Competition versus gatekeeping in a listpatient system:
The case of medicine prescriptions

Erik Biørn
Department of Economics, University of Oslo
P.O.Box 1095 Blindern, NO-0317 Oslo, Norway
e-mail: erik.biorn@econ.uio.no

Inger Cathrine Kann
Helse Sør-Øst Health Services Research Centre
Akershus University Hospital
P.O. Box 95, NO-1478 Lørenskog, Norway
e-mail: ikan@ahus.no

Hilde Lurås
Helse Sør-Øst Health Services Research Centre
Akershus University Hospital
P.O. Box 95, NO-1478 Lørenskog, Norway
e-mail: hilde.luras@ahus.no

Abstract

Most studies of general practitioners (GP) prescribing patterns are based on survey data and qualitative study methods. In this study on prescription of reimbursement drugs and addictive drug we make use of register data of a national sample. In a panel data model, taking observed heterogeneity like diagnosis, gender and age into account we estimate the effects of observable variables on prescription. We also take unobserved heterogeneity into account, paying attention to the fact that this composition may be endogenous, since the patient will choose a GP who fits his or her preferences. Results indicate that GPs practicing in municipalities with high competition among GPs prescribe more drugs compared to their colleagues practicing in low GP competition areas. We conclude that in a list patient system with capitation payment, the prescription style contributes to attract patients to the GP. Hence, their prescription style conflict with their role as gatekeepers to services paid for by national insurance. But even worse: their prescription might be a hazard to patients' health.

Keyterms: general practitioner, gatekeeper, prescription, competition.

1. INTRODUCTION AND BACKGROUND

A key factor determining general practitioners (GP)[1] behaviour is patients' health and diagnosis. Other important factors are the way the healthcare system is financed and the prevailing organisational model. The literatures on the effect of the way GPs are paid on their behaviour conclude that remunerating doctors by fee-for-service encourages the use of services. Per capita payment, on the other hand, provides incentives to compete for patients, but it also provides incentives to minimize efforts in the consultation by referring patients to specialists and prescribing medical drugs to reduce own workload. Salaried doctors receive the same income irrespective of their effort during each consultation and this payment system may therefore lead to lower levels of tests and referrals compared with fee-for-service and per capita (for a summary, see for instance Scott, Donaldson and Gerard and Robinson).[1-3]. Hence, the GP is an economic agent that responds to economic incentives. This is briefly the reason why the payment system for GPs and the organisation of general practice are policy instruments that are widely used to change GP behaviour in order to achieve policy goals. An important health policy question is whether these means are efficient in achieving health policy goals, for instance whether increased service provision is, in some sense, optimal for the patient and for society.

In the prevailing organisation of general practice in Norway every inhabitant is registered with a GP and the GPs are paid partly by capitation and partly by fee-for-service. Empirical evidence shows that this model causes competition among GPs both in order to attract new persons to the list and to keep persons already registered on the list [4]. Because residents in order to ensure their right of a second opinion, are allowed to visit a GP with whom they are not listed, it also seems that GPs compete on service provision on a more general basis[5]. Carlsen and Norheim [6] interviewed a sample of GPs after the introduction of the general practitioners scheme in 2001, and they conclude that the GPs are less conscious of their gatekeeper role and more focused on their role as the patients' agent than before.

In the competition for listed persons and the competition for consultations, prescription of medicines might be a mean for the individual GP to obtain the necessary popularity among potential patients. In this paper we study physician and market characteristics that contribute

---

[1] GP (general practitioner) =Primary care physician

to the explanation of prescription patterns in a list patient system. In particular, we study GPs who are both agents of their patients and gatekeepers to services paid for by national insurance. Most studies of prescribing patterns are based on survey data and qualitative study methods. Our analyses may be considered an important improvement of the research strategy by making use of register data of a national sample and by applying econometric methods extensively. Our main research question is whether competition for patients boosts the number of prescriptions, which both undermine the gatekeeping role of GPs and put patients' health at risk.

The paper proceeds as follows. In Section 2 we describe the organisation of primary health care in Norway, in section 3 we describe our data, and in section 4 a simple theoretical model on the effect of competition among GPs on their prescribing behaviour is presented. In section 5 the empirical modelling strategy and a description of the different competition indicators we apply, can be found, while the results are given in Section 6. In section 7 we conclude that competition among GPs increase their prescription rate which most likely conflict with their role as gatekeepers to services paid for by national insurance. Our most important finding however is that competition might be a hazard to patients' health both because it imply high prescription levels of harmful drugs and because it undermines the GPs role as coordinators of the medical prescription. Policy implications of the findings and suggestions for further work close the paper.

2. ORGANISATION OF PRIMARY HEALTH CARE IN NORWAY

Norway has a national health service that is mainly tax-financed. The organisation of primary health care is the responsibility of the municipalities, which is the lowest governmental level. A primary health care reform took place in 2001, which entailed that every inhabitant was registered with a GP (Sandvik 2005). More than 90 % of the GPs are self-employed with a payment system consisting of 30 % per capita payment[2] from the municipalities and the remaining 70 % from a fee-for- service component paid out from The Norwegian Labour and Welfare Administration (NAV) and from patients' co-payments[3]. The fee-for-service

[2] The average annual payment per person amounts to € 42 in 2008.
[3] The average income from fee-for-service per consultation amounts to between € 15 and € 20 in 2008. However, due to longer consultation and more tests the average income from consultations for people 70 years and older is about € 40 ([7])

component is paid out according to a fixed fee schedule negotiated between the state and the Norwegian Medical Association. The fees depend on the duration of the consultation, whether certain types of examinations and laboratory tests are initiated during the consultation, and whether the GP is a specialist in general medicine. The GP usually obtains no additional fee for prescribing medicines; this is included in the consultation fee[4]. The patients pay a fixed fee per consultation with an annual ceiling[5] (amounting to € 216 in 2008).

The GPs state the upper size limit[6] of their list, and report the number to the NAV. They are allowed to adjust this preferred list size continuously. To avoid cream-skimming the GPs must accept the patients that are allocated to them from the NAV. If the upper size limit stated by the GP is smaller than the number of residents who want to be listed with him or her, the list is registered as an open list[7]. According to the health authorities some GPs should have open lists to offer new residents a choice of GP and also to offer an alternative option for residents who are dissatisfied with their present GPs. Residents are allowed to switch GP twice a year, but this may be difficult in areas with few or no open list. The switching is organised by the NAV.

To ensure the populations' right of a second opinion the GP scheme allow residents to visit a GP with whom they are not listed. GPs mainly provide services to persons registered on his or her list (internal patients), but on average 21 % of all patient contacts are with patients not registered on the GP's list (external patients) [8]. The variation in external patient contacts is however huge. The main reason is probably whether the GP has an open list or not and hence, has capacity for external patients.

All inhabitants in Norway are compulsorily insured under the National Insurance Scheme, which offers reimbursement of certain medicines to patients suffering from chronic illnesses according to a list of diagnoses with a set of criteria the patients have to meet. To each diagnosis there is a corresponding list of reimbursable medicines? Based upon applications

---

[4] However, when the prescription is done on basis of a telephone call, the doctor receives a small fee amounting to € 4 in 2008. Such "simple" consultations constitute 43 % of the total consultations and amounts to about 20 % of the fee-for-service income paid out from NAV.
[5] Both co-payments on medicines, visits to physicians or psychotherapy and certain transportation costs are included in the ceiling.
[6] The maximum allowed listsize is 2500 persons.
[7] Whether the list is open and the upper size limit is public information.

from the pharmaceutical industry the Norwegian Medicines Agency decides the inclusion of medicines in the reimbursement program. Residents' co-payments for drugs follow two different payment systems. If the disease is not chronicle and the drug is not on the reimbursement list, the patient has to pay the full cost of the medication. If the drug and the disease are on the reimbursement list the patient has to pay 36 % of the drugs expenses up to a maximum of € 63 per prescription (in 2008). The physicians are to some extent able to bend the law, for instance by stating the disease to be chronicle even if it is not.

3. DATA AND DESCRIPTIVE STATISTICS

Data on patient specific prescriptions for the current study is extracted from the Norwegian Prescription Database (NorPD). The dataset contains information of all prescription drugs dispensed at pharmacies to individual patients 70 years and older from 2004-2007. Observations include drug information, characteristics of the patient, characteristics of the prescribing physician (both GPs and other physicians), and characteristics of the patient's municipality of residence. The patient's GP or any other physician may make the prescription. To identify the GP and his or her patientlist we merge data from the NorPD with data from the regular general practitioner database (NSD). Aggregated information on the resident municipality is taken from Statistics Norway database. In NorPD prescribed drugs is measured in defined daily doses (DDD). A DDD is defined as the assumed average maintenance dose per day for a drug used on its main indication in adults. We measure the quantity of prescribed drugs at the GP level by dividing the total amount of prescribed drugs in DDD by the number of patients the GP has prescribed for[8].

Table 1 Summary statistics, max and min and distributions of observations with respect to number of times observed.

VARIABLE	MEAN	STD. DEV.	MIN	MAX
Number of open_lists	40.1	(84)	0	336
No. of GP- patients Receiving a prescriptiom	105.5	(67)	31	584
GP_age	47.3	(11)	24	87
Percentage female patients	61.1	(12)	0	100

Distribution of T_i:	min	5%	25%	50%	75%	95%	max
	1	1	3	9	12	12	12

[8] By aggregating the prescriptions for all patients on the GPs list, and prescription for patients not on the list, we will (when full dataset arrives) be able to distinguish between the GPs prescriptions for patients on the list: internal patients and patients not on the list: external patients.

In our dataset 28 % of the physicians are females and the average age is 47 years. The average number of open lists in the municipality is 40, but the variation is huge from zero in some municipalities up to a maximum of 336 open lists. In each quarter of a year physicians prescribe medicine to 105 patients, aged 70 or older, varying between 31 and 584 patients, 61 % of the patients prescribed for are females (Table 1).

Table 2 Summary statistics

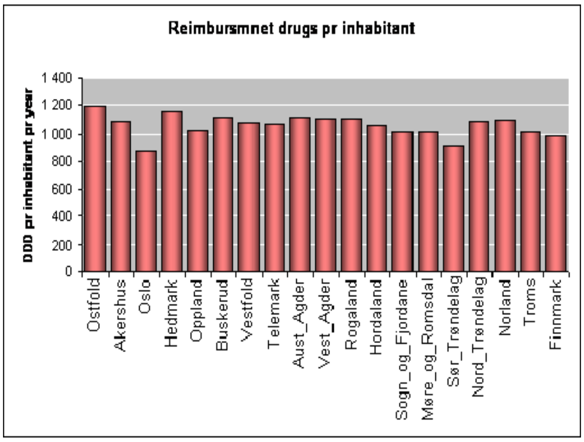
	NUMBER OF OPEN LISTS IN MUNICIPALITY											
	0--1		2--3		4--5		6—12		13--46		46-	
	mean	*sd*	**mean**	*sd*	**mean**	*sd*	**mean**	*sd*	**mean**	*sd*	**Mean**	*sd*
Addic. drugs per patient	**12,4**	*9*	**12,8**	*9*	**14,2**	*10*	**16,0**	*11*	**16,3**	*11*	**17,6**	*12*
Reimb. drugs per patient	**187**	79	**194**	*81*	**196**	*85*	**207**	*81*	**198**	*85*	**194**	*81*
Prescript. per GP	**264**	*219*	**264**	*212*	**269**	*232*	**296**	*252*	**311**	*238*	**321**	*229*
Female GP%	**30**	*46*	**30**	*46*	**27**	*44*	**25**	*44*	**27**	*44*	**31**	*46*
Specialists in gen. med %	**27**	*44*	**27**	*45*	**30**	*46*	**34**	*48*	**35**	*47*	**35**	*48*
GPs Age	**45**	*12*	**45**	*11*	**47**	*11*	**48**	*10*	**48**	*11*	**49**	*10*
Numb. Of pat. pr GP	**103**	*64*	**104**	*64*	**108**	*66*	**109**	*70*	**109**	*68*	**100**	*68*
Female Pat%	**60**	11	**60**	*11*	**60**	*12*	**61**	*13*	**62**	*14*	**63**	*15*
Num. obs	**6 721**		**12 910**		**9 198**		**12 363**		**10 051**		**10 627**	

As can be seen from
Table 2, total prescription per patient is higher the more competition there is among physicians. The average prescription of addictive drugs per patient is 12,4 DDD every quarter if there are zero or one open list (little competition), and 17,6 DDD if there are more than 46 open lists (high competition) in the municipality. It is interesting to note that the maximum individual prescription is 48 DDD in municipalities with low competition, and 202 in municipalities with high competition[9]. Almost the similar pattern can be observed for

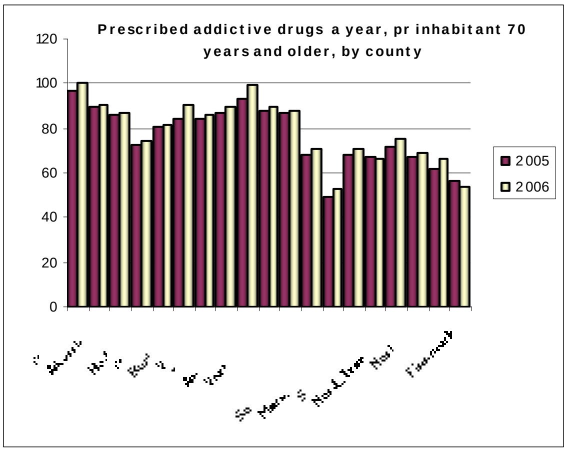
[9] Not reported in table

reimbursed drugs. Since the standard deviations are large, the differences are however not statistically significant.

Figur 1

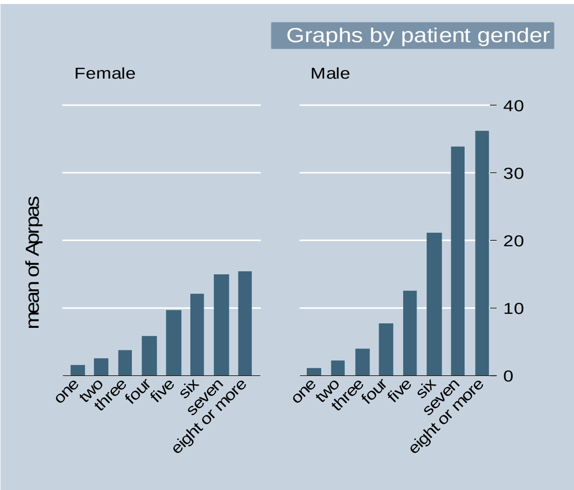


Figur 2

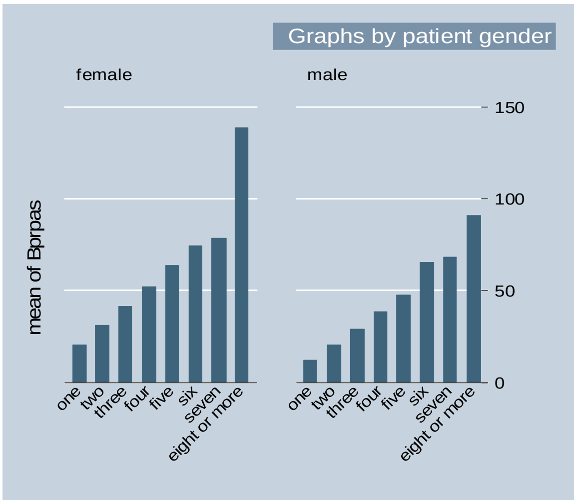


In figure 1 and 2 the average amount of drugs prescribed for persons aged 70 and above are reported on bases of geographical areas. As can be seen the prescription varies considerable between counties, but it is quite stable over years. For instance is the consumption level of addictive drugs twice as high in some counties than in others. This may be due to different cultures and different behaviour regarding prescriptions among physicians practising in different parts of Norway.

Figur 3 Addictive drugs (type A), by number of physicians visited.



Figur 4 Addictive drugs (type B), by number of physicians visited



In figure 3 and 4 we present the connection between prescription per patient and the number of prescribing physicians per patient each quarter. We do not know if there is causality, and in which direction it runs. But as can be seen the more prescribers per patient, the more addictive drugs are received per patient. Our conjecture is that this may be cased by patients being active "physician shoppers" in order to achieve more addictive drugs. This finding might indicate that drug prescribing may be a way to attract or please the patients. Another interesting aspect is of course that patients having this many prescribers complicate the GPs role as a coordinator of the drug prescription, but this will be the focus of our next study.

4. THEORETICAL MODEL

To illustrate the effects of competition on GP behaviour in the case of prescription, we put up a small stylized behavioural model for a typical[10] GP with a potential list of typical representative patients. The model is inspired by Iversen (2004)[9]. The physician's utility function can be specified as: $U = f(H_p, Y, X_i)$
where H_p is the health of the patient as perceived by the GP Y is the physician's income and X_i are other arguments such as the GPs leisure, professional status and intellectual satisfaction. The GP decisions are made in order to maximize his or her utility subject to time and income constraints. The GP will provide services, *s,* to patients consulting him or her. The GP's service provision to the patient S= *s(q,h)*, is a function of the quantity of drugs prescribed, *q*, and the time spent on consultation, *h*. Patients are supposed to appreciate both *h* and *q*. The patient's health is assumed to increase with increased use of reimbursed drugs, and decrease with increased use of addictive drugs: $\partial H_p / \partial q < 0 \; \partial H_p / \partial l > 0$.

The GP's cost, *t(nk,e)* [11], depend on the time spent on consultations, which is related to listsize, *n,* , the visit rate, *k,* of internal patients, and external visits, *e,* from patients not registered on the list. The GP's costs increase with increasing number of external and internal patient visits. $\partial t/\partial n > 0$ and $\partial t/\partial k' > 0$ and $\partial t/\partial e$. $\partial t/\partial n > \partial t/\partial t > \partial t/\partial e$. *l* is leisure. We assume $\partial U/\partial l > 0$ and $\partial\partial U/\partial l < 0$, i.e. the more leisure the less valuable leisure is for the GP.

---

[10] Physician and patient heterogeneity is not modelled here, but will be taken into account in the econometric model

[11] The time spent on consultation is assumed to be reduced the more drugs the physician prescribes and $t_q' < 0$[11], since the GP does not have to argue with the patient, or explain why he/she cannot prescribe, to simplify the model this is not taken into account, but is not essential to the conclusions.

Net income is then defined as $Fn + Pnk + p(N\text{-}n)e - t(nk,e)$[12], where, F is capitation payment per person on the list, P is the consultation fee and N is the number of inhabitants in the municipality. The visit indicator (k), indicate how much of the prescribed drugs that are prescribed by the GP where the patient is registered, while external consultations (e) indicate how much of the drugs that are prescribed to patients not registered on the GPs list. . To simplify we call the sum of visits $V=v(nk,e)$, regardless of wether the patient is external or internal. The definition of leisure is $T - Vh$ where T is the exogenous total time endowment, and h is time spent on the typical patient.

If the list is open the GP can increase own income by increasing the prescription level q, which presumably[13] will influence the number of visits (V) from external and internal patients. V consisting of:

- the demand for being listed with the GP, and hence the listsize n
- the number of internal visits k
- the number of external visits e

$\partial n/\partial q \geq 0$ $\partial k/\partial q \geq 0$ $\partial e/\partial q \geq 0$. But the GP also takes the patient health into consideration.

$$U=f(H_P, Y, l)=H_p+ Fn + Pnk +P(N\text{-}n)e - t(nk,e)+l$$

$$(F\partial n/\partial q+P\partial n/\partial qk+Pn\partial k/\partial q+P(N\text{-}n)\ \partial e/\partial q-\partial t/\partial q)=\partial l/\partial t-\partial H_p/\partial q$$

The first order conditions states that the GP will increase q until the marginal increase in net income from new patients, internal and external visits will equal the marginal utility from reduction in leisure from increased use of time and reduction/increase in patient health from increased use of drugs.

The GP must however, take the other GPs service level into consideration. Hence, the demand for being listed with the GP and the demand for external and internal service provision are respectively $n = n(s,S,\omega,\Omega,N,M)$, $k = k(s,S,\omega,\Omega,N,M)$ and $e=e(s,S,\omega,\Omega,N,M)$ which state that the demand for a certain GP depends on the service provision offered by the GP *relative*

[12] Patients are assumed to be homogenous, or rather we look on the average patient, so that the cost function is simply a product between number of patients, and the fee.

[13] Se descriptive statistics, and discussion on Physician shopping in section 3

to other GPs in the municipality *(s/S)*, the perceived exogenous characteristics of the GP *relative* to other GPs *(ω/Ω)* the total number of residents *(N)* in the municipality and the number of GPs with open lists in the municipality *(M)*. This interdependency can be modelled as a Nash equilibrium in a non-cooperative game.

Consider the following simple example of a two players, two strategy game, where the GPs provide compatible services. If they want to keep their patients on the list and at the same time both attract *more* visits and *new* persons to the list they have to choose a strategy to become the preferred GP:

Figur 5 Pay off matrix

	GP 2 adopts strategy 1	**GP 2 adopts strategy 2**
GP 1 adopts strategy 1	*A*, *A*	*B*, C
GP 1 adopts strategy 2	C, *B*	*D*, *D*

In our model the GPs can choose between two strategies:

Strategy 1: Strictly follow regulations; i.e. never prescribe reimbursement drugs when they are not on the authorities list, and never prescribe addictive drugs when this is not necessary (see section 2).

Strategy 2: Prescribe more of the drugs that the patient wants (here assumed to be addictive drugs and more drugs on the reimbursement scheme).

The outcomes for the GPs may be illustrated by the pay off matrix. The utility of the GP in situation A, B, C and D can be described as U(C) > U(A) >U(D) >U(B) for both GPs. Both GPs will improve their situation by switching from strategy **1** to strategy **2**, no matter what the other GP decides. For both GPs the problem has a single Nash Equilibrium: both players choose strategy 2.

If the GP’s list is not open, the GP does not want more patients. Hence, the GP will not compete for new patients, neither more external nor more internal consultations. If they change their attitude, we suppose they will open the list.

If the GP has an open list, and the more competition the GP face, the more likely it is that he or she choose strategy 2. In a situation where only one GP has an open list the GP will still choose strategy 2 since he or she does not know the competing GPs level of prescribing

If both GPs agree on a strategy, none of them will lose patients. If the GPs do not agree or one GP does not know what the other does, fewer patients may be the result if they choose strategy 1. Thus they will choose strategy 2.

From the theoretical model we derive the following hypotheses that will be tested in the empirical part:

- The higher competition among GPs, the more drugs will be prescribed by GPs facing competition
- The longer the patientlist is and the more patient visits the GP has, the less important it is to attract new patients and hence, less prescribed drugs per person.

5. ECONOMETRIC MODEL

The descriptive statistics presented in section 4 suggest that GPs in municipalities without competition between GPs prescribe less drugs than their colleagues in areas with high competition. The reason for this may be that strategy 2, as described in section 4, will be more likely. In this section we take this rather informal analysis a step further by outlining an econometric framework to identify the partial effects of competition on drug prescription while controlling for other explanatory variables. Briefly, the idea is the following: Since we cannot observe how GPs in areas with no competition at a specific time would have behaved if competition had prevailed - we utilize all observations, including those from GPs who experience competition - while exploiting the econometric model which pretends to describe GP behavior in both regimes. This may be said to represent the counterfactual, a substitute for not having a control group, a requirement which in the present setting would have been highly unrealistic.

The availability of panel data rather than cross-section data from one short period or non-overlapping cross-sections from several periods is crucial. Specifically, the fact that we possess panel data during which both GPs and patients have been observed moving between municipalities and patients have been observed moving between GPs located in the same municipality sets us in a position to utilize jointly the time variation in the data - the “within

GP" variation - and the cross-sectional variation - the “between GP" variation - in the estimation. The equation we consider is

(1) $y_{it} = k * + x_{it}\beta + z_i\gamma + \alpha_i + u_{it}$

where y_{it} is the amount of drugs prescribed by physician *i* in period *t*, the (row) vector x_{it} contains time varying observable individual GP characteristics - consisting of both aggregated information of the GPs' patients and individual GP specific information (like age) - and time varying observable municipality characteristics, (like number of inhabitants, and number of open lists in municipality) as well as time specific variables, like common trends or time dummies (for instance different seasons may require different drugs), the (row) vector z_i contains the time invariant, GP specific explanatory variables gender specialization, and the scalar α_i represents unobserved physician-specific for heterogeneity, like physician practice style.

The random effects version of this model imposes that not only the genuine disturbance u_{it} but also the GP specific effect α_i are uncorrelated with the regressor vectors x_{it} and z_i. Testing this hypothesis against the fixed effects variant, which refrain from imposing any such restriction, by a Hausman test, the random effects model is clearly rejected[14]. Several reasons why α_i may be correlated with elements of x_{it} and x_{it} can be given. For instance the number of patients in each medication group/diagnosis and the patient gender may be correlated with the physicians practice style. If patients are using drugs that a GP easily prescribes, he or she may attract more patients with similar addiction to the use of drugs, and/or with similar diagnosis. The self-selection of patients the GPs then implicitly perform by their practice style may make it difficult to distinction between the effect of observed GP characteristics and the effect of patient movements unless this kind of correlation is properly accounted for. To come to grips with this it may be convenient to formalize the relationship by means of the following linear equation:

(2) $\alpha_i = a + \bar{x}_{i\bullet}\lambda + z_i\pi + w_i$

---

[14] Hausman test: Ho: difference in coefficients not systematic

chi2(40) = 2518.83, Prob>chi2 = 0.0000, model with reimbursement drugs

chi2(40) = 1147.58 Prob>chi2 = 0.0000, model with addictive drugs where

$(x_{it}, z_{it}) \perp u_{it} \perp w_i$

Inserting equation (2) into (1) we get

$$(3)\quad y_{it} = k + x_{it}\beta + \bar{x}_{i\bullet}\lambda + z_i(\gamma + \pi) + w_i + u_{it}$$

where k = k* +a. Equation (3) shows that estimating β and γ from (1) when (2) holds raises two problems: (i) there is an omitted variables bias since the variable occurring in equation (3) but not in equation (1), $\bar{x}_{i\bullet}$ is certainly correlated with the included variable x_{it}, (ii) the coefficient of z_i remain unidentified whenever π is unknown: we think we estimate γ, but actually estimate z_is composite coefficient ($\gamma + \pi$). The problem with regression on equation (1) arises because equation (2) is part of the data generating process.

By using a Hausman and Taylor approach [10-12], making somewhat stronger assumptions with respect to correlation between α_i and $(x_{it}; z_i)$ than equation (2), we can overcome this by a certain use of instrumental variables. What we do is briefly, to postulate that the correlation "modeled" by equation (2) does not involve all elements in $(x_{it}; z_i)$, but only a subset (so that, formally, a subset of elements of λ and π are set to zero a priori). Because of the orthogonality between the "within variation" and the "between variation" of variables observed as panel data, it is not required to find (or postulate the existence of external instruments), we can use transformations of data that fulfils the conditions for valid instruments. Results from estimate equation (1) consistently and efficiently following this Hausman-Taylor approach is presented in [Table 3 and Table 4], where the random effect model, the fixed effect model and between variation models are also presented.

To account for differences in practice style between GPs practicing in different geographical areas we included a dummy variable for each county (see section 3)

Based on the hypotheses that arrive from the theoretical model and the available data we test whether the quantity of drugs prescribed *per patient* is higher

i. the more competition in the municipality i.e. the more open lists

ii. if the individual GP has an open list[15]

iii. the higher number of persons receiving a prescription per period in percentage of the patientlist[16]

iv. the longer the patientlists are[17]

When the GP's list is open, we assume that the GP wants to draw more persons to the list, and attract more internal and external visits. We therefore predict that the GP prescribe more drugs. Hence, whether an individual GP has an open list can be used as an individual indicator of competition, a micro indicator. To measure the competition level in the municipality we apply the macro indicator "number of open lists in the municipality" which is the micro indicator aggregated on municipality level. The number of open lists in the municipality indicates how many GPs the population may choose among.

6. RESULTS

The results from the different regression analyses can be found in
Table 3 reimbursed drugs, and Table 4; addictive drugs.

Table 3 Regression results Hausman Tayler regression, reimbursed drugs Compering with other model specifications. (endogenous is referring only to Haussman Thayler regression model)

	Hausmann Thayler		Fixed effect		Random effect		Between	
open_licenses	0.062***	(0.009)	0.063***	(0.010)	0.048***	(0.010)	-0.083*	(0.044)
GP is female	-13.044**	(5.589)			-13.675***	(4.172)	-22.156***	(7.475)
GP_age	1.176***	(0.156)	0.000	(0.000)	1.160***	(0.061)	0.626***	(0.067)
GP is spec. in general medicin	-1.405*	(0.723)	-2.834***	(0.787)	3.504***	(0.727)	31.849***	(1.950)
no of patients this quarter (endogenous)	-0.118***	(0.011)	-0.127***	(0.012)	-0.059***	(0.010)	0.179***	(0.024)
percent female patients (endogenous)	-0.465***	(0.037)	-0.475***	(0.039)	-0.419***	(0.034)	-0.482***	(0.070)
interaction femal GP and:								
-Percent female patients	0.355***	(0.061)	0.360***	(0.066)	0.324***	(0.057)	0.400***	(0.110)
-number of patients	0.024	(0.015)	0.032**	(0.016)	0.005	(0.014)	0.081***	(0.031)
-Age	1.515***	(0.244)	2.919***	(0.406)	0.688***	(0.114)	0.404***	(0.129)
-Spec_gen medicin	7.939***	(1.450)	9.981***	(1.627)	7.174***	(1.420)	0.446	(3.581)
Dummy for counties(STATISTICAL SIGNIFICANT RESULTS, BUT LEFT OUT TO SAVE SPACE)								
Percent of patients in each medicaton group (STATISTICAL SIGNIFICANT RESULTS, BUT LEFT OUT TO SAVE SPACE[18]) (endogenous)								

[15] This micro variable is not yet available, but will be soon.
[16] This micro variable is not yet available, but will be soon.
[17] This variable is not yet available. At this stage we use the number of patients prescribed for as a proxy.
[18] Can be sent contact: ikan@ahus.no

Year	7.333***	(0.231)	8.075***	(0.224)	7.591***	(0.202)	-1.554	(1.221)
Dummy for quarter, 1=0								
-quarter 2	-5.642***	(0.323)	-5.676***	(0.345)	-5.833***	(0.349)	-5.619	(3.451)
-quarter 3	29.477***	(0.324)	29.431***	(0.346)	29.344***	(0.350)	11.906***	(3.362)
-quarter 4	-24.192***	(0.375)	-24.284***	(0.400)	-23.776***	(0.404)	15.108***	(4.879)
Constant	167.376***	(3.383)	179.384***	(2.809)	165.360***	(2.642)	170.347***	(5.480)
Observations		61870		61870		61870		61870
Number of physicians		8360		8360		8360		8360
Mean number of obervations per physician		7,4		7,4		7,4		7,4
R-squared				0.413				0.585
Adjusted R-squ~d				0.314				0.583

Standard errors in parentheses

* p<0.10, ** p<0,05, *** p<0,01

Table 4 Regression results, addictive drugs Compering with other model specifications

	Hausmann Thayler		Fixed effect		Random efect		Between	
open_licenses	0.004***	(0.001)	0.004***	(0.001)	0.005***	(0.001)	0.018***	(0.006)
GP is female	-2.938***	(0.660)			-3.264***	(0.558)	-3.829***	(0.958)
GP_age	0.089***	(0.014)	0.000	(0.000)	0.083***	(0.008)	0.067***	(0.009)
GP is spec. in general medicin	-0.033	(0.100)	-0.277**	(0.109)	0.442***	(0.099)	3.219***	(0.250)
no of patients this quarter (endogenous)	0.022***	(0.002)	0.020***	(0.002)	0.018***	(0.001)	0.024***	(0.003)
Percent female patients (endogenous)	0.028***	(0.005)	0.026***	(0.005)	0.041***	(0.005)	0.050***	(0.009)
interaction femal GP and:								
-Percent female patients	0.045***	(0.008)	0.036***	(0.009)	0.047***	(0.008)	0.065***	(0.014)
-number of patients	0.010***	(0.002)	0.013***	(0.002)	0.009***	(0.002)	-0.006	(0.004)
-Age	0.011	(0.024)	-0.021	(0.056)	0.006	(0.015)	-0.012	(0.017)
-Spec_gen medicin	0.494**	(0.197)	0.408*	(0.225)	0.585***	(0.192)	0.484	(0.459)
Dummy for counties								
-county==2	0.449*	(0.239)	0.504*	(0.262)	0.183	(0.225)	-0.292	(0.457)
-county==3	0.190	(0.434)	0.215	(0.465)	-0.071	(0.438)	-3.600**	(1.627)
-county==4	-2.053***	(0.308)	-1.357***	(0.342)	-3.186***	(0.283)	-5.718***	(0.497)
-county==5	-0.849***	(0.315)	-0.321	(0.350)	-1.707***	(0.288)	-3.567***	(0.504)
-county==6	-0.285	(0.292)	0.034	(0.322)	-0.871***	(0.271)	-2.423***	(0.494)
-county==7	-0.193	(0.327)	0.318	(0.365)	-1.179***	(0.299)	-3.085***	(0.518)
-county==8	0.002	(0.343)	0.751*	(0.385)	-1.192***	(0.309)	-3.379***	(0.517)
-county==9	-3.431***	(0.423)	-3.255***	(0.475)	-3.846***	(0.383)	-3.393***	(0.702)
-county==10	-1.180***	(0.404)	-1.089**	(0.464)	-1.570***	(0.352)	-2.156***	(0.580)
-county==11	0.788**	(0.350)	1.199***	(0.411)	0.047	(0.296)	-1.325***	(0.449)
-county==12	-0.232	(0.319)	0.524	(0.371)	-1.296***	(0.275)	-3.369***	(0.451)
-county==14	-5.291***	(0.370)	-4.049***	(0.415)	-6.943***	(0.334)	-9.640***	(0.577)
-county==15	-1.397***	(0.336)	-0.506	(0.383)	-2.552***	(0.294)	-4.354***	(0.466)
-county==16	-2.143***	(0.322)	-1.213***	(0.365)	-3.335***	(0.285)	-5.198***	(0.475)

-county==17	-3.425***	(0.369)	-2.335***	(0.418)	-4.728***	(0.330)	-6.515***	(0.558)
-county==18	-1.965***	(0.303)	-0.985***	(0.344)	-3.166***	(0.267)	-5.115***	(0.434)
-county==19	-4.178***	(0.353)	-3.280***	(0.400)	-5.392***	(0.313)	-6.776***	(0.521)
-county==20	-8.125***	(0.437)	-7.172***	(0.487)	-9.323***	(0.393)	-10.439***	(0.689)
Percent of patients in each medicaton group (endogenous)								
-Alimentary tract and metabolism	-27.935	(28.278)	-20.408	(29.716)	-6.201	(28.122)	285.117***	(84.100)
-Blood and blood forming organs	-47.838	(34.975)	-60.248	(36.751)	-47.034	(35.365)	-429.201***	(120.906)
-Cardiovascular system	-1267.750***	(45.663)	-1271.674***	(48.001)	-1189.687***	(45.084)	-1090.993***	(138.047)
-Dermatologicals	-0.450	(1.704)	-0.499	(1.789)	-0.589	(1.785)	-8.474	(10.651)
-Genito urinary system and sex hormones	-41.124***	(14.859)	-47.442***	(15.623)	-76.945***	(14.262)	-233.477***	(35.323)
-Systemic hormonal preparations, excl sex hormones and insulins	-10.303	(19.177)	-12.561	(20.151)	-7.703	(19.461)	54.052	(69.270)
-Antiinfectives for systemic use	-70.218***	(16.405)	-65.697***	(17.241)	-90.134***	(16.703)	-353.130***	(59.838)
-Antineoplastic and immunomodulating agents	-19.944**	(9.119)	-16.591*	(9.584)	-43.501***	(8.504)	-74.692***	(20.221)
-Musculo-skeletal system	-42.223*	(22.223)	-46.031**	(23.348)	-34.424	(22.499)	-13.878	(77.033)
-Nervous system	2656.010***	(29.341)	2656.150***	(30.850)	2739.510***	(29.382)	3121.378***	(94.627)
-Antiparasitic products,insecticides and repellents	0.782	(4.222)	1.424	(4.435)	-4.357	(4.374)	-104.856***	(19.544)
-Respiratory system	-19.603	(21.815)	-27.277	(22.923)	-27.022	(20.859)	-146.875***	(50.525)
-Sensory organs	-6.918	(5.188)	-3.843	(5.468)	-63.223***	(4.209)	-132.137***	(7.870)
-Various	0.977	(1.104)	1.068	(1.160)	1.279	(1.117)	5.583	(3.774)
Year	0.310***	(0.028)	0.379***	(0.031)	0.379***	(0.028)	0.926***	(0.156)
Dummy for quarter, 1=0								
-quarter 2	-1.120***	(0.045)	-1.139***	(0.048)	-1.074***	(0.048)	2.105***	(0.442)
-quarter 3	0.309***	(0.046)	0.291***	(0.048)	0.343***	(0.048)	1.005**	(0.431)
-quarter 4	0.238***	(0.053)	0.236***	(0.055)	0.198***	(0.056)	1.082*	(0.625)
Constant	7.113***	(0.420)	7.024***	(0.389)	7.295***	(0.353)	5.502***	(0.702)
Observations		61870		61870		61870		61870
Number of physicians		8360		8360		8360		8360
Mean number of observations per physician		7,4		7,4		7,4		7,4
R-squared				0,184				0,584
Adjusted R-squ~d				0,056				0,582

The effect of the competition indicators

When we apply the competition indicator number of open lists in the municipality we find that when GPs face higher competition they prescribe more reimbursement and drugs addictive drugs, which confirm the hypothesis from the theoretical model[19]. The effect is however rather small, when the number of open lists increase with one, increases prescriptions with 0,016[20] standard DDD of addictive drugs per patient, per year, and 0,24[21] DDD of reimbursed

[19]More indicators at individual level will be tested when full dataset arrives.
[20] 0,04 in a quarter of a year as seen in Table 4

drugs per patient, per year. We also expected to find that increasing number of patients reduce the prescription level. And this is the result on reimbursed drugs. On addictive drugs however, the results show that GPs with many patients prescribe more per patient, which may be caused by the fact that these GPs have little time to argue with patients, and the easiest way to cope with a tight time schedule is to prescribe more drugs. In an analysis on GPs prescribing of sick leave certification long patient lists are similarly found to increase number[22] of prescribed sick leave certifications per patient [13], and the number of referrals per patient [5], which can be interpreted also as a way to reduce time spent on patients, by giving in to pressure from patients.

Characteristics of GPs with low prescribing levels

Controlling for GP gender shows us that female practitioners prescribe less addictive drugs, and fewer drugs on the reimbursement scheme than their male colleagues. This finding corresponds to results from a Norwegian study on GPs prescription of sickness certification [13] and a study on prescription behaviour in general [14]. This may indicate that female GPs are more anxious to follow regulations than their male colleges (other ref ?). To ensure that the effect of being a female GP, should not be influenced by female GPs being on average younger, not specialised and have more female patients, interaction variables are presented.

The younger the GPs are, the less they prescribe. Hence, the GPs age seems to influence on their prescription behaviour. This may either be a result of changing behaviour when ageing or it may be due to differences in the medical education over time. We also find that the prescription pattern differs between GPs with respect to earned speciality or competence, which may in addition to differences between GPs with respect to age, point to the importance of continuous educating GPs through their medical career.

GPs with many female patients, prescribe less reimbursed drugs, but more addictive drugs, indicating that the diagnosis list and medication lists of reimbursed drugs, cover male diagnosis better than female diagnosis.

---

[21] 0,062 in quarter of a year

Table 3

[22] Though the aggregated number of sickleave days were lower for GPs with many patients.

7. CONCLUSIONS AND POLITICAL IMPLICATIONS

Even if the effects are rather small, our results indicate that GPs practicing in municipalities with high competition among GPs prescribe more drugs compared to their colleagues practicing in low GP competition areas. This finding supports the hypotheses we derived in the theoretical model, and we may conclude that GPs use prescriptions to attract patients to their list and to increase the number of consultations from internal and external patients. Another important finding is that competition for patients increase the quantity of addictive drugs prescribed, which may set patients health at risk. Hence, focus on efficiency and making GPs compete for patients, have unintended side effects. It then seems that a listpatient system with capitation payment which is a health policy mean to increase competition in the market for GP services, both undermine the GPs role as a gatekeeper for services paid for by the National Insurance and as such increase the health care costs, and is a hazard to patients health.

Another interesting observation resulting from this study is that the descriptive statistics show that the total amount of prescription per patient increase when the number of prescribing doctors increase. This might of course be caused by the fact that persons with many doctors need more medication than others. But our hypothesis is that the lack of coordination in prescription among physicians especially in high-competition areas is a reason behind the high prescription levels, and that patients thereby are able to "shop" drugs without coordination of total amount. Anyhow this observation points to the importance of strengthen the coordinator role of the populations' medical prescriptions. In our next paper we will further explore the GP's role as coordinator of care and the effect contact with many physicians has on patients' health.

In many parts of the public sector the marked is introduced to increase efficiency, so also in primary health care. The rationale behind new public management is that competition for customers (here patients) will increase service quality and the quantity of services provided, and that a monetary reward increases performance. However, the evaluation of effects and undesired side effects are rare and do not keep pace with the rush to implement markets and pay for performance programs in the public sector. Since it is difficult to measure quality, especially in the long run, competition in healthcare is a demanding challenge. As pointed out by Mannion [15], fee-for-service, perhaps the strongest and most directly instrument to influence behaviour, have retained their dominant role in medicine, long after they have disappeared from most other occupations. Taking into account that health care, in contrast to for instance producing a car, is an art where outcome is difficult to measure this is rather odd. The Motivation Crowding Theory as proposed by Frey (1997), shows that monetary reward and supervision, crowds out intrinsic motivation (work morale), under identifiable conditions [16] which, as we see it, to a great extent is present in primary health care. Increasing weight on monetary reward and supervision may change attitudes in healthcare over time, and hence, may be difficult to reverse.

Studies of cost sharing have shown that all types of prescription medicines, both those considered 'essential' and those considered 'discretionary' are subject to reduced use when patients' out-of-pocket costs rise. This affects some groups more than others; the poor and the elderly appear to be particularly vulnerable.[17,18] This may be the reason why GPs find it easy to bend the law a little, to ensure the patients' medication. It may even be in the interest of society if this increased medication prevent and reduce hospitalisation and other more expensive health care costs than drugs, which are quite small in comparison. To study drug costs in connection to health care costs, long term care costs and other costs for the society is a difficult task, but it is an important area for further research.

Reference List

1. Donaldson C, Gerard K (1989). Paying General-Practitioners - Shedding Light on the Review of Health-Services. J R Coll Gen Pract 39:114-117

2. Robinson JC (2001). Theory and practice in the design of physician payment incentives. Milbank Q 79:149-+

3. Scott A. Chapter 22 Economics of general practice. In: Anthony JCaJ, editor. Handbook of Health Economics. Volume 1, Part 2 ed. Elsevier; 2000. p. 1175-200.

4. Iversen T, Luras H (2000). The effect of capitation on GPs' referral decisions. Health Econ 9:199-210

5. Grytten J, Sorensen R (2008). Busy physicians. J Health Econ 27:510-518

6. Carlsen B, Norheim OF (2003). Introduction of the patient-list system in general practice - Changes in Norwegian physicians' perception of their gatekeeper role. Scandinavian Journal of Primary Health Care 21:209-213

7. Nossen J. Hva foregår på legekontorene? Konsultasjonsstatistikk 2006. The Norwegian Labor and Welfare Administration (NAV) 2007 February;Available from: URL: http://www.nav.no/binary/805363647/file

8. http://www.ssb.no/alegetj/tab-2006-10-09-03.html. Statisitcs Norway 2005;

9. Iversen T (2004). The effects of a patient shortage on general practitioners' future income and list of patients. J Health Econ 23:673-694

10. Biørn E (2007). *Econometric Analysis of Panel Data - an Introduction*. Unipub Kompendier, 2007.Universitetet i Oslo :kap 8.4.
Ref Type: Generic

11. Greene W. Econometric Analysis, . 5th ed. ed. Prentice Hall, Upper Saddle River, 2003b.; 2003.

12. Hausman JA, Taylor WE (1981). Panel Data and Unobservable Individual Effects. Econometrica 49:1377-1398

13. Brage S, Kann IC. NAV-rapport nr. 03/2007 - Endringer i fastlegens sykmeldingspraksis. The Norwegian Labor and Welfare Administration (NAV) 2007;Available from: URL: .http://www.nav.no/binary/805351360/file

14. Wun YT, Chan CSY, Dickinson JA (2002). Determinants of physicians' attitude towards prescribing. J Clin Pharm Ther 27:57-65

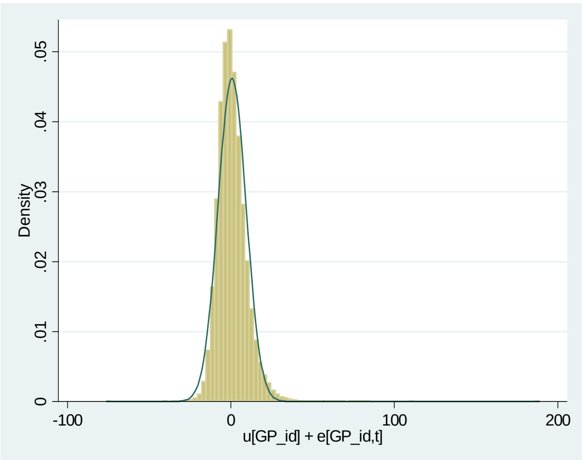
15. Mannion R, Davies HTO (2008). Payment for performance in health care. BMJ 336:306-308

16. Frey BS (1997). On the relationship between intrinsic and extrinsic work motivation. International Journal of Industrial Organization 15:427-439

17. Gardner TL, Dovey SM, Tilyard MW, Gurr E (1996). Differences between prescribed and dispensed medications. N Z Med J 109:69-72

18. ustvoll-Dahlgren A, Aaserud M, Vist G, Ramsay C, Oxman AD, Sturm H, Koesters JP, Vernby A (2008). Pharmaceutical policies: effects of cap and co-payment on rational drug use. Cochrane Database of Systematic Reviews

Figur 6 Residuals, and normal distribution (line) model: Hausman Taylor ,addictive drugs



Figur 7 Residuals, and normal distribution (line), model: Hausman Taylor, reimbursed drugs