in private practices. We regard community services as activities mainly motivated by nonprofit-seeking objectives.

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 GPs' 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 (2007) 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 (2008) add to this result by supplementing the earlier study by registrar data. They find that patients of 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 dataset used 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.

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 GPs' work in private practice usually belongs to the discipline of general medicine, community services at the municipality typically are on 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.

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

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.

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 provides s units of services to each of n patients, 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 a positive parameter. We postulate that the physician is motivated to provide community service,[3] and this motivation is captured by the utility $\theta V(a)$. We will 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 from 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.[4] 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 ($n = D$), in which case we say that the physician has a shortage of patient or that he 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

[3] We assume that voluntary and involuntary community services lead to the same utility. A more general form of the utility from community service is $V(\theta, a)$, but our results are unaffected by the simpler form $\theta V(a)$.

[4] Using Norwegian data, Iversen and Lurås (2008) show that service intensity has a negative impact on the number of patients switching physicians, but the magnitude of the response is too small to be of importance.

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. The physician's behavior is described by his choice of n, s and a that maximize his utility in (1) subject to the constraints $n \leq D$ and $S_1 \leq s \leq S_2$.

We begin by considering cases when the constraint $n \leq D$ 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 $n \leq D$ 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. 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. The tendency to increase n due to capitation remains robust for many utility specifications (see the Appendix).

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 $n \leq D$ 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 $n \leq D$ 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:

$$\begin{aligned} \left[\alpha - C'(Ds + a)\right] &= 0 \\ \beta + \theta V'(a) - C'(Ds + a) &= 0 \end{aligned}$$

to obtain comparative static results. 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.[5]

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.

The community service parameter θ may capture physicians' preferences on lifestyle and work over the long term. Our model can be regarded as a component of a physician's dynamic decisions on his private practice and community services. The decision variables are current choices while the parameters capture earlier decisions such as wealth and debt accumulations. For the empirical implementation, we proxy the community service parameter θ by gross wealth and gross debt under the assumption that θ is decreasing in these variables.

A physician who does not value community services highly may prefer luxurious consumption, which often takes the form of durables. Such a physician likely accumulates more wealth and debt in his financial portfolio. Perhaps more important, his higher debt obligation cannot afford him the "luxury" of performing community service, which has a much lower remuneration than in private practice.[6] These observations are consistent with our assumption that θ is decreasing in wealth and debt.

On the other hand, luxurious consumption may be on nondurable. A physician with this aptitude may not accumulate high wealth and debt, although he prefers to perform little community service. The behavior of such a physician is less agreeable with our assumption, which would identify him as one with a high value of θ. Our empirical results then would not yield any significant effects. Hence, our assumption that θ is decreasing in wealth and debt is conservative.

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 are physicians' preferences for community service, the larger the amount of community service they supply and the shorter the preferred list of patients. When

[5] 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.

[6] Furthermore, the amount of wealth and debt in a financial portfolio likely depends on a person's lifecycle, which is controlled by the age variables.

physicians' gross wealth and debt are negatively related to their preferences for community services, physicians who have accumulated higher gross wealth and debt perform less community services.

Data and descriptives

A survey of 35 Norwegian municipalities and two districts of the city of Oslo form 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).[7] 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 (a corresponding 89% response rate). 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.[8] GP characteristics include age, gender, number of children according to age groups, taxable income, wealth and debt. The GP practice characteristics include preferred numbers of patients, actual number of patients according to gender and age, and the total fees 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. Those physicians in the registrar data who did not appear in the survey were assigned 0 h 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 4 months after data collection. The merged data from the 2004 survey was available for the researchers 8 months after data collection.

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. Then we 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.

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

[8] The Norwegian primary physician database is administered by the Norwegian Social Science Data Service (NSD) and provides information of individual 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.[9] On average a physician works 4.88 h/week of community health services, with a maximum of 22.5 h/week. The between variation as a proportion of total variation is 71% and accordingly, the within variation is 29% of the total variation. About 14% of the GPs work more than the 7.5 h/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% of the GPs experience a shortage of patients, 8% have a list larger than they prefer.

As described previously, a GP's total practice income consists of capitation fees (NOK 299 per person[10] listed in 2003), patient copayments and service fees from the national insurance. We do not have reliable data on patient copayments. However, as patient copayments and service fees from the national insurance are both proportional to the volume of services provided, we use the annual income from national insurance fees as a proxy for the fee-for-service income. From Table 1 the mean of this fee is 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 majority of GPs are between 40 and 55 years old, and 74% of them are men. Seventy-eight percent of GPs are married, and they have on average 0.27 children below 6 years of age. About 6% of physicians are specialists in community medicine, while 59% have earned a specialist degree in general medicine. From Table 1, 4% of the GPs practice in a municipality with the lowest level of centrality, while 70% practice in a municipality with the highest level of centrality.

Wealth and debt are measured at the individual level. A GP's decisions are likely influenced both by the spouse's wealth and debt, too. We would prefer to have access to household wealth and debt, but because this information is unavailable to us, we could only use a physician's marital status (*Married*) as a control. In auxiliary regressions we have introduced interaction terms between *Married* and *Wealth/Debt* to check whether marital status affects the impact of *Wealth/Debt*. These interaction terms have not yielded statistically significant effect, and we have dropped them (so they do not appear in Tables 3 and 4 below).

Table 2 contains the descriptive statistics according to physicians' involvement in community health services. We categorize the information according to whether the physicians work more or less than 7.5 h, the obligation that municipalities may impose upon them. Those physicians who work more than 7.5 h 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 (28%) than those who do not

[9] 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.

[10] 1 USD was approximately 6.30 NOK in 2003.

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	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	1	0.54	0.46
Many	Binary variable set to 1 if (Prefer-list − list)<−100, otherwise 0	0.08		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	1	1.00	0.00
Comm-Med	Binary variable set to 1 if GP specialist in community medicine, otherwise 0	0.06		0	1	1.00	0.00
Mid-age	Binary variable set to 1 if 40 < GP's age ≤55	0.57		0	1	1.00	0.00
Old-age	Binary variable set to 1 if GP's age >55	0.17		0	1	1.00	0.00
Male	Binary variable set to 1 if GP is a male, otherwise 0	0.74		0	1	1.00	0.00
Married	Binary variable set to 1 if GP is a married, otherwise 0	0.78		0	1	0.89	0.11
Low-Central	Binary variable set to 1 if municipality has lowest level of centrality; otherwise 0	0.04		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	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	1	1.00	0.00
High-Central	Binary variable set to 1 if municipality has highest level of centrality; otherwise 0	0.70		0	1	1.00	0.00

Table 2 Descriptive statistics according to physician community health service

Variable	Volunt-hour = 0 (No. obs. = 700)				Volunt-hour = 1 (No. obs. = 112)			
	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	1	0.28		0	1
Many	0.09		0	1	0.03		0	1
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	1	0.63		0	1
Comm-Med	0.04		0	1	0.20		0	1
Mid-age	0.54		0	1	0.71		0	1
Old-age	0.18		0	1	0.12		0	1
Male	0.73		0	1	0.79		0	1
Married	0.76		0	1	0.79		0	1
Low-Central	0.03		0	1	0.11		0	1
Med-Central	0.07		0	1	0.10		0	1
High-1-Central	0.19		0	1	0.19		0	1
High-Central	0.71		0	1	0.61		0	1

(21%).[11] GPs who work less than 7.5 h have both higher gross debt and gross wealth, but those who work more than 7.5 h have a higher net wealth. Finally, those who work voluntary hours at municipalities are more likely to be specialists in community medicine.

Gross wealth and gross debt are independent variables in the regressions.[12] As we have argued in the previous section, those physicians who have higher levels of gross wealth are likely to have a more affluent lifestyle, and those who have higher debt require more income to pay for finance charges and interests. We associate weaker preferences for community services with higher physician gross wealth and debt.

Empirical specification and results

We would like to know what determines GPs' community services and private practice. The predictions of our model are summarized at the end of section "The model". The exogenous variables in the model are used as regressors. Hence, *Shortage, Many, Gr-debt* and *Gr-wealth* are included in order to test predictions from our theory. In addition, we include *Prop-female* and *Prop-old* to control for variation in list compositions. We also control for several physician characteristics, such as socio-demographic factors (*Mid-age*, *Old-age*, *Male* and *Married*) and type of specialty (*Gen-Med* and *Comm-Med*) because physicians who have chosen a

[11] Likewise, the proportion doing voluntary community health service conditional on *Shortage* is 17%, and the proportion doing voluntary community health service conditional on *Many* is 4%.

[12] 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.

specialty in community medicine likely provide more hours of community services. Finally, we adjust for the level of centrality of the municipality a physician practices in. For instance, distance to the nearest hospital is correlated with a municipality's centrality and possibly has an impact on private physician practice and community health service.

In our study, GPs' labor supply decisions on community service are censored because municipalities may impose up to 7.5 h of work per week on each physician. Furthermore, in our data, we observe cases in which GPs work less than 7.5 h. We do not know if individual GPs are experiencing an enforced minimum requirement, so we must allow the censoring threshold to vary between GPs. In other words, each physician faces his own censoring threshold. 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).

Different municipalities may want different numbers of hours of community services from GPs. A municipality might only let a GP work a fraction of the time of community service that GP would have preferred. This kind of rationing by municipalities on GPs' community service seems improbable in our setting. Survey data from Norway show that only 3% of GPs working less than 8 h of community work would have preferred more. Furthermore, municipalities are required to strive for an equitable distribution of hours of community work among GPs. In practice, equitable distribution means that a GP should not be asked to work more than 7.5 h if someone else with less than 7.5 h of work would prefer more. In our data only in six municipalities did all GPs there work less than 7.5 h; altogether, there were a total of 28 GPs (or 6% of the total) in these six municipalities. We continue with the assumption that whenever a physician is observed to have worked less than 7.5 h, it is a censored observation.

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. 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 $\tilde{y}_{it} \leq y_{it}$. In this case we say that the physician's community service supply has been censored. Again, note that the censoring threshold on y_{it} is allowed to vary across physicians and periods. 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 specify our censored regression model:

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

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 10. The main results of the estimation are in Table 3.

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. These are according to the prediction of our model. The magnitude of these effects is large. An increase of 10% from the mean of *Gr-debt* and *Gr-wealth* (which results in no change in net wealth) is expected to decrease community service by about 0.6 h, or 12% 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.

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

	Total-hour
Prop-female	−3.62 (11.44)
Prop-old	23.54 (16.28)
Shortage	−0.24 (1.36)
Many	−4.84 (2.74)
Gr-debt	−2.53* (1.01)
Gr-wealth	−3.70* (1.59)
Gen-Med	1.58 (2.02)
Comm-Med	10.36** (3.30)
Mid-age	3.09 (2.46)
Old-age	−4.32 (3.65)
Male	2.08 (2.81)
Married	−0.28 (1.72)
Med-Central	−0.12 (4.77)
High-1-Central	−6.51 (4.14)
High-Central	−5.94 (3.79)
Constant	−4.80 (8.27)
ρ	0.92
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 *(**) indicate that the parameter is significantly different from zero at the five (one) percent level for a two-tailed test

We use a standard 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., $\rho = \sigma_u^2/(\sigma_u^2 + \sigma_\varepsilon^2)$. 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 $\rho = 0.92$ indicates that the unobserved heterogeneity is significant. Accounting for physician heterogeneity in community health service supply is important for the estimation.

As a robustness check we run a binary random-effects logit model in which the dependent variable is set to one if the physician works more than 7.5 h of community services and to zero otherwise. We find that the effects of gross wealth and gross debt come up with similar signs and levels of statistical significance as in the random-effects tobit model.

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[13] of the form:

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

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:

[13] See for instance Cameron and Trivedi (2005, Chap. 21).

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

	FFS-NI	Total-FFS
Prop-female	390.73 (270.99)	501735** (160284)
Prop-old	120.34 (345.11)	552532** (198814)
Shortage	109.95** (30.39)	−39452* (18804)
Many	−5.68 (22.03)	65291* (29382)
Gr-debt	12.10 (11.80)	51372** (15246)
Gr-wealth	35.40 (19.30)	53598** (16141)
Gen-Med	50.55** (18.28)	101367** (30546)
Comm-Med	21.27 (44.67)	−72471 (42089)
Mid-age	−5.10 (27.93)	−20497 (36924)
Old-age	−13.69 (52.19)	−98268* (46103)
Male	107.17* (52.55)	164412** (40224)
Married	10.95 (26.10)	21567 (25449)
Med-Central	−86.85 (64.48)	21207 (57088)
High-1-Central	−68.89 (65.33)	101764 (54427)
High-Central	−131.19* (60.99)	53653 (45773)
Constant	144.19 (174.83)	−114233 (113115)
ρ	0.36	0.75
No. of observations	812	812
No. GPs	435	435
No. observations per GP	Min: 1	Min: 1
	Avg: 1.9	Avg: 1.9
	Max: 2	Max: 2
Hausman test		
	CHISQ(6) = 9.70	CHISQ(6) = 9.04
	p-value = 0.084	p-value = 0.108

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

(a) $\mathrm{E}\,(v_{\mathrm{it}}) = 0$,
(b) $\mathrm{Var}\,(v_{\mathrm{it}}) = \sigma_v^2$
(c) $\mathrm{Cov}\,(v_{\mathrm{it}}, v_{\mathrm{is}}) = 0$
(d) $\mathrm{E}\,(\alpha_i) = 0$
(e) $\mathrm{Var}\,(\alpha_i) = \sigma_\alpha^2$
(f) $\mathrm{Cov}\,(\alpha_i, v_{\mathrm{it}}) = 0$

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.[14] From Table 4 we see that the Hausman statistic is not statistically significant at the conventional five-percent level, so we proceed with the random effects model.

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, and a negative effect on the total income. Hence, we reject the hypothesis that more services to listed patients fully 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 fee-for-service income. Together these results imply that the additional income comes from a larger patient list. Simultaneous doubling in *Gr-wealth* and in *Gr-debt*

[14] 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.

from the mean is predicted to increase fee-for-service income by 20% 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 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 4 of section "The model". 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.

Municipality characteristics may be important determinants for physicians' decisions. A municipality's level of centrality picks up important location characteristics, and we have included three municipality dummies in the analyses. None turns out to be statistically significant in the analyses of hours of community services. In the analysis of fee-for-service income we only find that the highest level of centrality has a negative impact on the fee-for-service income per listed person. As an alternative to including dummies for municipality types we perform a two level analysis of fee-for-service income with physicians nested in municipalities. These analyses do not change the sign and significance of the effects compared with the results in Table 4.

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 the service motive.

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:

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

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 $n \leq D$ 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:

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

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 $n \leq D$ 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 function $W(s)$.

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: $\frac{\mathrm{d}n}{\mathrm{d}\theta} < 0$, $\frac{\mathrm{d}s}{\mathrm{d}\theta} > 0$ and $\frac{\mathrm{d}a}{\mathrm{d}\theta} > 0$. The results of the model specification implied by the objective function (1.B) are similar to those in section “The model".

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