Where did all the GPs go? Increasing supply and geographical equity in England and Scotland

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***Objectives*: To examine the effect on geographical equity of increases in the total supply of general practitioners (GPs) and the ending of entry restrictions in 2002 and to explore the factors associated with the distribution of GPs across England.**

***Methods*: Calculation of Gini coefficients to measure geographical equity in GPs per 100,000 population in England and Scotland. Multiple regression of GPs per capita and change in GPs per capita on demographics, morbidity, deprivation and measures of amenity in English Primary Care Trusts (PCTs).**

***Results*: Equity in England rose between 1974 and 1994 but then decreased, and in 2006 it was below the 1974 level. After 2002, England had a greater percentage increase in GP supply than Scotland and a smaller increase in inequity. The *level* of GP per capita supply in 2006 was positively correlated with morbidity and PCT amenity, and negatively correlated with unemployment and poor air quality. The *increase* in per capita supply between 2002 and 2006 was not significantly associated with morbidity, deprivation or amenities.**

***Conclusions*: Reducing geographical inequity in the provision of GPs requires targeted area level policies.**

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Introduction

Access to primary care is of interest worldwide because of its beneficial effects on population health.[1,2] Research has been undertaken in countries as diverse as Australia,[3] Canada,[4] China,[5] France,[6] Italy,[7] Norway,[8] Scotland,[9] a panel of 12 European countries (Ireland, Belgium, Spain, Luxembourg, Italy, Greece, Germany, UK, Netherlands, Denmark, Portugal, Austria)[10] and the USA.[11] Most find evidence of socio-economic inequity in use of primary care.

Availability of services is an important determinant of use. The geographical distribution of primary care services, especially of general practitioners (GPs), is therefore of interest and has been studied in Canada,[12] Australia,[13] and England and Wales.[14,15]

In the UK National Health Service (NHS) geographical differences in the supply of GPs per head of the population have existed since the founding of the NHS in 1948.[14–18] The White Paper, *Our Health, Our Care, Our Say*,[19] identified 30 areas (at the level of Primary Care Trusts [PCTs]) as being 'under-doctored' in terms of the number of GPs per head of the population (adjusted for need).

Three types of policy can be used to reduce differences in GP supply across areas: regulation of entry; targeted initiatives aimed at under supply in particular areas; and general supply increases. We use recent experience in the NHS to discuss the effects of two of these. Between 2002 and 2005 there was an unprecedented increase in the supply of GPs in England with whole time equivalent GPs per head of population increasing by 12.7% compared with a decrease of 0.1% between 1998 and 2002. By contrast, in Scotland supply grew by 2.3% and 3.3% over these periods. In 2002 both countries abolished centralized systems of entry regulation established when the NHS was founded in 1948.

GP distribution

In deciding where to practice, a GP will take account of the overall attractiveness of the area relative to other areas. Attractiveness depends inter alia on the income the GP expects to earn, how hard she or he will have to work, and the cultural and other amenities of the area.

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GPs may also be intrinsically motivated and care about the effect they can have on the health of the patients.

Different types of GPs (young/old, men/women, newly qualified/established) will place different weights on these area characteristics but on average, and in the absence of any entry barriers, GPs will sort themselves across areas so that the net advantages of locating in different areas are equalized. Areas with a high level of amenities will attract more GPs per head of population. Such areas will not however end up with all the GPs because income per GP will decline with the number of GPs. The income of a GP is driven largely by the number of patients on the practice list via capitation and quality payments, which vary with the number of patients on the practice list.[20] Patients in some areas will generate higher income than in others because the capitation payments vary with the age and morbidity of the population or because it is easier to achieve quality targets with certain types of patients.[21] But, whatever the characteristics of patients in an area, more GPs will lead to a reduction in income per GP. Thus the decline in GP income as their number increases, together with the amenities in an area, will determine their distribution and, as a consequence, the level of equity. The resulting distribution may leave more deprived areas with fewer GPs per capita, since such areas tend to have fewer amenities and to have patients who generate a lower income for GPs.

Methods

We undertook three types of analysis to investigate the factors affecting the distribution of GPs.

Inequality

We used the Gini coefficient to measure the inequity in the distribution of GPs per capita, adjusted for levels of need in the population. The Gini lies between 0 (when all areas have the same GP to need ratio) and tends to 1 if one area has all the GPs. It is a measure of relative inequality: an equi-proportionate increase in GPs has no effect on the Gini.

To allow for the changes in NHS administrative units in England, the 1994–2001 series was scaled multiplicatively to the 1974–1994 series and the 2002–2006 series was scaled multiplicatively to the 1994–2001 series. The whole series was then indexed with 1974 set to 100. To compare trends in inequality in 303 English PCTs and 15 Scottish Health Boards from 1996 to 2006 the country Ginis series were indexed with 1996 set to 100.

For 1974–1994, GPs were counted as the number of unrestricted principals. For 1995 onwards, GPs were counted as whole time equivalent practitioners excluding retainers and trainees. To construct a series for English GP supply for 1974–2006, we spliced the two series multiplicatively at 1995.

We wanted to relate the numbers of GPs in an area to the total population, not just to those who are registered with GPs, particularly as GP lists are not properly cleaned. We therefore used Census-based population estimates.

Four measures of need were adjusted for based on the proportion of each area's population reporting: limiting longstanding illness (LLI); proportion reporting 'not good' as opposed to 'fairly good' or 'good' health; age and sex specific consultation rates; and the mortality rate.

Determinants of GP supply per capita in PCTs

We used multiple regression analysis to investigate the relationships between English PCT characteristics and crude per capita GP supply over the period 2002–2006. Table 1 reports descriptive statistics for the variables used.

GP supply may be affected by the health of the local population: either positively because of the higher capitation payments for less healthy populations or an altruistic concern for population health; or negatively because areas with sicker populations generate more work for GPs. We used the proportion of the PCT population reporting 'not good' health as the population health measure (models using LLI produced very similar results). As a non-health measure of deprivation, we took the proportion of people of working age claiming unemployment benefits.[22]

We used the crime index[22] and an indicator of poor air quality[22] as indicators of the lack of attractiveness of a PCT to GPs. We also had measures of amenities from the 2004 and 2005 General Practitioners' Worklife Surveys. We used GPs' satisfaction with their access to good schools, access to amenities (e.g. leisure, cultural facilities) and local career opportunities for their spouse/partner. The PCT scores were derived by calculating the mean scores of all respondents over two years in each PCT. Finally, we included the average 2005 house price, taken from the UK Land Registry. These data are reported at Local Authority (LA) level but we calculated a PCT measure by re-weighting the LA data by the shares of the LA population belonging to each PCT.

There is a potential problem in using Ordinary Least Squares regression. Self-assessed health may be affected by GP supply;[1] indeed if it is not, it is unclear why GP supply is a policy concern. If GP supply affects health, then the estimated coefficient on self-assessed health may be biased. To test and control for such bias, we used two instrumental variables which predict self-assessed health but are not correlated with GP supply given the other variables included in the regression. The first was the estimated percentage of social and private housing in disrepair or poor condition. The second instrument was the proportion of the individuals in the PCT who are cohabiting. We estimated a two stage

Table 1 Descriptive statistics and variable definitions for English PCTs

Variable name	Definition	Source	Mean	SD	Min	Max
Not good health	People in not good health (%)	Census	9.079	2.169	4.608	17.299
Average age	Mean age of population	ONS	39.401	2.510	31.073	47.103
Female proportion	Women in population (%)	ONS	50.900	0.701	48.557	53.015
Non-white proportion	Non-white (%)	Census	7.811	11.144	0.564	70.872
Population density	Population density	Census	16.957	20.869	0.416	131.020
Cohabiting proportion	Cohabitants (%)	Census	51.469	6.788	27.660	60.670
Crime score	Crime index	IMD	−0.039	0.587	−1.309	1.387
Unemployment	Proportion of people of working age claiming unemployed benefits	IMD	0.035	0.015	0.010	0.106
Poor air quality	Combined air quality indicator	IMD	1.134	0.256	0.561	1.904
Poor housing	Social and private housing in poor condition	IMD	0.337	0.056	0.222	0.514
Good schools	Access to good schools (1 = very poor, 5 = very good)	NPCRDC Worklife Survey	3.878	0.639	1.333	5
Amenities	Access to good amenities (1 = very poor, 5 = very good)	NPCRDC Worklife Survey	3.835	0.528	1.800	5
Spouse job opportunities	Career opportunities for spouse/partner (1 = very poor, 5 = very good)	NPCRDC Worklife Survey	3.581	0.508	1.667	5
LLI	People with LLI (%)	Census	18.113	3.374	10.934	30.775
Mortality	Crude mortality rate (deaths per 1000)	ONS	9.377	1.694	4.310	15.529
House prices	Mean house price	Land Registry	187.564	72.388	78.982	756.125

LLI, Limiting long-term illness
Number of observations = 303. Where the variables vary over time (Female proportion, Average age, Mortality) the descriptive statistics are for 2006. Values from NPCRD Worklife Survey are average value of responses from all GPs in PCT in 2004 and 2005

least squares (2SLS) model of GP supply using these instruments to predict self-assessed health. This method allowed us to avoid bias.

Determinants of the change in GP supply per capita in PCTs

Young or recently qualified GPs find it easier to move between practices and PCTs because they have not been locked into partnership agreements. Thus PCT characteristics could have a different effect on the inflow and outflow of GPs compared with their effect on the total supply of GPs. We therefore also estimated models of the difference between the number of GPs per capita in 2002 and 2006 to see what PCT characteristics explain the *change* in the number of GPs over time.

Results

Figure 1 shows the long-term trends in the equity in GP distribution and in the total number of GPs in England. GP supply increased throughout the period with a particularly rapid increase between 2002 and 2006. The Gini, whether based on crude population or need-adjusted population, fell between 1974 and the mid 1990s but increased thereafter. By 2006 the Ginis equalled or exceeded their value in 1974.

Trends in England and Scotland are compared in Table 2 (2002–2006) and Figure 2 (1996–2006). The Ginis in both countries increased more rapidly after 2002 than before, with a particularly sharp increase in Scotland.

Table 3 reports the regression models for GPs per capita for 2002 and 2006. Models which pool all the years or which use the number, rather than the log of GPs per capita, produce very similar results. The first two models for each year show that there is no significant relationship between morbidity and GP supply, whether allowing for other factors or not. However, the 2SLS results which attempt to correct for two-way causation, show a positive association.

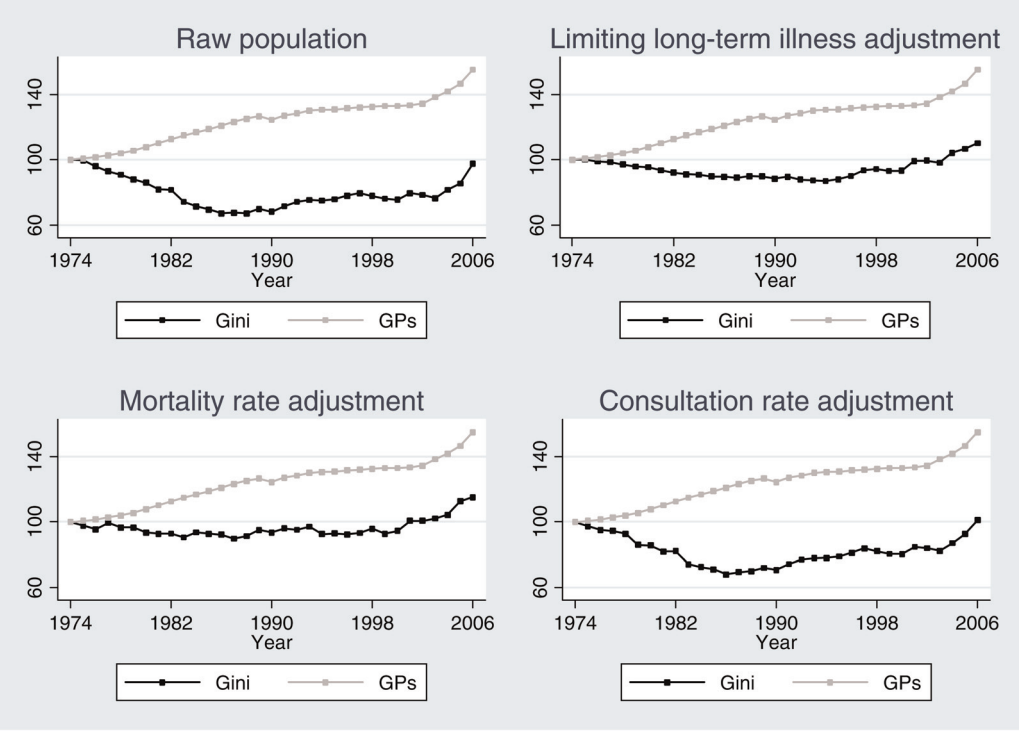
The results indicate the population characteristics which tend to reduce GP supply are higher unemployment, older populations, higher proportion of women in the population and lower proportion of population from minority groups.

Variables measuring the attractiveness of PCTs have plausible associations with GP supply: supply is lower in areas with poorer air quality, and higher, though not significantly so, in areas with less crime, better schools, better amenities and opportunities for spouses. Higher house prices are associated with higher GP supply, possibly because they reflect amenities not picked up in the other variables.

Table 4 reports the results for models relating the *change* in GP supply between 2002 and 2006 to PCT characteristics. None of the explanatory variables, apart from the air quality indicator, are statistically significant.

Discussion

The distribution of GPs has been an enduring policy issue. Policy-makers have attempted to make the distribution more equitable in three ways. First, through controls on entry into areas designated as relatively over-doctored to reduce inequity between over- and under-doctored areas. However, because there is free



GPs: unrestricted principals 1974–1993; all practitioners except retainers and trainees 1994–2006
Total number of GPs 1974–1993, whole time equivalent GPs 1994–2006

Figure 1 Equity of GP distribution and total GP supply, England, 1974–2006

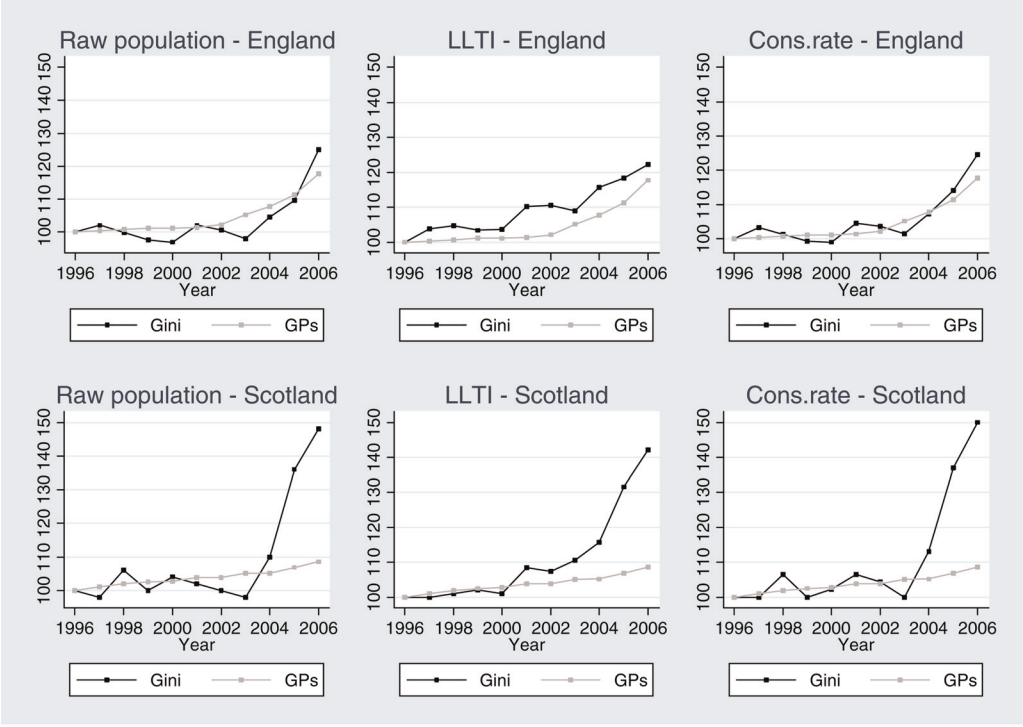
entry to under-doctored areas, the doctors who would have located in the over-doctored areas will tend to locate in the more attractive of the under-doctored areas. Thus inequity across under-doctored areas may increase under entry controls and the overall equity across the entire system could increase or decrease.

Since 1948 the NHS has restricted entry by GPs into areas which were classified as over-doctored.[16] Similar controls have been used in other countries such as the

Table 2 GP supply and Ginis, England and Scotland, 2002–2006

	Need adjustment	2002	2003	2004	2005	2006	Change (%) 2002–2006
England							
GPs per 100,000 (*n*)	None	58.81	60.88	62.91	64.87	65.19	10.8
WTE GPs per 100,000 (*n*)	None	54.04	55.40	56.49	57.96	60.93	12.7
Gini for nos GPs	None	0.069	0.068	0.072	0.076	0.079	14.5
Gini for WTE GPs	None	0.061	0.059	0.063	0.066	0.076	24.6
Gini for WTE GPs	LLI	0.115	0.113	0.120	0.123	0.127	10.4
Gini for WTE GPs	Consultation rate	0.065	0.064	0.067	0.071	0.078	20.0
Gini for WTE GPs	Self-assessed health	0.138	0.136	0.145	0.147	0.152	8.7
Gini for WTE GPs	Mortality	0.120	0.122	0.124	0.134	0.137	14.2
Scotland							
GPs per 100,000 (*n*)	None	76.84	78.30	78.17	80.22	81.12	5.7
WTE GPs per head	None	71.32	72.17	71.92	72.84	73.67	3.3
Gini for nos GPs	None	0.055	0.059	0.065	0.074	0.081	47.3
Gini for WTE GPs	None	0.050	0.049	0.055	0.068	0.074	48.0
Gini for WTE GPs	LLI	0.102	0.105	0.110	0.125	0.135	32.4
Gini for WTE GPs	Consultation rate	0.048	0.046	0.052	0.063	0.069	43.8
Gini for WTE GPs	Self-assessed health	0.145	0.149	0.153	0.167	0.182	25.5
Gini for WTE GPs	Mortality	0.065	0.068	0.074	0.088	0.088	35.4

LLI, Limiting long-term illness
Ginis for 303 English PCTs in all years; 15 Scottish Health Boards 2002–2005, 14 HBs in 2006
GPs: all practitioners except trainees and retainers. Scottish WTEs are estimated for 2006 (using the ratio of WTEs to headcounts in each HB in 2005 applied to headcounts in each HB in 2006)



GPs: All practitioners except retainers and trainees, whole time equivalents

Figure 2 Indices of GP supply and Ginis, England and Scotland, 1996–2006

Netherlands.[23] However, centralized entry controls were abolished in England in 2002 and in 2003 in Scotland and devolved to local primary care organizations. They were required to consult local GPs when taking decisions on allowing new practices and GPs to enter the area. The English Department of Health attempted to open up local GP markets by introducing open procurement processes which permitted the entry of new types of practices which employ GPs, but which are not necessarily owned by them.[24]

The second way of trying to achieve greater equity has been through payments conditional on location in particular types of area. This increases the net advantage of those areas and thus attract GPs into them. Under the NHS capitation system, GPs' payments have been weighted by the age of the patients on the practice list and the health or deprivation of the population resident in the area surrounding the GP practice. Therefore GPs have incentives to locate in areas where the demand for health care is high and the possibility of enrolling patients with higher capitations is greater.[25] However, if entry controls are in place in over-doctored areas, some of the GPs attracted into an under-doctored area by these factors may have been attracted from other under-doctored areas and therefore the net effect on equity is uncertain.

The third approach has been to increase supply. In the absence of entry controls an increase in the total supply of GPs will increase per capita GP supply in all areas. But equity may not be increased.[14,26] The increase in the number of GPs in an area will be smaller, the more rapidly GP income falls when the number of GPs in the area increases. Thus only if the reduction in income per GP with increased GP numbers is smaller in deprived areas than in affluent areas, will inequality diminish as a result of the increase in total supply of GPs.

Our results reveal some evidence as to the effects of these policies in the NHS. First, entry controls are not sufficient to prevent decreases in the equity of GP distribution: equity in England decreased between the mid 1990s and the abolition of controls in 2002. Second, entry controls probably increase the overall level of equity: there was a sharp fall in equity after the abolition of entry controls. Third, increases in total supply can be associated with reduced or increased equity. The growth in GP numbers in England from 1974 to 2000 was associated with an increase in equity up to the 1980s and then with a fall in equity from the early 1990s. After the abolition of entry controls the decrease in equity was less rapid in England than in Scotland, possibly because England had a sharp increase in the rate of growth of GP supply after abolition.

Fourth, our analysis suggests that inequity in distribution can be unintentionally affected by other policies which change the relationship between GP pay and area characteristics. We found that, after allowing for the two-way causation between GPs and

Table 3 Determinants of ln GPs per 100,000 in English PCTs

	2002 OLS	2002 OLS	2002 2SLS	2006 OLS	2006 OLS	2006 2SLS
Not good health	0.0113*	0.00141	0.341***	−0.00392	−0.00845	0.286***
	(1.783)	(0.114)	(3.059)	(−0.548)	(−0.577)	(2.869)
Average age		0.00565	−0.0330**		0.00443	−0.0236*
		(0.959)	(−2.134)		(0.639)	(−1.786)
Female proportion		−0.0119	−0.0501**		−0.0142	−0.0544**
		(−1.334)	(−2.217)		(−1.158)	(−2.276)
Non-white proportion		0.0154	0.0427**		0.0106	0.0347
		(1.458)	(2.124)		(0.836)	(1.622)
Population density		0.000657	−0.00215		0.00151*	−0.00110
		(1.024)	(−1.359)		(1.957)	(−0.721)
Crime score		0.0660***	−0.0347		0.0426*	−0.0452
		(3.073)	(−0.660)		(1.652)	(−0.891)
Unemployment		0.0456***	−0.110**		0.0440***	−0.0892*
		(2.944)	(−2.086)		(2.694)	(−1.756)
Poor air quality		−0.311***	−0.421***		−0.436***	−0.509***
		(−5.880)	(−4.863)		(−7.079)	(−6.425)
Good schools		0.00725	0.0557**		−0.00277	0.0410
		(0.580)	(2.149)		(−0.187)	(1.608)
Amenities		0.0380**	0.0404		0.0521**	0.0552*
		(2.400)	(1.298)		(2.546)	(1.893)
Spouse job opportunities		0.00194	0.0330		0.00117	0.0301
		(0.140)	(1.261)		(0.0621)	(1.097)
House prices		0.000566***	0.00243***		0.000454**	0.00204***
		(4.385)	(3.377)		(2.088)	(3.382)
Missing		−0.167***	−0.0799		−0.127***	−0.0552
		(−8.489)	(−1.403)		(−2.735)	(−0.602)
Constant	3.938***	4.562***	7.278***	4.115***	5.074***	7.705***
	(150.9)	(8.584)	(5.368)	(137.1)	(6.954)	(5.477)
Observations	303	303	303	303	303	303
R-squared	0.009	0.280	0.353	0.001	0.267	0.311
Robust Sargan test (*P* value)			0.050 (0.82)			0.350 (0.55)

Dependent variable: ln (GPs per 100,000 pop.)
Robust t statistics in parentheses
***p < 0.01, **p < 0.05, *p < 0.1
GPs: all practitioners except retainers and trainees. Missing: dummy variable = 1 if any missing items. All continuous explanatory variables are measured in standard deviation units so that coefficients are the effect of a 1 SD change in the variable

morbidity, GPs locate in areas with higher health needs. They also prefer to locate in areas with characteristics associated with lower deprivation levels, a more pleasant environment and higher levels of amenities.

Prior to April 2004, the NHS capitation system rewarded GPs for locating in areas with higher levels of non-health deprivation as measured, inter alia, by unemployment. The current capitation formula has higher payments in areas with poorer health and no longer directly reflects non-health deprivation. Practices now also receive quality incentive payments which increase with disease prevalence rates but which are harder to achieve with more deprived populations.[21] These changes in the payment system are too recent to be reflected in our analyses but our results suggest that they may reinforce the tendency observed for GPs to locate in areas with poorer health but with less non-health deprivation.

Finally, our analysis suggests that it would be misleading to use observed associations between area characteristics and current GP supply to predict how a national increase in supply will distribute itself across different types of area. We found (Tables 3 and 4) that of the six area factors significantly associated with the number of GPs, only one (air quality) was significantly associated with increased supply between 2002 and 2006.

There are two reasons why this may be so. First, older GPs who have already decided on a location will have higher costs of moving than newer, younger GPs. It is decisions by the latter which determine how an overall increase in supply is distributed across areas. These newer GPs may differ from older GPs in their trade-offs between different area and practice characteristics. For example, there has been an increase in the proportion of female GPs (32% to 43% between 1998 and 2008) and female GPs prefer shorter working hours.[27] Second, the relationship between GP incomes and area characteristics may have been changed by the increasing proportion of salaried GPs (an increase of approximately 17% between 1998 and 2008). Salaried positions offer GPs greater scope to achieve shorter, part-time and more regular hours of work[28] though at

Table 4 Determinants of change in log of GPs per 100,000 population in English PCTs between 2002 and 2006

	OLS	OLS	2SLS
Not good health	−0.0153***	−0.0126	−0.0196
	(−2.815)	(−1.112)	(−0.397)
Average age		−0.00150	−0.000836
		(−0.308)	(−0.133)
Female proportion		0.00251	0.00346
		(0.304)	(0.312)
Non-white proportion		−0.00317	−0.00374
		(−0.396)	(−0.411)
Population density		0.000941*	0.00100
		(1.889)	(1.569)
Crime score		−0.0234	−0.0213
		(−1.222)	(−0.920)
Unemployment		−0.00191	0.00125
		(−0.218)	(0.0515)
Poor air quality		−0.128***	−0.126***
		(−2.891)	(−2.754)
Good schools		−0.0108	−0.0119
		(−1.036)	(−0.963)
Amenities		0.0134	0.0133
		(0.869)	(0.879)
Spouse job opportunities		−0.000825	−0.00151
		(−0.0554)	(−0.0957)
House prices		−0.000141	−0.000179
		(−0.816)	(−0.609)
Missing		0.0423	0.0406
		(0.807)	(0.788)
Constant	0.177***	0.197	0.135
	(7.489)	(0.399)	(0.195)
Observations	303	303	303
R-squared	0.025	0.132	0.129
Robust Sargan test			1.057
(*P* value)			(0.30)

Dependent variable ln (GPs per 100,000 pop. 2006/GPs per 100,000 pop. 2002)
GPs: all practitioners except retainers and trainees. Robust t statistics in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
All continuous explanatory variables are measured in standard deviation units so that coefficients are the effect of a 1 SD change in the variable

considerably lower incomes than GPs who are partners in their practices. They also weaken the link between the number of GPs in an area and the income of new GPs, and thus change the trade-off that new GPs face between amenity and income.

Recently policy has taken a more targeted approach to addressing the issue of under-served areas. In 2006 the introduction of the Alternative Provider Medical Services (APMS) contract allowed PCTs to contract with a range of providers of primary care services – including existing public sector providers and also the private and voluntary sector – to procure specific primary care services in under-served areas. The policy was expanded in 2007 to require PCTs in England to tender for a new health centre offering services to registered and unregistered patients on an appointment or walk-in basis.[29] The degree to which this will improve equity of access is unclear since under-provision is no longer the main criteria for procurement. There are suggestions that the new extra capacity may remain unused in some areas, while in other places there are signals that the commercial sector are reluctant to take on the risks of entry.[29,30]

It remains to be seen how the targeted policies will interact with the other, less direct influences on GPs' decisions as to location and how they will eventually impact on equity. It is possible that the design of policies to encourage GPs into under-served areas will need to be targeted to an even greater degree. Whatever the past policy instruments responsible, it is reassuring that the supply of GPs is higher in areas where health needs are highest.

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