How does the type of remuneration affect physician behaviour? Fixed salary versus fee-for-service*

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Abstract

We analyse the effects of *fee-for-service* versus *fixed salary* on the treatment decisions of general practitioners (GPs) and on patients' health outcomes. Using rich Norwegian register data for the period 2009-2013, we find that GPs respond strongly and consistently to changes in remuneration type. Compared with fixed salary, GP payment by fee-for-service leads to an increase in the supply of consultations and a higher provision of medical services (along several dimensions) per consultation. This has also significant implications for patients' health outcomes, with a more than 16 percent reduction in the probability of an emergency hospital admission (more than 46 percent reduction for ambulatory care sensitive conditions) shortly after a GP consultation.

Keywords: Physicians, Primary care; Fixed salary; Fee-for-service.

JEL Classification: I11; I18; J33

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1 Introduction

How should provider payment schemes be designed in order to ensure efficient provision of health care? This is one of the classic questions in health economics and a long-standing policy issue in most countries. In this paper we address one particular aspect of this question by examining how the type of remuneration scheme affects the treatment decisions of general practitioners (GPs) and how this, in turn, affects the total cost of primary care provision and the patients' health outcomes. We make use of extremely rich and high-quality Norwegian register data, which cover all primary care consultations and all admissions to public hospitals for the period 2009-2013, in order to compare treatment decisions and patient health outcomes under two different remuneration schemes – *fixed salary* and *fee-for-service* – which coexist in the Norwegian primary care market.[1]

A key challenge in establishing a causal relationship between remuneration type and GP behaviour is self-selection of physicians into different remuneration schemes, since GPs' preferences for remuneration type might be systematically correlated with their treatment decisions. We deal with this potential problem by focusing on GP *locums*. These are (mainly) younger physicians, not yet established as regular GPs, who fill short-term positions that vary with respect to remuneration scheme. We identify 471 GP locums who are exposed to both types of remuneration (at least once) during the period of analysis. This allows us to estimate models with physician fixed effects, such that identification of the estimated effects is based on observing the same physician under different remuneration schemes.

Our data allows us to estimate the effects of remuneration type on a wide range of variables related to the GPs' treatment decisions: number of consultations, prolonged consultations, medical procedures, laboratory tests, patient recalls, issuance of sickness certificates and referral to hospital. In addition, we use the total fee per consultation as a monetary measure of the total amount of GP services provided. We also estimate the effect of remuneration type on patients' health outcomes, where the latter are proxied by using information on emergency admissions to hospital (shortly after a GP consultation).

[1] Remuneration based on fee-for-service also includes a capitation component that, on average, accounts for around 30 percent of the GP's income. See Section 4 for a more elaborate description of the institutional details of the Norwegian primary care market.

We find remarkably strong and consistent results. On average, a change in remuneration scheme from fixed salary to fee-for-service leads to a large increase in the supply of consultations (by more than 21 percent) and to a significant increase in the total amount of medical services provided per consultation (by around 4.5 percent, as measured by the total fee per consultation). The increase in the supply of services per consultation is consistent and significant across all measured dimensions of service provision. If being paid by fee-for-service instead of fixed salary, GPs more often provide prolonged consultations, perform more medical procedures, take more lab tests, recall patients more often, and are more prone to issue a sickness certificate. These results are all estimated with a high degree of precision.

We also explore the importance of GP preference heterogeneity by creating two sub-samples consisting of consultations with GP locums who later become regular GPs with fixed salary or fee-for-service contracts, respectively. Given that remuneration type for regular GPs is, to a much larger extent than for locums, a result of GP choice, we hypothesise that more (less) profit-oriented GPs self-select into remuneration contracts based on fee-for-service (fixed salary). Interestingly, we find that our previously described main results are to a large extent driven by the behaviour of locums who later on establish themselves as regular GPs with fee-for-service contracts. Given our underlying assumption, this suggests that the effects of remuneration type are larger for more profit-oriented physicians. This result, and all of our main results described above, confirm a set of hypotheses derived from a simple theoretical model of physician behaviour which is presented in Section 3 of the paper.

Finally, we analyse the extent to which the aforementioned effects of remuneration type have any implications for patients' health outcomes. It turns out that patients are significantly, and surprisingly strongly, affected by the remuneration scheme of the GPs they attend. The probability of experiencing an emergency admission to hospital within two weeks of a GP consultation is almost 16 percent lower if the GP had a fee-for-service contract instead of fixed salary (the corresponding probability is more than 46 percent lower if we consider ambulatory care sensitive conditions only). Thus, although switching from fixed salary to fee-for-service increases the costs of primary care provision, patients do seem to benefit, at least when using emergency admissions to hospitals as a measure of health outcomes. Based on the estimated value of the additional services provided by fee-for-service GPs, paying GPs by fee-for-service instead of fixed salary

implies that the corresponding reduction in emergency admissions to hospital can be obtained at a cost in the range of around NOK 3,300 per averted emergency admission.[2] The relatively modest magnitude of these costs, which are considerably lower than the average cost of emergency hospital admissions during our period of analysis, suggests that fixed-salary remuneration leads to underprovision of primary care services.

The rest of the paper is organised as follows. In Section 2 we present a relatively brief overview of the relevant literature and explain in detail how our paper contributes to this literature. We proceed in Section 3 by presenting a simple theoretical model of GP behaviour from which we derive some testable hypotheses. In Section 4 we explain the relevant institutional features of the Norwegian primary care market, whereas data and descriptive statistics are presented in Section 5. Our empirical strategy is explained in Section 6, and our main results are presented and discussed in Section 7. In Section 8 we identify and test for potential biases in our main analysis. The analysis is then extended in Section 9, where we explore the effects of GP heterogeneity with respect to profit orientation. Section 10 includes a brief discussion and comparison of the results obtained when basing the analysis on regular GPs instead of locums. Finally, Section 11 closes the paper with some concluding remarks.

2 Literature review

There is a huge literature, spanning several decades, providing solid evidence that physicians tend to respond, in one way or another, to financial incentives (e.g., Gaynor and Pauly, 1990; Gaynor and Gertler, 1995; Gruber and Owings, 1996; Croxson et al., 2001; Clemens and Gottlieb, 2014; Brekke et al., 2017). A smaller strand of this literature addresses the potential effects of different types of remuneration schemes on physician behaviour. Several studies find that remuneration schemes based on fee-for-service tend to stimulate the volume of patient visits in particular. Two relatively well-known early studies are Hickson et al. (1987) and Krasnik et al. (1990).[3] In the former study, the authors compare fee-for-service with fixed salary remuneration in a randomised controlled trial involving 18 pediatric physicians and find that the number of patient visits is

[2] NOK 100 $\approx$ EUR 10 $\approx$ USD 12.

[3] See also Gosden et al. (2000) for a review of the early literature on the effect of different remuneration schemes on physician behaviour.

significantly higher under fee-for-service payment. A similar result is found in the latter study, where fee-for-service is compared with capitation in a controlled before-and-after design with 100 randomly selected physicians.

The positive effect of fee-for-service payment on the number of patient visits is also corroborated in several later studies. For example, Sørensen and Grytten (2003) compare contracted (paid by fee-for-service) and salaried primary care physicians in Norway and find that the former type of physicians have more visits and other forms of patient contact. Based on Canadian survey data, Devlin and Sarma (2008) also find that fee-for-service payment leads to a significantly higher number of patient visits, compared with other forms of remuneration. Similar results are reported by Sarma et al. (2010). There is also some evidence that fee-for-service payment leads to less referrals to specialists, compared with other remuneration schemes. This result is found by, e.g., Liddy et al. (2014) and Sarma et al. (2018), when comparing fee-for-service with capitation using Canadian data.

However, there are also studies that report little or no effect of remuneration type on some dimensions of physician behaviour. For example, Grytten and Sørensen (2001) find no differences between fee-for-service and salaried physicians in how they respond to increased competition. Based on a field experiment in the UK, Gosden et al. (2003) find no significant differences between fixed salaries and fee-for-service on primary care physician behaviour.

The above referenced literature has a number of different weaknesses, though. First, it is notoriously hard to properly control for the effects of self-selection of physicians into different remuneration schemes, and the few studies that use an experimental design tend to be based on very small sample sizes.[4] Second, most studies are restricted to one or very few outcome measures, typically the number of patient visits or similar volume measures. Crucially, objective measures of patient health outcomes are virtually absent from the literature. It is also worth noting that previous studies are almost exclusively based on survey data.

The above mentioned limitations of the empirical literature have spurred the recent emergence of an equivalent experimental literature. Hennig-Schmidt et al. (2011) and Brosig-Koch et al. (2016) use lab experiments to compare the effects of fee-for-service versus capitation on

[4] Self-selection of primary care physicians into different remuneration schemes is documented by Rudoler et al. (2015), among others.

physician behaviour and find that fee-for-service induces a significant increase in the supply of services. However, based on a somewhat differently designed experiment, Green (2014) reports that fee-for-service leads to both lower quality of services and higher costs of care, compared to fixed salary or capitation. In a similar vein, and based on a medically framed real effort experiment, Lagarde and Blaauw (2017) find that, whereas fee-for-service payment leads to higher output than fixed salary, the latter remuneration scheme yields higher *quality* of output. By contrast, our empirical results do not provide any evidence that the choice between fee-for-service and fixed salary implies any quantity-quality trade-off, as suggested by some of the experimental literature.

The access to extremely rich register data allows us, in the present paper, to make significant contributions to the literature along three different dimensions. (i) We construct an empirical strategy that to a large extent eliminates the physician selection problem and therefore allows us to establish a credible causal relationship between type of remuneration scheme and physician behaviour. (ii) We measure the effects across a wide variety of outcomes, covering all main aspects of the physicians' treatment behaviour, which allows us to paint a much more complete picture of the relationship between remuneration type and physician behaviour. (iii) We measure the effect of remuneration type on objective proxies of patient health outcomes, which allows us to draw (at least tentative) conclusions regarding over- or underprovison of primary care services.

3 Theoretical model

In this section we present a simple theoretical model that captures what we believe to be the key mechanisms in the relationship between remuneration schemes and GP behaviour in the short run, when the GP's patient list size is fixed. We use this model to derive some predictions – stated in Proposition 1 below – that are tested in the empirical analysis.

Consider a GP who has a fixed patient list that generates demand for consultations from a certain number of patients per period. Each patient is characterised by a severity level s, which is randomly distributed on the interval $[\underline{s}, \overline{s}]$ according to a probability density function $f(s)$. We assume that s is observable to the GP during a consultation. The health benefit from being

treated by the GP is given by $b(q,s)$, where q is the amount of services provided by the GP. We assume that b is increasing and concave in q. We also assume that there exists a threshold severity level $\widehat{s}$, such that, if $s < \widehat{s}$, the GP must treat the patient himself, whereas, if $s \geq \widehat{s}$, the GP can choose between treating the patient himself or referring the patient to specialist care, in which case the patient enjoys a health benefit $\widetilde{b}(s)$. We assume that $\widetilde{b}(s) > b(q,s)$ for $s \geq \widehat{s}$ and that the difference $\widetilde{b}(s) - b(q,s)$ is strictly increasing in s, for all q. This implies that, for all patients who are potential candidates for referral (i.e., with $s \geq \widehat{s}$), the GP cannot fully compensate for a lack of specialist care by increasing his own service provision, and even less so the higher the severity of the patient.[5]

We assume that the GP has semi-altruistic preferences and maximises a linear combination of own profits and patient health benefit, net of non-monetary costs of consultations and service provision. Denoting the number of consultations by n, the non-monetary costs of consultations are given by an increasing and strictly convex function $k(n)$. The non-monetary costs of service provision, q, is given by an increasing and strictly convex function $c(q)$. In order to ensure that the GP always chooses a strictly positive level of service provision, we assume that $c(0) = 0$ and $\lim_{q \to 0} c_q(q) = 0$.

We consider two different remuneration schemes. If the GP has a *fee-for-service* contract, he receives a fee per consultation and also a fee per unit of services offered during a consultation. Let $\overline{p} > 0$ and $p > 0$ denote the consultation and service fees, respectively, net of monetary costs.[6] On the other hand, if the GP has a *fixed-salary* contract, his revenues per period only consist of a fixed wage w. Let $s^* \geq \widehat{s}$ be the threshold level of severity above which the GP refers a patient to specialist care. The GP's expected per-period payoff (with n consultations) is given by

$$U = (1-\theta)\, w + \left(\theta \overline{p} + \int_{\underline{s}}^{s^*} (\theta p q - c(q) + \alpha b(q,s))\, f(s)\, ds + \alpha \int_{s^*}^{\overline{s}} \widetilde{b}(s)\, f(s)\, ds \right) n - k(n), \quad (1)$$

where θ is an indicator variable that takes the value 1 (0) if the GP has a fee-for-service (fixed-

[5] Referral to specialist care (e.g., a hospital admission) might in itself imply a disutility for the patient, for example because of travelling. However, for sufficiently high-severity patients ($s \geq \widehat{s}$) we assume that such disutilities are more than outweighed by the health gains of receiving specialist care.

[6] Thus, we assume linearity in the monetary costs of consultations and service provision.

salary) contract, and where $\alpha > 0$ measures the degree of GP altruism.[7]

We assume that the GP chooses the number of consultations scheduled per period, n; the referral threshold rate, s^*; and the amount of services provided during each consultation, q. The latter choice is obviously made for each single consultation and depends (in part) on the patient's severity level. From (1) it is straightforward to derive the optimal amount of services provided to a patient with severity $s \leq s^*$, which is implicitly given by

$$\theta p - c_q(q) + \alpha b_q(q, s) = 0. \tag{2}$$

The service level is set such that the GP's marginal benefit is equal to the GP's marginal cost of service provision.

Let the solution to (2) be denoted by $q^*(\theta, s)$. If the optimal referral threshold s^* is an interior solution (i.e., if $s^* > \widehat{s}$), it is implicitly given by

$$\theta p q^*(\theta, s^*) - c(q^*(\theta, s^*)) + \alpha\left(b(q^*(\theta, s^*), s^*) - \widetilde{b}(s^*)\right) = 0. \tag{3}$$

Given the optimal service level, the (interior-solution) referral threshold is set such that the GP's profit from treating the marginal patient (with severity level s^*) is equal to the patient's health gain of being treated by a specialist instead of the GP, weighted by α.

Finally, regarding the GP's optimal choice of consultations, n^*, we assume that this is an interior solution to the problem where (1) is maximised with respect to n. One interpretation of this assumption is that that there is excess demand for consultations per period and that GP availability is rationed by waiting times. An alternative interpretation is that the GP can induce the desired demand for consultations through patient recalls. Given the optimal referral threshold, $s^*(\theta)$, and the optimal service provision, $q^*(\theta, s)$, the optimal number of consultations per period is implicitly given by

$$\theta\overline{p} + \int_{\underline{s}}^{s^*(\theta)} \left(\theta p q^*(\theta, s) - c(q^*(\theta, s)) + \alpha b(q^*(\theta, s), s)\right) f(s)\, ds + \alpha \int_{s^*(\theta)}^{\overline{s}} \widetilde{b}(s) f(s)\, ds - k_n(n) = 0. \tag{4}$$

[7] Notice that a fee-for-service contract ($\theta = 1$) implies that the GP must cover his monetary costs of consultations and service provision, whereas these costs are covered by the employer under a fixed-salary contract ($\theta = 0$).

The GP should optimally offer consultations up to the point where the marginal benefit from consultations is equal to the marginal cost. The marginal gain consists of three elements, given by the first three terms in (4): (i) the direct monetary (net) benefit $\overline{p}$ (which only applies under fee-for-service remuneration), (ii) the expected net benefit generated through service provision during one additional consultation, and (iii) the expected altruistic benefit derived through referral to specialist care, in case one additional consultation implies seeing a patient with severity $s > s^*(\theta)$.

Proposition 1 *For a given patient list size, a GP with a fee-for-service contract will supply more consultations, offer more services per consultation and adopt a weakly higher threshold for specialist referrals than an otherwise similar GP with a fixed-salary contract. These differences are larger for more profit-oriented GPs.*

Proof. See Appendix. ■

The intuition behind these results is relatively straightforward, though there are several different mechanisms at play. A fee-for-service GP has clearly a higher marginal benefit of service provision during a consultation, since the provision of such services generates extra revenue to the GP. These incentives are absent in a fixed-salary contract and fee-for-service remuneration therefore leads to higher service provision.

The effect of different remuneration schemes on patient referrals is not quite as clear-cut. Fee-for-service payment leads to *less* referrals, but only if the GP is sufficiently profit-oriented. Such a GP will generate a positive surplus from service provision (i.e, $pq^*(\theta, s^*) > c(q^*(\theta, s^*))$) and place a relatively low weight on patients' benefit of being treated by a specialist. Thus, a sufficiently profit-oriented fee-for-service GP optimally chooses $s^* > \widehat{s}$ and treats some patients (with $s \in (\widehat{s}, s^*)$) that would have been better off being treated by a specialist. Otherwise, if the GP is sufficiently altruistic, remuneration type does not affect referral decisions.

In contrast, fee-for-service remuneration will unambiguously stimulate the supply of consultations. The reason is simply that, under fee-for-service, extra revenues are generated by offering more consultations – directly through the consultation fee and indirectly through the generation of surplus from service provision during a consultation.

Finally, notice that the importance of remuneration type depends on GP preferences. A

more profit-oriented GP will respond stronger to a change in remuneration scheme along all three dimensions considered: service provision, patient referrals and supply of consultations. A more detailed description of the mechanisms behind this result is given in the proof of Proposition 1 in the Appendix.

4 Institutional background

In the Norwegian National Health Service, primary care provision is the responsibility of the municipalities, although funding and regulation are largely made by the central government. Since the implementation of the Regular General Practitioner Scheme (*Fastlegereformen* in Norwegian) in 2001, each inhabitant of Norway has the right to be listed with a GP and is free to choose his/her GP (as long as the chosen GP has vacant patient slots). The GP, on the other hand, cannot choose his/her patients and will be allocated new patients administratively by the regulator as long as the list is open. Entry of regular GP practices is regulated centrally by the health authorities. Each GP must sign a contract with the municipality of practice. Regarding patient lists, the only regulations are related to the number of slots (maximum 2500 and minimum 500 without special permission), that GPs with vacant slots cannot turn down patients who want to be listed with them, and that patients can switch to a different list at most twice per year. About 90% of regular GPs are self-employed physicians contracting with municipalities, with the remaining GPs being directly employed by the municipalities. The latter type of contract is relatively more common in rural areas, where the potential patient population is more limited.

The payment system for self-employed GPs is a combination of a capitation fee (covered by the municipalities) and fee-for-service (covered partly by the National Health Insurance Scheme and partly by patient copayment), where the fee-for-service part constitutes, on average, around 70% of the GP's total income. On the other hand, GPs employed by the municipality receive a fixed salary. Irrespective of payment scheme, towards the end of each consultation, GPs present remuneration claims electronically to the National Health Insurance Administration (GPs on fixed salary claim fee-for-service on behalf of their employer). These claims constitute an important source of information for our analysis. In order for physicians to qualify for health

insurance reimbursements, two different requirements must be met: they must be certified as medical doctors according to EU regulations or document that they are under supervision, and they must either have a regular GP contract or work as a regular GP locum.[8]

Although solo practices are not uncommon, most regular GPs work in group practices. This applies to 89.1% of the fee-for-service GPs and 81.2% of the salaried GPs, and the proportion of consultations that take place in group practices is around 80%. In any case, the fee-for-service is paid directly from the state to the individual GP, implying that the remuneration of GPs (in a given remuneration scheme) is identical in solo and group practices.

In this analysis, we study the behaviour of locums in order to investigate GP behaviour in general (we discuss and justify this strategy in Section 6). There are numerous reasons why locums are in demand, and locums are used as part of a normal GP work year. According to an agreement between the physicians' association and the municipalities' association, a full-time regular GP is obliged to receive patients at least 28 hours a week, 44 weeks a year. Regular GPs are entitled to absence from their practice for specific reasons, such as having holiday, taking courses, doing research, own illness or children's illness, pregnancy and childbirth.[9] Sometimes colleagues can step in, but in many cases a locum is needed. Consequently, the use of locums is quite widespread; our data shows that during one year (2009) about 30% of all GPs use a locum at least once. During our period of analysis, 8.1% (6.5%) of all consultations remunerated with fee-for-service (fixed salary) were carried out by a locum GP.

Besides the provision of primary care, GPs are also entrusted with important gatekeeping functions regarding referrals to specialist care and certification of sick leave. In Norway, sickness insurance is mandatory, with sickness coverage of 100% from the first day of sick leave. A medical certificate is required for spells of absence of more than three days or eight days, depending on whether the employer has signed a national agreement aimed at reducing sickness absence.

Municipalities are also responsible for emergency primary health care provision, which is offered at local primary care emergency centres (PCECs).[10] These centres are the sole providers

[8] For more information, see https://helsedirektoratet.no/autorisasjon-utdanning-og-godkjenning/autorisasjon-og-lisens/allmennlege#regelverk.

[9] This follows from an agreement called ASA 4310 between The Norwegian Association of Local and Regional Authorities and The Norwegian Medical Association.

[10] Small municipalities might not have separate PCECs, and in these cases emergency primary care is provided at the GP´s office.

of primary care during evenings, nights and weekends. In larger municipalities, PCECs also offer services at daytime. All regular GPs below the age of 60 are obliged to work part of their time at PCECs, unless they are exempted for health or social reasons. When working in a PCEC, GPs are paid according to the same fee-for-service schedule as the one that applies to regular GP practices, and the matching between physicians and patients in PCEC consultations is random. A distinctive feature of the Norwegian primary care market is that, compared to many other countries, primary care emergency services are frequently used, and often in relation to conditions that could just as well have been treated by the patient's regular GP, a pattern which is explained by relatively poor access to the GP during daytime (Sandvik et al., 2012).

5 Data and descriptive statistics

5.1 Data sources

In order to analyse how physicians respond to different remuneration schemes (fixed salary or fee-for-service), we apply Norwegian administrative register data from several sources. These data can be merged because patients and physicians are both identified by unique personal identifiers. From the *National Health Insurance Administration (HELFO)*, we obtain information about the fee-for-service payments to GPs from the National Insurance Scheme. For each consultation, the GP sends (electronically) a claim to the National Health Insurance. The GP specifies the medical reason for attendance (based on the International Classification of Primary Care, ICPC-2) and procedures performed in the consultation (based on detailed procedure codes). The invoice also includes the personal identity number of the operating GP and of the patient, and the date of consultation. Since there are specific codes and associated tariffs for each service, we observe the medical treatment provided to each patient, including medical procedures, laboratory tests, prolonged consultations[11], etc. We also observe the GP's total income per visit, as well as patient characteristics, such as age, gender, diagnosis and comorbidity. Data on the patient's education and total income, including labour income, are available from Statistics Norway.

The database *Fastlegedatabasen* has information on each GP list on a monthly basis (i.e., the GP identifier and the GP's list of patients). Thus, for every patient, it is possible to identify

[11] The exact length of the consultation is not observed, but prolonged consultations are easily identified because of the specific fee claimed.

his/her regular GP and GP characteristics such as age, gender, country of birth, and whether the GP is a specialist in general medicine.[12] We also know whether or not the GP works in a group practice, and whether or not the GP shares the patient list with another GP. Furthermore, information about both actual and desired patient list size allows us to observe whether the GP's list is full or not. Finally, the *Norwegian Patient Register* contains information on referrals and admissions to secondary care in Norway, including the day of referral and day of hospital admission, as well as type of admission (elective or emergency).

5.2 Identification of GP locums and their remuneration schemes

The National Health Insurance data inform us – for each consultation - who is the operating GP and how this GP is remunerated, but they do not identify locums directly. To identify whether the GP is a locum, we impose the following exclusion criteria: (i) the GP identifier of the consultation cannot correspond to that of the patient's own regular GP or any other regular GP registered in the *Fastlegedatabasen* in that particular month, and (ii) the GP registered for the consultation should not be an intern. We want to exclude all consultations with interns since internships are categorised by fixed salary only. By applying these exclusion criteria, we isolate the subsample of consultations held by locums. We then define characteristics of the practice (i.e., the regular GP of the treated patient), such as list length, by linking the treated patient with the patient list information.

Our explanatory variable of interest is the locum's remuneration scheme, which may vary over time since it mirrors the remuneration scheme of the regular GP practice that the locum works in.

5.3 Outcome variables

We investigate several dimensions of GPs' service provision: total fee per consultation, whether the patient visits the same GP practice within 14 days (recalls), whether the patient is referred to hospital for a planned admission, as well as number of consultations per day. We also investigate specific components of GPs' service provision during a consultation: whether the consultation

[12] Most GPs (more than 80%) become specialists in general medicine during their careers. Fee-for-service GPs with specialist certification are entitled to a higher basic consultation fee, though all other fees are the same for specialist and non-specialist GPs.

is prolonged or not, whether a test is taken, the number of medical procedures, and whether the GP issues a sickness certificate. Apart from referrals, these outcome variables are all generated from the *HELFO* data.[13]

Furthermore, we define three different measures of patient health outcomes: (i) visit at a primary care emergency centre (PCEC), (ii) emergency hospital admission, and (iii) emergency hospital admission for ambulatory care sensitive conditions, as defined in Purdy et al. (2009). These health indicators relate to the period shortly after a GP visit (1-14 days), and they are generated by merging data from the *HELFO* and the *Norwegian Patient Register* by means of the patient personal identifier. Each of these three measures should to some extent capture a patient's health outcome after a GP visit, though presumably with different degrees of precision. The first measure is probably the least precise proxy, since visits at PCECs might be related to unavailability of the patient's regular GP and might not necessarily be caused by acute illness. On the other hand, PCEC visits might be interpreted more broadly as a quality indicator of the primary care provision by the GP, reflecting either bad treatment resulting in an adverse event or lack of treatment (unavailability) inducing the patient to seek care at a PCEC. Among our two measures based on emergency hospital admissions, the more restricted measure based on ambulatory care sensitive conditions is arguably the most appropriate one for our purposes, since it is based on conditions for which effective primary care provision is, by definition, crucial to prevent the need for hospital admissions.

Our data sources cover all GP consultations and all admissions to public hospitals for the years 2009-2013.[14] We include all consultations where the patient is above 20 years of age. This leaves us with a data set of 5,134,780 observations (consultations), involving 4,438 locums. As we will explain more elaborately in the next section, our identification strategy relies on observing the same locum under different remuneration schemes. In our data we have 471 locums who has worked under each of the two contract types (fixed salary and fee-for-service) at least once. We therefore restrict our sample to all consultations involving this subset of locums. This sample consists of 699,878 consultations involving 316,926 different patients.[15]

[13] The variable referrals for planned admissions is generated by comparing the date of consultation in the *HELFO* data with the date of referral in the *Norwegian Patient Register*.

[14] Admissions to mental health hospitals are excluded.

[15] All our results are practically identical if we use the full sample of consultations involving all locums, including those that have worked exclusively under one of the two remuneration schemes.

In Table 1 we show the descriptive statistics characterising our main sample, where these statistics are decomposed according to type of remuneration scheme. The mean values of our dependent variables differ across the two remuneration types in a quite clear and consistent way. When paid by fee-for-service, locum GPs hold more consultations and offer more services per consultation than when paid with fixed salary, as shown by the higher average total fee per consultation. A patient recall is also more likely when the locum GP is paid fee-for-service. On the other hand, the frequency of planned hospital admissions is lower. A closer look at locum GPs' service provision during a consultation reveals that, along all dimensions studied, fee-for-service locums offer more services. They have a larger share of prolonged consultations, take more tests and perform more medical procedures. They also issue sickness certificates more often.

[Table 1]

The patient population also differs according to remuneration schemes. Patients in fee-for-service consultations are on average 3 years younger and the proportion of women as well as the average level of education and income are higher than for patients visiting locums on fixed salary. This could reflect a rural/urban difference. The proportion of patients with any comorbidity is also higher, on average, in consultations with fee-for-service locums, which could partly reflect a higher share of women in the patient population of fee-for-service GPs.

Regarding the characteristics of the 471 locums, the most noticeable features are that the average age is relatively low (37) and that less than 4 percent of them are specialists in general medicine, which indicates that most of them are early in their career. It is also worth noticing that practices remunerated with fee-for-service are characterised by somewhat longer patient lists, which again probably reflects an urban/rural difference. In the empirical analysis, we will control for a wide range of patient, GP and practice characteristics.

6 Empirical strategy

The main challenge involved in identifying the causal effect of different remuneration schemes on GP behaviour is to account for a potential selection bias arising from the fact that the matching

of GPs to remuneration schemes is partly a result of GP choice. If GPs' choices between fixed-salary and fee-for-service contracts are systematically related to differences in GP practice styles, which in turn might be related to differences in GP preferences (e.g., the GP's degree of profit orientation), the observed differences in GP behaviour across different remuneration schemes would to some extent capture differences in GP preferences rather than differences in remuneration schemes, which would lead to biased estimates.[16]

Our empirical strategy to tackle this potential selection problem is two-fold. First, we restrict our sample to consultations involving only GP *locums*. As described in the previous section, this subset of GPs consists of relatively young physicians, many of whom have not yet established their own practice. These are GPs who spend a period taking up available vacancies until they are able to enter the market as regular GPs. Thus, for this subset of GPs, it is reasonable to assume that the matching of GPs to remuneration schemes depends largely on the availability of temporary vacancies and is therefore, to a considerable extent, random. The fact that these are mostly short-term vacancies gives additional credibility to the assumption of random matching.[17] Second, the quality of our data allows us to identify GPs who face different remuneration schemes – fixed salary and fee-for-service – over time. Thus, we are able to estimate models with GP fixed effects, where identification is based on observing the same GP under both types of remuneration schemes.

For the locums used in our main sample, we have also checked that there is no systematic relationship between the sequence of vacancies and the type of remuneration. Thus, we find no pattern where locums tend to first work in a fixed-salary practice and then in a fee-for-service practice, or vice versa.[18] For the subset of GP locums who were observed in only two temporary positions (with different remuneration schemes), 59.8% had a fixed salary in the first position, which is reasonably close to what we would expect if remuneration schemes were randomly assigned to GPs.[19] This is reassuring for the internal validity of our empirical strategy.

Finally, it is also worth emphasising that not only is the use of locums widespread, as

[16] A more elaborate discussion of the likely direction of this bias is provided in Section 10, where we also compare our main results with equivalent estimates based on consultations with regular GPs.

[17] More than half of the vacancies in our sample are 5 weeks or less in duration, and more than 90 percent are less than a year. See Figures A1-A3 in the Appendix for the distribution of vacancy duration.

[18] Among the GP locums working under both remuneration schemes during a succession of temporary positions, 51.6% (48.4%) were paid by fixed salary (fee-for-service) in the first of these positions.

[19] 92 out of the 471 locums are observed in only two different positions.

discussed in Section 5, but it is also very common for GPs to work as locums at some point (usually at the beginning) of their careers. Our data show that, out of the 1,131 physicians who became regular GPs during the latter half of our period of analysis, 2010-2013, almost 80 percent of them (882 physicians) had worked as locums (during 2007-2013) before they became regular GPs. This suggests that the sample of consultations used in our analysis involves a set of GPs that are highly representative (apart from age) of the entire population of GPs in the Norwegian primary care market, which is reassuring for the external validity of our empirical strategy.

We estimate the following empirical model,

$$y_{ijtm} = \beta_0 + \beta_1 FFS_{it} + \mathbf{X}_{it}\beta_2 + \mathbf{Z}_{it}\beta_3 + \sigma_i + \mu_j + \kappa_m + \omega_t + \varepsilon_{ijtm}, \tag{5}$$

where y_{ijtm} measures the treatment decision (according to each of the variable definitions described in Section 5) of GP i in a consultation involving a patient with diagnosis j at time t in municipality m; FFS is an indicator variable that takes the value 1 (0) if the GP is paid by fee-for-service (fixed salary); $\mathbf{X}_{ijt}$ is a vector of patient characteristics, such as gender, age, education and income; and $\mathbf{Z}_{it}$ is a vector of practice characteristics, such as list size, solo or group practice, shared patient list or not, and whether or not the list is full. To better control for differences in patient populations across practices, we also include in $\mathbf{Z}_{it}$ aggregate patient list characteristics, such as share of males, average age and income, and distribution of education levels among the patients on the list. Then we include a number of fixed effects: σ_i is a GP fixed effect; μ_j is a diagnosis fixed effect (separate fixed effects for 649 main diagnoses and 588 comorbidities); κ_m is a municipality fixed effect (for 335 municipalities); and ω_t is a time fixed effect (year and month). Finally, ε_{ijtm} is an error term.

Our parameter of interest is β_1, which measures the effect of changing the GP remuneration scheme from fixed salary to fee-for-service. Importantly, the inclusion of a GP fixed effect implies that we are able to control for all time-invariant (observable and unobservable) GP characteristics, including the degree of altruism or profit-orientation, which is likely to affect the GP's response to different remuneration schemes. Furthermore, the inclusion of municipality fixed effects is important to control for potential biases related to the geographical distribution

of practices, such as differences in the mean distance to the GP office and to specialist services, and geographical differences in the relative share of fixed-salary contracts and in the degree of local GP competition.

In the estimations we employ a high-dimensional fixed effect model using the Stata module *reghdfe* (Correia, 2014), and standard errors are clustered at GP level.

7 Results and discussion

Our main results are presented in this section. First we present the effects of GP remuneration type on a wide range of variables that characterise different dimensions of the GP's treatment decisions. Subsequently, we report the effects of different remuneration schemes on our three different measures of health outcomes, as described in Section 5.3, and discuss potential implications for welfare and public policy.

7.1 Remuneration schemes and treatment decisions

The effects of the type of remuneration scheme on GP behaviour are presented in Table 2. In the first column we report the effect on the total fee per consultation, which is a monetary measure of the total amount of services offered by the GP during a consultation (i.e., the variable q in our theory model). The estimated coefficient indicates that a change in remuneration scheme from fixed salary to fee-for-service leads to a significant increase in the total amount of services provided per consultation. This result is in line with our theoretical prediction. The effect is also economically significant, with a magnitude (of NOK 12.5 or about USD 1.5) that corresponds to a percentage increase of around 4.5.

[Table 2]

In the second and third columns we report estimates along two other dimensions of GP behaviour, namely the frequency of patient recalls (within 14 days) and hospital referrals. The point estimates suggest that, on average, a change in remuneration scheme from fixed salary to fee-for-service leads to a higher frequency of patient recalls and a lower frequency of hospital referrals. These effects are once more in line with our theoretical predictions. The magnitudes

of the effects are also far from negligible, with the point estimates suggesting that remuneration type affects average recall and referral rates by 7.7 and 3.6 percent, respectively. However, whereas the former effect is estimated with a relatively high degree of precision, the latter effect is statistically insignificant (p-value of 0.135).

The positive effect of fee-for-service on the frequency of patient recalls can partly (though far from fully) explain the result reported in the final column of Table 2, that a change from fixed-salary to fee-for-service remuneration leads to a significant and large increase (by more than 21 percent) in the supply of consultations per day. Thus, fee-for-service remuneration does not only lead to higher service provision per consultation, but it also leads to a higher supply of consultations, which again confirms our theoretical predictions.

The estimated coefficients on the remaining independent variables suggest that larger amounts of service provision (per consultation) are provided to older, less educated and female patients. As we would expect, the average age of the patient list population is also positively correlated with the number of consultations supplied per day. On the other hand, the strong negative correlation between the share of low-educated list patients and the supply of consultations suggest that patients with less education have fewer GP visits but receive more services per visit.

The significantly positive effect of fee-for-service payment on the total fee per consultation, as reported in Table 2, suggests that fee-for-service GPs on average offer more services to patients during a consultation. We explore the sources of this effect by estimating the effect of fee-for-service payment on four variables that measure different types of services offered by the GP: (i) the share of consultations that are prolonged beyond 20 minutes, (ii) the share of consultations in which at least one lab test is taken, (iii) the number of medical procedures per consultation, and (iv) the share of consultations in which a sickness certificate is issued.

[Table 3]

The estimated results – reported in Table 3 – show that fee-for-service payment has a statistically significant and positive effect on all four variables. Notice also that the magnitudes of these effects are all quite sizeable. All else equal, if the payment scheme of a GP changes from fixed salary to fee-for-service, the GP will, on average, increase the share of prolonged consulta-

tions by 8.5 percent, increase the frequency of testing by 3.7 percent,[20] increase the number of medical procedures by 23.5 percent, and increase the propensity to issue sickness certificates by 5.6 percent.

Summing up, we find that a change in payment scheme from fixed salary to fee-for-service leads to a (statistically and economically) significant increase in the GP's service provision during a consultation, and this increase applies to all dimensions measured, as evidenced by the results shown in Table 3. Furthermore, such a change in payment scheme also leads to a higher frequency of patient recalls and a higher supply of consultations. All the above mentioned effects are estimated with a high degree of precision (at least at the 1 percent level of statistical significance), and these results are all consistent with the predictions from our theory model, as summarised by Proposition 1 in Section 3.

7.2 Remuneration schemes and health outcomes

The increase in GP service provision due to fee-for-service payment implies, all else equal, a higher cost of primary care provision for the public payer. In fact, the coefficient reported in the first column of Table 2 gives a precise estimate of the extra cost per consultation that can be attributed to the change in GP behaviour caused by a change in payment scheme.

However, from a welfare or policy perspective, the additional costs of a fee-for-service payment scheme must be weighed against the potential benefits of a higher level of primary care provision. Does the increase in GP service provision improve patients' health outcomes, or does a fee-for-service system contribute to 'overprovision' of primary care services with little or no health benefits? In order to take some steps towards answering this question, we estimate the effects of fee-for-service payment on the three different measures of health outcomes described in Section 5.3.

[Table 4]

The results, reported in Table 4, show that patients who have attended a fee-for-service (instead of fixed salary) GP obtain a significantly better health outcome according to all three

[20] Since we only observe whether or not at least one lab test is taken during a consultation, this variable can only be measured at the extensive margin. The estimated coefficient is therefore arguably a lower bound estimate on the effect of remuneration scheme on the frequency of testing at both the extensive and the intensive margin.

measures used. The effects are also large in magnitude. Compared to visits with a fixed-salary GP, patients who have visited a fee-for-service GP have, on average, a 15.7 percent lower probability of experiencing an emergency hospital admission within two weeks of the GP consultation. If we restrict these cases to ambulatory care sensitive conditions, the corresponding reduction in emergency admission probability is more than 46 percent. The probability of a visit to a primary care emergency centre within the same time frame is also significantly reduced, by 10.2 percent on average. This result might partly be explained by easier access to own regular GP for patients listed with fee-for-service GPs, for example through longer opening hours, as indicated by the higher number of consultations per day (cf. Table 2).

7.3 Welfare and policy implications

Our results suggest that the number of emergency admissions to hospital can be reduced by changing GP remuneration from fixed salary to fee-for-service. But at which costs? The value of our estimated coefficient (Table 4) implies that one emergency hospital admission is averted for every 263 GP consultations, on average, if the GP is paid by fee-for-service instead of fixed salary. Since the estimated value of the additional services provided per consultation by a fee-for-service GP is NOK 12.55 (Table 2), this implies that, by a change of remuneration scheme from fixed salary to fee-for-service, emergency admissions to hospital can be reduced at a cost of around NOK 3,300 per averted emergency admission. By comparison, the average cost of emergency hospital admissions during 2009-2013 can be estimated at around NOK 23,000.[21] Even if we only consider the extra payment from the public payer triggered by each emergency hospital admission, which was around NOK 9,200, on average, during 2009-2013, these costs are substantially higher than our estimated costs of reducing emergency hospital admissions through a change in GP remuneration from fixed salary to fee-for-service.[22]

Our dependent variables in this part of the analysis are of course imperfect measures of health outcomes, and the results should therefore be interpreted with some care. Nevertheless, our results give some indications that the higher supply of primary care services induced by

[21] During 2009-2013, the average DRG price was around NOK 37,100. With an average DRG weight for emergency hospital admissions of 0.62 during the same period, this implies an average cost of around NOK 23,000.

[22] In Norway, secondary care is financed by a combination of DRG pricing and block grants, with a DRG share of 40% during 2009-2013.

fee-for-service contracts leads to improved health outcomes, and that emergency admissions to hospital can be reduced at a relatively low cost through changes in GP remuneration, which suggests that GP remuneration based on fixed salaries leads to underprovision of primary care services relative to fee-for-service remuneration.

However, we must stress that there are several caveats to this tentative welfare analysis. First, by measuring health gains in terms of secondary care cost savings we are hardly capturing the full value of these gains. Second, potential health gains from changes in GP remuneration might also be influenced by general equilibrium effects in the primary care market. For example, a large-scale change of GP remuneration schemes might lead to exit and entry of physicians, which, in case of GP heterogeneity, might change the distribution of GP 'types' in the market, with corresponding changes in service provision.[23] Furthermore, from a policy perspective, costs and benefits in the health care sector should not be evaluated in isolation, but should be seen in conjunction with costs and benefits in other sectors that are indirectly affected by changes in GP behaviour. For example, we have shown that fee-for-service payments lead to a higher frequency of sick-listing, which implies that this payment scheme imposes a higher cost on the sickness benefit system and leads to a productivity loss in the labour market. A full-fledged welfare analysis, which is beyond the scope of this paper, would need to take all these direct and indirect effects into account.

8 Potential biases

While our empirical strategy is designed to overcome potential problems related to GPs' selection of remuneration scheme, there might still be remaining sources of bias. In this section we perform additional tests to address two such potential sources: (i) patient selection related to GP remuneration, and (ii) locums' adoption of regular GPs' practice styles.

8.1 Patient selection

Our identification strategy relies on the implicit assumption that the characteristics of the patient population of a GP is unrelated to the GP's remuneration scheme. However, even if we control

[23] We explore the issue of GP heterogeneity in Section 9.

for a wide range of patient characteristics, both at aggregate and individual level, such as age, gender, income, education, diagnosis and comorbidity, we cannot *a priori* rule out the possibility that there might exist some systematic differences between the patients of fixed-salary GPs and fee-for-service GPs that we are not fully able to control for in our empirical model, potentially leading to biased estimates.

We test the hypothesis of patient selection in two different ways. First we construct a sample consisting of consultations at primary care emergency centres, involving the same patients that we observe in our main sample (consisting of consultations with GP locums). More specifically, we construct this sample such that all consultations (at emergency centres) involve patients who, in our main sample, are observed in consultations only with fee-for-service GPs or only with fixed-salary GPs. Naturally, this sample includes all GPs who have treated patients at emergency care centres, therefore a much larger GP population than in the main analysis. As explained in Section 4, attending a primary care emergency centre is an alternative way for patients to access primary care in Norway and is typically used if the patient's regular GP (or a substitute GP) is not available. At PCECs, physicians are paid according to the same fee-for-service schedule as regular GPs and, more importantly, the matching between physicians and patients is random.

This allows us to construct the following placebo test. By defining an indicator variable that takes the value 1 (0) if the consultation involves a patient who is observed only in consultations with fee-for-service (fixed-salary) GPs in the main sample, we can test whether these two categories of patients are treated differently, on average, in consultations at primary care emergency centres. Since the matching between patients and GPs at PCECs is random, any such differences should only reflect differences in unobserved demand side characteristics between the two patient groups, for instance patient severity. Thus, if the results reported in the previous section are purely caused by differences in GP remuneration schemes, we should not expect to find any systematic differences in how the two groups of patients are treated at primary care emergency centres.

We estimate a model equivalent to (5), where the variable FFS is re-interpreted as indicating whether or not a patient's regular GP is paid by fee-for-service. The model is estimated with the full set of patient characteristics and the same fixed effects as before. Inclusion of GP fixed

effects implies that the estimated effects are identified by GPs who at primary care emergency centres treat both patient categories.[24]

[Table 5]

The results, reported in Table 5, reveal that there are practically no differences in the way these two categories of patients are treated in emergency centre consultations. All the point estimates are very close to zero, and the only statistically significant coefficient has the opposite sign of what we would expect if our main results were caused by patient selection on severity.

One potential concern with the above described placebo test is that patients who are observed in consultations at PCECs might not be representative of the entire patient population of regular GPs, such that remaining unobserved differences between the patients of fee-for-service and fixed-salary GPs, respectively, cannot be ruled out. We therefore complement our analysis with a second placebo test, much in the same spirit as the first one, where we test for treatment differences across the two categories of patients in regular GP practice consultations, but where the GP is someone else then the patient's regular GP.

When a regular GP is absent from work, the GP is usually replaced by a locum if the period of absence is sufficiently long. But for very short-term absences, patients will often be directed to other regular GPs with available capacity within the same municipality.[25] Our data allows us to observe if a consultation takes place with the patient's own regular GP or with another (substitute) regular GP. We use this information to construct a sample of consultations with 'substitute' regular GPs where, in each consultation, the GP is seeing a patient from another GP's list. We construct this sample by imposing the following conditions: (i) the patients do not belong to a list that is shared by two or more GPs, (ii) all patients are observed also in our main sample (involving 471 locums), (iii) each patient is observed only on the list of a fee-for-service GP or only on the list of a fixed-salary GP, (iv) all substitute GPs are paid by fee-for-service, and (v) each substitute GP is observed treating both categories of patients (listed with a fee-for-service GP or a fixed-salary GP).

[24] The outcome variables are the same as in Tables 2-3, except for patient recalls and number of consultations, which are not relevant in the context of PCEC consultations.

[25] In case of absence from work, regular GPs' obligation to provide a replacement, either by locums or by other regular GPs, is regulated by the agreement (ASA 4310) between The Norwegian Association of Local and Regional Authorities and The Norwegian Medical Association.

By applying these sample selection criteria, we are left with a sample of 421,244 observations (consultations), involving 3,371 'substitute' GPs. Using this sample, we estimate a model similar to the placebo test based on PCEC consultations, using the same treatment variables, and where the variable FFS indicates whether or not a patient's regular GP is paid by fee-for-service. This allows us to test whether there are any systematic differences between patients listed with fee-for-service vs. fixed salary GPs, based on how they are treated in regular GP consultations by the *same* substitute GP.

[Table 6]

The results of this alternative placebo test are displayed in Table 6 and clearly show that there are no systematic differences in the treatment offered to these two categories of patients, when they are seen by another regular GP than their own. The point estimates are very close to zero and statistically insignificant. The only dimension in which the magnitude of the point estimate is comparable to the effect of fee-for-service remuneration in our main analysis, is the rate of hospital referral. In terms of statistical significance, though, the difference in referral rates between the two patient categories is not distinguishable from zero.

In sum, we take the results from these two tests as reassuring confirmation that the estimates from our main model do not seem to reflect systematic differences between the patient populations of fee-for-service and fixed-salary GPs.

8.2 Practice style adoption

Another potential source of bias is related to the possibility that locums might, to some extent, adopt the practice style of the regular GP that they replace. If the practice style of a GP is influenced by the culture and environment in which she works, a locum who replaces a GP in a group practice might be similarly influenced by the other GPs in the practice.[26] And even in solo practices, a locum's treatment behaviour might in theory be influenced by initial instructions or guidelines given by the regular GP who is being temporarily replaced. If locums' behaviour partly reflects the behaviour of the GPs they replace, the GP selection problem partially reappears.

[26] Molitor (2018) shows that 60-80 percent of the differences in physicians' treatment behaviour in the US can be attributed to factors related to the practice environment.

In order to test the hypothesis of practice style adoption, we once more make use of information about GP behaviour at primary care emergency centres. As explained in Section 4, all regular GPs below the age of 60 are in principle obliged to work at PCECs part of their time. Since a GP's work at her own practice and in a PCEC occur simultaneously over time, it seems reasonable to assume that GPs will, to a large extent, bring their practice styles to the PCECs when working there. Under this assumption, we can use treatment patterns in PCEC consultations to identify differences in practice styles across GPs. In contrast to consultations at regular GP practices, where differences in treatment behaviour across different GPs might reflect systematic differences in patient characteristics, the random matching of GPs and patients at PCECs implies that, for a sufficiently high number of consultations and adequate control for potential confounders, any differences in treatment patterns across GPs must necessarily reflect differences in practice style.

As a proxy for GP practice style, we construct a 'generosity' index, which is a measure based on the GP's average value of service provision (measured by the total fee) per consultation at PCECs. More specifically, we estimate the following regression:

$$y_{ijtm} = \mu_j + \kappa_m + \omega_t + \phi_{ijtm} + \varepsilon_{ijtm}, \tag{6}$$

where y_{ijtm} is the total value of primary care service (total fee) provided by GP i to a patient with diagnosis j at time t in a PCEC in municipality m; μ_j, κ_m, and ω_t are fixed effects for diagnosis, municipality and time (year, month, and day of the week); and ϕ_{ijtm} is a variable indicating whether or not the patient is seen by a GP who is a specialist in general medicine.[27] The sample of consultations is restricted to those involving GPs that are observed in at least 250 PCEC consultations. The index is calculated by taking the mean of the unexplained random variation ε_{ijtm} for each GP from this regression and add the average value of service provision for all GPs (which is equal to NOK 367.85). The distribution of GP practice styles, based on the above described 'generosity index', is displayed in Figure 1, which shows that the index is close to normally distributed with a fair amount of variation across GPs.

[Figure 1]

[27] The fee-for-service schedule depends on the specialist status of the physician.

Our next step is to use the set of locum consultations where the locum replaces a fee-for-service GP. We restrict the consultation sample to one remuneration type to control for the locum's own incentives. From this set of consultations, we identify the set of locums that, during the period of observation, replace at least two GPs that are included in the 'generosity index' sample. We then re-estimate (5) using the same set of dependent variables as shown in Tables 2-3, but replacing the variable FFS with our measure of GP practice style, which enables us to test whether the same locum behaves differently depending on the practice style of the GP that she replaces, all else equal. If locums' treatment behaviour is characterised by practice style adoption, it should be reflected by positive and statistically significant estimate of this coefficient.

[Tables 7 and 8]

The results of these regressions, given in Tables 7-8, show no signs of practice style adoption by GP locums. The estimated values of the relevant coefficient are practically zero in all regressions. The only statistically significant result is for total fee per consultation, but besides being very close to zero, the sign of the coefficient indicates the opposite of practice style adoption. Thus, although this is certainly a less than perfect test for practice style adoption, the results from this test nevertheless give support to our interpretation of the main results in Tables 2-3, namely that the estimated differences in treatment behaviour are causally explained by changes in remuneration scheme.

9 Profit orientation and GP selection

In this section we extend our empirical analysis by exploring potential differences between GP *types*, and the importance of GP selection into different types of remuneration schemes, by linking GPs' behaviour as locums to their remuneration scheme when they later on enter the market as regular GPs. GPs are likely to differ along several dimensions that are not directly observable, including their degree of altruism or profit-orientation, as measured by the parameter α in our theory model. In Section 3 we show that the effects of different remuneration schemes on GP behaviour are smaller the less profit-oriented the GPs are. In our main analysis, we control

for GP heterogeneity by estimating models with GP-fixed effects, and our estimated effects of different remuneration schemes capture the average response of a group of GPs that presumably differ in their degree of profit orientation.

In order to explore the possibility of heterogeneous effects along this particular dimension, we exploit the fact that our data allows us to observe some of the GP locums (in the main sample) after they have entered the market as regular GPs, either with a fee-for-service contract or with a fixed-salary contract. While we have argued that the matching between GP and type of remuneration scheme in short-term vacancies is to a large extent random, it seems entirely reasonable to assume that the type of remuneration scheme a GP is exposed to in a regular practice is, to a much larger extent, a result of the GP's own choice. Being a self-employed GP with fee-for-service payment is potentially much more profitable, but also entails much more risk, than being employed on a fixed-salary contract. Thus, it seems reasonable to assume that more profit-oriented GPs seek to enter the market in fee-for-service practices, whereas less profit-oriented GPs tend to select themselves into fixed-salary practices. If this assumption holds, we can explore how the effects of different remuneration schemes depend on the GP's degree of profit-orientation by constructing a sample of consultations involving GP locums who later become regular GPs (within our period of observation). We then re-estimate (5), adding to the regression equation a term interacting the variable FFS with another indicator variable that takes the value 1 (0) if the locum later becomes a regular GP with a fixed salary (fee-for-service) contract. This allows us to test whether the treatment response to changes in remuneration scheme systematically differs between these two physician categories.[28]

[Tables 9 and 10]

The results are presented in Tables 9 and 10 (which correspond to Tables 2 and 3 in Section 7). Although the estimated effects are not perfectly consistent across all dimensions of GP behaviour, these results nevertheless indicate that more profit-oriented physicians (proxied by their choice of remuneration contract as regular GPs) tend to respond significantly stronger to changes in remuneration scheme when working as locums. These differences occur along several

[28] Notice that the length of the panel allows us to observe only a subset of the GP locums after they have entered the market as regular GPs. Thus, the sample used in this extension is considerably smaller than the sample used in the main analysis. Out of 108 locums, 38 became regular GPs on fixed salary.

dimensions and are particularly pronounced for the total value of service provision (total fee) per consultation, the daily supply of consultations, and the number of medical procedures performed during a consultation.

In sum, these results are consistent with our theoretical predictions that the effects of different remuneration schemes are stronger for more profit-oriented GPs, and therefore add credibility to our underlying assumption that more profit-oriented GPs are more likely to select themselves into GP practices with fee-for-service payments. As such, these results also underline the importance of our identification strategy in order to overcome this selection problem.

10 Locums versus regular GPs

In this penultimate section of the paper, we briefly explore the potential importance and implications of our main empirical strategy by comparing our results on primary care provision in Tables 3 and 4 with the corresponding results obtained using a sample of regular GPs instead of locums. Because of the low number of regular GPs who switch between different contract types within our observation period, the effects of remuneration scheme on the behaviour of regular GPs cannot be estimated with physician fixed effects, therefore exposing the analysis to the potential problem of GP selection. In the Appendix, we show that, *a priori*, the direction in which our results would be biased by GP selection is not clear. Given that GP selection is driven by the degree of profit-orientation, and that profit-oriented GPs provide more (less) services than altruistic GPs under fee-for-service (fixed salary), the effect of remuneration type on GP service provision is likely to be overestimated (underestimated) if the share of profit-oriented physicians is sufficiently low (high), or if the difference in service provision under fee-for-service is sufficiently large (small) relative to the difference in service provision under fixed salary, all else equal.

However, besides a potential selection bias, there is also another relevant difference between locums and regular GPs, namely the time horizon of the decision making. Since the GP locums mainly fill relatively short-term vacancies (cf. Figures A1-A3 in the Appendix), their decision making is presumably taking place in the context of fixed demand. Thus, our choice of empirical strategy implies that we are measuring mainly *short-run* effects of remuneration type on

physician behaviour. Regular GPs, on the other hand, have presumably a longer time horizon, taking into account that their behaviour is likely to affect demand. More specifically, it seems reasonable to assume that demand depends positively on the amount of services provided by the GP. If so, this implies that the difference in GPs' incentives for service provision under fee-for-service and fixed salary, respectively, is larger in the long run (for regular GPs) than in the short run (for locums). In other words, a regular GP that is paid by fee-for-service might provide a higher amount of services not only to generate more revenues from a fixed list of patients, but also to attract more patients to his list.[29]

In sum, the differences between regular GPs and locums related to selection and time horizon indicate that smaller estimated effects of remuneration scheme when using a sample of regular GPs can only be explained by selection bias, whereas larger effects can be explained by both selection bias and differences in time horizon. To explore this further, we contrast our main results in Tables 3 and 4 with the corresponding results derived from a re-estimation of (5) based on consultations involving all regular GPs on fixed salary and a random sample of 10 percent of regular GPs with fee-for-service contracts. The estimation regression is identical to (5) apart from the absence of GP fixed effects.

[Tables 11 and 12]

The results, which are displayed in Tables 11 and 12, show a qualitatively similar picture as the results based on consultations with locums. However, with few exceptions, the magnitude of the effects is larger for the sample with regular GP consultations. Although the effects shown in Tables 11-12 could be overestimated due to GP selection bias, our conjecture is that the difference between the two sets of results can, at least partly, be explained by the longer time horizon of regular GPs, where considerations for future demand are incorporated in the GP's treatment decisions. For example, the 11 percent increase in the rate of sickness certification (as a result of fee-for-service remuneration) compared to the 5.6 percent increase for locums, could be explained by an effect documented in a recent paper by Markussen and Røed (2017), who show that patients tend to choose GPs with a more lenient sick-listing practice.

[29] This applies to all types of services except hospital referrals, where the difference in long-run incentives between the two payment schemes is theoretically ambiguous. For a given demand, fee-for-service yields incentives for less referrals, but this will presumably have a negative long-run effect on demand, if patients prefer a more lenient referral practice.

11 Concluding remarks

In this paper we analyse the effects of two different types of physician remuneration – *fee-for-service* and *fixed salary* – on physicians' treatment decisions and patients' health outcomes. Using extremely rich Norwegian register data, covering the period 2009-2013, we estimate the effects of remuneration type on a wide range of outcome variables, including objective measures of health outcomes. We identify these effects empirically by comparing the treatment behaviour of the same physicians (*GP locums*) working under different payment schemes in different short-term vacancies within a relatively short period of time, which is our strategy to overcome the problem of self-selection of physicians into different remuneration schemes.

We find strong and consistent results. All else equal, if a GP is paid by fee-for-service instead of a fixed salary, the GP supplies a higher number of consultations, offers more prolonged consultations, performs more medical procedures and takes more tests per consultation, recalls patients more often and issues more often sickness certificates. All these results confirm a set of hypotheses that we derive from a simple theoretical model of physician behaviour under fixed demand. This model also predicts that the aforementioned effects are stronger for more profit-oriented physicians, which we confirm in our empirical analysis by using type of contract (fee-for-service or fixed salary) as *regular GP* as a proxy for the locum GP's degree of profit-orientation.

The type of GP remuneration is also found to have significant and strong effects on patients' health outcomes, as measured by the probability of emergency admissions to hospital shortly after a GP consultation. All else equal, this probability is almost 16 percent lower if the GP is paid by fee-for-service instead of fixed salary. If we restrict this measure to emergency admissions for ambulatory care sensitive conditions, the resulting drop in probability is more than 46 percent. When seen in conjunction, our estimates suggest that, by making GP payment based on fee-for-service instead of fixed salary, emergency admissions to hospitals can be reduced at a cost of around NOK 3,300 per averted emergency admission. This indicates that fixed-salary payment of physicians leads to underprovision of primary care services.

Finally, we would like to stress that, by basing our analysis on the behaviour of locums who mainly fill relatively short-term vacancies, we are essentially measuring the *short-run* effects of

remuneration type on physician behaviour. Given that GP-specific demand responds positively to the GP's level of service provision in the longer run, our estimates of the effects of remuneration type on GPs' service provision could arguably be seen as lower bound estimates of the long run effects.

Appendix

Proof of Proposition 1

The first part of the proposition presents the effects of remuneration type on service provision, patient referrals and the supply of consultations. We will consider each of these effects in turn.

(i) *Service provision.* It follows directly from (2) that the marginal benefit of service provision is higher under fee-for-service ($p+\alpha b_q(q,s)$) than under fixed salary ($\alpha b_q(q,s)$). Thus, $q^*(1,s) > q^*(0,s)$.

(ii) *Patient referrals.* Recall that $b(q,s) < \widetilde{b}(s)$ for $s \geq \widehat{s}$. For a fixed-salary GP ($\theta = 0$), the left-hand side of (3) is given by

$$-c\left(q^*(0,s^*)\right) + \alpha\left(b\left(q^*(0,s^*),s^*\right) - \widetilde{b}(s^*)\right) < 0.$$

Thus, (3) never holds if $\theta = 0$ and the optimal referral decision is therefore a corner solution with $s^*(0) = \widehat{s}$. If $\theta = 1$, it follows from (3) that a necessary condition for the existence of an interior solution is $pq^*(\theta,s^*) > c\left(q^*(\theta,s^*)\right)$. From (2), this condition holds if α is sufficiently low. Given that this condition is satisfied, the optimal referral decision is an interior solution if the second term in (3), which is related to the patients' loss of not being referred to specialist care, is sufficiently low, which also requires a sufficiently low value of α. Thus, $s^*(1) > \widehat{s}$ if α is sufficiently low. Otherwise, $s^*(1) = s^*(0) = \widehat{s}$.

(iii) *Consultations.* From (4), we define the GP's marginal benefit of consultations as

$$m(\theta) := \theta\overline{p} + \int_{\underline{s}}^{s^*(\theta)} \left(\theta p q^*(\theta,s) - c\left(q^*(\theta,s)\right) + \alpha b\left(q^*(\theta,s),s\right)\right) f(s)\,ds + \alpha\int_{s^*(\theta)}^{\overline{s}} \widetilde{b}(s)\,f(s)\,ds. \tag{A1}$$

The difference in the marginal benefits of consultations between fee-for-service GPs and fixed-

salary GPs can be written as

$$\begin{aligned} & m(1) - m(0) \\ = \; & \overline{p} + \int_{\underline{s}}^{\widehat{s}} \left[\begin{array}{c} \left(pq^*(1,s) + \alpha b\left(q^*(1,s),s\right) - c\left(q^*(1,s)\right)\right) \\ -\left(\alpha b\left(q^*(0,s),s\right) - c\left(q^*(0,s)\right)\right) \end{array} \right] f(s)\, ds \\ & + \int_{\widehat{s}}^{s^*(1)} \left(pq^*(1,s) - c\left(q^*(1,s)\right) + \alpha\left(b\left(q^*(1,s),s\right) - \widetilde{b}(s)\right)\right) f(s)\, ds \end{aligned} \tag{A2}$$

This difference consists of three terms, where the first term ($\overline{p}$) is by definition positive. It follows straightforwardly from the optimal service provision condition, (2), that the second term is also strictly positive for $p > 0$. Finally, the third term is zero if $s^*(1) = \widehat{s}$ and strictly positive if $s^*(1) > \widehat{s}$ (if $s^*(1)$ is an unconstrained maximum, the value of the integrand is positive for $s < s^*(1)$ and zero for $s = s^*(1)$). Thus, $m(1) > m(0)$, which implies that $n^*(1) > n^*(0)$.

The final part of the proposition states that more altruistic GPs respond less to a change of remuneration scheme along all three dimensions analysed. Once more, let us consider each effect in turn:

Service provision. From (2), the difference in the marginal benefit of service provision between fee-for-service GPs and fixed-salary GPs is constant and given by p. It also follows from (2) that $q^*(\theta, s)$ is monotonically increasing in α. Because of the convexity of the effort cost function, $c(q)$, the increase in the marginal benefit of service provision (by switching from fixed salary to fee-for-service) will have a smaller (positive) effect on optimal service provision when α is higher. Thus, the difference $q^*(1,s) - q^*(0,s)$ is strictly decreasing in α.

Patient referral. It follows directly from the above proof of $s^*(1) \geq s^*(0)$ that a higher value of α increases the scope for a corner solution in the optimal referral decision of a fee-for-service GP (i.e., $s^*(1) = s^*(0) = \widehat{s}$). Furthermore, in case of an interior solution under fee-for-service contracts (i.e., $s^*(1) > s^*(0) = \widehat{s}$), since $q^*(1,s)$ is monotonically increasing in α, a higher value of α will reduce the surplus from service provision ($pq^*(1,s^*) - c\left(q^*(1,s^*)\right)$), thereby reducing the marginal benefit of a higher referral threshold s^*. Simultaneously, a higher value of α increases the marginal cost of a higher referral threshold, since the patient benefit of specialist care is given a larger weight (cf. Eq. (3)). In sum, this implies that an increase in α leads to a reduction in $s^*(1)$, thereby reducing the difference in referral practice between fee-for-service

and fixed-salary GPs.

Consultations. If follows directly from (4) that a higher value of α increases the marginal benefit of consultations, thereby increasing the optimal number of consultations offered. For a given difference in the marginal gain of consultations, $m(1) - m(0)$ as defined by (A2), the convexity of $k(n)$ then reduces the positive effect of switching to fee-for-service payment when α is higher. This is equivalent to the effect on service provision as explained above.

Additionally, a higher value of α also *reduces* the difference $m(1) - m(0)$, thereby *reinforcing* the previously explained effect. A higher value of α reduces the difference between $m(1)$ and $m(0)$ through two different channels. First, a higher α increases the optimal service provision. Because of the convexity of $c(q)$, this reduces the additional surplus that can be gained by service provision under fee-for-service remuneration, which contributes to reducing the difference between $m(1)$ and $m(0)$. Second, a higher α reduces $s^*(1)$, as previously shown, which in turn reduces the expected marginal benefit of consultations under fee-for-service due to the possibility of treating instead of referring (last term in (A2)).

Distribution of temporary vacancies according to their duration

In Figures A1-A3 we show the distribution of temporary GP positions according to their duration (in weeks). Figure A1 shows this distribution for all positions, whereas Figures A2 and A3 show the distributions for positions with fee-for-service and fixed-salary contracts, respectively. Notice that, for presentational purposes, the figures only include temporary positions up to 104 weeks' duration.

[Figures A1-A3]

GP selection bias

In order to derive some conditions determining the direction of the bias caused by GP selection, consider a stylised example with two types of physicians, profit-oriented and altruistic, denoted by P and A, respectively, and suppose that profit-oriented physician constitute a share β of the total physician mass. Let q_S^i and q_{FFS}^i be the amount of services offered by a type i physician under fixed salary and fee-for-service, respectively, where $i = P, A$. Suppose further

that the population of regular GPs is characterised by complete self-selection of physicians to remuneration schemes, where profit-oriented physicians select fee-for-service contracts whereas altruistic physicians select fixed-salary contracts.[30]

Now assume that the ranking of service provision across physician types and remuneration schemes is given by

$$q^P_{FFS} > q^A_{FFS} > q^A_S > q^P_S. \tag{A3}$$

In other words, fee-for-service induces more service provision than fixed salary for both physician types, but altruistic physicians provide more services than profit-oriented physicians if remuneration is fixed salary, whereas the opposite is true if remuneration is fee-for-service.

Under these assumptions, if we compare service provision across the two remuneration schemes for regular GPs, the effect of fee-for-service is given by

$$\Delta_{GP} = q^P_{FFS} - q^A_S. \tag{A4}$$

On the other hand, the average effect of fee-for-service for locums, under the assumption of random assignment, is given by

$$\Delta_{Loc} = \beta q^P_{FFS} + (1-\beta)\, q^A_{FFS} - \left(\beta q^P_S + (1-\beta)\, q^A_S\right). \tag{A5}$$

Thus, by using regular GPs, the effect of fee-for-service is overestimated (underestimated) if

$$\Delta_{GP} - \Delta_{Loc} > (<)\, 0. \tag{A6}$$

It can easily be shown that this condition is given by

$$\frac{1-\beta}{\beta} > (<)\, \frac{q^A_S - q^P_S}{q^P_{FFS} - q^A_{FFS}}. \tag{A7}$$

Thus, the effect is overestimated if the share of profit-oriented physicians is sufficiently low, or if $q^P_{FFS} - q^A_{FFS}$ is sufficiently large relative to $q^A_S - q^P_S$. Otherwise, the effect is underestimated.

[30] In this example, the relative share of fee-for-service contracts is solely determined by the distribution of physician types. Although this is obviously not true in reality, the main mechanisms determining the direction of the selection bias are still the same.

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Tables

Table 1. Descriptive statistics, by the GP locum's remuneration scheme

	Fee-for-service (1)	Fixed salary (2)
Dependent variables		
Total fee per consultation	286.8 (155.7)	263.1 (146.8)
Recall within 14 days	0.183	0.164
Referral to hospital, planned admission	0.054	0.067
Number of consultations per day[1]	12.0 (4.9)	7.6 (4.1)
Prolonged consultation	0.373	0.335
Laboratory test	0.401	0.360
Number procedures	0.178 (0.461)	0.113 (0.369)
Sick note issued[2]	0.188	0.148
Emergency adm. 1-14 days, PCEC[3]	0.016	0.015
Emergency adm. 1-14 days, hospital[4]	0.024	0.027
Ambulatory care sensitive conditions 1-14 days	0.001	0.002
Patient characteristics		
Age	51.3 (18.9)	54.3 (19.2)
Male	0.392	0.429
Comorbidity indicator	0.162	0.110
Total income/10,000 NOK	35.3 (26.7)	33.5 (60.5)
Low education	0.336	0.373
Medium education	0.425	0.448
High education	0.239	0.179
Locum GP characteristics		
Male	0.546	
Age	37.0 (9.6)	
Norwegian	0.628	
Specialist	0.037	
Practice characteristics		
List length/100	11.50 (3.44)	9.43 (3.21)
Full list	0.532	0.327
Group practice	0.833	0.630
Joint patient list	0.059	0.243
Patient list characteristics		
Proportion males	0.487	0.511
Average age	38.75	42.06
Proportion low education[5]	0.291	0.333
Proportion medium education[5]	0.427	0.457
Average total income/10,000 NOK[5]	38.39	36.60
Observations	572,357	127,599
Patients	243,832	73,104
GPs	471	

[1] Means per day of practice. [2] Means for the employed part of the patient list population. [3] Emergency admission at primary care emergency centre (PCEC) within 14 days after GP consultation. [4] Emergency admission at hospital within 14 days after GP consultation. [5] Patients aged 20 and above.

Table 2. Effects of remuneration schemes on GP behaviour.

	(1) Total fee per consultation	(2) Recall within 14 days	(3) Referral to hospital (planned)	(4) Number of consultations per day
Practice characteristics				
Fee-for-service	12.5518***	0.0138**	-0.0020	2.3167***
	(4.68)	(3.06)	(-1.50)	(18.38)
List length	-0.3515	0.0019**	-0.0001	0.1435***
	(-1.09)	(2.97)	(-0.66)	(8.47)
Full list	0.7564	0.0018	-0.0009	-0.0311
	(0.48)	(0.58)	(-0.94)	(-0.37)
Group practice	1.1870	-0.0017	0.0007	-0.3265*
	(0.56)	(-0.36)	(0.42)	(-2.51)
Joint patient list	-0.5029	0.0180*	-0.0051*	-0.8180***
	(-0.10)	(2.08)	(-2.29)	(-3.26)
Patient characteristics				
Patient male	-2.1028***	-0.0068***	0.0014*	-
	(-3.60)	(-3.68)	(2.12)	
Patient age	0.3157***	0.0007***	0.0002***	-
	(17.24)	(14.06)	(9.85)	
Low education	2.7060***	0.0252***	-0.0021**	-
	(3.88)	(12.88)	(-2.82)	
Medium education	-1.7440**	0.0134***	-0.0005	-
	(-3.08)	(8.24)	(-0.69)	
Income	-0.0256	-0.0001*	0.0000	-
	(-1.52)	(-2.09)	(1.23)	
Patient list characteristics				
Males (proportion)	-14.9555	0.0373	0.0035	1.0284
	(-1.24)	(1.59)	(0.48)	(1.54)
Age (mean)	-0.1339	-0.0008*	-0.0000	0.0593***
	(-0.72)	(-2.12)	(-0.02)	(5.14)
Low education (proportion)	13.4147	0.1099**	0.0164	-3.8330**
	(0.89)	(3.17)	(1.67)	(-2.99
Medium education (proportion)	16.1046	0.0545	0.0117	-3.6572*
	(0.75)	(1.34)	(0.95)	(-2.55)
Income (mean)	0.1074	0.0001	0.0002*	-0.0152
	(0.63)	(0.19)	(2.08)	(-1.61)
Fixed effects:				
Municipality	Yes	Yes	Yes	Yes
GP	Yes	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes	-
Comorbidity	Yes	Yes	Yes	-
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes
Mean *y*	282.431	0.180	0.056	10.852
GPs	471	471	471	471
Observations	699,949	699,949	699,949	64,499

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are clustered at physician level.

Table 3. Effects of remuneration schemes on service provision during a GP consultation.

	(1) Prolonged consultation	(2) Lab test	(3) Procedures	(4) Sickness certificate
Fee-for-service	0.0311***	0.0147**	0.0390***	0.0150**
	(3.28)	(2.91)	(7.86)	(2.69)
Practice characteristics	Yes	Yes	Yes	Yes
Patient characteristics	Yes	Yes	Yes	Yes
Patient list characteristics	Yes	Yes	Yes	Yes
Fixed effects:				
Municipality	Yes	Yes	Yes	Yes
GP	Yes	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes	Yes
Comorbidity	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes
Mean *y*	0.366	0.394	0.166	0.268
GPs	471	471	471	471
Observations	699,949	699,949	699,949	459,738

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are clustered at physician level.

Table 4. Effects of remunerations schemes on health outcomes (emergency admission within 1-14 days)

	(1) Primary care emergency centres	(2) Hospital admission	(3) Hospital admission, ambulatory care sensitive conditions
Fee-for-service	-0.0016*	-0.0038***	-0.0006**
	(-1.95)	(-3.83)	(-2.65)
Practice characteristics	Yes	Yes	Yes
Patient characteristics	Yes	Yes	Yes
Patient list characteristics	Yes	Yes	Yes
Fixed effects:			
Municipality	Yes	Yes	Yes
GP	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes
Comorbidity	Yes	Yes	Yes
Year	Yes	Yes	Yes
Month	Yes	Yes	Yes
Mean *y*	0.0157	0.0242	0.0013
GPs	471	471	471
Observations	699,949	699,949	699,949

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are clustered at physician level.

Table 5. Placebo test: Consultations at primary care emergency centres[1].

	(1) Prolonged consultation	(2) Lab test	(3) Procedure	(4) Sickness certificate	(5) Total fee	(6) Admitted to hospital (emergency)
Fee-for-service GP[2]	-0.0045*	0.0007	-0.0006	0.0021	-0.8600	0.0003
	(-2.35)	(0.32)	(-0.33)	(1.06)	(-0.83)	(0.18)
Patient characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects:						
Municipality	Yes	Yes	Yes	Yes	Yes	Yes
GP	Yes	Yes	Yes	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes	Yes	Yes	Yes
Comorbidity	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes	Yes	Yes
Mean *y*	0.385	0.365	0.155	0.124	397.373	0.130
GPs	10,589	10,589	10,589	9,828	10,589	10,589
Observations	527,396	527,396	527,396	321,181	527,396	527,396

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are clustered at the physician level.[1)] The patient sample is restricted to patients who are observed merely in consultations with fee-for-service GPs or with fixed-salary GPs. [2)] The variable equals 1 if the patient is enlisted with a regular GP with FFS payment.

Table 6. Placebo test: Consultations with substitute GPs on fee-for-service contracts[1].

	(1) Prolonged consultation	(2) Lab test	(3) Procedure	(4) Sickness certificate	(5) Total fee	(6) Referral to hospital (planned)
Fee-for-service GP	-0.0012	0.0024	0.0006	0.0005	-0.0432	-0.0022
	(-0.39)	(0.76)	(0.17)	(0.12)	(-0.04)	(-1.60)
Patient characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects:						
Municipality	Yes	Yes	Yes	Yes	Yes	Yes
GP	Yes	Yes	Yes	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes	Yes	Yes	Yes
Comorbidity	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes	Yes	Yes
Mean *y*	0.262	0.416	0.189	0.280	310.587	0.044
GPs	3,371	3,371	3,371	3,326	3,371	3,371
Observations	421,123	421,123	421,123	275,969	421,123	421,123

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are clustered at the physician level.[1)] See notes to Table 5.

Table 7. Practice style adoption and GP behaviour[1].

	(1) Fee per consultation	(2) Recall within14 days	(3) Admitted to hospital (planned)	(4) Number of consultations per day
Index fee per consultation	-0.0289*	-0.0000	0.0000	-0.0026
	(-1.99)	(-1.01)	(0.46)	(-1.19)
Practice characteristics	Yes	Yes	Yes	Yes
Patient characteristics	Yes	Yes	Yes	Yes
Patient list characteristics	Yes	Yes	Yes	Yes
Fixed effect				
Municipality	Yes	Yes	Yes	Yes
GP locum	Yes	Yes	Yes	Yes
Diagnoses	Yes	Yes	Yes	Yes
Comorbidity	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes
Mean y	282.682	0.174	0.054	12.578
GPs	587	587	587	587
Observations	855,128	855,128	855,128	67,987

t statistics in parentheses, * p < 0.05, ** p < 0.01, *** p < 0.001. Standard errors are clustered at physician level.
[1)] The GP observed is the locum GP, while the variable of interest (the index) is based on the behaviour of regular GP that the locum GP has substituted for.

Table 8. Practice style adoption and service provision during a consultation.

	(1) Prolonged consultation	(2) Test	(3) Procedures	(4) Sick note
Index fee per consultation	-0.0000	0.0001	-0.0001	0.0000
	(-0.19)	(1.16)	(-1.90)	(0.82)
Practice characteristics	Yes	Yes	Yes	Yes
Patient characteristics	Yes	Yes	Yes	Yes
Patient list characteristics	Yes	Yes	Yes	Yes
Fixed effect:				
Municipality	Yes	Yes	Yes	Yes
GP locum	Yes	Yes	Yes	Yes
Diagnoses	Yes	Yes	Yes	Yes
Comorbidity	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes
Mean y	0.348	0.421	0.186	0.277
GPs	587	587	587	587
Observations	855,128	855,128	855,128	571,337

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are clustered at physician level.
See notes to Table 7.

Table 9. Effects of remuneration schemes on GP behaviour *while a locum*, by degree of GP's profit orientation. Sample restricted to consultations with locums who *later* become regular GPs.

	(1) Total fee per consultation	(2) Recall within 14 days	(3) Referral to hospital	(4) Number of consultations per day
Fee-for-service	18.3280***	0.0020	-0.0063*	2.9834***
	(3.84)	(0.20)	(-2.26)	(8.05)
Fee-for-service*Less profit-oriented GPs	-29.7364**	-0.0051	0.0077	-2.2385***
	(-3.40)	(-0.29)	(1.17)	(-4.65)
Practice characteristics	Yes	Yes	Yes	Yes
Patient characteristics	Yes	Yes	Yes	-
Patient list characteristics	Yes	Yes	Yes	Yes
Fixed effects:				
Municipality	Yes	Yes	Yes	Yes
GP	Yes	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes	-
Comorbidity	Yes	Yes	Yes	-
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes
Mean *y*	268.777	0.164	0.057	10.871
GPs	108	108	108	108
Observations	199,505	199,505	199,505	18,354

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are clustered at physician level.

Table 10. Effects of remuneration schemes on GP behaviour *while a locum*, by degree of GP's profit orientation. Sample restricted to consultations with locums who *later* become regular GPs.

	(1) Prolonged consultation	(2) Lab test	(3) Procedure	(4) Sickness certificate
Fee-for-service	0.0215	0.0238	0.0543***	0.0177
	(1.42)	(1.53)	(8.25)	(1.77)
Fee-for-service*Less profit-oriented GPs	-0.0562*	-0.0136	-0.0544***	0.0206
	(-2.07)	(-0.72)	(-5.28)	(1.50)
Practice characteristics	Yes	Yes	Yes	Yes
Patient characteristics	Yes	Yes	Yes	Yes
Patient list characteristics	Yes	Yes	Yes	Yes
Fixed effects:				
Municipality	Yes	Yes	Yes	Yes
GP	Yes	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes	Yes
Comorbidity	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes
Mean *y*	0.326	0.383	0.170	0.185
GP locums	108	108	108	108
Observations	199,505	199,505	199,505	199,505

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are clustered at physician level.

Table 11. Effects of remuneration schemes on GP behaviour. (Regular GPs)

	(1) Total fee per consultation	(2) Recall within 14 days	(3) Referral to hospital (planned)	(4) Number of consultations per day
Practice characteristics				
Fee-for-service	17.7231***	0.0330***	-0.0072***	4.0895***
	(3.52)	(7.78)	(-4.15)	(16.82)
Practice characteristics	Yes	Yes	Yes	Yes
Patient characteristics	Yes	Yes	Yes	Yes
Patient list characteristics	Yes	Yes	Yes	Yes
Fixed effects:				
Municipality	Yes	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes	Yes
Comorbidity	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes
Mean *y*	330,970	0.178	0.052	15.787
GPs	4,609	4,609	4,609	4,609
Observations	5,065,437	5,065,437	5,065,437	2,206,469

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are clustered at physician level.

Table 12. Effects of remuneration schemes on service provision during a GP consultation. (Regular GPs)

	(1) Prolonged consultation	(2) Lab test	(3) Procedures	(4) Sickness certificate
Practice characteristics				
Fee-for-service	0.0136	0.0180*	0.0615***	0.0302***
	(0.78)	(2.07)	(7.28)	(3.84)
Practice characteristics	Yes	Yes	Yes	Yes
Patient characteristics	Yes	Yes	Yes	Yes
Patient list characteristics	Yes	Yes	Yes	Yes
Fixed effects:				
Municipality	Yes	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes	Yes
Comorbidity	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes
Mean *y*	0.320	0.444	0.203	0.274
GPs	4,609	4,609	4,609	4,609
Observations	5,065,437	5,065,437	5,065,437	3,127,765

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are clustered at physician level.

Figures

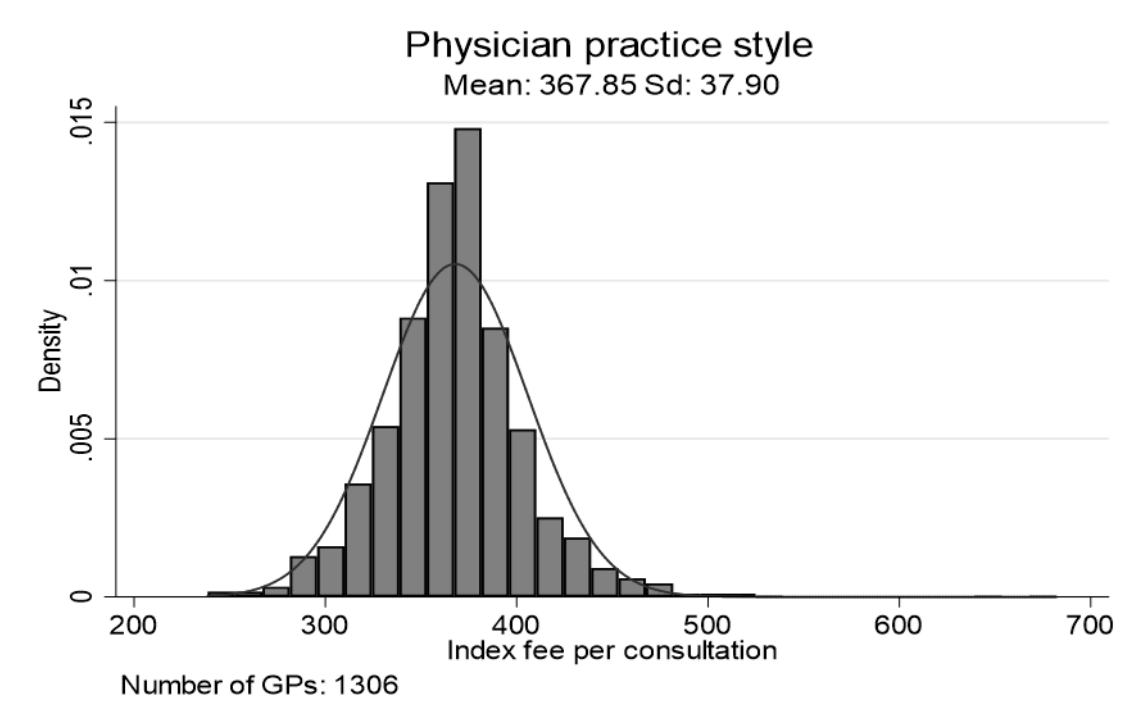

Figure 1. Distribution of physician practice styles in PCEC consultations.

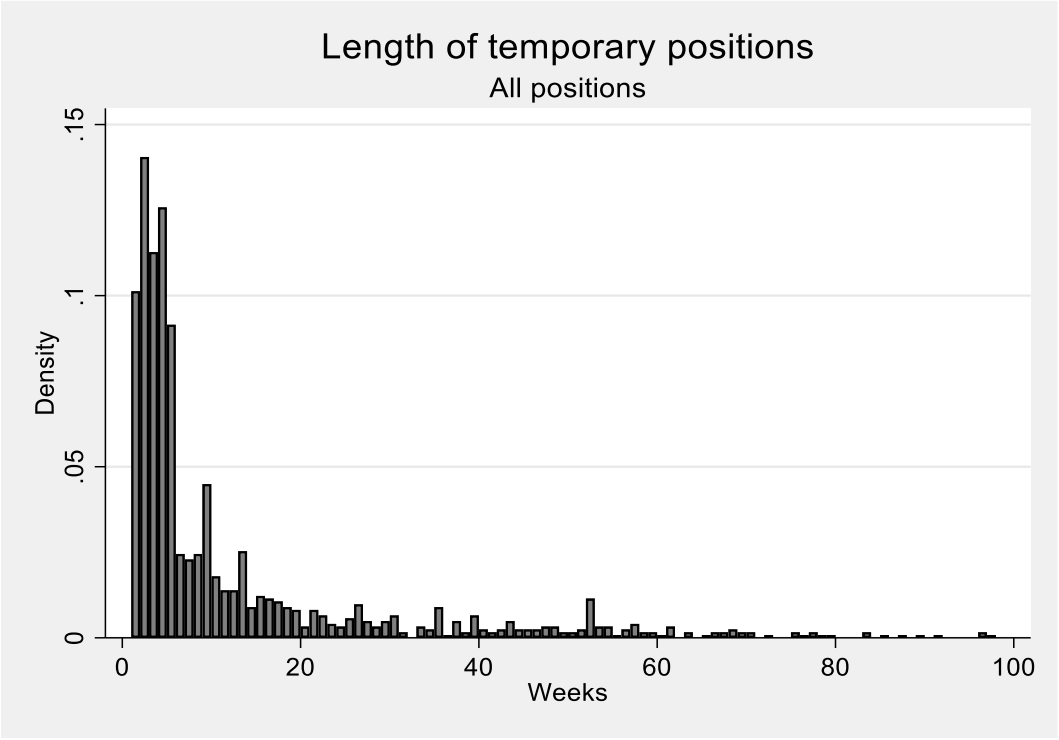

Figure A1. Distribution of all GP temporary positions according to number of weeks.

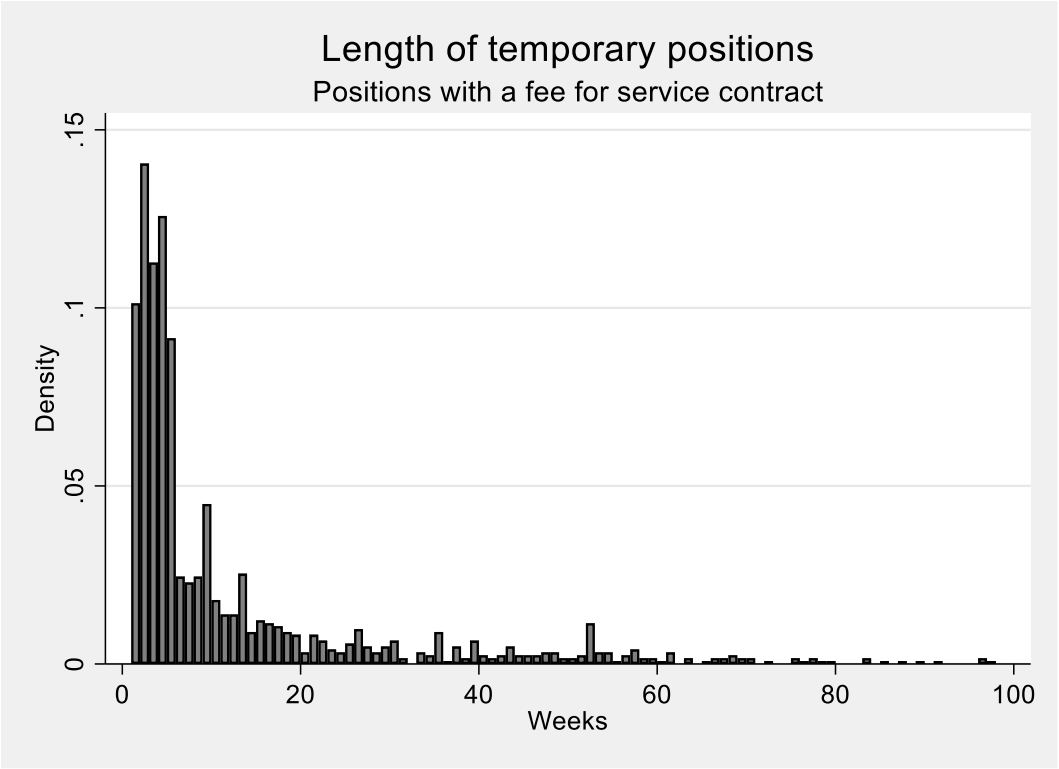

Figure A2. Distribution of GP temporary positions with fee-for-service contracts according to number of weeks.

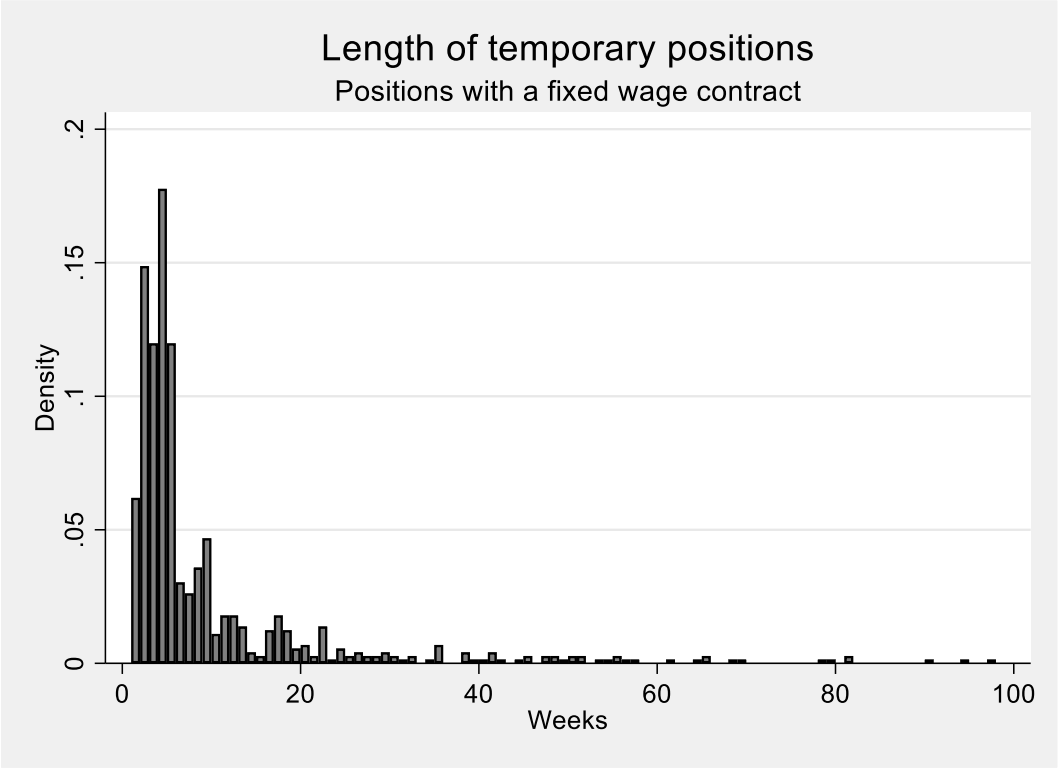

Figure A3. Distribution of GP temporary positions with fixed-salary contracts according to number of weeks.