Competition, Gatekeeping, and Health Care Access

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Abstract

We study gatekeeping physicians' referrals of patients to specialty care. We derive two theoretical results when competition in the physician market intensifies. First, physicians refer patients to specialty care more often due to competitive pressure. Second, physicians earn more by treating patients themselves, so refer patients to specialty care less often. We assess empirically the overall effect of competition with data from a Norwegian survey in 2008-9 and Statistics Norway. From the data we construct three measures of competition: the number of open primary physician practices with and without population adjustment, and the Herfindahl-Hirschman Index. The empirical results suggest that competition has negligible or small positive effects on referrals overall. Our results do not support the policy claim that increasing the number of primary care physicians reduces secondary care.

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1 Introduction

Primary health care has generated many policy discussions. In many European countries, each inhabitant must be enrolled with a primary care physician to receive national health services. In the United States, Title V of the Affordable Health Care Act provides subsidies for the training of primary care physicians and allied health professionals (see http://www.healthcare.gov/law/full/index.html). Furthermore, Title IV of the Act promotes prevention, and it is expected that preventive care will be provided by primary care physicians.

Primary health care is less expensive than secondary and specialty care, so the emphasis on primary care for cost control is understandable. Perhaps, the most explicit cost-control perspective is the primary care physician's gatekeeping function. In many health plans in the U.S. and European countries, a patient can only obtain specialty care upon a referral made by his primary care doctor, also referred to as a gatekeeper. In this paper, we model the primary care physician's referral decision, and empirically assess the relationship between physician market conditions and gatekeeping.

A referral decision by a primary care physician or general practitioner (GP) likely depends on many factors such as medical conditions, current medical practice guidelines, availability of secondary care, the GP's service capacity, and financial incentives. The current policy recommendation of increasing the number of GPs adds one more dimension to the complex referral decision. Given a population of patients, more GPs will ultimately mean a more competitive market for the doctors. This paper studies the relationship between competition in the GP market and a GP's referrals of patients to specialist care.

Such a study faces a number of difficulties. First, the number of GPs in any market changes slowly, even under any policy intervention. For example, subsidies in the U.S. Affordable Care Act are for physician training. This "natural" experiment will generate data only after many years, or perhaps even a decade. Similarly, in an experiment of a long duration, confounding factors affecting referral decisions will change over time. These changes may be difficult to track or unobservable to the analyst. Second, in a multi-payer system such as the U.S., different health plans use different incentive contracts. Referral decisions likely will be influenced by these incentives. However, information on physician payment contracts is seldom available.

Our strategy is to use a cross-sectional data set, which can be interpreted as a snapshot that captures long-run changes, because different locations have had unique experiences for some time. (For example, differences between two countries at a given point in time result from long-term cultural developments.) We use data from a 2008-2009 survey in Norway as our primary source, and supplement them with register data from Statistics Norway, and from the National Health Insurance Administration. Because data are collected over a one-year period, time-varying confounding factors are irrelevant. The details of the survey and data are in the next section. Here, we would like to point out that i) all self-employed Norwegian GPs are paid by the same financial contract, ii) 95% of all Norwegians GPs are self-employed, and iii) each Norwegian should be listed with a GP who is a gatekeeper for secondary care. In sum, problematic selection issues in multi-payer systems are avoided.

In Norway, a GP either lets his or her medical practice be open or closed to new patients. We use the number of open practices (with and without population density adjustments) as a measure of competition intensity in the GP market. The GP market is more competitive when there are more open practices because consumers have more options and each GP faces a more elastic demand. We also use the more conventional Herfindahl-Hirschman index as an alternative measure. Our use of the number of open practices in a geographical area as a measure of competition is unique. We are unaware of any other data set that contains similar information.

Our empirical work seeks to explain specialty referral by competition intensity. We start with a model of GPs' referral decisions. As in much of the literature, we assume that a GP is guided by a profit motive and a concern for the patient. A GP's practice style is how he values a patient's potential benefits from specialty care and profits from providing services himself. Practice styles are assumed to be affected by market conditions. When the GP market becomes more competitive, the patient has more options. A GP who wants to retain a patient should adopt a practice style that values the patient's benefits more. Competition may have a second effect. As the GP market becomes more competitive, a GP has less patients. Therefore, the GP incurs less disutility when he treats the patient himself. For a fixed reimbursement rate the net profit from providing services increases.

Competition in the GP market has two opposing effects on referrals. More competition encourages a GP to show more concern for the patient, and therefore increases specialty referral. More competition also raises a GP's net profit for providing service himself, and therefore decreases specialty referral. Our model offers this new perspective, and we are able to assess empirically the overall effects of competition on specialty referrals.

The data sets allow us to control for patients' socioeconomic status, age and gender, as well as self-assessed health and chronic illness conditions. We also control for general and specialty health care access at the market level. Our (logit and negative binomial) regressions also account for clustering at the municipality levels. We find that competition either has insignificant or positive effects on GPs' referrals for patients to specialty care. In other words, we find no evidence that more competition among GPs will reduce their specialty referrals. Our results do not lend support to the secondary-care-reduction effect envisioned by a policy that promotes primary care.

Our data do not let us estimate separately the two opposing effects derived from our theoretical model. This, however, does not make our results less relevant. Our model of referral does capture the multi-faceted effects of competition on referrals, and an increase in primary care physician density results in more than a single change. This is an important aspect of the complexity in physician-patient interaction.

The literature on the primary and secondary health services is huge, whether that literature refers to health economics, health services research, or medicine. The health economics literature on the relations between primary and secondary care is smaller but growing. In any case, the interest in primary care and health cost is topical. Using U.S. data, Baicker and Chandra (2004), and Chernew et al. (2009) find that the percentage of primary care physicians in a market is negatively associated with Medicare's reimbursement per beneficiary. Chernew et al. (2009), however, find no correlation between the percentage of primary care physicians and the growth in Medicare spending; thus Medicare policies that seek to reduce spending levels, but not growth rates, will ultimately fail to address cost issues.

Bradley Wright and Ricketts III (2010) use area-level data to show that within a location, a higher density of primary care physicians is associated with less inpatient admission and emergency room visits. Fortney et al. (2005) present results from a natural experiment at the U.S. Department for Veterans Affairs, in which the number of primary care facilities were increased in some districts but not in others. Using a difference-in-difference analysis of longitudinal data and instrumental variables for potential endogeneity problems, they find that an increase in primary care encounters is associated with a decrease in specialty medical encounters. Fortney et al. conclude that primary care is a substitute for specialist health care. With survey data at the individual-patient level, Atella and Deb (2008) study whether primary care physicians and secondary specialists are substitutes or complements. They estimate a structural simultaneous equation model where visits to different types of physicians are endogeneous. When unobserved heterogeneity is appropriately accounted for, they find that primary care physicians and specialists are substitutes.

We model primary care physicians' referral decisions. The theoretical literature on referrals is quite rich. Barros and Olivella (2005) study cream skimming due to physicians working in public service self-referring patients to their own private practice. Biglaiser and Ma (2007) examine the welfare effects of allowing dual practice and self-referrals. In our model the physician does not self-refer. Also, the referred specialists can reject referrals; this option has not been considered by existing papers in the literature.

Allard et al. (2011) consider how referral to secondary care is affected by incentive contracts for primary care physicians. Jeolvac (2003) compares optimal payment schemes with and without gatekeeping. Brekke et al. (2007) study the effect of GP gatekeeping on equilibrium quality in an imperfectly competitive secondary care market. Gonzales (2010) investigates the interactions between patients and GPs when some patients are informed about whether specialty care is appropriate. Our paper does not deal with the issues in these four papers. Our model is parsimonious, and focuses on competition in the GP market. Yet, it derives a set of predictions that we have taken to data.

The literature on competition in the health market is extensive; Gaynor and Town (2011) provide the latest review. It is fair to say that studies of competition have mainly focused on prices, qualities, costs, and health outcomes, and studies that use U.S. data outnumber those that use non-U.S. data. We are not aware of another paper that addresses the effect of competition in the primary care physician market on secondary care referral. Our paper therefore is the first to offer some evidence on this issue.

The common measures of competition in the literature are the number of providers (hospitals, physicians, nursing homes, etc.) within a geographical area, the n-firm concentration ratio, and the Herfindahl-Hirschman Index (see for example Wong et al. (2005)). In a patient-list system such as Norway, these measures do not capture the fact that patients can switch to another GP only if they can find open practices. We are unaware of any other study that uses the number of open GP practices as a measure of competition, with one exception Iversen and Ma (2011) show that more intense competition, measured either by GP open practices or GP's desired practice sizes, significantly leads to more diagnostic radiology referrals.

The rest of the paper is organized as follows. The next Section describes the Study Setting. A model of GP referral to either private or public specialist is set up in Section 3. Then we present our data set and descriptives in Section 4. The estimation results are in Section 5 while concluding remarks follow in Section 6. Finally, an Appendix contains the proofs of propositions.

2 Study setting

Norway has a three-tier government structure. At the top is the state, the next tier consists of 18 county councils, and the bottom tier consists of 430 municipalities. Norwegians' health care is covered by a decentralized national health services system. Municipalities are responsible for primary health care. Since 2002, secondary health care is the responsibility of the state.

Each Norwegian is listed with a primary care physician, or a General Practitioner (GP). The Norwegian government is concerned about geographical distribution of GPs, and strictly regulates the entry of new GPs into municipalities. Licenses for GPs to practice at municipalities are allocated by the Directorate of Health. Patients may switch GPs twice a year, and in a year about 3% of the patients do so. Patterns of patients switching physicians vary considerably, and depend on physician characteristics (Iversen and Lurås, 2011). Almost all GPs (95%) are self-employed. A GP typically contracts with his resident municipality. A GP's revenue from practicing medicine can be divided into three roughly equal parts. First, he receives a capitation fee from the contracted municipality for each listed patient. Second, he receives fee-for-service reimbursements from the National Insurance Scheme (NIS, a public scheme that is an integral part of the state account) according to a fixed schedule negotiated between the state and the Norwegian Medical Association. Third, a GP receives copayments from patients for office consultations and tests. All fees and copayments are set at the national level, without any geographical variations. Hence, to GPS (and specialists) the payment system is entirely given.

Almost all hospitals in Norway are public. Four Regional Health Authorities (RHAs) manage public hospitals. A number of private hospitals, both for-profit and not-for-profit, operate in Norway. Major private not-for-profit hospitals contract with the RHAs, and provide acute and elective care on the same terms as public hospitals. Private for-profit hospitals are very few and are geographically concentrated around the capital Oslo. The RHAs buy some services from private for-profit hospitals. The remaining services are paid for by private health insurance or by patients directly.

Patients receive specialty outpatient consultations at public hospitals or at private offices. Specialists working at public hospitals receive salaries. Most private specialists contract with RHAs. Such a contract gives a private specialist an annual practice allowance from an RHA and fee-for-service reimbursements from the NIS. Private specialists are mainly located in urban areas. Approximately one third of all outpatient consultations are given by private specialists. A patient pays the same copayment whether the consultation is at a public hospital or a private office.

A GP is a gatekeeper. A GP must grant a referral before a patient receives specialty care at a public hospital or at a private office operated by a specialist under an RHA contract. A referral allows a patient to go to several visits for a defined medical condition within a year.

In 2009, the Norwegian government presented a major proposal for reforming the health care sector (Report No. 47 (2008–2009)). The coordination reform was to solve problems due to low care quality for patients with chronic diseases, and high care costs. A part of the proposal suggested a substantial increase in GPs and related resources. However, due to lack of evidence, the Norwegian parliament rejected this part of the reform. Our research, therefore, provides evidence for this policy discussion.

3 A model of referral

A patient is under the care of a primary care physician, or a General Practitioner (GP). The GP has to decide between treating the patient himself and referring the patient to secondary care. A referral can be made to a Public Specialist or a Private Specialist, who work, respectively, in the public and private sectors.

3.1 Patient, GP, and Specialists

The patient is fully insured, and delegates treatment decisions to physicians. Let u denote the patient's benefit from the GP's treatment. This benefit depends on a patient's health status, and may take any value in an interval $[0, L]$. The GP observes this benefit u before making the referral decision. The GP does not know how much benefit the patient may obtain from secondary care, but believes that this is a random variable v. To simplify notation, we also let v vary on $[0, L]$, and it has a distribution F, and a density f. We assume that the distribution of v is independent of u;

if they were correlated, we would simply replace the distribution F by a conditional one.

Upon seeing the patient, a Specialist learns the value of v, as well as the value of u. Our interpretation is that the GP sends along the patient's medical information to the Specialist, who can infer the benefit u from primary care. There is a delay when a patient is referred to the Public Specialist, so the benefit becomes δv, $0 < \delta < 1$, if the patient is treated by the Public Specialist. Most public systems use waiting time as a rationing mechanism. This is true in Norway, and motivates our delay assumption. There is no delay when the patient is referred to the Private Specialist, so if the Private Specialist provides treatment, the patient's benefit is v.

A private physician working in the private sector is paid according to a fee-for-service contract with a national insurance system. The private GP has a fee-for-service rate p, while the Private Specialist has a rate q. We interpret p and q as unit profits, net of service costs. Very often we have $p < q$, so a Specialist receives a higher rate than a GP (although we do not use this inequality). The Public Specialist receives a salary. This difference in payments implies different incentives for service provisions.

Physicians behave as if their preferences are weighted average of profits and patient's (expected) benefits. Physicians practice medicine according to professional protocols, but also care about profits. Alternatively, we can regard medical services as implicit or explicit bargaining outcomes between physicians and patients. Such outcomes (such as the Nash bargaining solution) are often a weighted average of a physician's profit and a patient's benefit. In the literature a physician's tradeoff between patient benefit and profit is said to constitute his practice style.

It is well-known that physician practice styles vary widely. Definitive medical guidlines and protocols are not always available, and doctors operate under a grey area of medicine (Iversen and Luràs, 2000, and Chandra et al.,2011). It is well documented that the same medical condition may be treated differently across locations. Further, patients' preferences may have an effect on how physicians select treatments (Skinner, 2011). We further hypothesize that practice-style variations are influenced by GP market conditions. When GPs compete vigorously for patients, they may adjust their practice styles to put on more weight on patient benefit. Alternatively, a more competitive GP market may endow patients with better outside options. This implies a better bargaining outcome for them.

3.2 The referral process and physician utilities

We allow a Specialist the option to reject a referral and send the patient back to the GP for primary care services; this option is often ignored in the literature. The referral process is modelled as follows:

Stage 1: The GP observes the patient's benefit value u from his treatment, and decides between treating the patient, referring the patient to the Private Specialist, and referring the patient to the Public Specialist.

Stage 2: Upon a referral, the Private or Public Specialist gets to learn both u and v, the latter having being drawn according to distribution F. The Specialist decides between treating the patient and sending the patient back to the GP (who then has to treat the patient). There will be a delay if the referral has been to the Public Specialist.

The GP's utility is $p + \alpha u$ if he treats the patient; he values profit p from fee-for-service (net) revenue and the patient's benefit at αu, where the strictly positive practice-style parameter α measures the importance of the patient's benefit. If the GP refers the patient to the Private Specialist, and the referral is accepted, his utility is αv. In this case, the GP no longer receives the fee-for-service payment p, but his concern for the patient remains. We continue to use the practice-style parameter α to measure how the GP values the patient's benefit v from specialty care. If the GP refers the patient to the Public Specialist, the patient experiences a delay, so the GP's utility is discounted by a factor of δ to $\alpha\delta v$. In the Norwegian system, the GP also receives a capitation payment for each patient under his care. At the time of referral, the GP has already received the capitation payment, so we do not write it down explicitly.

The Private Specialist's utility is similarly defined as $q + \beta v$ if he accepts the referral, where the practice-style parameter $\beta > 0$ is the Specialist's weight on the patient's benefit. If he rejects the referral and sends the patient back to the GP, his utility is βu. Again, the Specialist values the patient's utility at the practice-style parameter β even when the patient is referred back to the GP.

The Public Specialist receives a fixed salary, so we let his payoff from treating the patient derive entirely from his concern for the patient. We normalize the Public Specialist's salary to 0, and his practice-style parameter to 1. When the Public Specialist sees the patient, the delay is already a sunk cost, so we write his utility from treating the patient as v, and his utility from sending the patient back to the GP as u.

3.3 Equilibrium decisions by Specialists

The Public Specialist receives a salary and acts in the patient's best interest, so he treats the patient if $v > u$, and sends the patient back to the GP otherwise. The Private Specialist, however, may not act in the patient's best interest. If the Private Specialist accepts the referral, his payoff is $q + \beta v$. If he rejects the referral, the patient receives treatment from the GP, so the Private Specialist's payoff is βu. The Private Specialist accepts the referral if and only if $q + \beta v \geq \beta u$. Even when $v < u$, he may not redirect the patient back to the GP because he earns a monetary profit q by providing treatment. He will send the patient back to the GP only if the monetary payoff, q, is less than the incremental utility, $\beta(u - v)$, or equivalently $v < u - q/\beta$.

3.4 GP's utilities from treating and referring the patient

We now consider the GP's expected utilities from his three options in Stage 1. He takes into consideration the best responses of both Specialists. First, if the GP treats the patient, his utility is

$$p + \alpha u. \tag{1}$$

Second, if the GP refers the patient to the Public Specialist, the referral will be accepted if and only if $v \geq u$. The GP's expected utility from this referral is

$$\int\limits_{v<u} \delta[p + \alpha u] \, \mathrm{d}F(v) + \int\limits_{v \geq u} \delta \alpha v \, \mathrm{d}F(v). \tag{2}$$

Here, the first integral (for $v < u$) corresponds to the Public Specialist rejecting the referral, so the GP's payoff is $p + \alpha u$, and this happens after a delay. The second integral (for $v > u$) corresponds to the Public Specialist accepting the referral, so the GP's payoff is αv, and again this happens after a delay.

Third, if the GP refers the patient to the Private Specialist, the referral will be accepted if and only if $q + \beta v \geq \beta u$. The GP's expected utility from referring the patient to the Private Specialist is

$$\int\limits_{v<u-q/\beta} [p + \alpha u] \, \mathrm{d}F(v) + \int\limits_{v \geq u-q/\beta} \alpha v \, \mathrm{d}F(v). \tag{3}$$

Here, the first integral (for $v < u - q/\beta$) corresponds to the Private Specialist rejecting the referral. The second integral (for $v \geq u - q/\beta$) corresponds to the Private Specialist accepting the referral.

3.5 GP's equilibrium referral

We assume that the parameter configuration in the model admits equilibria in which a referral may occur. The GP's equilibrium choice is obtained by comparing the treatment payoff $p + \alpha u$, and referral to Specialists' payoffs, respectively, expressions (2), and (3). His choice is guided by two considerations. First, the GP and the Private Specialist value both profits and the patient's benefit, but the Public Specialist is paid a salary, so a perfect agent for the patient. Second, referring the patient to the Public Specialist means a delay. The first consideration is in favor of the GP referring the patient to the Public Specialist, but the second is against it.

First, suppose that u is large. The GP's best strategy is to provide treatment himself. There is only a small chance that a referral will show that v is higher than u. A referral to the Public Specialist is suboptimal because of the delay. A referral to the Private Specialist is suboptimal because the Private Specialist's concern for the patient is only partial. Second, suppose that u is small. Here, secondary care likely will benefit the patient. Referring the patient to the Public Specialist causes a delay, so the GP's equilibrium choice must be to refer the patient to the Private Specialist. Third, for medium values of u, the information about v is valuable, as in the second case. Here, the GP should also make a referral. However, whether the GP will refer the patient to the Public or Private Specialist depends on the discount factor δ, the parameters α and β, the fee-for-service rates p and q, and the distribution F.

Figure 1 plots the GP's typical expected utilities from his three choices, as functions of the patient's benefit from the GP, u. The solid line is the GP's utility from treating the patient (expression (1)). The dashed line is the utility from referring the patient to the Public Specialist (expression (2)). The dotted line is the utility from referring the patient to the Private Specialist (expression (3)). The GP's equilibrium utility is given by the upper envelope of the three utility lines. In this example, at small u, the GP obtains the highest utility from referring the patient to the Private Specialist. For medium u, the highest utility is from referring the patient to the Public Specialist, while for large u, the highest utility is from the GP treating the patient himself. In general, however, each pair of the three expected utility lines can cross multiple times.

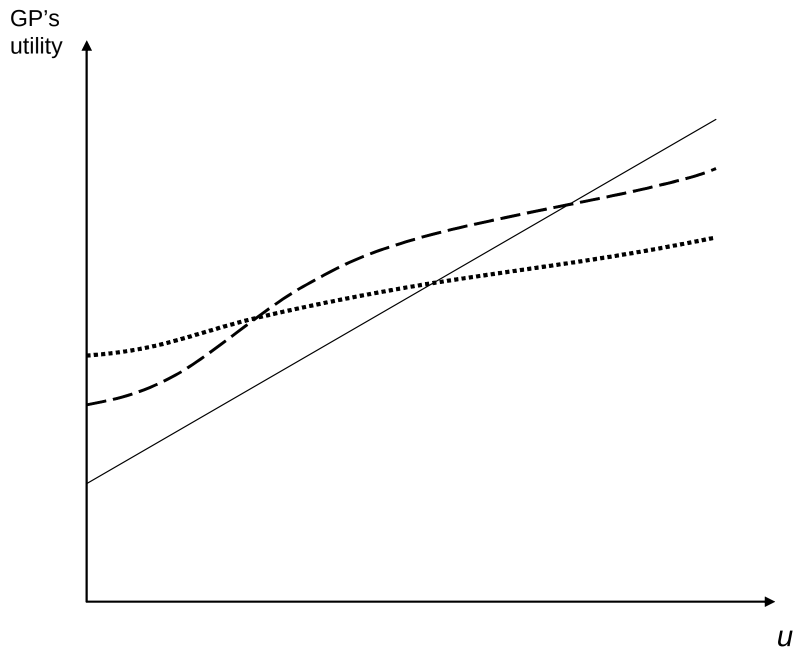

Figure 1: GP's utilities from providing treatment and referrals

3.6 Competition and GP referrals

Competition in the GP market manifests in our model in two ways. First, we have hypothesized that competition acts as a constraint. In a more competitive environment, a GP caters more to the patient's needs, and this means an increase in the GP's practice-style parameter α.

Proposition 1 *In a more competitive market leading to a higher practice-style parameter α, the GP refers the patient to the Public or Private Specialist more often.*

A second way competition affects equilibrium referral is through its effect on the GP's net revenue p. If the total demand for GP services is constant, then as competition increases, each GP may have less patients. The GP has more leisure, so his disutility from work may decrease. This implies that the net revenue p may increase. The higher value of p implies a stronger incentive for the GP to provide treatment.

Proposition 2 *In a more competitive market leading to a higher GP fee-for-service rate p, the GP refers the patient to the Public or Private Specialist less often.*

A more competitive GP market means higher values of p and α. More intense competition, therefore, produces effects that act in opposite directions. Our empirical work investigates which of the two effects is stronger.

4 Data and descriptives

Statistics Norway conducts an annual, cross-sectional "Survey of living conditions in Norway" (available at http://www.ssb.no/a/english/innrapportering/lev/). The main topic rotates. Every three to four years the population's self-assessed health and reported health care utilization will be the main topic. The main data for our study are from the Survey with health as the main topic conducted in 2008 and 2009 (Wilhelmsen, 2009). Statistics Norway drew a representative sample of 10,000 non-institutionalized residents aged 16 and above. The response rate was 66.8%. In total, 6,465 face-to-face or telephone interviews were completed. Compared with the Norwegian population, our sample is somewhat overly represented by women and those between 45 and 66 years old.

The Survey asked for information on living and health conditions such as common socioeconomic characteristics, self-assessed health status, etc. Data of respondents' income and education are obtained from the national registers. For our empirical work, the key information from the Survey includes the respondent's self-assessed health, number and types of chronic diseases, and use of primary and secondary health services during the twelve-month period before the survey. From the national registers, we obtain the identity of a respondent's regular GP. This information is merged with the survey data. We also add information of GPs and specialty care at the level of the respondent's municipality.

Our interest is to measure the intensity of competition between GPs. We use three measures of competition intensity. The variable $\#\mathrm{OPEN}$ is the number of GP practices in a respondent's municipality that accept new patients. The variable $\#\mathrm{OPEN/CAPITA}$ is $\#\mathrm{OPEN}$ divided by the municipality's population measured in units of 10,000. Finally, the variable $\mathrm{HERFINDAHL}$ is the Herfindahl-Hirschmann index. We explain our choices for these three competition-intensity measures in turn.

More GPs with open practices means more choices for those patients who are dissatisfied with their current GPs. Norwegian GPs receive a capitation payment for each patient in his list.

It likely is an economic loss for the GP when a patient leaves his practice. A higher value of #OPEN, therefore, indicates a more competitive market for GPs. The variable #OPEN, however, is strongly correlated with municipality population. To control for municipality population size, we use #OPEN/CAPITA as another measure of competition intensity.

In Norway, almost all GPs contract with a municipality, while most Norwegians list with GPs in their home municipalities. However, Norwegians are free to use GPs outside of their home municipalities. Our third index for competition intensity, HERFINDAHL, takes into account these details. The Herfindahl-Hirschman index is often used for measuring market concentration. Its use for the health market is also common (Gaynor and Town 2011, and Pauly 2004). For a given market, the index is the sum of squares of each firm's market share; a firm's market share is the ratio of a firm's output to the total market output. For a monopoly, the index is 1, while for a market consisting of N identical firms, the index is $1/N$ $(= \sum_{i=1}^{N}(1/N)^2)$. A lower value of the index indicates a more competitive market.

For each GP, his output is the number of patients listed with him. A GP competes against other GPs in a market, that is constructed as follows (see also Chen and Godager 2011). For each GP in our data, we identify a geographical area within a 10-kilometer radius from the center of his postal code. We call this a GP's circle. A GP competes against another GP if and only if their two circles intersect. Therefore, the market for a GP consists of all the GPs with circles overlapping with his. For each GP, we compute the Herfindahl index using patient lists of GPs in his market. Being based on actual market outcomes, the Herfindahl index does not take into account any excess demand for a GP or a GP's excess capacity. Our other competition measures, the number of open GP practices with and without population adjustment, do capture excess demand or supply.

In our regressions, we seek to explain specialty care by market conditions. The three key variables to identify competition intensity are #OPEN, #OPEN/CAPITA, and HERFINDAHL. We do not use the list size of a respondent's GP because that is endogenous; physician supply may well correlate with patients' health status, and hence the specialty referral decision (see, for example, Dranove and Wehner 1994). Our market-level measures for competition, however, are arguably exogenous or predetermined. Most important, our competition measures are aggregated over many physicians. A single GP's referral decision for a single patient cannot influence market competition intensity. Furthermore, whether a GP practice is open to new patients has been stable over time. Our regressions are identified by variations of #OPEN across municipalities, and variations of HERFINDAHL across markets. The #OPEN measure is based on municipality boundaries but the HERFINDAHL measure is not. Our choices provide a robustness check on the patients' choice sets when they consider switching between GPs.

We use municipality-level indexes to control for patients' access to health care. These indexes are calculated in Lafkiri (2010), and updates of those in Iversen and Kopperud (2005). We use two indexes: access to hospital care, and access to specialty care by private practitioners in a nonhospital setting. Access to hospital care is measured by the variable ACCESSPUB, that reflects hospital capacity in terms of the number of physicians, and is constructed as follows. Hospitals (in a municipality) have catchment municipalities. The variable ACCESSPUB is the number of physician specialists at public hospitals per 10,000 standardized inhabitants in the catchment municipalities. The standardization is according to automobile travel time between catchment municipalities to hospitals, with lower weights on populations farther away from hospitals. Access to private specialists, ACCESSPRIV, is constructed similarly, but now with the number of private specialists as the capacity measure. Indexes are standardized over the total number of Norwegian municipalities. We note that while the Herfindahl index is based on distances, not on patients' residential municipalities, all other capacity measures describe access in municipalities where patients reside.

Table 1 presents definitions of variables and descriptive statistics. In the sample, 83% of respondents reported seeing a GP in the twelve-month period before the interviews, while 40% reported having a consultation with a specialist. Since some patients visited both private and public specialists, the respective percentages of visits (at 20% and 27%) sum to more than 40%. On average, among respondents who had at least one GP consultation, they saw the GP more than 4 times. The corresponding average numbers of specialty consultations with the private specialist, public specialist, and any specialist are, respectively, 2.07, 2.46, and 2.70. Table 1 also presents respondents' gender and age information.

We use a number of variables to control for health status. Respondents were asked to rate their health in five grades. About 80% reported that their health status was either very good or good. The remaining 20% reported that their health status was fair, poor, or very poor. Although the self-assessed health status variables suggest a relatively healthy sample, 40% of the respondents had at least one chronic disease.

The mean (truncated) gross household income is 639,000 Norwegian Kroners (about US$106,000 at the approximate exchange rate of US$1 to 6Kr in 2008 and 2009). While there may be a nonlinear relationship between specialty-care utilization and a patient's income, we decided to exclude higher-order income terms to avoid multicollinearity. To capture this potentially nonlinear effect, in the estimations we use a binary variable HINC which is set to 1 for those with gross household income above the median, and 0 otherwise. Education may also have a nonlinear effect. There may be significant utilization differences between those with higher education and those without. Again, we use a binary variable HIGHEDU which is set to 1 for those with 14 or more years of education. In the sample, 35% of the respondents achieved at least two years of education beyond the high school.

On average, 37.8 GPs in the respondent's municipality would accept new patients. This corresponds to 45% of all GPs in the sample. Adjusting for the population size, we find a mean of 3.89 for #OPEN/CAPITA which is the number of open GP practices per 10,000 of inhabitants. The variable of HERFINDAHL has a mean of 0.11. The means of the two standardized variables of health care access ACCESSPUB and ACCESSPRIV are 1.80 and 0.70, respectively.

TABLE 1 ABOUT HERE

5 Estimation and results

We would like to estimate the impact of competition intensity on GPs' secondary care referrals. Our estimation strategy takes into account data characteristics. GPs are clustered in municipalities. In our sample, the number of patients listed with the same GP varies between 1 and 22, with a median of 2. The number of individuals residing in the same municipality varies between 1 and 744, with a median of 30. Observations within each cluster likely are correlated due to unobserved characteristics such as physician practice style, location, and customs. Therefore, we allow for correlated error terms within municipality clusters, and estimate population-averaged panel-data models with robust standard errors by Stata 11.

We use a logit regression for estimating the probability of any specialty referral by a GP, and a negative binomial regression for estimating the number of speciality referrals. In each, we separately estimate regressions for referrals to Private and Public Specialists. In many cases, especially for chronically ill patients, a single GP referral is all that is needed for many secondary-care visits. The logit model lets us make a distinction between those patients who have at least one referral, and those who have none. Nevertheless, a patient may require multiple modalities of secondary care or visits. The actual number of specialty visits is therefore of interest. We can regard the number of referrals as counts. After having rejected the Poisson model, we use a negative binomial regression.

There are three measures of competition intensity, and we separately estimate referrals to Private and Public Specialists, so there are a total of six sets of regression results in Table 2. All estimated coefficients are marginal effects at the sample mean. Again, the dependent variable in Table 2 is the probability of one or more GP referrals. Columns 2, 3, and 4, respectively, use #OPEN, #OPEN/CAPITA, and LOGHERFINDAHL (the logarithm of HERFINDAHL) to measure competition intensity, and report results for referrals to Private Specialists. In these three regressions, we use the variable ACCESSPRIV to control for access to private secondary care. Columns 5, 6, and 7 are for referrals to Public Specialists, and have the same format, except that we use the variable ACCESSPUB to control for access to hospital care.

TABLE 2 ABOUT HERE

The competition intensity indicators #OPEN and #OPEN/CAPITA have no effect on the probability of GPs referring a patient to specialty care at private or public settings. For the third competition-intensity measure, LOGHERFINDAHL, has no effect on referrals to Public Specialists, but a negative and significant (at 5%) effect on referrals to Private Specialist. A higher value of LOGHERFINDAHL indicates a higher market concentration, which proxies less competition. Hence, the negative effect says that as competition becomes more intense, GPs refer patients to Private Specialists more often. Our results do not support the hypothesis that more GPs would lead to reductions in secondary care.

Our results cannot be attributed GPs' tendency to locate in municipalities where illnesses (and hence referrals) are more prevalent. This is because our market-condition measures, #OPEN and #OPEN/CAPITA, are measures of excess capacities. We do not use GPs' actual list sizes except in the construction of the Herfindahl-Hirschman index. There is no reason to expect a positive correlation between excess capacity and illness. (In fact, a negative correlation might be more likely because GPs have more cases to take care of when they are located in areas with sicker patients.)

The reverse association that more specialty referrals result in more open GP practices is implausible. An open practice is a signal of excess capacity, but the current payment system does not reward GPs for having open practices. Also, a GP receives a capitation payment when he enrolls a patient. If the GP makes his practice open to new patients, the capitation payment must be attractive to him. More specialty referrals mean less treatment provision, so a GP loses the fee-for-service payment also.

We have used ACCESSPRIV and ACCESSPUB to control for access to private and public specialty care. Although ACCESSPRIV has the expected positive and significant effects on referrals to Private Specialists, ACCESSPUB has insignificant effects on referrals to Public Specialists.

In all regressions, we have controlled for gender, age, socioeconomic status and self-assessed health. The estimated marginal effects of all these controls are as expected. Being female raises the probability of a referral for specialty care at both private and public settings. Senior citizens are more likely to have a referral than the young, but the effects are only significant for referrals to Private Specialists. Those with better self-assessed health have a smaller probability of consulting secondary care providers, while the opposite is true for those who have chronic diseases. Well-educated individuals and those with above-median incomes have higher probabilities of using specialty care. but for the latter group the positive effects are insignificant for referrals to Public Specialists.

We considered including ACCESSPRIV and ACCESSPUB in each of the regressions. However, these two access variables are strongly correlated, and we chose only the natural one for the corresponding regression (for example ACCESSPRIV for the regressions with private specialist referral as the dependent variable). We also considered estimating a system of equations for a decision process. Here, the GP first decides between providing treatment and referring the patient to specialty care. If the GP decides against providing treating, then he chooses between a private specialist referral and a public specialist referral. However, no information in our data would allow us to identify each individual equation in this system.

TABLE 3 ABOUT HERE

In Table 3, we report results from the negative binomial regressions. The dependent variables are the number of visits to the Private and Public Specialists. Again, there are six sets of regression results, and they follow the same format as those in Table 2. More intense competition as measured by LOGHERFINDAHL has a positive and significant (at 1%) effect on the number of visits to Private Specialists but no effect on the number of visits to Public Specialists. The competition measure #OPEN has a similar effect. These are the only significant marginal effects of competition measures on specialty visits. The estimated marginal effects of the control variables generally follow the same corresponding patterns as in the logit regressions.

6 Concluding remarks

In many policy discussions, the idea of having more primary care physicians has been promoted. It is thought that that will lead to better primary care, and reduce secondary care at the same time. We have constructed a model of GPs' secondary care referrals. Then we have used a set of Norwegian survey data and register data to test whether competition among GPs will lead to more or less referrals.

We model the referral decision of a GP who is paid by both capitation and fee-for-service. Our theory predicts two opposing effects when the GP market becomes more competitive. First, GPs become more concerned with patients' welfare as the GP market becomes more competitive, so they refer patients to secondary care more often. Second, competition may reduce GPs' workload, so they earn a higher net profit from providing treatments to patients themselves, so they refer patients to secondary care less often.

Using data from a representative survey of Norwegian citizens conducted by Statistics Norway in 2008-2009 and linked data of survey respondents' GPs and municipalities, we assess the overall effects of competition. We find no evidence that more competition in the GP market will reduce speciality care. Our three competition measures either have insignificant effects or small and positive effects on the likelihood of a referral and the number of specialty visits.

The basis for a policy to increase primary care physicians seems straightforward. When there are more GPs, patients have more choices, and likely receive more care from them. Nevertheless, the relationship between GP competition and secondary care is multifaceted. One might even argue that making referrals is one of the GP's responsibility, so increasing the number of GPs will increase referrals.

A policy that aims to reduce costly specialty care seems to require a change in medical practices. A success in cost reduction is achieved when secondary care is substituted by primary care. This means that the traditional guidelines for GPs' and specialists' responsibilities have to be redrawn. Alternatively, an integrated approach, in which GPs and specialists together internalize cost and benefit may offer a better avenue for efficiency.

7 Appendix

Proof of Proposition 1: A GP refers a patient if and only if his expected utility from referral is higher than the utility from treating the patient. This is equivalent to

$$p + \alpha u \leq \min \left\{ \begin{array}{c} \displaystyle\int\limits_{v<u} \delta[p + \alpha u] \; \mathrm{d}F(v) + \int\limits_{v \geq u} \delta \alpha v \; \mathrm{d}F(v), \\ \displaystyle\int\limits_{v<u-q/\beta} [p + \alpha u] \; \mathrm{d}F(v) + \int\limits_{v \geq u-q/\beta} \alpha v \; \mathrm{d}F(v) \end{array} \right\}, \tag{4}$$

the two terms on the right-hand side of the inequality being the expected utilities from referrals to the Public and Private Specialists, respectively.

The derivative of (1) with respect to α is u. The derivative of (2) with respect to α is

$$\int\limits_{v<u} \delta u \; \mathrm{d}F(v) + \int\limits_{v \geq u} \delta v \; \mathrm{d}F(v). \tag{5}$$

Finally, the derivative of (3) with respect to α is

$$\int\limits_{v<u-q/\beta} u \; \mathrm{d}F(v) + \int\limits_{v \geq u-q/\beta} v \; \mathrm{d}F(v). \tag{6}$$

Suppose that at some u, say $\widehat{u}$, we have

$$p + \alpha \widehat{u} = \int\limits_{v<\widehat{u}} \delta[p + \alpha \widehat{u}] \; \mathrm{d}F(v) + \int\limits_{v \geq \widehat{u}} \delta \alpha v \; \mathrm{d}F(v)$$

so that the GP is indifferent between treating the patient and referring the patient to the Public Specialist. We rewrite this condition as

$$p + \alpha \widehat{u} = \delta p F(\widehat{u}) + \alpha \left\{ \int\limits_{v<\widehat{u}} \delta \widehat{u} \; \mathrm{d}F(v) + \int\limits_{v \geq \widehat{u}} \delta v \; \mathrm{d}F(v) \right\}. \tag{7}$$

Because $p > \delta p F(\widehat{u})$, we have

$$\alpha \widehat{u} < \alpha \left\{ \int\limits_{v<\widehat{u}} \delta \widehat{u} \; \mathrm{d}F(v) + \int\limits_{v \geq \widehat{u}} \delta v \; \mathrm{d}F(v) \right\}.$$

This inequality says that at $\widehat{u}$, the derivative of (1) with respect to α, namely $\widehat{u}$, is strictly smaller than (5), the derivative of (2) with respect to α.

At $\widehat{u}$, as α increases, the GP's expected utility from referring the patient to the Public Specialist increases faster than the utility from treating the patient. Because of (7), we conclude that at $\widehat{u}$ the GP refers the patient to the Public Specialist when α increases.

Next, suppose that at some u, say $\widetilde{u}$, we have

$$p + \alpha\widetilde{u} = \int\limits_{v<\widetilde{u}-q/\beta} [p + \alpha\widetilde{u}] \, \mathrm{d}F(v) + \int\limits_{v\geq\widetilde{u}-q/\beta} \alpha v \, \mathrm{d}F(v)$$

so that the GP is indifferent between treating the patient and referring the patient to the Private Specialist. We rewrite this condition as

$$p + \alpha\widetilde{u} = pF(\widetilde{u} - q/\beta) + \alpha \left\{ \int\limits_{v<\widetilde{u}-q/\beta} \widetilde{u} \, \mathrm{d}F(v) + \int\limits_{v\geq\widetilde{u}-q/\beta} v \, \mathrm{d}F(v) \right\}. \tag{8}$$

Because $p > pF(\widetilde{u} - q/\beta)$, we have

$$\alpha\widetilde{u} < \alpha \left\{ \int\limits_{v<\widetilde{u}-q/\beta} \widetilde{u} \, \mathrm{d}F(v) + \int\limits_{v\geq\widetilde{u}-q/\beta} v \, \mathrm{d}F(v) \right\}.$$

This inequality says that at $\widetilde{u}$, the derivative of (1) with respect to α, namely $\widetilde{u}$, is strictly smaller than (6), the derivative of (3) with respect to α.

At $\widetilde{u}$, as α increases, the GP's expected utility from referring the patient to the Private Specialist increases faster than the utility from treating the patient. Because of (8), we conclude that at $\widetilde{u}$, the GP refers the patient to the Private Specialist when α increases.

Proof of Proposition 2: With respect to p, the derivative of the GP's utility from treating the patient in (1) is 1. The derivative of the GP's utility from referring the patient to the Public Specialist (2) is

$$\int\limits_{v<u} \delta \, \mathrm{d}F(v) < 1.$$

Finally, the derivative of the GP's utility from referring the patient to the Private Specialist (3) is

$$\int\limits_{v<u-q/\beta} \mathrm{d}F(v) < 1.$$

Clearly, the GP's utility rises faster in p when he treats the patient than when he refers the patient to either the Public or Private Specialists.

If the GP treats a patient at some u, we have

$$p + \alpha u \geq \max \left\{ \begin{array}{c} \displaystyle\int_{v<u} \delta[p + \alpha u] \; \mathrm{d}F(v) + \int_{v \geq u} \delta \alpha v \; \mathrm{d}F(v), \\ \displaystyle\int_{v<u-q/\beta} [p + \alpha u] \; \mathrm{d}F(v) + \int_{v \geq u-q/\beta} \alpha v \; \mathrm{d}F(v) \end{array} \right\}. \tag{9}$$

As p increases, the utility term on the left-hand side of (9) increases at a rate of 1, but each utility term on the right-hand side of (9) increases at a rate less than 1. Hence, the inequality in (9) remains valid as p increases.

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Table 1: Descriptives

Variable	Definition	N	Mean	Std.dev.	Min	Max
Variables at the municipality or market level						
#OPEN	Nnumber of GPs who accept new patients	6416	37.80	66.23	0	213
#OPEN/CAPITA	Number of GPs per 10,000 inhabitants who accept new patients	6416	3.89	2.72	0	24.30
HERFINDAHL	Herfindahl-index	6213	0.11	0.18	0.00	1
LOGHERFINDAHL	Ln(HERFINDAHL)	6213	-3.20	1.50	-5.96	0
ACCESSPRIV	Access indicator: private specialists	6425	0.70	1.12	-1.53	2.21
ACCESSPUB	Access indicator: public hospital physicians	6425	1.80	3.71	-1.59	11.78
Variables at the level of individual						
CONSULT GP	Dummy=1 if visited a GP during previous 12 months	6447	0.83	0.37	0	1
#CONSULT GP	Number of GP visits given number of visits > 0	5311	4.16	5.53	1	130
CONSULT PRIV. SPEC.	Dummy=1 if visited a private specialist during previous 12 months	6447	0.20	0.40	0	1
#CONSULT PRIV. SPEC.	Number of visits given number of visits > 0	1279	2.07	3.95	1	100
CONSULT PUB. SPEC.	Dummy=1 if visited a public specialist during previous 12 months	6447	0.27	0.44	0	1
#CONSULT PUB. SPEC.	Number of visits given number of visits > 0	1726	2.46	3.50	1	55
CONSULT SPEC. CARE	Dummy=1 if visited specialist health service during previous 12 months	6447	0.40	0.49	0	1
#CONSULT SPEC. CARE	Number of visits given number of visits > 0	2553	2.70	4.29	1	102
MALE	Dummy=1 if male	6447	0.49	0.50	0	1
YOUNG	Dummy=1 if 16 years ≤ Age ≤ 25 years	6447	0.14	0.35	0	1
MIDDLE1	Dummy=1 if 25 years ≤ Age ≤ 45 years	6447	0.34	0.47	0	1
MIDDLE2	Dummy=1 if 45 years ≤ Age ≤67 years	6447	0.37	0.48	0	1
OLD	Dummy=1 if 67 years ≤ Age	6447	0.15	0.35	0	1
VGOODHEALTH	Dummy=1 if very good self-assessed health	6447	0.36	0.48	0	1
GOODHEALTH	Dummy=1 if good self-assessed health	6447	0.44	0.50	0	1
CHRONIC	Dummy=1 if at least one chronic disease	6435	0.40	0.49	0	1
INCOME	Gross household income in NOK 1,000	6430	639	347	-1460	1460
HINC	Dummy=1 if INCOME > Median of INCOME	6447	0.49	0.50	0	1
HIGHEDU	Dummy=1 if > 14 years of education	6447	0.35	0.48	0	1

Table 2: Referral to private specialists and public specialists: Results from logit regressions

	Private Specialist			Public Specialist		
	Marg. eff. (Std.Err)	**Marg. eff. (Std.Err)**	**Marg. eff. (Std.Err)**	**Marg. eff. (Std.Err)**	**Marg. eff. (Std.Err)**	**Marg. eff. (Std.Err)**
#OPEN	0.000 (0.000)			0.000 (0.000)		
#OPEN/CAPITA		-0.001 (0.002)			0.003 (0.002)	
LOGHERFINDAHL			-0.009** (0.005)			0.007 (0.005)
ACCESSPRIV	0.028*** (0.005)	0.030*** (0.005)	0.025*** (0.006)			
ACCESSPUB				-0.008 (0.007)	-0.002 (0.002)	-0.001 (0.002)
Control variables						
MALE	-0.082*** (0.009)	-0.082*** (0.009)	-0.081*** (0.009)	-0.053*** (0.010)	-0.053*** (0.010)	-0.053*** (0.010)
YOUNG	-0.051*** (0.015)	-0.051*** (0.015)	-0.050*** (0.015)	-0.011 (0.016)	-0.011 (0.016)	-0.011 (0.017)
MIDDLE2	0.019 (0.012)	0.019 (0.013)	0.018 (0.013)	0.026* (0.015)	0.026* (0.015)	0.027* (0.016)
OLD	0.055*** (0.018)	0.055*** (0.019)	0.058*** (0.019)	0.027 (0.017)	0.026 (0.017)	0.025 (0.018)
VGOODHEALTH	-0.063*** (0.014)	-0.063*** (0.014)	-0.064*** (0.014)	-0.175*** (0.017)	-0.174*** (0.017)	-0.171*** (0.017)
GOODHEALTH	-0.026** (0.013)	-0.025* (0.013)	-0.025* (0.013)	-0.106*** (0.016)	-0.105*** (0.016)	-0.100*** (0.016)
CHRONIC	0.064*** (0.010)	0.064*** (0.010)	0.065*** (0.010)	0.132*** (0.013)	0.132*** (0.013)	0.136*** (0.013)
HINC	0.028** (0.011)	0.028** (0.011)	0.029** (0.012)	0.007 (0.011)	0.008 (0.011)	0.003 (0.011)
HIGHEDU	0.029*** (0.010)	0.030*** (0.010)	0.028*** (0.011)	0.032*** (0.011)	0.033*** (0.011)	0.035*** (0.011)
NO. MUNICIPALITIES	176	176	172	176	176	172
OBS PER MUNICIPALITY						
MIN	1	1	1	1	1	1
AVG	36	36	36	36	36	36
MAX	743	743	738	743	743	738
N	6404	6404	6201	6404	6404	6201
P	0.000	0.000	0.000	0.000	0.000	0.000

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

Table 3: Utilization of private specialists and public specialists: Results from negative binomial regressions

	Private Specialist			Public Specialist		
	Marg. eff. (Std.Err)	**Marg. eff. (Std.Err)**	**Marg. eff. (Std.Err)**	**Marg. eff. (Std.Err)**	**Marg. eff. (Std.Err)**	**Marg. eff. (Std.Err)**
#OPEN	0.000*** (0.000)			0.001 (0.001)		
#OPEN/CAPITA		-0.010 (0.008)			0.007 (0.008)	
LOGHERFINDAHL			-0.046*** (0.011)			-0.001 (0.018)
ACCESSPRIV	0.061*** (0.018)	0.084*** (0.015)	0.040** (0.018)			
ACCESSPUB				-0.011 (0.023)	-0.000 (0.004)	-0.000 (0.006)
Control variables						
MALE	-0.101** (0.039)	-0.103*** (0.038)	-0.102** (0.040)	-0.092** (0.039)	-0.092** (0.039)	-0.087** (0.040)
YOUNG	-0.113*** (0.042)	-0.118*** (0.040)	-0.108*** (0.040)	0.072 (0.092)	0.070 (0.091)	0.083 (0.096)
MIDDLE2	-0.086*** (0.031)	-0.092*** (0.031)	-0.085*** (0.031)	0.018 (0.064)	0.017 (0.064)	0.020 (0.065)
OLD	-0.031 (0.037)	-0.035 (0.036)	-0.028 (0.036)	0.019 (0.070)	0.017 (0.070)	0.017 (0.071)
VGOODHEALTH	-0.231***(0.041)	-0.232***(0.039)	-0.235*** (0.040)	-0.530*** (0.062)	-0.528*** (0.063)	-0.520*** (0.064)
GOODHEALTH	-0.049 (0.042)	-0.045 (0.041)	-0.046 (0.042)	-0.319*** (0.050)	-0.319*** (0.050)	-0.308***(0.050)
CHRONIC	0.189***(0.074)	0.189***(0.049)	0.194*** (0.045)	0.400*** (0.062)	0.400*** (0.062)	0.407*** (0.063)
HINC	0.001 (0.040)	-0.006 (0.040)	-0.000 (0.040)	0.004 (0.048)	0.006 (0.048)	-0.014 (0.049)
HIGHEDU	0.070** (0.030)	0.080** (0.031)	0.055* (0.029)	0.034 (0.035)	0.036 (0.036)	0.045 (0.036)
NO. MUNICIPALITIES	176	176	172	176	176	172
OBS PER MUNICIPALITY	1	1	1	1	1	1
MIN	36	36	36	36	36	36
AVG	743	743	738	742	742	737
N	6393	6393	6192	6393	6393	6190
P	0.000	0.000	0.000	0.000	0.000	0.000

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