What explains the quality and price of GP services?
An investigation using linked survey and administrative data

Abstract

We examine patient socio-economic status, the strength of the patient-doctor relationship and local area competition as determinants of the quality and price of GP services. We exploit a large-sample patient data set in Australia and its linkage to administrative databases. The sample contains over 260,000 patients and over 12,600 GPs, observed between 2005 and 2010. Controlling for GP fixed effects and patient health, we find no strong evidence that quality differs by patient age, gender, country of origin, health concession card status and income, but quality is increased by stronger patient-doctor relationship. Using a competition measure that is defined at the individual GP level and not restricted to a local market, we find that competition lowers quality. Price is increasing in patient income while competition has a small impact on price.

1. Introduction

Providing high quality healthcare has always been a core goal of any health system. Primary care by general practitioners (GPs) is an essential part, yet we know very little about it. Do GPs provide different quality care to different patients? Can we increase quality by promoting competition? In a review paper of studies of the market for GP services, Gaynor and Town (2011) describe this lack of empirical evidence as "frustrating" [p.101]. The biggest constraint has been data availability: a consumer survey provides only patient information whilst a GP survey does not have detailed information about each patient. In this paper, we have the opportunity contribute to this literature by observing the linkage between patients and GP services in Australia. Patient data is derived from a large-sample general population survey, so it is not restricted to patients of selected GP practices. For these patients, GP services data are comprehensive, derived from Australian government administrative records. We focus on the role of patient socio-economic status, the intensity of the patient-doctor relationship and the level of competition in determining quality. In addition, as Australian GPs can set their own fees, we also examine the variation in price associated with these factors.

A significant proportion of the existing literature on the quality of GP services consists of program evaluation studies of pay-for-performance (P4P) programs. These programs pay GPs for achieving quality target(s). The UK Quality and Outcome Framework (QOF), enacted nation-wide since 2004, is the largest P4P scheme in scale and in scope (Roland, 2004; Roland et al 2006). The QOF includes a wide range of indicators of patient care, including clinical (80 indicators), organisational (43 indicators), patient experience (4 indicators) and additional services (8 indicators). In other countries, including Australia, P4Ps are smaller in scope, applying to specific services and/or only implemented in certain GP groups or selected provinces and states. Some P4Ps have been found successful in increasing quality (Dudley et al. 1908; Petersen et al., 2006; Eijkenaar et al., 2013; Wang et al., 2011; Scott et al., 2009; McElduff et al., 2004), but others are found to have a transitory impact (Lester et al., 2010) or have produced incentives for GPs to "game" the programs by manipulating the target measures to increase their incomes (Norton, 1992; Doran et al., 2008; Gravelle et al, 2010). Some P4Ps have also been found to result in cream-skimming patients to more easily achieve the targets (Shen, 2003; Roski et al., 2003).

The mixed results of P4P program evaluations, suggest there may be other factors influencing the provision of quality care. Competition could be one of them. There is evidence that competition can increase quality of hospital services (e.g., Propper et al 2008). Gaynor and Town (2011)

review the effect of competition in physician services. However of the fifteen studies of competition reviewed, none had quality as an outcome. Recently Gravelle et al (2013) have studied the effect of competition on quality using Australian GP longitudinal survey data, Medicine in Australia: Balancing Employment and Life (MABEL). They find that competition has no effect on the average length of consultation, their measure of quality. While their sample coverage is nation-wide, the number of GPs in the survey is less than 4,000, of which only half are included in the analysis so sample selection may be a concern. In addition, perhaps due to a high attrition rate, they do not use the panel aspect of the survey to exploit time variation. The quality measure is also self-reported, so biases due to measurement error are likely e.g., GPs with more competition may be more likely to overstate service quality.

Quality may be provided differently to different patients, but because of a lack of appropriate data, the role of patient characteristics has largely been overlooked in this literature. A few studies from the US have found discrimination against low-income and uninsured patients in hospital care (Lopez et al., 2010; Doyle 2005). There is also evidence of racial discrimination in the US, with ethnic minorities, who tend to have lower incomes, receiving lower quality care (Miranda and Cooper, 2004; Betancourt et al., 2003). This may partly be explained by the privately-driven nature of the US health care market. Whether patient socio-demographic characteristics affect treatment quality in the setting of universal health care systems, such as Australia, is an empirical question, which we investigate in this study. It may be possible for patient socio-economic status to affect quality through improved communication with doctors, in turn leading to better health outcomes (Willems et al., 2005).

To study price discrimination, we take advantage of the institutional settings of primary care in Australia, where GPs are paid on a fee-for-service basis and are free to set fees at any level (unbounded above) beyond a regulated floor price. Although there are incentives for GPs to charge at the floor price (which is termed 'bulk-billing'), the free price-setting ability induces heterogeneity in fees across GPs, as well as across patients of individual GPs, who may bulk-bill only some of their patients. Patients have free access to any GP. There is no restriction in terms of insurance group or other membership, enrolment on a GP patient list, or residential location. Without recourse to administrative data it is difficult to observe how much a GP charges each patient.

Our data is derived from a large survey in New South Wales (NSW), the largest state of Australia. It contains over 260,000 respondents and is linked to claims databases of all out-of-hospital doctor consultations, including GP services, used by each respondent during 2005-2010.

In addition to the subsidy paid by the government (Medicare), the claims data contains the actual fee paid by the patient for each service item provided. We construct our quality indicators from these claims data: three measures are based on GPs' management of chronic diseases and a further measure is based on consultation length. Based on over 12,600 GPs in our sample over the study period, many of whom are observed for multiple years; our full sample contains 43,638 GP-year observations. Using GP fixed effects models which account for individual GP heterogeneity, we find that competition does not increase quality. In fact, in one of our models in which the competition measure is based on the GP rather than a geographically defined local area, we find that competition lowers quality. We find no strong quality differential by patient characteristics, except that quality increases with the strength of the patient-doctor relationship. In relation to price, we find that the average price is lowered by competition but the size of the competition effect is small, about 1-3% of the mean price for a large (two standard deviations) increase in the competition measures. The average price is increasing in patient income and decreasing in the patient-doctor relationship.

2. Australian Primary Care Market

Australia has a mixed public and private health system. The public health system, Medicare, heavily subsidises a wide range of medical services and prescription drugs and provides free public inpatient treatment. Private health insurance does not cover out-of-hospital services, with a few exceptions for non-subsidised drugs and ancillary services such as dental and allied health.

Australian general practitioners have a gatekeeper role, providing primary care and controlling access to specialist services and diagnostics. The latest Primary Health Care Research and Information Service (PHCRIS) census in 2010-2011, reported that there were 7,035 practices and 24,720 practising GPs around the country, or one GP per 1,118 population. During our study period, GP services were spatially coordinated by Divisions of General Practice (DGP), administrative entities whose boundaries were devised taking account of population demographics, patient flows and health service use[1]. While DGP neither regulated a GP within its boundaries nor restricted a patient's choice of GP, the divisions developed recruitment and retention strategies and gave a sense of geographic proximity in terms of the characteristics of the local GP market. According to the latest PHCRIS enumeration, there were 111 DGP across the

[1] The DGP was a community-level organisation that allowed local residents to have a say in the provision of their needs. DGPs were diverse in terms of size, but they had common goals of delivering support and services to GPs and strengthening primary care for their local communities. In 2012, DGP were replaced by Medicare Locals. http://www.medicalobserver.com.au/news/medicare-locals-boundaries-mapped

country, with the smallest serving just over 15,000 population with 17 GPs and the largest DGP serving over 650,000 population with 853 GPs. There were 34 DGP in NSW, with an average population size of 207,000, and an average of 220 GPs (200 full-time equivalents).

GPs operate privately on a fee-for-service basis with subsidies for specified services defined by the Medicare Australia Medical Benefits Schedule (MBS). The MBS provides a description of each eligible service (item), its schedule fee and the subsidy level (Medicare rebate) that provides a floor price for the item. There are about 50 GP attendance items, which are consultations that vary by time (normal hours or after hours), length (specified in 20 min blocks), and location (consultation room, home visit, hospital or residential aged care facility or institution). By far the most common is item number 23 for a level B consultation at a consultation room outside hospital setting during normal hours. The MBS description of consultations reflects both length and content. Level A consultations are mostly used for straightforward tasks such as immunisation. Level B consultations involve "taking a selective history, examination of the patient with implementation of a management plan in relation to one or more problems, or a professional attendance of less than 20 minutes duration involving components of a higher level service." Level C consultations involve a higher level service, "taking a detailed history, an examination of multiple systems, arranging any necessary investigations and implementing a management plan in relation to one or more problems, and lasting at least 20 minutes." The highest level is a level D consultation, which is more comprehensive, for more complex problems lasting at least 40 minutes. In 2010-2011, the distribution for these four consultation levels was 2.8%, 86%, 10% and 0.8% (Medicare Australia, 2011). Reflecting the higher levels of complexity, the associated schedule fees are also increasing from $16 for a level A consultation, to $34.90 for level B, $67.65 for level C, and $99.55 for level D consultations. The schedule fee is indexed to wage inflation on an annual basis.

For all GP attendance items, the Medicare rebate is 100% of the schedule fee. If a GP charges above this level, patients pay the gap as an out-of-pocket cost. While there is no rule governing an upper bound to the charge, Medicare pays financial incentives to GPs who charge specific classes of patients the floor price (bulk bill). In 2009/2010, Medicare paid an extra $5.70 per service to GPs who bulk billed minors (aged under 16) and health concession card holders. GPs in rural or remote areas and in some metropolitan areas, deemed to have GP shortages, receive an extra $8.55 per bulk-billed service. Over 80% of GP services provided outside hospitals are bulk billed (Australian Government Department of Human Services, 2012, chapter 7). Bulk billing rates are higher in areas of greater GP density reflecting higher local competition (Jones and Savage, 2004; Johar, 2012).

One of the major concerns with a fee-for-service payment system is that it may compromise quality of care, for instance by encouraging a high volume of short consultations. There is a growing body of evidence suggesting that GPs with longer consultation times provide better clinical care and also achieve greater communication with patients, increased levels of patient satisfaction and lower prescribing rates (Goedhuys and Rethans, 2001; Freeman et al., 2002; Howie et al., 1991; Jaye and Tilyard, 2002; Béjean et al., 2007; Campbell et al., 2001; Wilson et al., 2002). In the extreme case of 'six minute medicine', a GP charging at the rebate level can generate 75% more revenue from ten level B consultations in an hour than from three 20 minute level C consultations. Britt et al., (2004) using self-reported survey data, find that Australian GPs report spending an average of 11 minutes on level B consultations and 27 minutes on level C consultations. Using these figures, we can illustrate the existing financial disincentives to provide long consultations. In a 7 hour day, a GP who charges at the rebate levels can derive 29% more revenue from providing level B consultations than level C consultations. GPs whose market power would allow them to charge high fees are likely to benefit more from adopting this high volume strategy.

In an attempt to promote high quality care, the government introduced the Practice Incentive Program (PIP) in July 1998. The PIP offers 13 financial incentives to practices which achieve target measures in selected services (cervical cancer screening, diabetes and asthma), improving capacity in terms of computerisation, adhering to prescribing guidelines, providing after-hours care and services to indigenous, rural or older patients and involvement in teaching. The PIP for cervical cancer screening and diabetes, makes 3 payments: (i) a sign-on payment, a one-off payment for setting up a register and reminder system; (ii) outcome payments which reward higher screening rates or completions of the annual cycle of care for patients with diabetes; and (iii) service incentive payments, an annual payment for every newly screened woman or new diabetes patient. PIP asthma incentives provide only sign-on and service incentive payments. The PIP operates at the practice level, and over 70% of GP practices participate.

A further programme aimed at improving patient outcomes is chronic disease management (CDM). By 2020 it is expected that 80% of Australia's burden of disease will be attributed to chronic conditions and that this proportion will grow as the population ages. CDM is a coordinated approach to minimise the impact of chronic illness and prevent or delay its progression, thereby improving the quality of life and health outcomes of those diagnosed with one or more chronic diseases. Unlike PIP, CDM is not a pay-for-performance scheme. CDM requires a comprehensive health assessment, the use of multidisciplinary shared care plans, the application of evidence-based protocols in managing patient's health and care needs, and the

promotion of active self-management where possible. CDM is a potentially time consuming task for GPs. For example, in providing a Management Plan, a GP, must: (a) assess patient's health care needs, problems and conditions; (b) develop agreed management goals with the patient; (c) identify actions to be taken by the patient; (d) identify treatment and services that the patient is likely to need and make arrangements for these services; and (e) document all of these steps in the GP management plan document. A new management plan may be required around once every two years, with regular reviews (recommended six monthly) of the patient's progress against the plan.

3. Data and Methodology

The data are derived from three sources: (i) the NSW 45 and Up Study which surveyed each respondent once during 2006-2010 (45 and Up Study Collaborators, 2007); (ii) Medicare Australia's Medicare Benefit Schedule data for 2005-2010; and (iii) DGP data from PHCRIS. The 45 and Up survey is a large sample study, involving 266,804 respondents. This is 10% of the 45+ population in NSW and the sample demographic characteristics align with the 45+ population characteristics from the national health survey (Johar et al., 2012). For our sample, we exclude respondents who volunteered to be part of the survey and those who do not have a valid age. The final sample is 265,468 respondents. This survey data is linked at the individual level to Medicare data, covering all subsidised medical services used by the survey respondents.[2] The GPs in our study are those with either FRACGP/CRRM or VRGP/ACCRM accreditation, who provide services to respondents of the 45 and Up Study at any time during the period 2005-2010. A unique encrypted GP identifier indicates his/her pool of patients. There is no practice-level identifier.

These GPs may provide multiple services to a single respondent and may treat more than one respondent. They also may be located outside NSW if they provide services to the 45 and Up survey respondents. On average, a survey respondent visits two different GPs per year and between four and five unique GPs over the 5 year period. The GP coverage of our 45+ sample is very high, with over 8,000 GPs in the sample each year; this is close to the number of GPs in

[2] The 45 and Up survey is collected and managed by the Sax Institute which also performs the linkage to the Medicare data (for details see http://www.saxinstitute.org.au/). The linked, de-identified data is accessed with ethics approval. Participants were randomly selected from the Medicare database for this population age group. The survey was done in stages, but the bulk of it (about 80%) was collected in 2008. This variation in survey year is due to sampling process rather than the choice of respondents.

NSW reported by PHCRIS.[3] The unit of observation is GP-year; we aggregate patient-year data to GP-year level data. Over the five year period of our data, we have 12,652 accredited GPs resulting in 43,638 GP-year observations.

We derive all of our variables for the analysis based on the definition of a patient pool. A patient in this study is a respondent of the 45 and Up Study. Each year a GP has about 52 patients. We acknowledge that this definition of a patient pool misses patients under the age of 45, so price and quality may be measured with error if, for example, GPs tend to charge older patients lower fees or provide extra care to them. Measurement error in outcome variables however does not create bias if it is uncorrelated with covariates. In addition, the GP fixed effect approach provides some control over the variation in the full patient list.

3.1. Quality

As quality indicators, we consider several measures, all derived from the administrative data. The first measures are CDM activities: the number of CDM consultations per 100 total consultations and the GP's per patient revenue from CDM. In 2009, the rebate for the first CDM consultation by an individual GP was about $134 and a CDM review attracted $67. Although technically GPs can charge anything above the CDM rebate, we find that the majority charge at the floor price (the mark-up is less than $1 on average). The second measure is based on PIP. PIP items (cervical screening, asthma cycle and diabetes cycle) are conducted during consultations and attract the same rebate as non-PIP consultations. PIP payments are paid separately at the practice-level. Because we do not have practice identifiers, we cannot use revenue as an intensity measure of PIP activities. Hence we use only the number of PIP consultations per 100 total consultations. The final measure that we use is the share of long consultations out of total consultations. The long consultations are given by level C and level D consultations (i.e., over 20 minutes).

3.2. Price

The measure of price is the average fee charged by a GP for Medicare item 23 consultations, measured in constant A$2009. In order to have a single price, we select a specific item, rather than a type of service (e.g., standard consultations, which have a different price if performed after hours or not in a GP consulting room). We use Item 23 because all GPs provide it and it is the most frequent service provided by GPs. The average fee is computed including all item 23 consultations, not just item 23 consultations where fees are above the Medicare rebate; GPs who

[3] In 2010, the PHCRIS estimated there are 7,822 practising GPs in NSW. Our GP number is larger because our sample may include GPs in other states used by the 45 and Up survey respondents during the study period. The data can be downloaded from www.phcris.org.au/products/asd/keycharacteristic/KeyDGPstatistics.xls

bulk-bill many of their patients will have a lower average price. There are over 4 million item 23 consultations in our data during the entire study period. An average GP provides about 107 item 23 consultations in a year to our patient sample. As this price is obtained from administrative data rather than survey data, we avoid the likely measurement errors in self-reported fee data, which are likely to be correlated with observed determinants of price, such as competition.

3.3. Competition

We consider three measures of competition, each with strengths and limitations. The first measure is the full-time GP to thousand population ratio at the DGP level. We obtain this information from the PHCRIS data. Physician density is commonly used, with the expectation that the higher the ratio the more intense is the competition level in the area. There is, however, concern that a DGP may be too wide to define a local market. Our second measure therefore attempts to address the issue of locality by narrowing the market to a postcode-level. There are over 600 residential postcodes in NSW with an average population of about 10,800 residents, as opposed to the 34 DGPs' average of some 200,000 residents. Our sample covers all 34 DGPs and over 520 postcodes in each year (549 postcodes over all 5 years). PHRICS does not collect information at the postcode-level. However, given the wide coverage of our data, we can utilise internal variation.

Using the GPs in the sample, for each year we compute the number of GPs in a given postcode. This number may include part-time GPs because we have no information on GP hours. Using postcode-year observations, the average number of GPs per postcode in our data is 20 with a median of 13. As a reference, the total number of full-time GPs in NSW in the PHRICS data implies an average of approximately 16 GPs per postcode. Hence, despite being restricted to GPs used by respondents, our data covers a large number of GPs per postcode, suggesting high accuracy of this measure of competition.

Any area-based measure of competition may be correlated with unobserved area determinants of price and quality. To the extent that a GP's location preference is pre-determined however, these biases are removed by GP fixed effects. Our third measure attempts to break this notion of locality and uses information about other GPs used by patients. Gravelle et al (2013) propose a new measure of competition at the GP practice-level based on distance to other practices (not limited to GPs in the survey). In our case, because we do not know the location of GPs who are not used by sample respondents, we cannot use this measure. Alternatively, for each patient, we find the list of GPs he/she visits in each year; this includes any GP, not only those that practice in the same location as the patient's residence. Based on this information and the identification of a

patient pool for each GP in a given year, we count the number of unique, other GPs used by the GP's patients to capture the extent of his/her potential competitors. Most patients (95%) visit no more than two different GPs in a year. For comprehensiveness, we construct our measure of number of potential competitors by considering patients using up to three different GPs. This does not mean that we restrict the number of a GP's potential competitors to three. Each GP can have any number of competitors, depending on whether or not his/her patients see many GPs. For example, a GP with four patients will have 12 competitors if each patient sees 3 distinct other GPs, but he/she will have no competitors if all of them see only him/her. Although a patient's choice set of GPs is not observed by a GP, the patient may convey that he/she is also seeing other GPs and this may induce the GP to lower his/her price and increase quality; the GP may also notice that the number of patient appointments is declining. This measure is in the spirit of the competition measure proposed by Gravelle et al (2013), in that both measures define competition at the individual GP level.

3.4. Patient profile

From the survey, we obtain patient socio-demographic and income status information. The health information in the 45 and Up survey data provides information on a patient's long-term health conditions. The information includes diagnosed chronic illnesses, consumption of over-the-counter medicines, and medical treatments received for various conditions. We use all of these variables to construct a summary measure of a patient's health, which is a count of having been diagnosed or treated for the following conditions: any type of cancer, high blood pressure, heart disease, blood diseases, high cholesterol, thyroid disorders, digestion problems, bone diseases, asthma or hay fever, stroke, Parkinson's disease, depression and diabetes. The maximum score is 12 for someone with all of the above conditions. This health score seeks to capture health status more accurately than would the condition that initiated a single GP consultation. In addition, to allow for a different impact on price and quality indicators of specific conditions, we construct separate variables for each of cancer, hypertension, heart, high cholesterol, asthma and diabetes.

We also obtain information about a GP's relationship with patients. The literature has suggested that an ongoing relationship or familiarity with GP can facilitate higher quality care, but we cannot find any evidence of the effect on price of the patient-doctor relationship. On the one hand, a closer relationship may attract a discount or shorter consultation because the GP is familiar with the patient's medical history, but on the other hand loyalty may also allow the GP to charge a premium.

3.5. Descriptive statistics and multivariate analysis

Table 1 presents the summary statistics of all variables overall (GP-years) as well as indicating the extent of variation by providing the standard deviations between GPs and within each GP over time. The average price overall (in constant $A2009) is about $37, about $5 above the floor price. The between variation (between different GPs) is much larger than the within variation (within a GP over time). On average there are 4 CDM consultations and 0.3 PIP consultations per 100 consultations. PIP consultations are infrequent because PIP participation is not universal, and PIP only covers cervical screening, asthma and diabetes. The average per patient revenue from CDM is about $13 and the average long consultation rate is 16%. As with price, the between variation in quality is larger than the within variation, but there is still considerable within variation. The competition measures indicate that the average GP per thousand people in a DGP is 0.94, the average number of GPs in a postcode is 49, and the average number of GP specific competitors is 26. The within variation in these competition measures is quite small, which should not be surprising since GP supply is slow changing.

[Table 1 here]

Because the analysis is conducted at the GP level, patient characteristics have to be aggregated. We therefore compute for each GP: the share of patients in various age and income groups, the share of male patients, the share of health concession card patients, the share of patients who were foreign born, the average health score index and the share of patients with specific chronic diseases. To create a measure of the strength of the patient-GP relationship, for each GP, we first identify patients who only visited that GP during the entire year. Then among these patients, we calculate the proportion who visited that GP only once ('One-off'). The idea here is to capture minimal patient-GP interaction, but removing correlation with competition (i.e., patients visiting a number of different GPs). However there will be GPs with all of their patients also seeing other GPs in which case the ratio One-off is not defined. We create an indicator variable for these GPs ('One-off missing').

As expected, patient characteristics exhibit smaller within GP variation, because respondents tend to go to the same GP. However, the extent of the within variation is not small, despite the restriction that the patient pool consists only of survey respondents. Patients of an average GP in the sample tend to have 2-3 chronic conditions; 3-4 in 10 patients have high blood pressure, high cholesterol or cancer (including skin cancer and melanoma); 1-2 in 10 patients have asthma, diabetes or heart problems and 4 in 10 patients are male. Approximately 20% GPs have no patients who visit them exclusively during the year. Of the remaining 80%, the mean One-off ratio is about 0.25.

To model the impact of market and patient characteristics on price and quality of care, we estimate GP fixed effect models. In the administrative patient claims databases, we do not have detailed information about the GP, such as is available in GP survey data. However, most GP background characteristics such as gender, origin, medical qualifications and professional ethics are fixed, so a GP fixed effect model will control for the confounding effects of these time-invariant factors that might affect price and quality. Location and practice-level variables such as whether the GP practices as a solo practitioner or in a group practice are also relatively slowly changing, at least over the short-term of our data, so their effects are also likely to be absorbed by the GP fixed effect. As Table 1 indicates, there is significant within GP variation in the data, which aids credibility of the GP fixed effect model. While the fixed effect models are preferred, we also provide pooled OLS estimates as a comparison to highlight the bias in failing to adequately account for fixed effects. Because the impact of time-invariant factors can be identified in OLS, we include the SEIFA index of socio-economic advantage and dummy variables for remoteness based on the ARIA index, both constructed by the Australian Bureau Statistics. In all models we also include year dummy variables to pick up macroeconomic trends.

4. Results

Table 2 reports the sources of price variation. All three competition measures have negative coefficients in the fixed effect models, confirming that average price is lowered by competition. All else constant, a two standard deviation increase in the competition measures leads to a $0.55-$1.05 reduction in price on average, or about 1-3% of the mean price. This impact is not very large, suggesting that GP's pricing behaviour, at least for the most demanded service, is quite insensitive to even large changes in competition.

[Table 2 here]

In relation to the extent of patient-based discrimination, we find that price is decreasing in patient general health, age, concession card and foreign-born status, and increasing in patient income. The income gradient is quite large given that income information is not typically supplied to GPs, although GPs may infer it from indicators such as address and occupation. This result may reflect increasing willingness to pay by income. The marginal effect of the share of the highest income patients is a $5 increase in fee, on average, relative to that of the share of the lowest income patients. This result is consistent with Johar (2012) which shows that there is a $6 fee gap for item 23 between the highest and lowest income patients of an average GP. There is no evidence

of discrimination by the patient gender. Familiarity with a GP attracts a discount, as we find that price is increasing in One-off. The GP fixed effect models have good explanatory power, indicated by the high R-squared of nearly 0.9. The bulk of the variation (about 80%) is due to GP heterogeneity, but patient characteristics play a non-trivial role.

In OLS, we can identify the effects of remoteness and the area's socio-economic advantage index. We find that price is lower in major cities and higher in areas of greater socio-economic advantage. In the fixed effect models, these effects are absorbed by the fixed effects. For time-varying variables, the OLS and area fixed effect models show several marked differences. OLS exaggerates the effect of competition, suggesting that omitted factors that negatively affect price (e.g. city areas) are positively correlated with competition. In other words, GPs who do not mind competition are also those who are prepared to receive a lower average price. The OLS model indicates significant discrimination against male patients. Even after controlling for the area socio-economic advantage level, individual patient income still shows a very strong gradient, especially for the highest income group. OLS overestimates the patient income effect, suggesting a positive correlation between the GP's latent financial motive and patient income. The effects of the proportions of foreign-born and one-off patient-GP interaction are also exaggerated. OLS indicates that GPs whose patients also see other GPs have higher prices, but this can be explained by GP fixed effects (e.g., the characteristics of patient pool). These differences highlight biased causal inference when relying on OLS estimates of price determinants.

We investigate whether competition has a bigger impact on the bulk-billing rate than on the price level. Table 3 reports the results using bulk-billing rate as the dependent variable instead of price. Slightly over 30% of cases involve 100% bulk-billing, with the remainder incurring some out-of-pocket charge. The mean bulk-billing rate is 71%. We find that the impact of competition on the bulk-billing rate is larger than the impact on price, but it is still quite small. Fixed effect Model 1 predicts 0.06 percentage points (8% of the mean bulk-billing rate) increase in bulk-billing rate for a two standard deviation increase in the GP to population ratio while fixed effect Model 3 predicts 0.03 percentage points increase in the bulk-billing rate for a two standard deviation increase in the number of local competitors. Fixed effect Model 2 predicts smaller impacts and not significantly different from zero. Other results are consistent with Table 2. For instance, we find no significant correlation between the bulk-billing rate and gender, and the bulk-billing rate is negatively correlated with patient income.

[Table 3 here]

Tables 4 and 5 report the results for models which use the CDM measures as the quality indicator. Models 1 and 2 use the GP to population ratio and the number of GPs in a postcode as measures of competition. The fixed effect models indicate that competition has no significant impact on CDM activities. However in Model 3, using the number of competitors for a GP's patients as the competition measure, which is not confined to the definition of a local GP market, we find that competition lowers CDM activities. This negative competition effect is unexpected. Previous results based on OLS or within-area models indicate that competition and quality are positively correlated. Our results are the first to be based on within-GP variation, which removes many time-invariant confounding factors driving the positive correlation between competition and quality across GPs. A two standard deviation increase in the number of competitors is associated with 2.2 fewer CDM consultation per 100 consultations (55% of the mean) and $3 lower per patient CDM revenue (24% of the mean). Since the average size of a patient pool for GPs in the sample is about 50, a two standard deviation change, which is also 50, is equivalent to each patient seeing another GP.

[Table 4 here]

[Table 5 here]

The GP fixed effect models indicate that CDM activities are also increasing in diabetes patients, but there is no evidence of a positive impact for other chronic diseases. One explanation for this is that, relative to other chronic conditions, there is more knowledge and agreement on the protocol for diabetes diagnosis and care, which may include CDM. Diabetes is also closely linked to diet and lifestyle choices, and CDM can integrate consultations with a nutritionist. Diabetes also tends to be co-morbid with other conditions such as high cholesterol and hypertension. CDM activities are decreasing in patient income and one-off patient-GP interactions, suggesting a positive effect of patient-doctor relationship on quality.

Table 6 reports the results for PIP. Like CDM, competition has no impact on quality according to the area-based competition measures (FE1 and FE2), however GPs with more competitors provide lower quality. PIP activities are increasing in the shares of diabetes and female patients Diabetes and cervical screening are two of the three components of PIP. The correlation with diabetes is particularly strong, perhaps reflecting the wide knowledge and guidelines available about diagnosing and managing diabetes and GPs' more aggressive attitude towards tackling diabetes. Asthma, the other component of PIP, is not significant, perhaps due to the low likelihood of a new asthma diagnosis in our older population sample and/or self-management is enough for the stage of their asthmatic condition. Finally, PIP is decreasing in one-off patient-GP

interactions. OLS indicates that PIP activities are lower in socio-economically advantaged areas which may reflect relatively lower rates of diabetes and asthma in these areas.

[Table 6 here]

Table 7 reports the results for our last measure of quality, the share of long consultations. Again, the competition effect depends on the measure of competition used. Quality is increasing in area-based competition measures but decreasing in the number of competitors to individual GPs. In any case, however, we find that the size of the competition effect is rather trivial. For a large (two standard deviations) increase, we find that the effect is about 11-13% of the mean rate for the area-based measures and 3% for the number of competitors. The proportion of long consultations is decreasing in the proportion of high cholesterol patients, which may capture alternative treatment options such as drugs (rather than consultation). It is also decreasing in the one-off patient-GP interaction. OLS results support the common conjecture that higher income patients tend to receive longer consultations. The fixed effect models however suggest that this positive correlation is not causal.

[Table 7 here]

In summary, we find that competition has a negative impact on price, but the size of the impact is trivial. The competition impact on the bulk-billing rate is larger, but still considerably small. Price is increasing in patient income. The effect of patient income on quality is significant only in some models but the direction of the impact is always negative. On the other hand, we find a robust positive impact of patient-doctor relationship on quality. Area-based measures of competition have no impact on quality, but we find negative competition effects on all of our four quality indicators due to an increase in the number of individual GP's competitors.

Gravelle et al (2013) suggests that the competition effect may be enhanced by the absence of price competition, because then, competing on quality is the only way to attract patients. In our data, we can use the information on patient characteristics that are highly correlated with bulk billing. Bulk-billed patients are more likely to be health concession card holders and are less likely to be high income earners, so we create interaction terms between competition and patient concession status and high income. A significant coefficient on the interaction term with health card in the same direction as the competition effect would support this view. On the other hand, the competition effect should be smaller with a higher share of high income patients. Table 8 reports the results based on fixed effect model FE3. Separate models were estimated for each interaction term. For CDM, the results are as expected; the coefficients of the interaction terms

with income have the opposite sign to the competition effect while the coefficient of the interaction term with health card has the same sign. This suggests that the adverse impact of competition on quality may be particularly felt by low income patients and concession card holders (e.g., old patients, low income and rural patients). The results for long consultation also support this prediction. In contrast, for PIP, we do not find the expected results, perhaps due to varying prevalence of asthma, diabetes and cervical cancer, the three conditions covered by PIP, by patient socioeconomic status.

[Table 8 here]

So far we have assumed that survey information is stable across years. This may not be true, for example, patients may acquire a new illness or change their income over time. As a robustness check, we exclude medical services that occur more than twelve months prior to the survey date, and re-estimate all models. We retain 92% of the sample and the results are robust: strong positive impact of income in the price equation and consistent positive impact of diabetes in all quality equations. As another robustness check, we impose a sample restriction to include only GPs who appear at least four times in the five year period to get better identification of the fixed effect. We retain over 75% of the sample and again we find that the main results are robust.

6. Conclusion

Exploiting the opportunity to observe the behaviour of thousands of GPs and the characteristics of their patients, we study the determinants of quality and price of GP services. We find some evidence that competition may lower quality, rather than increase it. Moreover, we find some evidence that the adverse impact of competition is more likely to be experienced by low income patients and concession card holders. This finding is derived from a measure of competition that is defined at the individual GP level and is not restricted to the definition of a local GP market. In terms of patient characteristics, we find only one strong determinant of quality, the patient-doctor relationship, suggesting that there is an additional degree of care that is exerted when a GP treats a patient who he/she has previously treated. With regard to the determinants of price, although competition lowers price, only a large change in competition will induce a meaningful change in price. A big driver of price variation is patient income, although there is little evidence that quality is higher for high income patients.

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Table 1: Descriptive statistics

	Overall Mean	s.d.	Between s.d.	Within s.d.	Fixed effect Mean
Outcome					
Price	$37.38	$8.80	$8.41	$3.96	$37.68
Bulk-billing rate	0.711	0.336	0.337	0.116	0.695
CDM /100 consultation	3.904	10.118	8.961	5.996	3.506
CDM $/patient	$12.88	$26.56	$24.03	$14.58	$11.10
PIP /100 consultations	0.306	1.429	1.567	0.770	0.281
% long consultation	0.164	0.175	0.165	0.074	0.154
Competition					
FT GP/1000 pop	0.943	0.161	0.156	0.034	0.928
# competitors (/10)	2.575	2.473	2.233	0.894	2.061
# GPs in a postcode (/10)	4.880	4.505	4.482	0.317	4.934
GP's Patients					
Illness score	2.307	0.817	0.918	0.416	2.340
Asthma	0.157	0.155	0.177	0.084	0.160
Diabetes	0.108	0.134	0.154	0.069	0.109
Heart	0.155	0.156	0.177	0.084	0.157
High cholesterol	0.290	0.194	0.221	0.102	0.291
Hypertensive	0.433	0.213	0.241	0.112	0.438
Cancer	0.350	0.211	0.237	0.108	0.358
Male	0.427	0.225	0.248	0.108	0.425
Aged <55	0.259	0.192	0.208	0.106	0.251
Aged <55-64	0.331	0.202	0.226	0.116	0.337
Aged <65-74	0.227	0.188	0.212	0.104	0.235
Aged <75+	0.178	0.175	0.189	0.089	0.171
Foreign-born	0.306	0.249	0.260	0.098	0.293
Income <$20k	0.218	0.196	0.221	0.095	0.225
Income $20k-<$40k	0.169	0.165	0.189	0.087	0.174
Income $40k-<$70k	0.167	0.150	0.172	0.082	0.165
Income $70k+	0.222	0.195	0.209	0.091	0.214
Income missing	0.224	0.172	0.198	0.091	0.222
Health concession card	0.313	0.224	0.251	0.108	0.324
One-off	0.207	0.279	0.225	0.198	0.188
One-off missing	0.218	0.413	0.421	0.223	0.342

Note: 'Overall mean' ignores the panel nature of the data. 'Fixed effect mean' is GP average over time with only one observation per GP. One-off missing is a dummy variable that takes a value of 1 if a GP did not have any patient who visited just him/her in a given year (which determines the denominator of One-off), and 0 otherwise. One-off missing is always 0 when One-off is zero but One-off can be zero because patients who visited just him/her in a given year always made multiple visits. The overall sample size is 43,638 GP-year observations.

Table 2: The determinants of average price

	OLS1		FE1		OLS2		FE2		OLS3		FE3	
	b	s.e.	b	s.e.	b	s.e.	b	s.e.	b	s.e.	b	s.e.
FT GP/1000 pop	-5.593***	(0.313)	-1.708**	(0.695)								
# GPs postcode (/10)					0.148***	(0.009)	-0.116*	(0.062)				
# competitors (/10)									-0.449***	(0.022)	-0.136***	(0.024)
Illness score	-0.198*	(0.111)	-0.439***	(0.137)	-0.241**	(0.112)	-0.441***	(0.137)	-0.246**	(0.111)	-0.440***	(0.137)
Asthma	0.173	(0.320)	0.598	(0.368)	0.217	(0.320)	0.602	(0.367)	0.305	(0.319)	0.611*	(0.368)
Diabetes	-0.652**	(0.332)	-0.174	(0.402)	-0.610*	(0.333)	-0.168	(0.402)	-0.733**	(0.330)	-0.178	(0.402)
Heart	-0.012	(0.327)	-0.195	(0.392)	0.104	(0.328)	-0.193	(0.392)	0.090	(0.327)	-0.199	(0.392)
High cholesterol	-0.392	(0.275)	0.609*	(0.326)	-0.462*	(0.276)	0.613*	(0.326)	-0.473*	(0.275)	0.610*	(0.326)
Hypertensive	-0.582**	(0.261)	0.436	(0.301)	-0.432	(0.262)	0.441	(0.300)	-0.456*	(0.261)	0.428	(0.300)
Cancer	1.593***	(0.254)	0.753**	(0.293)	1.606***	(0.254)	0.760***	(0.293)	1.916***	(0.254)	0.771***	(0.293)
Male	-2.579***	(0.204)	-0.384	(0.271)	-2.635***	(0.205)	-0.384	(0.271)	-2.525***	(0.205)	-0.403	(0.271)
Aged <55	-1.498***	(0.312)	2.745***	(0.409)	-1.802***	(0.312)	2.755***	(0.409)	-1.479***	(0.311)	2.740***	(0.409)
Aged <55-64	1.340***	(0.273)	3.153***	(0.355)	1.219***	(0.274)	3.178***	(0.355)	1.266***	(0.273)	3.150***	(0.355)
Aged <65-74	0.230	(0.280)	1.347***	(0.343)	0.211	(0.281)	1.359***	(0.343)	0.241	(0.280)	1.349***	(0.343)
Foreign-born	-3.029***	(0.178)	-0.742***	(0.274)	-3.525***	(0.176)	-0.742***	(0.273)	-3.465***	(0.174)	-0.763***	(0.273)
Income $20k-<$40k	2.386***	(0.283)	0.597*	(0.362)	2.456***	(0.285)	0.584	(0.362)	2.629***	(0.282)	0.613*	(0.361)
Income $40k-<$70k	4.960***	(0.355)	2.331***	(0.439)	4.994***	(0.358)	2.315***	(0.438)	5.367***	(0.354)	2.363***	(0.439)
Income $70k+	13.738***	(0.357)	5.224***	(0.435)	13.651**	(0.357)	5.217***	(0.435)	13.871**	(0.356)	5.264***	(0.436)
Income missing	3.036***	(0.274)	1.806***	(0.358)	3.063***	(0.275)	1.794***	(0.358)	3.173***	(0.273)	1.819***	(0.358)
Health concession	-3.831***	(0.224)	-2.245***	(0.286)	-3.887***	(0.225)	-2.238***	(0.286)	-3.913***	(0.224)	-2.245***	(0.286)
One-off	0.635***	(0.145)	0.303***	(0.115)	0.683***	(0.145)	0.303***	(0.115)	1.041***	(0.144)	0.326***	(0.115)
One-off missing	1.330***	(0.106)	0.075	(0.110)	1.350***	(0.106)	0.074	(0.110)	0.451***	(0.116)	0.029	(0.110)
Inner region	2.155***	(0.102)			2.492***	(0.099)			2.940***	(0.094)		
Outer region	2.214***	(0.144)			3.659***	(0.123)			3.225***	(0.124)		
Remote	1.144***	(0.270)			2.371***	(0.268)			1.769***	(0.269)		
SEIFA	9.156***	(0.626)			11.844**	(0.602)			11.831**	(0.599)		
Constant	26.543***	(0.880)	32.136**	(0.792)	18.076**	(0.739)	31.170**	(0.591)	19.651**	(0.740)	30.977**	(0.490)
R-squared	0.317		0.890		0.316		0.890		0.324		0.890	

Note: All models include dummy variables for year. Standard errors are White's robust standard errors. *, ** and *** indicates statistical significance at 10%, 5% and 1% level, respectively.

Table 3: The determinants of bulk-billing rate

	OLS1		FE1		OLS2		FE2		OLS3		FE3	
	b	s.e.	b	s.e.	b	s.e.	b	s.e.	b	s.e.	b	s.e.
FT GP/1000 pop	0.326***	(0.011)	0.174***	(0.027)								
# GPs postcode (/10)					-0.004***	(0.000)	0.001	(0.002)				
# competitors (/10)									0.022***	(0.001)	0.006***	(0.001)
Illness score	0.011**	(0.005)	0.014**	(0.006)	0.013***	(0.005)	0.015**	(0.006)	0.013***	(0.005)	0.015**	(0.006)
Asthma	0.008	(0.013)	-0.007	(0.015)	0.006	(0.013)	-0.008	(0.015)	0.002	(0.013)	-0.008	(0.015)
Diabetes	0.026*	(0.015)	0.030*	(0.017)	0.025*	(0.015)	0.030*	(0.017)	0.030**	(0.015)	0.030*	(0.017)
Heart	0.010	(0.014)	0.020	(0.017)	0.005	(0.014)	0.02	(0.017)	0.005	(0.014)	0.021	(0.017)
High cholesterol	0.008	(0.012)	-0.027*	(0.014)	0.013	(0.012)	-0.028**	(0.014)	0.013	(0.012)	-0.028**	(0.014)
Hypertensive	-0.001	(0.011)	-0.026**	(0.013)	-0.009	(0.011)	-0.026**	(0.012)	-0.008	(0.011)	-0.026**	(0.012)
Cancer	-0.067***	(0.011)	-0.033***	(0.013)	-0.069***	(0.011)	-0.034***	(0.013)	-0.083***	(0.011)	-0.035***	(0.013)
Male	0.117***	(0.008)	0.005	(0.011)	0.122***	(0.008)	0.005	(0.011)	0.115***	(0.008)	0.006	(0.011)
Aged <55	0.109***	(0.013)	-0.122***	(0.017)	0.125***	(0.013)	-0.122***	(0.017)	0.110***	(0.013)	-0.122***	(0.017)
Aged <55-64	-0.019	(0.012)	-0.138***	(0.015)	-0.013	(0.012)	-0.140***	(0.015)	-0.014	(0.012)	-0.139***	(0.015)
Aged <65-74	0.022*	(0.012)	-0.052***	(0.015)	0.022*	(0.012)	-0.053***	(0.015)	0.021*	(0.012)	-0.052***	(0.015)
Foreign-born	0.171***	(0.008)	0.032***	(0.011)	0.198***	(0.007)	0.032***	(0.011)	0.196***	(0.007)	0.033***	(0.011)
Income $20k-<$40k	-0.115***	(0.013)	-0.025	(0.016)	-0.121***	(0.013)	-0.024	(0.016)	-0.128***	(0.013)	-0.025	(0.016)
Income $40k-<$70k	-0.212***	(0.015)	-0.091***	(0.018)	-0.219***	(0.015)	-0.090***	(0.018)	-0.234***	(0.015)	-0.092***	(0.018)
Income $70k+	-0.516***	(0.014)	-0.182***	(0.018)	-0.518***	(0.015)	-0.182***	(0.018)	-0.524***	(0.014)	-0.184***	(0.018)
Income missing	-0.118***	(0.012)	-0.068***	(0.015)	-0.119***	(0.012)	-0.067***	(0.015)	-0.125***	(0.012)	-0.068***	(0.015)
Health concession	0.169***	(0.010)	0.100***	(0.012)	0.172***	(0.010)	0.100***	(0.012)	0.174***	(0.010)	0.100***	(0.012)
One-off	-0.008	(0.006)	-0.007	(0.004)	-0.012**	(0.006)	-0.007	(0.004)	-0.029***	(0.006)	-0.008*	(0.004)
One-off missing	-0.026***	(0.004)	-0.001	(0.004)	-0.028***	(0.004)	-0.001	(0.004)	0.017***	(0.005)	0.002	(0.004)
Inner region	-0.097***	(0.004)			-0.132***	(0.004)			-0.144***	(0.004)		
Outer region	-0.099***	(0.006)			-0.182***	(0.005)			-0.161***	(0.005)		
Remote	-0.032***	(0.011)			-0.100***	(0.011)			-0.073***	(0.011)		
SEIFA	-0.261***	(0.023)			-0.402***	(0.022)			-0.412***	(0.022)		
Constant	0.691***	(0.033)	0.642***	(0.032)	1.154***	(0.029)	0.792***	(0.024)	1.097***	(0.028)	0.782***	(0.021)
R-squared	0.261		0.891		0.249		0.890		0.268		0.891	

Note: All models include dummy variables for year. Standard errors are White's robust standard errors. *, ** and *** indicates statistical significance at 10%, 5% and 1% level, respectively.

Table 4: The determinants of quality using CDM/100 consultations

	OLS1		FE1		OLS2		FE2		OLS3		FE3	
	b	s.e.	b	s.e.	b	s.e.	b	s.e.	b	s.e.	b	s.e.
FT GP/1000 pop	3.117***	(0.339)	1.391	(1.216)								
# GPs postcode (/10)					-0.027***	(0.010)	-0.103	(0.098)				
# competitors (/10)									0.107***	(0.018)	-0.437***	(0.064)
Illness score	0.487***	(0.148)	0.125	(0.181)	0.505***	(0.148)	0.125	(0.181)	0.507***	(0.148)	0.125	(0.181)
Asthma	-0.14	(0.418)	-0.155	(0.456)	-0.162	(0.418)	-0.160	(0.456)	-0.183	(0.418)	-0.132	(0.456)
Diabetes	3.018***	(0.583)	2.726***	(0.707)	3.015***	(0.583)	2.724***	(0.707)	3.041***	(0.582)	2.697***	(0.706)
Heart	-1.603***	(0.419)	-0.701	(0.544)	-1.656***	(0.418)	-0.693	(0.545)	-1.654***	(0.418)	-0.699	(0.545)
High cholesterol	0.912***	(0.323)	0.640	(0.439)	0.969***	(0.323)	0.632	(0.439)	0.969***	(0.323)	0.619	(0.439)
Hypertensive	0.282	(0.293)	-0.248	(0.402)	0.214	(0.292)	-0.245	(0.403)	0.218	(0.292)	-0.279	(0.402)
Cancer	-0.195	(0.296)	-0.021	(0.380)	-0.217	(0.296)	-0.028	(0.380)	-0.288	(0.296)	0.007	(0.380)
Male	-0.526**	(0.226)	-0.487	(0.358)	-0.467**	(0.226)	-0.488	(0.358)	-0.497**	(0.226)	-0.553	(0.358)
Aged <55	0.944***	(0.355)	-0.372	(0.565)	1.085***	(0.355)	-0.376	(0.565)	1.012***	(0.355)	-0.421	(0.566)
Aged <55-64	0.345	(0.341)	-0.217	(0.497)	0.392	(0.340)	-0.226	(0.497)	0.384	(0.340)	-0.301	(0.497)
Aged <65-74	-0.181	(0.361)	0.115	(0.484)	-0.183	(0.361)	0.115	(0.484)	-0.188	(0.360)	0.098	(0.484)
Foreign-born	-0.644***	(0.216)	-0.632*	(0.346)	-0.392*	(0.214)	-0.626*	(0.346)	-0.402*	(0.213)	-0.686**	(0.347)
Income $20k-<$40k	-0.606	(0.398)	-0.629	(0.560)	-0.671*	(0.397)	-0.634	(0.559)	-0.708*	(0.397)	-0.563	(0.561)
Income $40k-<$70k	-1.271***	(0.354)	-1.464***	(0.536)	-1.359***	(0.354)	-1.463***	(0.535)	-1.438***	(0.352)	-1.327**	(0.538)
Income $70k+	-2.138***	(0.365)	-1.372**	(0.558)	-2.182***	(0.365)	-1.370**	(0.558)	-2.222***	(0.364)	-1.225**	(0.560)
Income missing	-0.653*	(0.368)	-0.68	(0.527)	-0.662*	(0.367)	-0.679	(0.527)	-0.689*	(0.367)	-0.61	(0.527)
Health concession	0.018	(0.271)	0.372	(0.383)	0.042	(0.271)	0.365	(0.383)	0.049	(0.271)	0.340	(0.383)
One-off	-2.223***	(0.215)	-0.532**	(0.242)	-2.257***	(0.215)	-0.530**	(0.242)	-2.341***	(0.219)	-0.453*	(0.245)
One-off missing	-2.738***	(0.162)	0.286	(0.293)	-2.752***	(0.162)	0.288	(0.293)	-2.538***	(0.168)	0.145	(0.282)
Inner region	0.703***	(0.144)			0.319**	(0.141)			0.240*	(0.136)		
Outer region	0.445**	(0.190)			-0.338*	(0.174)			-0.238	(0.174)		
Remote	0.722	(0.513)			0.077	(0.514)			0.215	(0.514)		
SEIFA	0.595	(0.684)			-0.696	(0.671)			-0.722	(0.669)		
Constant	-0.59	(0.996)	2.278*	(1.256)	3.747***	(0.878)	4.050***	(0.792)	3.426***	(0.869)	4.765***	(0.642)
R-squared	0.028		0.655		0.026		0.655		0.027		0.657	

Note: All models include dummy variables for year. Standard errors are White's robust standard errors. *, ** and *** indicates statistical significance at 10%, 5% and 1% level, respectively.

Table 5: The determinants of quality using CDM revenue per patient

	OLS1		FE1		OLS2		FE2		OLS3		FE3	
	b	s.e.	b	s.e.	b	s.e.	b	s.e.	b	s.e.	b	s.e.
FT GP/1000 pop	9.286***	(0.945)	3.929	(3.313)								
# GPs postcode					-0.052*	(0.028)	0.315	(0.289)				
# competitors (/10)									-0.014	(0.040)	-0.614***	(0.076)
Illness score	2.901***	(0.573)	1.533**	(0.705)	2.952***	(0.573)	1.540**	(0.705)	2.945***	(0.573)	1.535**	(0.705)
Asthma	-2.212	(1.417)	-1.023	(1.780)	-2.276	(1.414)	-1.032	(1.779)	-2.270	(1.415)	-0.996	(1.779)
Diabetes	10.432***	(2.102)	7.816***	(2.568)	10.433***	(2.101)	7.801***	(2.568)	10.451***	(2.102)	7.770***	(2.567)
Heart	-5.546***	(1.753)	-1.838	(2.148)	-5.696***	(1.752)	-1.843	(2.149)	-5.684***	(1.753)	-1.831	(2.148)
High cholesterol	1.772	(1.301)	0.666	(1.523)	1.951	(1.303)	0.656	(1.522)	1.970	(1.303)	0.629	(1.522)
Hypertensive	0.244	(1.100)	-1.554	(1.402)	0.050	(1.097)	-1.567	(1.403)	0.067	(1.098)	-1.599	(1.402)
Cancer	-3.417***	(1.151)	-3.087**	(1.384)	-3.489***	(1.150)	-3.101**	(1.383)	-3.494***	(1.152)	-3.054**	(1.383)
Male	-0.729	(0.841)	-0.683	(1.235)	-0.539	(0.839)	-0.683	(1.235)	-0.506	(0.840)	-0.776	(1.235)
Aged <55	-1.689	(1.440)	-1.836	(1.959)	-1.286	(1.439)	-1.858	(1.958)	-1.306	(1.438)	-1.913	(1.958)
Aged <55-64	-2.675*	(1.404)	-1.495	(1.848)	-2.546*	(1.404)	-1.556	(1.848)	-2.566*	(1.403)	-1.634	(1.848)
Aged <65-74	-3.441**	(1.503)	-1.064	(1.774)	-3.454**	(1.503)	-1.092	(1.775)	-3.466**	(1.503)	-1.094	(1.774)
Foreign-born	0.229	(0.797)	0.631	(1.174)	0.966	(0.791)	0.63	(1.174)	0.942	(0.790)	0.560	(1.174)
Income $20k-<$40k	-5.394***	(1.499)	-5.692***	(2.058)	-5.601***	(1.500)	-5.660***	(2.057)	-5.622***	(1.499)	-5.595***	(2.057)
Income $40k-<$70k	-7.507***	(1.471)	-8.955***	(2.230)	-7.805***	(1.471)	-8.914***	(2.229)	-7.865***	(1.468)	-8.753***	(2.230)
Income $70k+	-10.045***	(1.379)	-9.390***	(2.180)	-10.227***	(1.381)	-9.372***	(2.179)	-10.317***	(1.377)	-9.177***	(2.181)
Income missing	-3.783**	(1.523)	-4.231**	(1.968)	-3.808**	(1.522)	-4.199**	(1.968)	-3.798**	(1.522)	-4.124**	(1.968)
Health concession	0.131	(1.133)	0.138	(1.466)	0.200	(1.132)	0.122	(1.466)	0.192	(1.133)	0.085	(1.466)
One-off	-16.498***	(0.370)	-5.541***	(0.426)	-16.604***	(0.372)	-5.542***	(0.426)	-16.600***	(0.366)	-5.429***	(0.425)
One-off missing	-12.786***	(0.369)	-4.218***	(0.548)	-12.830***	(0.370)	-4.214***	(0.548)	-12.862***	(0.390)	-4.414***	(0.552)
Inner region	0.091	(0.367)			-1.160***	(0.348)			-1.350***	(0.333)		
Outer region	-0.361	(0.538)			-2.684***	(0.498)			-2.675***	(0.498)		
Remote	-1.213	(0.903)			-3.114***	(0.887)			-3.093***	(0.889)		
SEIFA	-4.942***	(1.888)			-8.676***	(1.895)			-8.460***	(1.891)		
Constant	12.312***	(2.920)	10.679***	(4.003)	25.028***	(2.777)	12.657***	(2.969)	24.681***	(2.775)	15.958***	(2.681)
R-squared	0.092		0.721		0.090		0.721		0.090		0.721	

Note: All models include dummy variables for year. Standard errors are White's robust standard errors. *, ** and *** indicates statistical significance at 10%, 5% and 1% level, respectively.

Table 6: The determinants of quality using PIP/100 consultations

	OLS1		FE1		OLS2		FE2		OLS3		FE3	
	b	s.e.	b	s.e.	b	s.e.	b	s.e.	b	s.e.	B	s.e.
FT GP/1000 pop	-0.247***	(0.046)	-0.071	(0.163)								
# GPs postcode					-0.003*	(0.001)	0.012	(0.014)				
# competitors (/10)									-0.012***	(0.003)	-0.026***	(0.004)
Illness score	-0.059**	(0.024)	-0.022	(0.032)	-0.060**	(0.024)	-0.022	(0.032)	-0.060**	(0.024)	-0.023	(0.032)
Asthma	0.113	(0.087)	-0.020	(0.084)	0.115	(0.086)	-0.020	(0.084)	0.117	(0.087)	-0.019	(0.084)
Diabetes	1.499***	(0.171)	0.812***	(0.161)	1.497***	(0.171)	0.812***	(0.161)	1.496***	(0.170)	0.810***	(0.161)
Heart	0.062	(0.086)	-0.100	(0.106)	0.065	(0.086)	-0.101	(0.106)	0.066	(0.086)	-0.100	(0.106)
High cholesterol	0.239***	(0.066)	0.207**	(0.098)	0.233***	(0.067)	0.207**	(0.098)	0.235***	(0.067)	0.206**	(0.098)
Hypertensive	0.088*	(0.052)	-0.008	(0.068)	0.092*	(0.052)	-0.009	(0.068)	0.093*	(0.052)	-0.010	(0.068)
Cancer	0.034	(0.050)	0.104	(0.080)	0.037	(0.050)	0.105	(0.080)	0.043	(0.050)	0.107	(0.080)
Male	-0.263***	(0.041)	-0.115*	(0.067)	-0.270***	(0.041)	-0.115*	(0.067)	-0.264***	(0.041)	-0.119*	(0.067)
Aged <55	0.060	(0.062)	0.104	(0.084)	0.051	(0.062)	0.104	(0.084)	0.056	(0.062)	0.102	(0.084)
Aged <55-64	0.050	(0.061)	0.095	(0.086)	0.048	(0.061)	0.095	(0.086)	0.047	(0.061)	0.092	(0.086)
Aged <65-74	-0.022	(0.058)	-0.040	(0.078)	-0.021	(0.058)	-0.040	(0.078)	-0.022	(0.058)	-0.040	(0.078)
Foreign-born	-0.099**	(0.040)	0.074	(0.079)	-0.117***	(0.040)	0.073	(0.079)	-0.118***	(0.040)	0.071	(0.079)
Income $20k-<$40k	0.221***	(0.085)	-0.016	(0.092)	0.229***	(0.085)	-0.016	(0.092)	0.230***	(0.085)	-0.013	(0.092)
Income $40k-<$70k	0.079	(0.081)	0.073	(0.107)	0.093	(0.081)	0.073	(0.107)	0.094	(0.081)	0.080	(0.107)
Income $70k+	0.133*	(0.073)	-0.060	(0.101)	0.145**	(0.073)	-0.060	(0.101)	0.139*	(0.073)	-0.052	(0.101)
Income missing	0.066	(0.071)	0.047	(0.098)	0.066	(0.071)	0.047	(0.098)	0.070	(0.071)	0.050	(0.098)
Health concession	-0.049	(0.049)	0.015	(0.075)	-0.050	(0.049)	0.015	(0.075)	-0.052	(0.049)	0.013	(0.075)
One-off	-0.173***	(0.035)	-0.036	(0.033)	-0.169***	(0.035)	-0.037	(0.033)	-0.161***	(0.035)	-0.032	(0.033)
One-off missing	-0.248***	(0.023)	-0.051	(0.033)	-0.247***	(0.023)	-0.051	(0.033)	-0.270***	(0.025)	-0.060*	(0.033)
Inner region	0.039**	(0.017)			0.088***	(0.019)			0.076***	(0.018)		
Outer region	0.017	(0.025)			0.077***	(0.025)			0.069***	(0.026)		
Remote	-0.083*	(0.045)			-0.035	(0.046)			-0.046	(0.046)		
SEIFA	-0.426***	(0.092)			-0.343***	(0.092)			-0.318***	(0.092)		
Constant	0.880***	(0.145)	0.232	(0.187)	0.571***	(0.130)	0.106	(0.126)	0.565***	(0.129)	0.240**	(0.112)
R-squared	0.026		0.712		0.026		0.712		0.026		0.712	

Note: All models include dummy variables for year. Standard errors are White's robust standard errors. *, ** and *** indicates statistical significance at 10%, 5% and 1% level, respectively.

Table 7: The determinants of quality using percentage of long consultations

	OLS1		FE1		OLS2		FE2		OLS3		FE3	
	b	s.e.	B	s.e.	b	s.e.	b	s.e.	b	s.e.	B	s.e.
FT GP/1000 pop	0.063***	(0.007)	0.067***	(0.018)								
# GPs postcode					-0.001***	(0.000)	0.002	(0.002)				
# competitors (/10)									-0.007***	(0.000)	-0.001*	(0.000)
Illness score	0.021***	(0.002)	0.008**	(0.003)	0.022***	(0.002)	0.008**	(0.003)	0.021***	(0.003)	0.008**	(0.003)
Asthma	-0.011*	(0.007)	0.013	(0.009)	-0.011*	(0.007)	0.013	(0.009)	-0.01	(0.007)	0.013	(0.009)
Diabetes	0.002	(0.008)	0.016	(0.010)	0.002	(0.008)	0.015	(0.010)	0.001	(0.008)	0.015	(0.010)
Heart	-0.001	(0.007)	0.011	(0.009)	-0.002	(0.007)	0.011	(0.009)	-0.002	(0.007)	0.011	(0.009)
High cholesterol	-0.028***	(0.006)	-0.032***	(0.008)	-0.027***	(0.006)	-0.032***	(0.008)	-0.026***	(0.006)	-0.032***	(0.008)
Hypertensive	-0.044***	(0.005)	-0.003	(0.007)	-0.046***	(0.005)	-0.003	(0.007)	-0.045***	(0.006)	-0.003	(0.007)
Cancer	0.000	(0.005)	-0.003	(0.007)	0.000	(0.005)	-0.004	(0.007)	0.004	(0.005)	-0.004	(0.007)
Male	-0.084***	(0.004)	-0.002	(0.006)	-0.083***	(0.004)	-0.002	(0.006)	-0.080***	(0.004)	-0.003	(0.006)
Aged <55	0.030***	(0.007)	0.008	(0.010)	0.033***	(0.007)	0.008	(0.010)	0.036***	(0.007)	0.008	(0.010)
Aged <55-64	0.002	(0.006)	-0.011	(0.008)	0.003	(0.006)	-0.012	(0.008)	0.003	(0.006)	-0.012	(0.008)
Aged <65-74	-0.004	(0.007)	-0.005	(0.009)	-0.004	(0.007)	-0.005	(0.009)	-0.004	(0.007)	-0.005	(0.009)
Foreign-born	-0.009**	(0.004)	0.010	(0.006)	-0.004	(0.004)	0.010	(0.006)	-0.004	(0.004)	0.010	(0.006)
Income $20k-<$40k	0.011	(0.007)	-0.003	(0.009)	0.009	(0.007)	-0.003	(0.009)	0.011	(0.007)	-0.003	(0.009)
Income $40k-<$70k	0.018**	(0.007)	-0.013	(0.010)	0.016**	(0.007)	-0.012	(0.010)	0.018**	(0.007)	-0.012	(0.010)
Income $70k+	0.020***	(0.007)	-0.018*	(0.010)	0.019***	(0.007)	-0.018*	(0.010)	0.018**	(0.007)	-0.018*	(0.010)
Income missing	0.000	(0.006)	-0.003	(0.009)	0.000	(0.006)	-0.002	(0.009)	0.002	(0.006)	-0.002	(0.009)
Health concession	-0.001	(0.005)	0.011	(0.007)	-0.001	(0.005)	0.010	(0.007)	-0.002	(0.005)	0.010	(0.007)
One-off	-0.005	(0.003)	-0.007**	(0.003)	-0.006*	(0.003)	-0.007**	(0.003)	-0.001	(0.003)	-0.007**	(0.003)
One-off missing	-0.034***	(0.002)	-0.008***	(0.003)	-0.034***	(0.002)	-0.008**	(0.003)	-0.048***	(0.003)	-0.008***	(0.003)
Inner region	0.006**	(0.002)			-0.002	(0.002)			-0.005**	(0.002)		
Outer region	0.020***	(0.003)			0.004	(0.003)			-0.001	(0.003)		
Remote	0.026***	(0.006)			0.013**	(0.006)			0.006	(0.006)		
SEIFA	0.416***	(0.013)			0.390***	(0.013)			0.401***	(0.013)		
Constant	-0.295***	(0.019)	0.117***	(0.020)	-0.207***	(0.016)	0.169***	(0.014)	-0.203***	(0.016)	0.180***	(0.012)
R-squared	0.080		0.827		0.078		0.827		0.085		0.827	

Table 8: Competition and patient economic status

	CDM/100		CDM rev/patient		PIP		Long consult	
	b	s.e.	b	s.e.	b	s.e.	b	s.e.
Models with interaction terms								
Model 1: # competitors ('10)	-0.491***	(0.094)	-0.824***	(0.135)	-0.020***	(0.007)	-0.002***	(0.001)
Model 1: # competitors ('10) x $70k+	0.215	(0.299)	0.842*	(0.453)	-0.021	(0.022)	0.007**	(0.003)
Model 2: # competitors ('10)	-0.297***	(0.100)	-0.354**	(0.159)	-0.029***	(0.007)	0.001	(0.001)
Model 2: # competitors ('10) x health card	-0.503*	(0.292)	-0.934*	(0.504)	0.013	(0.022)	-0.007***	(0.003)

Note: Models 1 and 2 are FE3 estimated separately with addition of interaction term. *, ** and *** indicates statistical significance at 10%, 5% and 1% level, respectively.