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

Kurt R. Brekke[†], Tor Helge Holmås[‡], Karin Monstad[§], Odd Rune Straume[¶]

September 2018

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 during 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 close to 20 percent reduction in the probability of an emergency hospital admission shortly after a GP consultation.

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

JEL Classification: I11; I18; J33

[†]Department of Economics, Norwegian School of Economics (NHH), Helleveien 30, N-5045 Bergen, Norway. E-mail: kurt.brekke@nhh.no.

[‡]Uni Research Rokkan Centre, Nygårdsgaten 112, N-5008 Bergen, Norway. E-mail: tor.holmas@uni.no.

[§]Corresponding author. Uni Research Rokkan Centre, Nygårdsgaten 112, N-5008 Bergen, Norway. E-mail: karin.monstad@uni.no.

[¶]Department of Economics/NIPE, University of Minho, Campus de Gualtar, 4710-057 Braga, Portugal; and Department of Economics, University of Bergen. E-mail: o.r.straume@eeg.uminho.pt.

1

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 somatic 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 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 26 percent) and to a significant increase in the total amount of medical services provided per consultation (by 6.5 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 provide more prolonged consultations, perform more medical procedures, take more lab tests, recall patients more often, and are more prone to issue a sickness certificate. However, patients are less often referred to hospital by fee-for-service GPs. These results are all estimated with a high degree of precision.

We also explore the importance of GP 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. The underlying assumption is that remuneration type for regular GPs is, to a much larger extent than for locums, a result of GP choice, where 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 a week of a GP consultation is almost 19 percent lower if the GP had a fee-for-service contract instead of a fixed salary. 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 cor-

responding reduction in emergency admissions to hospital can be obtained at a cost in the range of NOK 5,900-6,800 per averted emergency admission, depending on the exact definition of our health outcome variable (emergency admissions within 7 or 14 days after a GP consultation).[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 test the robustness of these results. The analysis is then extended in Section 9, where we explore the effects of GP heterogeneity with respect to profit orientation. Section 10 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 significantly higher under fee-for-service payment. A similar result is found in the latter study,

---

[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.

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. (forthcoming), when comparing fee-for-service with capitation using Canadian data. Our study provides additional evidence that fee-for-service remuneration yields lower referral rates by GPs, although our basis of comparison is fixed-salary remuneration instead of capitation.[4]

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.[5] 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.

---

[4]In the short run, when demand is fixed, physician remuneration based on capitation is equivalent to a fixed salary.

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

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 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 at the end of the section – 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 $s > \widehat{s}$, 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 $s > \widehat{s}$ and for all q, implying that all patients who are potential candidates for referral would prefer to be referred to specialist care.[6]

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. These non-monetary costs are given by the increasing and strictly convex effort cost functions $k(n)$ and $c(q)$, respectively, where n is the number of consultations and q is the amount of service provision per consultation.

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.[7] We assume that p is such that the maximisation of $pq - c(q)$ has an interior solution (i.e., $q > 0$). On the other hand, if the GP has a *fixed-salary* contract, his revenues per period only consist of a fixed wage w per period. 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-

---

[6]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 ($s > \widehat{s}$) we assume that such disutilities are more than outweighed by the health gains of receiving specialist care.

[7]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.[8]

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. It follows straightforwardly from (2) that, for every severity level s, a fee-for-service GP ($\theta = 1$) will optimally choose a higher level of service provision than a fixed-salary GP ($\theta = 0$).

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. However, since $b(q^*(\theta, s^*), s^*) < \widetilde{b}(s^*)$, (3) never holds if the GP has a fixed salary ($\theta = 0$). Thus, for every patient with severity $s \geq \widehat{s}$, a fixed-salary GP has no incentive to treat the patient himself and will optimally set $s^* = \widehat{s}$.

The referral incentives are potentially different for a fee-for-service GP. If $\theta = 1$, an interior solution exists if $p q^*(\theta, s^*) > c(q^*(\theta, s^*))$, which is always true for sufficiently low values of α.[9] 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.

---

[8] 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 ($\theta = 0$).

[9] Given the assumption that the maximisation of $pq - c(q)$ is maximised at a strictly positive value of q, it follows from (2) that $p q^*(\theta, s^*) > c(q^*(\theta, s^*))$ if α is sufficiently low.

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

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

It follows from a simple inspection of (4) that a fee-for-service GP ($\theta = 1$) will optimally supply a higher number of consultations per period than a fixed-salary GP ($\theta = 0$) will do. With the latter remuneration scheme, the marginal benefit for the GP of supplying more consultations is solely related to increases in patients' health benefits, to which the GP attaches altruistic value. With fee-for-service remuneration, on the other hand, the GP's marginal benefit of supplying consultations is enhanced by monetary benefits (the consultation fee plus service fees, net of monetary costs), leading to a higher optimal supply of consultations.

It is also easy to verify from (2)-(4) that the magnitude of the difference in the decisions (q^*, s^*, n^*) between fee-for-service and fixed-salary GPs is inversely related to the degree of GP altruism (α). Put differently, a more profit-oriented (less altruistic) GP will respond stronger to a change in remuneration scheme. We summarise the above analysis as follows:

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.*

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. 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.[10]

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.[11] Sometimes colleagues can step in, but in many cases a locum is needed. Consequently, the use of locums is

---

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

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

quite widespread; our data shows that during one year (2009) about 30% of all GPs use a locum at least once.

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.

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) 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 the invoice was sent to *HELFO*. 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[12], etc. We also observe the GP's total income per visit, as well as patient characteristics, such as age, gender, comorbidity and diagnosis. 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 his/her regular GP and GP characteristics such as age, gender, country of birth, and whether

---

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

the GP is a specialist. 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 is prolonged or not, whether a test is taken, the number of medical procedures, and whether the GP issues a sickness certificate. Furthermore, we define two different measures of patient health outcomes: emergency admission to a primary care emergency centre and emergency admission to a somatic hospital. These health indicators relate to the period shortly after the GP visit (1-7 or 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. All other outcome variables (apart

from referrals) are generated from the *HELFO* data.[13]

Our data sources cover all GP consultations and all admissions to public somatic hospitals for the years 2009-2013. 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.

In Table 1 below, these GPs are grouped in three categories according to their remuneration scheme. Some locums have received only fee-for-service payment or only a fixed salary in all consultations in our data set, and the mean values for these two categories are shown in Columns 1 and 2, respectively. For those locums who have experienced both remuneration schemes, Columns 3 and 4 show average values by payment scheme.

[Table 1]

As is evident by the first column of Table 1, the majority of GPs who have practiced as locums at some point during the observational period, have worked in practices with fee-for-service payment only (3,139 out of 4,438 locums), while 828 locums have been on fixed salary only (Column 2). This is to be expected, since fee-for-service is by far the most common type of remuneration in the Norwegian regular GP scheme. There is, however, a substantial number of locums who have experienced both payment schemes (471 GP locums).

Whether we compare Column 1 with Column 2 or Column 3 with Column 4, the same picture emerges. 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.

The patient population also differs according to remuneration schemes. Patients in fee-for-service consultations are on average 2.5-3 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

---

[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*.

fixed salary. This could reflect a rural/urban difference. On the other hand, the proportion of patients with comorbidity is also higher, on average, in consultations with fee-for-service locums. Descriptive statistics show that locums are quite similar across remuneration categories; about half of them are men and the average age is about 36 years, only 3-5 percent are medical specialists, which indicates that many of them are early in their career. We note that practices remunerated with fee-for-service are characterised by longer patient lists, which again probably reflects an urban/rural difference. In the empirical analysis, we will control for a wide range of patient and GP characteristics, and in our robustness analysis (Section 8) we will address the question of geographical location of practices.

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 related to the fact that the matching of GPs to remuneration schemes might be partly a result of GP choice. If GPs can choose between fixed-salary contracts and fee-for-service contracts, and if these choices 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.

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.[14]

---

[14]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 an illustration of how the temporary positions are

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 category of locums that have worked under both remuneration schemes, 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.[15] 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.[16] 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 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 shows 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,

$$y_{ijt} = \beta_0 + \beta_1 * FFS + \beta_2 * l_{it} + \beta_3 * \mathbf{X}_{ijt} + \sigma_i + \mu_j + \omega_t + \varepsilon_{ijt}, \tag{5}$$

where y_{ijt} 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 main diagnosis j at time t; FFS

_____

distributed according to their durations.

[15] 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.

[16] Among the GP locums working under both remuneration schemes, 92 physicians are observed in only two different positions.

is an indicator variable that takes the value 1 (0) if the GP is paid by fee-for-service (fixed salary); l_{it} is the list length of GP i at time t; $\mathbf{X}_{ijt}$ is a vector of patient characteristics, such as age, education, income and an indicator for having any comorbidity; σ_i is a GP-fixed effect; μ_j is a diagnosis-fixed effect; ω_t is a time-fixed effect (year and month); and ε_{ijt} 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. In all our estimations, 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 two different measures of health outcomes 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 that corresponds to a percentage increase of around 6.5.

[Table 2 here]

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

16

type of remuneration scheme is shown to have a highly significant effect along both dimensions. All else equal, a significantly lower share of consultations will result in a referral to hospital care if the GP is paid by fee-for-service instead of a fixed salary, which is in line with our theoretical predictions. The effect is also sizeable and corresponds to a reduction in the frequency of hospital admissions by more than 15 percent. Fee-for-service GPs also recall patients with a higher frequency than do fixed-salary GPs, with an estimated difference of almost 9 percent. This 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 26 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.

For the remaining independent variables that are intuitively related to GP behaviour, the estimated coefficients have the expected sign. In particular, older and sicker (measured by comorbidity) patients tend to consume a higher level of GP services and be subject to recall and hospital referral on a more frequent basis.

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: (1) the share of consultations that are prolonged beyond 20 minutes, (2) the share of consultations in which at least one lab test is taken, (3) the number of medical procedures per consultation, and (4) the share of consultations in which a sickness certificate is issued.

[Table 3 here]

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 relatively 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 consultations by 12 percent, increase the frequency of testing by 7 percent, increase the number of medical procedures by 23 percent, and increase the propensity to issue sickness certificates

by 9 percent.

Summing up, we find that a change in payment scheme from fixed salary to fee-for-service leads to a relatively large 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 reduces the GP's propensity to refer patients to hospital care and leads to a higher supply of consultations. All the above mentioned effects are estimated with a high degree of precision, and these results are 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 two different measures of health outcomes, namely the rate of emergency admission (within 7 or 14 days of a GP consultation) to primary care emergency centres or to (somatic) hospitals.

[Table 4 here]

The results, reported in Table 4, show that patients who have attended a fee-for-service GP have a significantly lower probability of experiencing an emergency admission to hospital shortly after the GP consultation. These effects are also quite large in magnitude. For example, the probability of experiencing an emergency admission to hospital within a week of a GP consultation is almost 19 percent lower if the GP is paid by fee-for-service instead of a fixed salary. The estimated coefficients for admission to primary care emergency centres are also

18

negative, though not statistically significant.

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? Considering emergency admissions within 7 days, the value of our estimated coefficient (Table 4) implies that one emergency admission is averted for every 370 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 18.44 (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 6,800 per averted emergency admission. This cost estimate reduces to around NOK 5,900 if we consider emergency admissions within 14 days. By comparison, the average cost of emergency hospital admissions during 2009-2013 can be estimated at around NOK 23,000.[17] 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.[18]

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 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. Furthermore, we have shown that GP remuneration based on fee-for-service yields fewer hospital referrals, thus implying a further reduction in the cost of secondary care provision. Overall, we believe that our analysis provides suggestive evidence that GP remuneration based on fixed salaries leads to underprovision of primary care services and higher total health care costs, relative to

---

[17]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.

[18]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 remuneration.

However, we must stress that there are several caveats to this tentative welfare analysis. 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.[19] 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 Robustness

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 for a wide range of patient characteristics, 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. In this section we test this hypothesis by conducting two different robustness checks.

First, we construct a sample consisting of consultations at local (municipal) 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

---

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

larger GP population than in the main analysis. 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 primary care emergency centres, 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 emergency centres is random, any such differences should only reflect differences in average severity between the two patient groups. 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.

[Table 5 here]

We estimate models with and without municipality-fixed effects (in addition to GP-fixed effects), and the results are reported in Table 5. Since we include GP fixed effects, the effects are identified by GPs who at primary care emergency centres treat both patient categories. These results reveal that there are practically no differences in the way these two categories of patients are treated in emergency centre consultations. There are statistically significant differences along some of the dimensions of service provision, but they are inconsistently signed and, more importantly, these differences are all of negligible magnitude. When we include municipality-fixed effects (Panel B in Table 5), the only statistically significant differences are found in the frequency of testing and in the total fee per consultation (which is weakly significant), but the magnitudes of these differences are very close to zero. We take these results 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.

Our second robustness check addresses a potential concern related to an unequal geographical distribution of the two types of remuneration schemes. Since fixed-salary GP practices are more

prevalent in rural than in urban areas, our results might be affected by the potential existence of systematic differences between rural and urban GP practices, such as differences in the degree of local competition and in the composition of the patient population (as indicated in Section 5), that might affect GP behaviour.

We deal with this potential concern by restricting the main analysis sample to consultations involving only GPs who have worked as locums more than once *in the same municipality*. Using this restricted sample, we re-estimate the effects of remuneration type in a model where we include both GP and municipality fixed effects. This implies that identification is based on GPs who are observed under both types of remuneration schemes in the same municipality (our sample contains 290 GPs of this kind). This approach should also eliminate any potential concern about physician selection based on the geographical location of vacancies.

[Tables 6 and 7 here]

The results from this robustness check are reported in Tables 6-8. Reassuringly, the estimated effects of remuneration type on GP behaviour (displayed in Tables 6 and 7) are very similar, in terms of both precision and magnitude, to the ones we obtain when using the main sample, as reported in Tables 2 and 3. The only notable difference is the effect of fee-for-service payment on hospital referral rates, which is statistically insignificant (though the point estimate is still negative).

[Table 8]

In Table 8 we show the effects of remuneration type on patient health outcomes. Interestingly, these effects are even larger (and also more precisely estimated) than those obtained from the main sample (shown in Table 4). Using the restricted sample, the probability of experiencing an emergency hospital admission within a week of a GP consultation is now 25 percent lower if the GP is paid by fee-for-service instead of fixed salary. Furthermore, the effect of fee-for-service remuneration on the rate of emergency admissions to primary care emergency centres is also negative and (weakly) statistically significant.

9 Extension: Profit orientation and GP self-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 creating two subsamples – each consisting of consultations with GP locums who later become regular GPs with, respectively, fee-for-service payment and fixed salary – and re-estimate (5) for each of the two subsamples.[20]

[Table 9]

---

[20]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 sum of the two subsamples is considerably smaller than the sample used in the main analysis.

The results are presented in Tables 9 and 10 (which are equivalent to Tables 2 and 3 in Section 7). According to our underlying assumptions, the estimated effects of fee-for-service versus fixed-salary remuneration for relatively profit-oriented GPs are shown in Panel A, whereas the equivalent effects for less profit-oriented (more altruistic) GPs are shown in Panel B.

Considering first Table 9, the difference in the estimates between Panel A and Panel B is quite striking. Regarding the total amount of services offered per consultation (as measured by the total fee), a change in remuneration scheme from fixed salary to fee-for-service yields a significant and strong response from profit-oriented GPs (Panel A), whereas the response from more altruistic GPs (Panel B) is not significantly different from zero. The former type of GPs also respond stronger with respect to their hospital referral practice and their supply of consultations.

[Table 10]

The same pattern appears when we consider the different dimensions of GP service provision. The response of profit-oriented GPs to fee-for-service payment is significant and strong along all four dimensions (Panel A). On the other hand, the response from more altruistic GPs is weaker (apart from sick-listing) and statistically insignificant along two of the four dimensions measured (Panel B).

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   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, issues more often sickness certificates, but refers patients less often to specialist care (hospitals). 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 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 20 percent lower if the GP is paid by fee-for-service instead of fixed salary. 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 in the range of NOK 5,900-6,800 per averted emergency admission. This indicates that fixed-salary payment of physicians leads to underprovision of primary care services.

Finally, we would like to point out that physician payment schemes might have additional long-run effects on physician behaviour that are not fully accounted for in our analysis. 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. In the longer run, it is reasonable to assume that GPs can, to some extent, affect demand through their treatment decisions. 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 than in the short run (given that the marginal patient is 'profitable' for the GP). In other words, a 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.[21] Thus, 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

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. Out of 11,177 positions (9,105 with fee-for-service contracts and 2,072 with fixed-salary contracts), 177 positions (164 with fee-for-service and 13 with fixed salary) have a duration of more than 104 weeks.

[Figures A1-A3 here]

References

[1] Brekke, K.R, Holmås, T.H., Monstad, K., Straume, O.R., 2017. Do treatment decisions depend on physicians' financial incentives? Journal of Public Economics, 155, 74–92.

[2] Brosig-Koch, J., Hennig-Schmidt, H., Kairies-Schwarza, N., Wiesen, D., 2016. Using artefactual field and lab experiments to investigate how fee-for-service and capitation affect medical service provision. Journal of Economic Behavior & Organization, 131, 17–23.

[3] Clemens, J., Gottlieb, J.D., 2014. Do physicians' financial incentives affect medical treatment and patient health? American Economic Review, 104, 1320–1349.

---

[21] 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.

[4] Croxson, B., Propper, C., Perkins, A., 2001. Do doctors respond to financial incentives? UK family doctors and the GP fundholder scheme. Journal of Public Economics, 79, 375–398.

[5] Devlin, R.A., Sarma, S., 2008. Do physician remuneration schemes matter? The case of Canadian family physicians. Journal of Health Economics, 27, 1168–1181.

[6] Gaynor, M., Pauly, M.V., 1990. Compensation and productive efficiency of partnerships: evidence from medical group practice. Journal of Political Economy, 98, 544–573.

[7] Gaynor, M., Gertler, P., 1995. Moral hazard and risk spreading in partnerships. RAND Journal of Economics, 26, 591–613.

[8] Gosden, T., Sibbald, B., Williams, J., Petchey, R., Leese, B., 2003. Paying doctors by salary: a controlled study of general practitioner behaviour in England. Health Policy, 64, 415–423.

[9] Gosden, T., Forland, F., Kristiansen, I.S., Sutton, M., Leese, B., Giuffrida, A., Sergison, M., Pedersen, L., 2000. Capitation, salary, fee-for-service and mixed systems of payment: effects on the behaviour of primary care physicians. Cochrane Database of Systematic Reviews, 3 (3).

[10] Green, E.P., 2014. Payment systems in the healthcare industry: An experimental study of physician incentives. Journal of Economic Behavior & Organization, 106, 367–378.

[11] Gruber, J., Owings, M., 1996. Physician financial incentives and cesarean section delivery. RAND Journal of Economics, 27, 99–123.

[12] Grytten, J., Sørensen, R., 2001. Type of contract and supplier-induced demand for primary physicians in Norway. Journal of Health Economics, 20, 379–393.

[13] Hennig-Schmidt, H., Selten, R., Wiesen, D., 2011. How payment systems affect physicians' provision behaviour - an experimental investigation. Journal of Health Economics, 30, 637–646.

[14] Hickson, B., Altemeier, A., Perrin, M., 1987. Physician reimbursement by salary or fee-for-service: effect on physician practice behavior in a randomized prospective study. Pediatrics, 80, 344–350.

[15] Krasnik, A., Groenewegen, P., Pedersen, P., von Scholten, P., Mooney, G., Gottschau, A., Flierman, H., Damsgaard, M., 1990. Changing remuneration systems: effects on activity in general practice. British Medical Journal, 300, 1698–1701.

[16] Lagarde, M., Blaauw, D., 2017. Physicians' responses to financial and social incentives: A medically framed real effort experiment. Social Science & Medicine, 179, 147–159.

[17] Liddy, C., Singh, J., Kelly, R., Dahrouge, S., Taljaard, M., Younger, J., 2014. What is the impact of primary care model type on specialist referral rates? A cross-sectional study. BMC Family Practice, 15: 22.

[18] Rudoler, D., Deber, R., Barnsley, J., Glazier, R.H., Dass, A.R., Laporte, A., 2015. Paying for primary care: The factors associated with physician self-selection into payments models. Health Economics, 24, 1229–1242.

[19] Sarma, S., Devlin, R.A., Hogg, W., 2010. Physicians' production of primary care in Ontario, Canada. Health Economics, 19, 14–30.

[20] Sarma, S., Mehta, N., Devlin, R.A., Kpelitse, K.A., Li, L., forthcoming. Family physician remuneration schemes and specialist referrals: Quasi-experimental evidence from Ontario, Canada. Health Economics.

[21] Sørensen, R., Grytten, J., 2003. Service production and contract choice in primary physician services. Health Policy, 66, 73–93.

Tables

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

	Fee-for-service only	Fixed salary only	Both fee-for-service and fixed salary	
			Fee-for-service	Fixed salary
	(1)	(2)	(3)	(4)
Dependent variables				
Total fee per consultation	286.0 (154.5)	253.4 (147.1)	286.8 (155.7)	263.1 (146.8)
Recall within 14 days	0.180	0.160	0.183	0.164
Referral to hospital, planned admission	0.052	0.066	0.054	0.067
Number of consultations per day[1]	12.6 (5.2)	7.0 (3.8)	12.0 (4.9)	7.6 (4.1)
Prolonged consultation	0.355	0.309	0.373	0.334
Laboratory test	0.422	0.374	0.401	0.360
Number procedures	0.192 (0.466)	0.095 (0.344)	0.178 (0.461)	0.113 (0.369)
Sick note issued[2]	0.192	0.133	0.188	0.147
Emergency adm. 1-7 days, PCEC[3]	0.010	0.009	0.010	0.010
Emergency adm. 1-14 days, PCEC	0.015	0.014	0.016	0.015
Emergency adm. 1-7 days, hospital	0.014	0.016	0.014	0.017
Emergency adm. 1-14 days, hospital[4]	0.024	0.026	0.024	0.027
Patient characteristics				
Age	50.9 (18.9)	53.6 (19.8)	51.3 (18.9)	54.3 (19.2)
Male	0.384	0.412	0.392	0.429
Comorbidity	0.150	0.112	0.162	0.110
Total income/10,000 NOK	35.5 (27.5)	32.4 (22.7)	35.3 (26.7)	33.5 (60.5)
Low education	0.316	0.353	0.336	0.373
Medium education	0.424	0.441	0.425	0.448
High education	0.260	0.206	0.239	0.179
Locum GP characteristics				
Male	0.492	0.501	0.546	
Age	36.0 (8.6)	35.9 (10.4)	37.0 (9.6)	
Norwegian	0.691	0.700	0.628	
Specialist	0.053	0.033	0.037	
Practice characteristics				
List length/100	12.33 (3.53)	9.12 (3.41)	11.50 (3.44)	9.43 (3.21)
Observations	4,203,027	231,875	572,263	127,615
Patients	1,251,826	111,357	243,813	73,113
GPs	3,139	828	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 7 days after GP consultation. [4] Emergency admission at somatic hospital within 14 days after GP consultation.

Note: Means are taken across consultations for 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	18.4412***	0.0154***	-0.0083***	3.1264***
	(33.56)	(10.53)	(-9.76)	(67.91)
List length	-0.7265***	0.0016***	-0.0002**	0.2752***
	(-19.54)	(15.98)	(-2.96)	(73.87)
Patient characteristics				
Patient male	-0.7489***	-0.0062***	0.0022***	-
	(-5.33)	(-16.47)	(10.13)	
Patient age	0.2694***	0.0006***	0.0002***	-
	(66.24)	(55.72)	(26.85)	
Low education	2.7391***	0.0258***	-0.0027***	-
	(15.38)	(54.24)	(-9.70)	
Medium education	-1.5126***	0.0123***	-0.0006*	-
	(-9.24)	(28.19)	(-2.52)	
Income	-0.0460***	-0.0002***	0.00002***	-
	(-19.76)	(-27.51)	(6.23)	
Comorbidity	48.5234**	0.0036***	0.0163***	-
	(259.25)	(7.24)	(56.03)	
Mean y	284.048	0.179	0.0532	11.872
Fixed effects:				
GP	Yes	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes	-
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes
GPs	4,438	4,438	4,438	4438
Observations	5,134,780	5,134,780	5,134,780	432,513

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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

	(1) Prolonged consultation	(2) Lab test	(3) Procedures	(4) Sickness certificate
Practice characteristics				
Fee-for-service	0.0429***	0.0291***	0.0420***	0.0235***
	(24.87)	(17.18)	(26.81)	(12.30)
List length	-0.0043***	-0.0001	-0.0002*	0.0005***
	(-36.74)	(-0.50)	(-2.30)	(3.70)
Patient characteristics				
Patient male	-0.0146***	-0.0081***	0.0009*	-0.0120***
	(-33.00)	(-18.84)	(2.33)	(-24.43)
Patient age	0.0014***	0.0016***	-0.0001***	-0.0021***
	(111.91)	(124.35)	(-7.69)	(-121.29)
Low education	-0.0285***	-0.0030***	0.0054***	0.0431***
	(-50.90)	(-5.45)	(10.62)	(70.99)
Medium education	-0.0177***	-0.0027***	0.0020***	0.0272***
	(-34.45)	(-5.29)	(4.23)	(51.97)
Income	0.0001***	-0.0001***	-0.0001***	0.0002***
	(13.36)	(-11.31)	(-11.10)	(30.59)
Comorbidity	0.1197***	0.0605***	0.0633***	0.0700***
	(203.52)	(105.07)	(118.53)	(106.93)
Mean y	0.354	0.416	0.184	0.275
Fixed effects:				
GP	Yes	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes
GPs	4,438	4,438	4,438	4,438
Observations	5,134,780	5,134,780	5,134,780	3,418,090

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4. Effects of remuneration schemes on health outcomes.

	Primary care emergency centres		Somatic hospital	
	(1)	(2)	(3)	(4)
	Emergency admission within 7 days	Emergency admission within 14 days	Emergency admission within 7 days	Emergency admission within 14 days
Practice characteristics				
Fee-for-service	-0.0005	-0.0005	-0.0027***	-0.0031***
	(-1.34)	(-1.12)	(-5.97)	(-5.27)
List length	-0.0000	-0.0000	-0.0000	0.0000
	(-1.36)	(-0.80)	(-0.36)	(0.54)
Patient characteristics				
Male	-0.0009***	-0.0015***	0.0015***	0.0020***
	(-8.82)	(-12.44)	(12.37)	(13.15)
Age	-0.00003***	-0.0001***	0.0002***	0.0002***
	(-10.62)	(-15.70)	(43.73)	(57.27)
Low education	0.0034***	0.0054***	0.0027***	0.0047***
	(27.31)	(35.01)	(17.61)	(24.71)
Medium education	0.0011***	0.0018***	0.0005***	0.0010***
	(9.27)	(12.68)	(3.80)	(5.97)
Income	-0.00002***	-0.00003***	-0.00003***	-0.00005***
	(-13.11)	(-17.03)	(-14.62)	(-20.93)
Comorbidity	0.0002	0.0005**	-0.0000	0.0002
	(1.28)	(2.90)	(-0.13)	(0.87)
Mean *y*	0.0097	0.0154	0.0145	0.0238
Fixed effects:				
GP	Yes	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes
GPs	4,438	4,438	4,438	4,438
Observations	5,134,780	5,134,780	5,134,780	5,134,780

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5. Placebo test: Consultations[1] at primary care emergency centres. Service provision estimated without/with municipality-fixed effects.

	(1) Prolonged consultation	(2) Lab test	(3) Procedure	(4) Sickness certificate	(5) Total fee	(6) Admitted to hospital (emergency)
A. Without municipality-fixed effects						
Fee-for-service GP	-0.0075***	0.0097***	-0.0011	-0.0001	-0.1826	0.0045***
	(-5.63)	(7.65)	(-0.92)	(-0.07)	(-0.32)	(4.59)
B. With municipality-fixed effects						
Fee-for-service GP	-0.0025	0.0045***	-0.0014	0.0014	1.2432*	0.0005
	(-1.86)	(3.48)	(-1.13)	(1.14)	(2.13)	(0.45)
Mean y	0.361	0.374	0.155	0.120	392.671	0.140
Fixed effects:						
GP	Yes	Yes	Yes	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes	Yes	Yes
GPs	11,693	11,693	11,693	11,455	11,693	11,693
Observations	2,410,043	2,410,043	2,410,043	1,510,752	2,410,043	2,410,043

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

[1]Patient sample restricted to patients who, in the main sample, are observed merely in consultations with fee-for-service GPs or with fixed-salary GPs.

Table 6. Robustness check: Effects of remunerations schemes on GP behaviour, sample restricted to GPs who have worked as locums more than once *in the same municipality*.

	(1) Fee per consultation	(2) Recall within 14 days	(3) Admitted to hospital (planned)	(4) Consultations per day
Fee-for-service	15.1836***	0.0107***	-0.0002	2.3338***
	(14.46)	(3.86)	(-0.11)	(36.82)
Mean y	285.333	0.177	0.052	11.968
Fixed effects:				
Municipality	Yes	Yes	Yes	Yes
GP	Yes	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes
GPs	1,777	1,777	1,777	3,565
Observations	2,723,074	2,723,074	2,723,074	432,513

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7. Robustness check: Effects of remunerations schemes on service provision, sample restricted to GPs who have worked as locums more than once *in the same municipality*.

	(1) Prolonged consultation	(2) Lab test	(3) Procedure	(4) Sickness certificate
Fee-for-service	0.0258***	0.0268***	0.0468***	0.0298***
	(10.12)	(10.75)	(19.93)	(10.69)
Mean y	0.351	0.415	0.190	0.276
Fixed effects:				
Municipality	Yes	Yes	Yes	Yes
GP	Yes	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes
GPs	1,777	1,777	1,777	1,777
Observations	2,723,074	2,723,074	2,723,074	2,723,074

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8. Robustness check: Effects of remunerations schemes on health outcomes, sample restricted to GPs who have worked as locums more than once *in the same municipality*.

	Primary care emergency centres		Somatic hospital	
	(1)	(2)	(3)	(4)
	Emergency admission within 7 days	Emergency admission within 14 days	Emergency admission within 7 days	Emergency admission within 14 days
Fee-for-service	-0.0017*	-0.0022*	-0.0037***	-0.0045***
	(-2.29)	(-2.41)	(-4.13)	(-4.05)
Mean y	0.010	0.016	0.015	0.024
Fixed effects:				
Municipality	Yes	Yes	Yes	Yes
GP	Yes	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes
GPs	1,777	1,777	1,777	1,777
Observations	2,723,074	2,723,074	2,723,074	2,723,074

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9. Effects of remuneration schemes on GP behaviour *while a locum*, by degree of GP's profit orientation[1]. 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
A. More profit-oriented GPs				
Fee-for-service	18.6515***	0.0135**	-0.0147***	3.2731***
	(13.86)	(3.86)	(-7.22)	(26.47)
Mean *y*	280,368	0.174	0.052	12.9752
GPs	852	852	852	852
Observations	1,499,807	1,499,807	1,499,807	115,590
B. Less profit-oriented GPs				
Fee-for-service	2.9378	0.0239***	-0.0102***	2.4128***
	(1.85)	(5.37)	(-3.58)	(18.29)
Mean y	264.328	0.157	0.060	8.698
GPs	180	180	180	180
Observations	129,595	129,595	129,595	14,902
Fixed effects:				
GP	Yes	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes	-
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[1] Panel A and B are estimated for two different subsamples of locums; those who later establish their own patient list with fee-for-service payment (Panel A) and with fixed salary (Panel B), respectively.

Table 10. Effects of remuneration schemes on GP service provision, by degree of GP's profit-orientation.

	(1) Prolonged consultation	(2) Lab test	(3) Procedure	(4) Sickness certificate
A. More profit-oriented GPs				
Fee-for-service	0.0425***	0.0415***	0.0421***	0.0289***
	(10.27)	(10.15)	(10.63)	(6.28)
Mean y	0.336	0.424	0.209	0.288
GPs	852	852	852	852
Observations	1,499,807	1,499,807	1,499,807	1,002,374
B. Less profit-oriented GPs				
Fee-for-service	-0.0102	0.0056	0.0211***	0.0413***
	(-1.95)	(1.05)	(4.61)	(6.99)
Mean y	0.326	0.382	0.146	0.244
GPs	180	180	180	180
Observations	129,595	129,595	129,595	85,711
Fixed effects:				
GP	Yes	Yes	Yes	Yes
Diagnosis	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
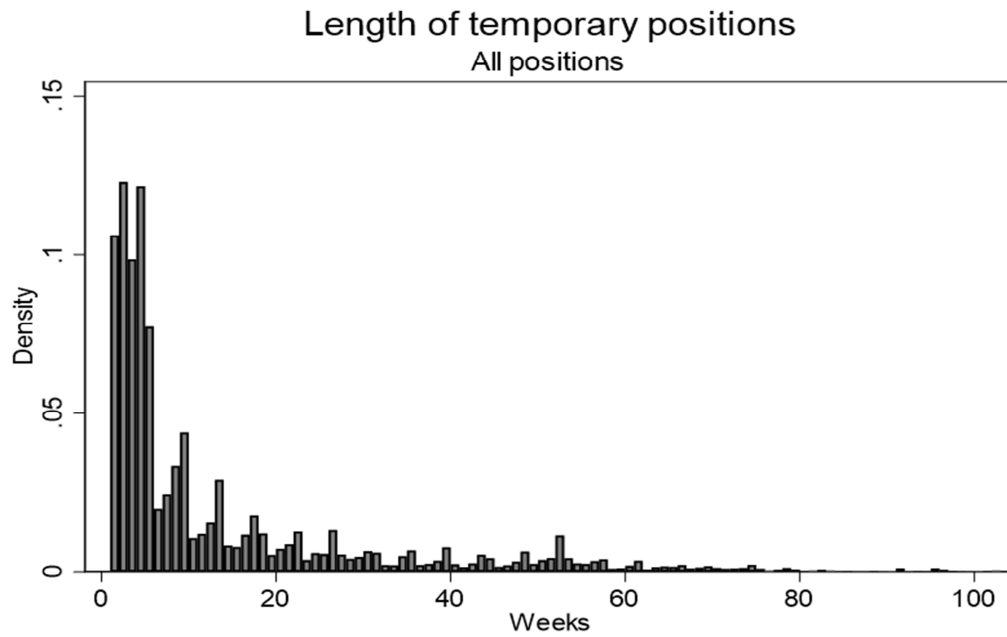
Figures

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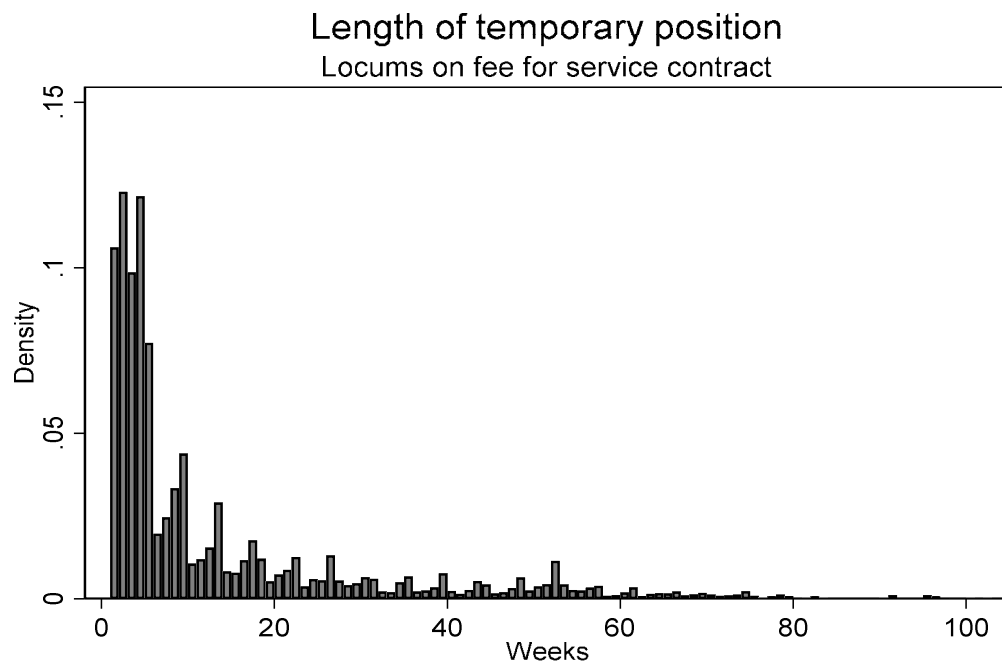

Figure A2. Distribution of GP temporary positions with fee-for-service contracts according to number of weeks.
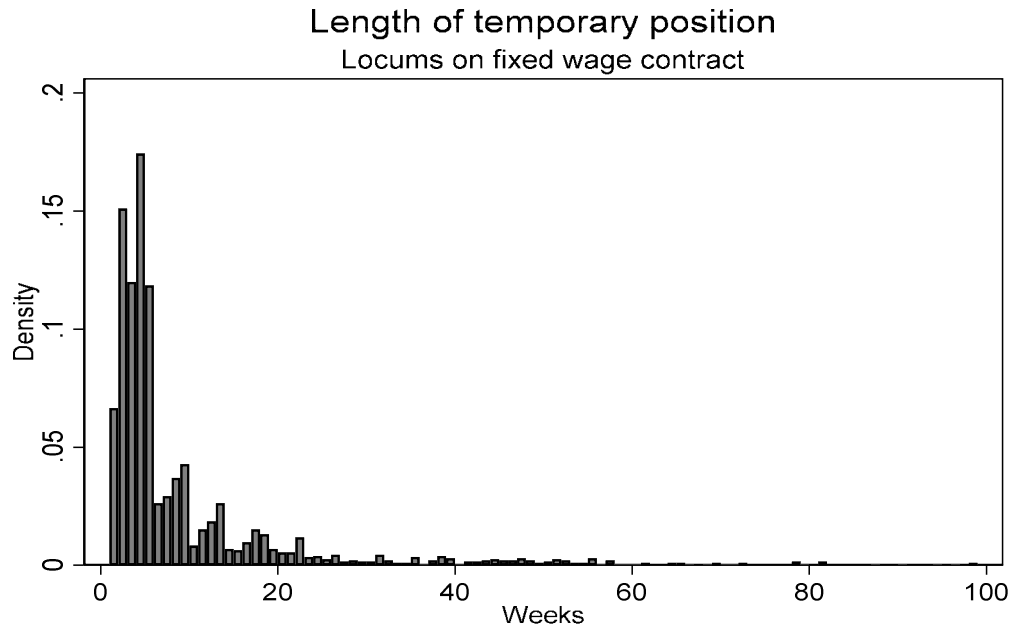
Figure A3. Distribution of GP temporary positions with fixed-salary contracts according to number of weeks.