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Determinants of General Practitioners' Wages in England

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Abstract

We analyse the determinants of annual net income and wages (annual net income/hours) of general practitioners (GPs) using a unique, anonymised, non-disclosive dataset derived from tax returns for 21,657 GPs in England for the financial year 2002/3. The average GP had a gross income of £189,300, incurred expenses of £115,600, and earned an annual net income of £73,700. The mean wage was £35 per hour. Net income and wages depended on gender, experience, list size, partnership size, whether or not the GP worked in a dispensing practice, whether or not they worked in a Primary Medical Service (PMS) practice, and the characteristics of the local population (limiting long term illness rate, proportion from ethnic minorities, population density, Index of Multiple Deprivation 2000). The findings have implications for discrimination by GP gender and country of qualification, economies of scale by practice size, incentives for competition for patients, compensating differentials for local population characteristics, and the attractiveness of PMS versus General Medical Services contracts.

JEL No.s: I11, J31, J44

Keywords. Physician, family. General practitioner. Income. Wages. Contract.

1. Introduction

There were 29,340 general practitioners (GPs) working for the National Health Service (NHS) in England in September 2005 (NHS Staff 1995-2005 database, 2008). Most GPs are independent contractors organised in small partnerships, often owning their practice premises. Each practice has a list of registered NHS patients. GPs are paid under one of two contracts. At the time of our study in 2002/3 around 80% were in practices with a nationally negotiated General Medical Services (GMS) contract under which they which they were paid by a mixture of capitation, lump sum allowances, items of service, and target incentives (NHS Staff 1995-2005 database, 2008). Capitation payments varied with the age of patients and with the deprivation level of the area in which they lived.

GPs had to meet all practice expenses from their gross income, except for some specific reimbursements for the costs of practice nurses. The levels of the payments under the GMS contract were set by the Doctors and Dentists Review Body to achieve a national target average net income, called Intended Average Net Income. GPs could influence their income via the number of registered patients, items delivered under fee-for-service, and achievement of target payments. Additionally, where there was no local pharmacy GPs were permitted to dispense the medicines they prescribed. Dispensing practices can make a profit from dispensing since they receive a dispensing fee per item and are reimbursed for the drugs they buy at a rate which often exceeds the price they paid.

In 2002/3 around 20% of GPs had Primary Medical Services (PMS) contracts negotiated between the practice and the local Primary Care Trust (PCT). Under a PMS contract the practice received a lump sum in exchange for agreeing to provide the services they would have provided under the GMS contract, plus additional services for particular patient groups. The amount received was typically the amount the practice would have received under GMS, plus an addition intended to cover the cost of the extra services. As under GMS, each practice had to meet its expenses from its gross income, but around 8% of PMS GPs (NHS Staff 1995-2005 database, 2008) were directly employed by their PCT and received a fixed salary, bearing no practice expenses.

The way in which the pay of GPs varies with their contract type, as well as other personal, practice, and patient characteristics has considerable relevance for policy (Wordsworth et al., 2004), and has also received much attention in the media (see, e.g., BBC website, 2008a, 2008b). However, research on GPs' pay is sparse. The little evidence that exists is based on the UK-wide GP Earnings and Expenses Enquiry (EEQ) published each year by the Technical Steering Committee of the NHS Information Centre for Health and Social Care (GP Earnings and Expenses Enquiry, 2008). This is used to support GP contract negotiations between the NHS Confederation (the employers) and the British Medical Association (the doctors' trade union). It focuses predominantly on univariate analyses of mean annual gross income, expenses and net income earned by GPs, stratified by whether GPs are contracted or salaried, their contractual status (PMS versus GMS), and their dispensing status. The EEQ does not generally include multivariate analyses of GP earnings, nor does it consider hours worked or wages.

We use a unique, anonymised, non-disclosive dataset on GP gross income and expenses derived from tax returns held at Her Majesty's Revenue and Customs (HRMC) and undertake three types of analysis. First, we use multiple regression analysis to investigate how GP, practice, and local population characteristics affect GPs' net income, gross income and expenses. Second, we combine HRMC data with estimates of GP hours derived from a national sample survey of GPs to calculate hourly wages (net income/estimated hours). We estimate multiple regression models of the relationship between wages and individual, practice, and local population characteristics. Third, we examine in more detail the way in which the type of practice contract (PMS versus GMS) affects GP wages. We decompose the observed log wage differentials due to the contract into the portion due to differences in characteristics (providing information on the characteristics of practices who had switched to PMS) and the portion due to differences in coefficients (providing information on the incentives for practices with given characteristics to switch).

We consider the implications of our analysis for a number of policy questions:

- Government plans for the NHS require a substantial increase in the supply of labour from GPs (Department of Health, 2000). In 2004, 39% of GPs were female and 19% qualified overseas (NHS Staff 1995-2005 database, 2008). There is evidence of gender and ethnic pay

discrimination in other labour markets (see, e.g., Bell and Ritchie, 1998; Connolly and Gregory 2002, 2007). Since pay has a substantial influence on labour supply it is of interest to know if female or overseas qualified GPs are paid less than otherwise similar male and UK qualified GPs.

- Between 1995 and 2004 the proportion of single handed GP practices fell from 0.32 to 0.27 and the average number of GPs per practice increased from 3.0 to 3.7. Government policy has been accused of attempting to reduce the number of single handed practitioners (Smith, 2004). We investigate whether the trend to larger practices might be explained in part by the impact of practice size on GP income.
- There is policy concern over inequalities in the geographical distribution of GPs, and there has been little change in the extent of inequality over the past 30 years (Gravelle and Sutton, 2001; Hann and Gravelle, 2004). One reason might be that the remuneration system does not provide sufficient pay differentials to compensate GPs for working in less attractive areas. We therefore examine the extent to which GPs' pay varies with the characteristics of the areas in which they work.
- From 1998 GPs have been able to choose between the traditional nationally negotiated GMS contract and a locally negotiated PMS contract. By 2004 36% of GPs had opted to switch to the PMS contract. We investigate whether PMS GPs had higher incomes, thus possibly explaining this trend and whether the incentives to switch to a PMS contract were aligned with the aims of the introduction of the PMS contract.
- GPs' contracts with the NHS determine their gross income – apart from a small number of directly employed salaried GPs. Their net income is determined by their gross income and the expenses they choose to incur to satisfy their contracts. By separately examining the factors affecting gross income and expenses we can shed some light on the incentives facing GPs and their responses to policy. For example, does net income increase with practice size and, if so, is this due to the way in which the contract links gross income to size or to economies of scale so that expenses increase less than proportionately with size. The latter explanation suggests that increases in the average size of practices has generated real cost savings.
- Part of the rationale for remunerating GPs via capitation fees is that they encourage GPs to compete for patients by providing better quality care. But the power of the incentive will depend on how net income varies with the number of patients. Hence we investigate whether GPs in practices with longer lists per GP have higher net incomes.

2. Data and methods

2.1 Data

Our main source of data is a dataset of GPs' annual income and expenses for the financial year 1st April 2002 to 31st March 2003 based on anonymised non-disclosive data derived from tax returns held by HMRC. The data were collated as part of the EEQ. The incomes data in the HMRC dataset are based on Schedule D (self employed) income from all sources. The dataset includes salaried GPs, but only those who reported earning Schedule D income only. It does not include GPs who earned Schedule E (employment) income.

The data were linked to three other datasets by HMRC statisticians. First, they were linked using unique individual GP identifiers to the General Medical Statistics (GMS) database for 2002 (General Medical Statistics database, 2008). The GMS database contains detailed information on individual GP characteristics and the characteristics of the practices in which they work. Second, practices were linked to a dataset of local population characteristics. The limiting long term illness rate, the proportion of the population in non-white ethnic groups, and persons per hectare for output areas from the 2001 Census (Census 2001 database, 2008), and the Index of Multiple Deprivation 2000 (IMD 2000) for 1998 local authority wards from the Indices of Deprivation 2000 project (Indices of Deprivation for wards in England 2000 database, 2008), were attributed to practices based on the proportion of the registered practice population resident in each output area/ward based on the 2002 Attribution Dataset (Attribution data set of GP registered populations, 2008). Third, practices were linked to area type classifications based on the Primary Care Organisation in which every practice was located (National Statistics 2001 area classifications for health areas dataset, 2008). The result was a unique, anonymised, non-disclosive dataset for statistical analysis containing data on GPs' annual income

and expenses, their individual characteristics, the characteristics of the practices in which they work, and characteristics of the local populations and areas.

Access to the anonymised dataset was granted to the researchers for a limited number of analysis sessions by statisticians at HMRC at the request of the NHS Confederation and the BMA. The dataset was held by statisticians at HMRC and was analysed in their offices. The researchers were required to sign and comply with official agreements on data security. They were not allowed to take away the data or any results that would have identified individual GPs. The researchers have no further access to the data and so are unable to undertake further analyses.

Information on hours worked was taken from the sample of GPs who participated in the 2004 General Practitioner Worklife survey, conducted by the National Primary Care Research and Development Centre in February 2004 (Whalley et al, 2005; Gravelle and Hole, 2007). A questionnaire was mailed to 4,208 GPs in England, of whom 2,261 (54%) responded. The questionnaire covered personal, practice and job characteristics, and included questions on hours worked per week.

2.2 Determinants of net income

GP annual net income is defined in the HMRC dataset as gross income (total gross Schedule D income from all sources plus professional income not included in the profits of the practice) minus expenses (total allowable expenses). We examined the determinants of GP net income, gross income and expenses by linear regression of these variables on individual, practice and local population characteristics and area type. The covariates were:

1. Individual characteristics: gender; experience (years since qualification); part time status; and, country of qualification.
2. Practice characteristics: list size; partnership size; whether or not the practice is designated as a dispensing practice; and, whether or not it has a PMS contract.
3. Local population characteristics: morbidity (standardised rate of limiting long term illness); ethnicity (proportion of the population from an ethnic minority); population density (persons per hectare); and, deprivation (IMD 2000).
4. Area type: "Cities and Services"; "Coastal and Countryside"; "London Centre"; "London Cosmopolitan"; "London Suburbs"; "Mining and Manufacturing"; "Prospering UK".

Since net income is gross income minus expenses, and since the regression model is linear, the difference between the coefficients on a variable in the gross income and expense models equals the coefficient on the variable in the net income model.

2.3 Estimating wages

While HMRC tax records provide a comprehensive and reliable measure of GP annual gross income and expenses, they do not contain data on hours worked. Since income increases with hours worked (Gravelle and Hole, 2006) we calculated hourly earnings, or wages.

We used the NPCRDC 2004 GP Worklife survey to predict hours worked for GPs in the HMRC dataset. Using the observations from the Worklife survey we regressed hours worked per week on socio-demographic, practice and area characteristics. We started with the set of all variables which were common to the Worklife and HMRC datasets. The final set of explanatory variables was derived by backwards stepwise regression. We then applied the coefficients estimated on the Worklife dataset to the variables in the HMRC dataset to calculate predicted hours worked per week for every GP in the HMRC dataset.

We assumed that each GP worked for 47 weeks per year, which is implied by the annual leave entitlements usually accorded to GP specialty registrars (British Medical Association, 2007). We calculated GP wages by dividing net annual income by predicted yearly hours (predicted weekly hours multiplied by 47).

2.4 Determinants of wages

We analysed the determinants of GP wages by linear regression of the estimated GP wage variable (net annual income/(estimated weekly hours*47)) on the same covariates as those used in the net income model. Comparison of the net income model results with the results from the wage model indicates whether the pattern of estimated impacts of factors on GP remuneration is robust to the specification of remuneration as income or wage.

2.5 Decomposing wage differentials by contract type (GMS versus PMS)

The results from the wage regression shows that GPs in PMS practices earn more than those in GMS practices all else equal. We explored these differences in more detail with variants of the Blinder-Oaxaca decomposition (Blinder, 1973; Oaxaca, 1973) of the difference in the mean log wage between PMS and GMS GPs. We ran separate log wage equations for GPs working in PMS and GMS practices

$$\log y_i^j = x_i^j \beta_i^j + \varepsilon_i^j \,,\ j = 1, 2 \qquad (1)$$

where *i* indexes GPs and *j* indexes contract type (j = 1 for PMS, j = 2 for GMS). log *y* is the natural logarithm of the estimated GP wage variable, *x* is a vector of individual, practice and local population characteristics and area types that affect GP wages, β is a vector of coefficients and ε is an error term. We estimate (1) by least squares so that $\overline{\log y}_i^j = \overline{x}_i^j \hat{\beta}_i^j$.

The difference in mean log wages can be decomposed as

$$D = \overline{\log y}^1 - \overline{\log y}^2 = \underbrace{\left(\overline{x}^1 - \overline{x}^2\right)\beta^*}_{E} + \underbrace{\left[\overline{x}^1\left(\hat{\beta}^1 - \beta^*\right) + \overline{x}^2\left(\beta^* - \hat{\beta}^2\right)\right]}_{U} \qquad (2)$$

where β^* is the vector of coefficients which would be obtained if the two types of GP were treated identically (Neumark, 1988). Neumark (1988) proposed that β^* be obtained as the coefficients from estimating the model $\log y_i = x_i \beta_i + \varepsilon_i$ on pooled data. Other suggestions can be taken as special cases of $\beta^* = \lambda\hat{\beta}^1 + (1-\lambda)\hat{\beta}^2$. Oaxaca (1973) suggested that β^* could be either $\hat{\beta}^1$ or $\hat{\beta}^2$, i.e., λ =1 or λ = 0. Reimers (1983) suggested that λ = 0.5 and Cotton (1988) that $\lambda = n^1 / \left(n^1 + n^2\right)$, where n^j is the number of individuals in each group. We present decompositions based on all of these specifications of β^*.

The first term on the right hand side of (2) can be interpreted as the part of the wage differential due to differences in the variables or observed characteristics across the two groups weighted by the appropriate returns. It is the explained part of the observed differential, *E*. The second term is the unexplained component, *U*. *E* provides information about the differences between PMS and GMS practices and hence about which kinds of practice were most likely to have switched. For example, whether or not PMS practices have more deprived populations. *U* provides information about the incentives for practices of different types to switch. For example, whether or not the reward for switching was higher in practices with more deprived populations.

3. Results

3.1 Determinants of net income

The HMRC dataset contains data for 22,222 GPs in England (80% of the total in September 2002; NHS Staff 1995-2005 database, 2005). The HMRC dataset had missing values for some of the local population characteristics and the final estimation sample size was 21,657. Table I presents summary statistics for key variables included in the analyses. The mean annual gross income (std. dev.) was £189,327 (£87,112). Mean allowable expenses were £115,631 (£66,502). Mean annual net income was £73,696 (£29,450). Summary statistics for the covariates are in the Appendix. Around 80% of GPs qualified in the UK, one third were female, the average list per GP was 1,860 patients, and the modal partnership size was four.

Table I Variable means and definitions for key variables (*N* = 21,657)

Variable	Mean	Std.Dev.	Min.	Max.	Definition
Gross income	189,327	87,112	194	3,042,694	Total gross Schedule D income from all sources plus professional income not included in the profits of the practice
Expenses	115,631	66,502	107	2,619,664	Total allowable expenses
Net income	73,696	29,450	87	716,230	Total income minus total allowable expenses
Predicted hours	44.8	7.8	22.7	56.6	Predicted hours worked per week
Wage	35.00	12.05	0.06	284.88	Hourly wages (net income/(predicted hours*47)
Log wage	3.49	0.37	-2.75	5.65	Natural logarithm of hourly wages

Table II reports results from the regressions models for GP gross income, expenses and net income. Working in a PMS practice increased net income by £12,500 (17%) per annum because the increase in gross income (£41,237) was greater than the increase in expenses (£28,737). GPs in dispensing practices had much higher expenses (£87,703) because they purchased the drugs they dispensed; but their net income was increased because their gross income increased by (£108,323); they made a profit on dispensing.

The coefficient on list per GP in the net income model suggests that for every additional patient per GP, gross income increased by £47.60 and expenses increased by £28.40. The combined effect was *an increase in net income of around £19.20 per additional patient. The elasticity of net income with* respect to patients per GP is 0.49.

Figure 1 uses the results from Table II to illustrate the relationship between the numbers of GPs in the practice and mean income and expenses per GP, conditional on the other factors included in the regression models. Conditional mean income and expenses were computed by fixing the other variables in the model at their sample mean values and computing the linear prediction of income and expenses for each partnership size. The results show that up to a partnership size of 10 GPs (only 1.4% of GPs are in larger practices) both gross income and expenses per GP decline with partnership size. Net income does not vary with the size of the practice over this range.

Table II Determinants of net income

	Net income			Gross income		Expenses	
	Coef.	t	Percentage effect or Elasticity[e]	Coef.	t	Coef.	t
Female	-21,420	-8.43	-29.07%	-53,977	-8.51	-32,557	-6.65
Experience	18,836	19.40	0.10	45,668	15.79	26,832	11.82
Experience squared	-3,459	-16.16		-8,543	-13.33	-5,085	-10.00
Job share[a]	-37,949	-7.63	-51.49%	-10,5166	-8.36	-67,217	-6.90
Part time[a]	-37,110	-7.57	-50.36%	-10,1038	-8.27	-63,928	-6.77
Qualified: non-UK Europe[b]	-1,639	-1.47	-2.22%	-5,004	-1.51	-3,365	-1.27
Qualified: rest of world[b]	-880	-1.48	-1.19%	-12,585	-7.53	-11,705	-8.78
List per GP/1000	19,259	22.72	0.49	47,643	23.11	28,383	18.05
Partnership size: 2[c]	5,959	5.46	8.09%	-1,747	-0.51	-7,706	-2.75
Partnership size: 3[c]	6,376	6.02	8.65%	-5,404	-1.60	-11,781	-4.24
Partnership size: 4[c]	6,456	5.96	8.76%	-10,806	-3.17	-17,263	-6.13
Partnership size: 5[c]	6,578	5.72	8.93%	-14,588	-4.06	-21,166	-7.14
Partnership size: 6[c]	6,215	5.11	8.43%	-17,701	-4.66	-23,915	-7.66
Partnership size: 7[c]	5,214	3.96	7.07%	-20,334	-4.98	-25,547	-7.65
Partnership size: 8[c]	4,144	2.92	5.62%	-27,313	-6.25	-31,457	-8.80
Partnership size: 9[c]	6,020	3.70	8.17%	-24,633	-5.01	-30,653	-7.73
Partnership size: 10[c]	1,149	0.59	1.56%	-34,345	-6.00	-35,494	-7.84
Partnership size: 11[c]	4,171	2.03	5.66%	-19,831	-2.79	-24,002	-4.05
Partnership size: 12[c]	-6,143	-2.34	-8.34%	-96,906	-13.21	-90,763	-15.63
Partnership size: 13[c]	-1,450	-0.40	-1.97%	-49,810	-3.77	-48,360	-4.19
Partnership size: 14[c]	3,783	1.09	5.13%	-55,448	-5.56	-59,231	-6.18
Partnership size: 15[c]	-10,884	-2.80	-14.77%	-71,676	-7.47	-60,792	-8.91
Partnership size: 16[c]	20,891	4.50	28.35%	-21,604	-2.01	-42,495	-5.91
Dispensing practice	20,620	27.40	27.98%	108,324	43.97	87,703	43.94
PMS practice	12,500	14.72	16.96%	41,237	19.28	28,737	17.40
Limiting long term illness	-7,841	-5.56	-0.10	-32,581	-8.03	-24,740	-7.65
Ethnic minorities	15,884	6.18	0.02	25,942	4.34	10,058	2.12
Population density	-34	-2.45	-0.01	-239	-6.36	-205	-7.24
IMD 2000	47	3.03	0.02	139	3.37	92	2.82
"Cities and Services"[d]	564	0.38	0.77%	-35,258	-8.91	-35,822	-11.61
"Coastal and Countryside"[d]	2,643	1.54	3.59%	-20,505	-4.56	-23,147	-6.67
"London Cosmopolitan"[d]	1,500	0.91	2.04%	-14,398	-3.39	-15,899	-4.64
"London Suburbs"[d]	791	0.49	1.07%	-29,173	-7.09	-29,964	-9.32
"Mining Manufacturing"[d]	1,602	0.96	2.17%	-37,923	-8.66	-39,525	-11.66
"Prospering UK"[d]	2,282	1.40	3.10%	-31,115	-7.33	-33,397	-10.19
Constant	78,929	4.39		298,846	6.55	219,917	6.19
N	21,657			21,657		21,657	
R^2	0.4073			0.4380		0.3875	

Controls are also included but not shown for whether or not a return was made to HMRC in quarter 4, whether or not HMRC data were available or all GPs in the practice, and very small list size. The t-values are based on robust standard errors.

[a] The omitted category is "Full time". [b] The omitted category is "Qualified: UK". [c] The omitted category is "Partnership size: 1". [d] The omitted category is "London Centre". [e] For dummy variables the percentage effect is calculated as 100*coefficient/mean net income; for continuous variables the elasticity is calculated as (coefficient*variable mean)/mean net income. For the experience variables the elasticity is calculated as the sum of the elasticities for experience and experience squared evaluated at the mean experience.

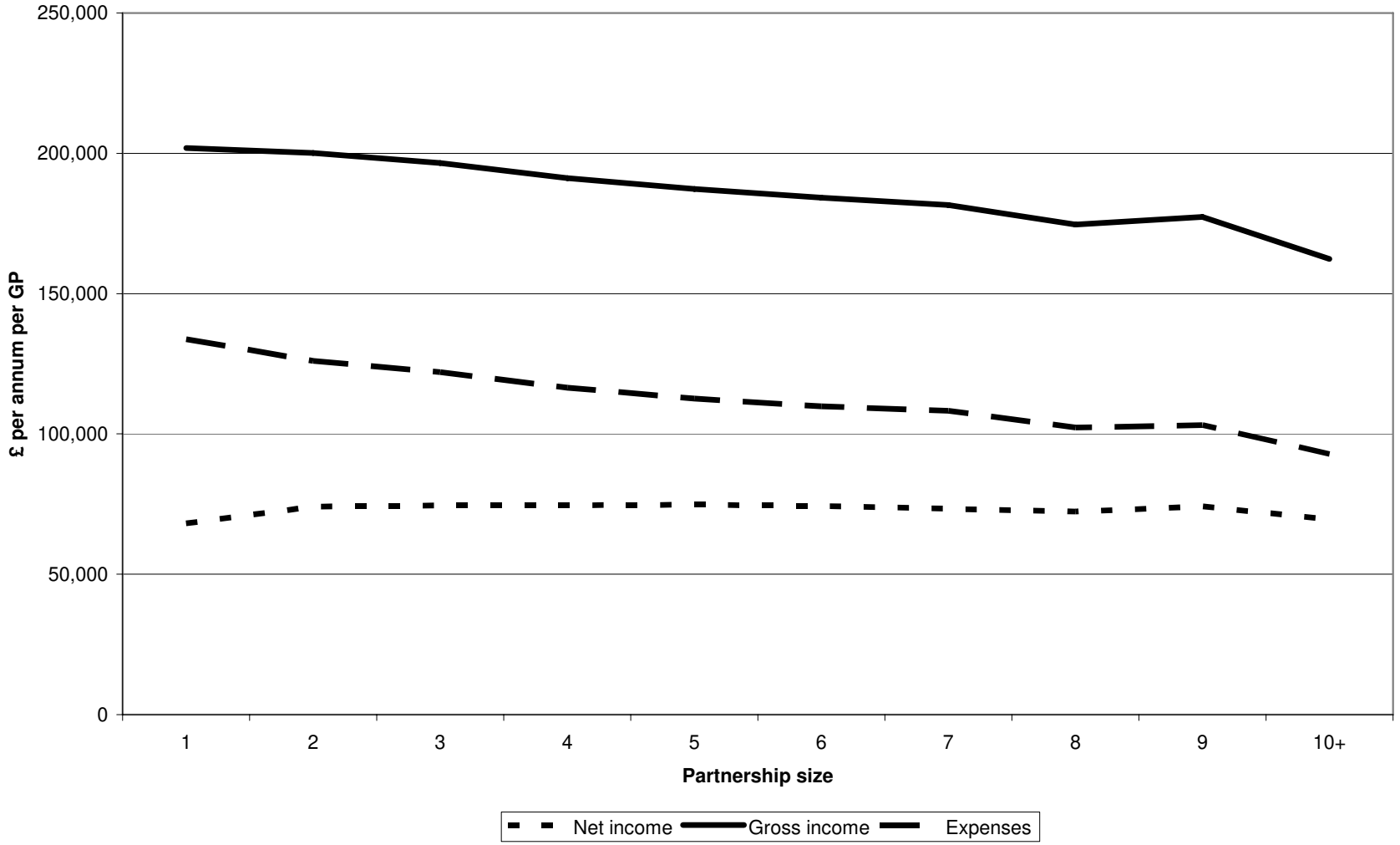

Figure 1 Conditional mean gross income, expenses, and net income (£ per annum per GP) by partnership size calculated at the sample mean values of the covariates

3.2 Hours worked

The model used to predict GP hours is in Table III (additional models of the hours of work of the GPs in the Worklife survey which used all the available Worklife survey variables are reported in Gravelle and Hole, 2007). The coefficients from the analysis of weekly hours worked in the Worklife survey sample are plausibly signed. Full time GPs work 13.5 hours (30%) more than part-timers. Female GPs work 6.9 hours less than male GPs, even after allowing for the fact that female GPs are more likely to be part time. GPs in practices with more patients per GP work more hours, whereas conditional on this, those in practices serving larger populations work fewer hours.

Table III also has summary statistics for the covariates used to estimate hours worked in both the Worklife survey dataset and the HMRC dataset. The characteristics are similar in both datasets, except for the smaller proportion of salaried GPs in the Worklife survey (the salaried GP figures in the HMRC dataset include PMS GPs grouped as 'contracted or salaried', where it is not possible to distinguish whether or not they are salaried (GP Earnings and Expenses Enquiry, 2008). The actual and predicted hours worked per week are also reported. The mean values in the two datasets are similar, with a larger standard deviation in the Worklife survey because these are actual observations of hours worked, which include idiosyncratic error terms.

Table III Model used to predict GP hours

	2004 General Practitioner Worklife survey dataset (N = 1,825)					HMRC dataset (N = 22,222)	
	Regression model			Summary statistics		Summary statistics	
	Coef.	t	Percentage effect or elasticity[a]	Mean	Std.Dev.	Mean	Std.Dev.
Female	-6.872	-11.15	-15.44%	0.340	0.474	0.336	0.472
Full time	13.523	19.03	30.38%	0.795	0.404	0.804	0.397
List per GP / 1,000	2.686	3.47	0.08	1.648	0.685	1.851	0.495
(List per GP / 1,000) squared	-0.177	-3.19		3.187	7.280	3.672	2.460
Dispensing	1.474	2.48	3.31%	0.185	0.389	0.146	0.353
10% of GPs with most deprived patients	-1.957	-1.75	-0.00	0.069	0.254	0.088	0.284
Salaried	-2.130	-1.7	-4.78%	0.025	0.157	0.206[b]	0.404[b]
Practice list size / 1,000	-0.214	-3.7	-0.04	8.962	4.524	8.337	4.200
Constant	34.091	27.39					
R^2		0.3700					
Hours worked per week				44.520[c]	12.910[c]	44.790[d]	4.200[d]

The t-values are based on robust standard errors.
[a] Percentage effect is calculated for dummy variables as 100*coefficient/mean hours; for continuous variables elasticity is calculated as (coefficient*variable mean)/mean hours. For list per GP/1000 the elasticity is calculated as the sum of the elasticities on list per GP/1000 and on (list per GP/1000) squared evaluated at the mean of list per GP. [b] This includes PMS GPs grouped as 'contracted or salaried', where it is not possible to distinguish whether or not they are salaried. [c] Actual. [d] Predicted.

3.3 Determinants of GP wages

Mean (std. dev.) hourly wages per GP, were £35.00 (£12.05) (Table I). The results from the wage regression are in Table IV. Female GPs had significantly lower wages than male GPs, though the magnitude of the difference was quite small at just over 2%. The relationship between experience and wages is inverse U-shaped, with the maximum occurring 27 years after qualifying. The coefficients on part-time and job share working are not significant: GPs had the same average reward for hours worked whether full or part time. Having overseas qualifications had only a small and statistically insignificant negative effect on the wage.

Table IV Determinants of wages

	Coef.	t	Percentage effect or Elasticity[e]
Female	-0.743	-4.11	-2.12%
Experience	8.708	19.06	0.10
Experience squared	-1.586	-15.89	
Job share[a]	-0.668	-0.96	-1.91%
Part time[a]	0.440	1.77	1.26%
Qualified: non-UK Europe[b]	-0.772	-1.38	-2.21%
Qualified: rest of world[b]	-0.356	-1.33	-1.02%
List per GP/1000	6.893	24.45	0.37
Partnership size: 2[c]	3.393	7.27	9.69%
Partnership size: 3[c]	4.118	9.18	11.77%
Partnership size: 4[c]	4.638	10.50	13.25%
Partnership size: 5[c]	5.169	11.47	14.77%
Partnership size: 6[c]	5.489	12.05	15.68%
Partnership size: 7[c]	5.447	11.50	15.56%
Partnership size: 8[c]	5.522	10.84	15.78%
Partnership size: 9[c]	7.120	11.90	20.34%
Partnership size: 10[c]	5.052	6.86	14.43%
Partnership size: 11[c]	7.467	8.75	21.33%
Partnership size: 12[c]	3.072	3.00	8.78%
Partnership size: 13[c]	7.931	4.13	22.66%
Partnership size: 14[c]	8.372	4.50	23.92%
Partnership size: 15[c]	3.033	1.68	8.67%
Partnership size: 16[c]	22.199	15.79	63.43%
Dispensing practice	7.420	30.24	21.20%
PMS practice	8.618	38.73	24.62%
Limiting long term illness	-3.128	-4.75	-0.09
Ethnic minorities	8.739	7.72	0.02
Population density	-0.014	-2.28	-0.01
IMD 2000	0.030	4.18	0.02
"Cities and Services"[d]	-0.371	-0.53	-1.06%
"Coastal and Countryside"[d]	0.426	0.53	1.22%
"London Cosmopolitan"[d]	0.342	0.44	0.98%
"London Suburbs"[d]	-0.407	-0.55	-1.16%
"Mining Manufacturing"[d]	-0.038	-0.05	-0.11%
"Prospering UK"[d]	0.459	0.61	1.31%
Constant	5.644	4.38	
N		21,657	
R^2		0.2179	

Controls are also included but not shown for whether or not a return was made to HMRC in quarter 4, whether or not HMRC data were available or all GPs in the practice, and very small list size. The t-values are based on robust standard errors.

[a] The omitted category is "Full time". [b] The omitted category is "Qualified: UK". [c] The omitted category is "Partnership size: 1". [d] The omitted category is "London Centre". [e] For dummy variables the percentage effect is calculated as 100*coefficient/mean wage; for continuous variables the elasticity is calculated as (coefficient*variable mean)/mean wage. For the experience variables the elasticity is calculated as the sum of the elasticities on experience and experience squared evaluated at the mean experience.

PMS GPs earned significantly higher wages than GMS GPs, with a wage premium of £8.62 (25%). Working in a dispensing practice also had a large (21%) positive effect on wages.

More patients per GP led to higher wages (elasticity 0.37). This is to be expected given that a large component of GP income varies directly with the number of patients on the list. Conditional on list size and the other covariates, single handed GPs have the lowest wages: for example GPs in practices with two GPs have 9.7% higher wages all else equal.

There were higher wages for GPs working in more deprived areas (higher values of the IMD 2000 indicate greater deprivation), in more rural areas, or areas with larger proportions of the population from ethnic minorities. GPs in practices in areas with sicker populations had smaller wages. Conditional on the other covariates there were no statistically significant wage differentials associated with the ONS area type.

The pattern of effects (signs, significance and percentage effects) of the covariates on wages (Table IV) is broadly similar to their effect on net income (Table II), indicating that the estimated impacts of the covariates are robust to the specification of remuneration. The main differences are with the effects of the female, and the part-time variables. Being female and being part-time reduced both wages and net income but the effects are much greater in the net income model: female GPs earn 2% lower wages than male GPs, earn 29% lower net income than male GPs, and work 15% fewer hours; part-time GPs earn around 2% lower wages than full time GPs, around 50% lower net income and work around 30% few hours. For both females and part-time GPs, wages are only slightly lower than those of the comparator, but the net income is much lower. The former is a function of the lower net income combined with the lower hours worked.

3.4 Decomposing wage differentials by contract type (GMS versus PMS)

The log wage models used in the decomposition are in Table V. The main difference between the models for PMS and GMS GPs is that in the PMS model, gender has no significant effect on log wages, while female GMS GPs earn significantly lower wages than their male counterparts. Compared with PMS GPs who work full time, those working on a job share or part-time basis have no significant wage penalty, while for GMS GPs the effects are significant and negative.

The summary results of the decompositions are in the top panel of Table VI. This shows how different assumptions about the appropriate comparator coefficients (β^*) affect the apportionment of the overall differential between the explained (due to differences in mean characteristics) and unexplained (due to differences in coefficients) portions. The decomposition into explained and unexplained portions is sensitive to the value of the comparator coefficients β^*, with the explained component sometimes negative and sometimes positive. However, the unexplained component accounts for in excess of 90% of the overall difference in all cases. Hence, whatever the basis of the decomposition, the majority of the higher mean log wage in PMS practices is attributable to the differential effect of the characteristics on wages, not to differences in the characteristics of GPs in PMS and GMS practices.

The implication of these findings is that the higher observed wages of PMS GPs in the sample is mainly explained by their superior returns to individual, practice and local population characteristics and area types. A GP working in a PMS practice with identical characteristics to a GP working in a GMS practice would have earned considerably higher wages than the GMS GP. PMS contracts were negotiated with local PCTs. We can therefore interpret the difference between the effects of characteristics on wages as showing how GP bargaining power varied with the characteristics.

The PMS contract was intended to encourage the supply of GP services to under served classes of patients. Comparison of the mean population and area characteristics for PMS and GMS GPs in Tables V and VI show that PMS GPs are more likely to be in practices with slightly more patients per GP and where populations are sicker, more deprived and have a higher proportion from ethnic minorities. The detailed decompositions in the lower part of Table VI suggest that the financial incentives are rather mixed. The gain from switching to PMS is greater the larger the number of patients per GP in the practice. The rewards from being in a PMS contract rather than a GMS contract are also higher in less densely populated areas, in areas with more deprived patients and with a higher proportion of patients from ethnic minorities. But the rewards are smaller for PMS practices in areas with sicker populations.

Table V. Log wage models by contract type (GMS versus PMS).

	PMS				GMS				Pooled	
	Coef.	t	Mean	$x\beta$ [g]	Coef.	t	Mean	$x\beta$ [g]	Coef.	t
Female	-0.022	-1.37	0.32	-0.007	-0.022	-3.96	0.338	-0.008	-0.026	-4.55
Experience	0.365	8.59	2.243	0.819	0.292	19.85	2.233	0.652	0.321	21.51
Experience squared	-0.067	-7.40	5.664	-0.379	-0.054	-16.88	5.655	-0.303	-0.060	-18.57
Job share[a]	-0.014	-0.27	0.017	0.000	-0.057	-2.91	0.015	-0.001	-0.037	-1.91
Part time[a]	0.014	0.69	0.174	0.002	-0.016	-2.18	0.178	-0.003	-0.003	-0.44
Qualified: non-UK Europe[b]	-0.025	-0.47	0.015	0.000	-0.018	-0.95	0.016	0.000	-0.026	-1.37
Qualified: rest of world[b]	-0.004	-0.20	0.176	-0.001	-0.010	-1.27	0.147	-0.002	-0.006	-0.81
List per GP/1000	0.248	18.82	1.911	0.474	0.188	30.96	1.840	0.346	0.215	37.63
Partnership size: 2[c]	0.185	6.13	0.106	0.02	0.106	9.17	0.107	0.011	0.123	10.73
Partnership size: 3[c]	0.249	7.91	0.111	0.028	0.155	13.38	0.135	0.021	0.169	14.54
Partnership size: 4[c]	0.242	7.78	0.149	0.036	0.188	16.30	0.173	0.032	0.197	17.11
Partnership size: 5[c]	0.310	10.15	0.172	0.053	0.196	16.67	0.166	0.033	0.221	19.03
Partnership size: 6[c]	0.333	10.32	0.129	0.043	0.214	17.70	0.143	0.031	0.233	19.36
Partnership size: 7[c]	0.320	9.06	0.087	0.028	0.216	16.74	0.096	0.021	0.233	18.06
Partnership size: 8[c]	0.336	9.04	0.072	0.024	0.218	15.11	0.058	0.013	0.248	17.36
Partnership size: 9[c]	0.411	9.14	0.034	0.014	0.238	12.82	0.024	0.006	0.288	15.96
Partnership size: 10[c]	0.318	4.76	0.011	0.004	0.207	8.19	0.011	0.002	0.231	9.18
Partnership size: 11[c]	0.474	6.33	0.009	0.004	0.264	7.94	0.006	0.001	0.326	10.28
Partnership size: 12[c]	0.274	1.93	0.002	0.001	0.171	3.17	0.002	0.000	0.217	4.06
Partnership size: 13[c]	0.442	5.52	0.008	0.003	0.149	2.34	0.001	0.000	0.362	7.73
Partnership size: 14[c]	0.408	4.08	0.005	0.002	[f]	[f]	[f]	[f]	0.463	6.04
Partnership size: 15[c]	0.251	2.83	0.006	0.002	[f]	[f]	[f]	[f]	0.334	4.93
Partnership size: 16[c]	0.663	5.35	0.003	0.002	[f]	[f]	[f]	[f]	0.742	7.65
Dispensing practice	[e]	[e]	[e]	[e]	0.213	30.26	0.184	0.039	0.159	21.15
Limiting long term illness	-0.113	-2.06	1.025	-0.116	-0.052	-2.39	0.975	-0.05	-0.055	-2.59
Ethnic minorities	0.271	3.47	0.093	0.025	0.252	7.43	0.079	0.02	0.224	6.96
Population density	0.000	-0.94	29.949	-0.013	0.000	-0.37	27.236	-0.002	-0.001	-2.78
IMD 2000	0.001	1.78	26.385	0.028	0.001	2.32	23.246	0.013	0.001	2.90
"Cities and Services"[d]	-0.035	-0.53	0.269	-0.009	0.033	1.57	0.233	0.008	0.011	0.50
"Coastal and Countryside"[d]	0.047	0.65	0.078	0.004	0.034	1.41	0.091	0.003	0.024	0.99
"London Cosmopolitan"[d]	0.106	1.65	0.046	0.005	-0.061	-2.74	0.024	-0.001	0.028	1.26
"London Suburbs"[d]	0.034	0.51	0.066	0.002	-0.022	-1.00	0.047	-0.001	0.003	0.15
"Mining Manufacturing"[d]	0.009	0.12	0.213	0.002	0.030	1.28	0.132	0.004	0.024	1.02
"Prospering UK"[d]	0.035	0.51	0.314	0.011	0.040	1.78	0.448	0.018	0.019	0.84
Constant	2.509	24.76	1.000	2.509	2.526	68.60	1.000	2.526	2.523	69.02
Sum				3.644				3.457		
N	4,474				17,183				21,657	
R^2	0.1326				0.1581				0.1336	

Controls are also included but not shown for whether or not a return was made to HMRC in quarter 4, whether or not HMRC data were available or all GPs in the practice, and very small list size. The t-values are based on robust standard errors.

[a] The omitted category is "Full time". [b] The omitted category is "Qualified: UK". [c] The omitted category is "Partnership size: 1". [d] The omitted category is "London Centre". [e] There are no PMS practices designated as dispensing practices in the data. [f] There are no GMS practices with more than 13 partners in the data. [g] β = coefficient multiplied by mean value.

Table VI. Decomposition log wage differentials by contract type (GMS versus PMS).

Summary of decomposition					
	$\lambda = 0$ $(\beta^* = \hat{\beta}^{GMS})$	$\lambda = 1$ $(\beta^* = \hat{\beta}^{PMS})$	$\lambda = 0.5$ $\beta^* = \frac{\hat{\beta}^{PMS} + \hat{\beta}^{GMS}}{2}$	$\lambda = 0.207$[a]	Pooled[b]
Explained	-0.028	0.017	-0.005	-0.018	0.002
Unexplained	0.215	0.170	0.193	0.206	0.186
Total difference	0.188	0.188	0.188	0.188	0.188

Decomposition by variable $(\lambda = 0, \beta^* = \hat{\beta}^{GMS})$

	Explained $(\bar{x}^{PMS} - \bar{x}^{GMS})\hat{\beta}^{GMS}$	Unexplained $\bar{x}^{PMS}(\hat{\beta}^{PMS} - \hat{\beta}^{GMS})$	Total difference $(\bar{x}^{PMS}\hat{\beta}^{PMS} - \bar{x}^{GMS}\hat{\beta}^{GMS})$
Female	0.000	0.000	0.000
Experience	0.003	0.164	0.167
Experience squared	-0.001	-0.076	-0.077
Job share	0.000	0.001	0.001
Part time	0.000	0.005	0.005
Qualified: non-UK Europe	0.000	0.000	0.000
Qualified: rest of world	0.000	0.001	0.001
List per GP/1000	0.013	0.115	0.128
Partnership size: 2	0.000	0.009	0.009
Partnership size: 3	-0.004	0.011	0.007
Partnership size: 4	-0.004	0.008	0.004
Partnership size: 5	0.001	0.020	0.021
Partnership size: 6	-0.003	0.015	0.012
Partnership size: 7	-0.002	0.009	0.007
Partnership size: 8	0.003	0.009	0.012
Partnership size: 9	0.002	0.006	0.008
Partnership size: 10	0.000	0.001	0.001
Partnership size: 11	0.001	0.002	0.003
Partnership size: 12	0.000	0.000	0.000
Partnership size: 13	0.001	0.002	0.003
Partnership size: 14	0.000	0.002	0.002
Partnership size: 15	0.000	0.002	0.002
Partnership size: 16	0.000	0.002	0.002
Dispensing practice	-0.039	0.000	-0.039
Limiting long term illness rate	-0.003	-0.063	-0.066
Ethnic minorities	0.004	0.002	0.006
Population density	0.000	-0.011	-0.011
IMD 2000	0.002	0.014	0.016
“Cities and Services”	0.001	-0.018	-0.017
“Coastal and Countryside”	0.000	0.001	0.001
“London Cosmopolitan”	-0.001	0.008	0.007
“London Suburbs”	0.000	0.004	0.004
“Mining and Manufacturing”	0.002	-0.005	-0.003
“Prospering UK”	-0.005	-0.001	-0.006
Constant	0.000	-0.017	-0.017
Sum	-0.028	0.215	0.188

Numbers may not add due to rounding error.

[a] λ = frequency weight for PMS GPs = (number of PMS GPs in the sample)/(total number of GPs in the sample). [b] The appropriate returns are based on the pooled log wage model in Table V.

4. Concluding remarks

4.1 Caveats

Our study has several limitations. First, the HMRC data only includes Schedule D (i.e., self-employed) income. We were unable to include salaried GPs who earned Schedule E (employment) income in the analysis. Second, since the HMRC does not hold data on hours worked by GPs, we had to use hours predicted from the NPCRDC sample survey of GPs which only has information on a subset of the variables in the HMRC data set. Third, we were unable to find reliable evidence on the number of weeks worked per annum by GPs and, in particular, on the way in which this might vary with GP characteristics. We therefore assumed that all GPs work the same number of weeks. If, for example, PMS GPs work fewer or more weeks per annum than GMS GPs then our results may under or overestimate the PMS wage premium. Fourth, our analysis is based on HMRC data for the financial year 2002/3 and so does not reflect the changes in the GMS and PMS contracts which occurred in 2004. Fifth, one explanation for the wage premium to PMS contracts is the self-selection of high wage-earning GMS GPs into the PMS group. Practices were more likely to opt for the PMS contract if they had been fundholders in the internal market (Gravelle and Hann, 2006), suggesting that PMS practices were more entrepreneurial than GMS GPs (Whynes, Ennew, and Feigham, 1999). But this does not mean that the PMS wage premium is due to GP characteristics rather than the contract itself: more entrepreneurial GPs are likely to be better at recognising opportunities for greater income and to be more willing to switch. Sixth, because of the restrictions placed on the researchers to ensure data confidentiality, only a limited set of analyses could be undertaken.

Despite these caveats, because of the richness of the dataset our results have some potentially important implications for policy.

4.2 Potential policy implications

Discrimination. Female GPs have markedly lower incomes than otherwise similar male GPs but their wages are only slightly lower. Thus, once allowance is made for hours worked, there seems little evidence of gender discrimination in these data. Our analysis also suggests that there is no evidence for pay discrimination against overseas qualified GPs.

Economies of scale. Compared to GPs in practices with the modal number of GPs (four) single handed GPs have 7% lower wages and 9% smaller incomes. This may explain the gradual decline in the proportion of single handed practices from 32% in 1994 to 27% in 2004. Holding other factors, especially patients per GP, constant, expenses per GP decline steadily with the number of GPs over most of the range of observed practice sizes (see Figure 1). Increasing the number of GPs and patients pro rata will reduce costs per GP and per patient served. However, once there are two GPs or more in a practice, gross income per GP fell at the same rate as practice expenses, so that there is no financial incentive for GPs to further increase practice size. Whether the incentives for choice of partnership size are appropriate depends on how the overall output of practices varies with size. There is some evidence that both patient satisfaction (Crow et al, 2002) and clinical quality (Doran et al, 2006; Gravelle, Sutton and Ma, 2008) decline with practice size. Thus there may be too great an incentive for GPs to increase their practice size.

Incentives for competition for patients. Both GP wages and net income are responsive to the number of patients per GP (elasticities of 0.37 and 0.49, respectively): GPs appear to have an incentive to compete for patients.

Compensating differentials. There were higher wages and net incomes for GPs working in more deprived areas, rural areas, or areas with a larger proportion of the population from ethnic minorities, but GPs in practices in areas with sicker populations had smaller wages and net incomes. The effects on wages were typically small with wage elasticities between -0.9 and 0.02. There were no significant wage differentials associated with the ONS area type. The results suggest that pay is not greatly affected by area characteristics, so that the relative supply of GPs in areas has not been affected by relative geographical pay differentials. This is consistent with other findings (see, e.g., Elliott et al., 2006) and suggests that area differences in supply are driven by non-pay factors.

PMS versus GMS contracts. Practices with PMS contracts were expected to provide more services for their patients. The fact that their expenses are higher by around £28,700 per GP suggests that they may have done so. But, as Table II shows, their gross incomes are greater by £41,200 per GP, leading to higher net income (17% higher) and higher wages (25%). Thus PMS GPs seem to have been overcompensated for the additional costs they incur. PMS contracts were meant to increase the supply of services to under served groups of patients. The decomposition of the differences in log wages between PMS and GMS GPs in Table VI shows that the financial incentives for switching from GMS to PMS may not have been well aligned with the policy objective. GPs with sicker patients and in more densely population areas would have a reduced wage if they switched to PMS. On the other hand they would have a higher wage from switching if they were in practices with fewer GPs per patient or with more deprived patients.

As the example of the ONS Longitudinal Survey (2008) demonstrates, it is possible to use datasets containing potentially sensitive data whilst preserving confidentiality. Our study shows the potential usefulness of an anonymised, non-disclosive dataset derived from GP tax returns to address a number of important policy questions. We recommend that, in the interests of improved policy making, datasets on income such as the one used in our study should, with appropriate safeguards, be made available for future use by researchers.

References

Attribution data set of GP registered populations. http://www.ic.nhs.uk/statistics-and-data-collections/population-and-geography/population/attribution-data-set-of-gp-registered-populations--2007 [24 February 2008].

BBC website. http://news.bbc.co.uk/1/hi/health/6157219. Average GP pay rises to £106,000 [22 January 2008a].

BBC website http://news.bbc.co.uk/1/hi/health/4373519.stm. Are GPs worth £100,000? [22 January 2008b].

Bell D, Ritchie F. (1998.) Female earnings and gender differentials in Great Britain 1977–1994. *Labour Economics* **5**: 331-357.

Blinder A. (1973.) Wage discrimination: reduced form and structural estimates. *Journal of Human Resources* **8**: 436-455.

British Medical Association. (2007.) *Framework for a written contract of employment for GP specialty registrars.* http://www.bma.org.uk/ap.nsf/Content/framecontractGPregs0707 [24 February 2008].

Census 2001 database. http://www.statistics.gov.uk/census2001/census2001.asp [24 February 2008].

Connolly S, Gregory M. (2002.) The national minimum wage and hours of work implications for low paid women. *Oxford Bulletin of Economics and Statistics* **64** Supplement 1: 607-631.

Connolly S, Gregory M. (2007.) Women and work. In: Crafts N, Gazeley I, Newell A (eds.) *Work and pay in 20th Century Britain*. Oxford University Press: Oxford.

Cotton J. (1988.) On the decomposition of wage differentials. *Review of Economics and Statistics* **70**: 236-243.

Crow R, Gage H, Hampson S, Hart J. (2002.) The measurement of satisfaction with healthcare: implications for practice from a systematic review of the literature. *Health Technology Assessment*; Vol. 6: No. 32.

Department of Health. (2000.) *The NHS Plan, Cm 4818*. Department of Health: London. Doran T, Fullwood C, Gravelle H, Reeves D, Kontopantelis E, Hiroeh U, Roland M. (2006.) Family practice performance in the first year of the UK's new 'pay for performance' scheme: good clinical practice or gaming? *New England Journal of Medicine*, 355:375-384.

Elliott R, Sutton M, Gravelle H, Hole A, Ma A, Morris S, Sibbald B, Skåtun D. (2006.) *Adjusting the General Medical Services allocation formula to reflect recruit and retention difficulties.* Report to the GMS Formula Review Group.

General Medical Services database. http://www.ic.nhs.uk/statistics-and-data-collections/workforce/nhs-staff-numbers/nhs-staff-1995--2005 [24 February 2008].

GP Earnings and Expenses Enquiry. http://www.ic.nhs.uk/statistics-and-data-collections/primary-care/general-practice [24 February 2008].

Gravelle H, Hann M. (2006.) Factors affecting general practitioners' choice between General Medical Service and Primary Medical Service contracts. http://www.york.ac.uk/inst/che/research/primarycurrent.htm [24 February 2008].

Gravelle H, Hole A. (2007.) The work hours of GPs: survey of English GPs. *British Journal of General Practice* **57**: 96-100.

Gravelle H, Hole A. (2006.) Equal pay for equal work? The effect of gender on the income of English general practitioners. HESG discussion paper, University of York, July 2006.

Gravelle H, Sutton M. (2001.) Inequalities in the geographical distribution of GPs in England and Wales 1974-1995. *Journal of Health Services Research and Policy* **6**: 6-13.

Gravelle H, Sutton M, Ma A. (2008.) Doctor behaviour under a pay for performance contract: further evidence from the Quality and Outcomes Framework. *CHE Research Paper* 34. York, University of York.

Hann M, Gravelle H. (2004.(The mal-distribution of general practitioners in England and Wales 1974-2003. *British Journal of General Practice* **54**:894-898.

Indices of Deprivation for wards in England 2000 database. http://www.statistics.gov.uk/StatBase/Product.asp?vlnk=9421&More=Y [24 February 2008]

National Statistics 2001 Area Classification of Health Areas database. http://www.statistics.gov.uk/about/methodology_by_theme/area_classification/ha/default.asp [24 February 2008].

Neumark D. (1988.) Employers' discriminatory behavior and the estimation of wage discrimination. *Journal of Human Resources* **23**: 279-295.

NHS Staff 1995-2005 database. http://www.ic.nhs.uk/statistics-and-data-collections/workforce/nhs-staff-numbers/nhs-staff-1995--2005 [24 February 2008].

Oaxaca R. (1973.) Male-female wage differentials in urban labor markets. *International Economic Review* **14**: 693-709.

ONS Longitudinal Survey. http://www.statistics.gov.uk/services/Longitudinal.asp [24 February 2008].

Reimers C. (1983.) Labor market discrimination against Hispanic and Black men. *Review of Economics and Statistics* **65**: 570-579.

Smith, J. (2004.) *The Shipman Enquiry. Fifth Report - safeguarding patients: lessons from the past proposals for the future*. Published 9 December 2004. Command Paper Cm 6394 http://www.the-shipman-inquiry.org.uk/5r_page.asp [19 October 2006].

Whalley D, Bojke C, Gravelle H, Sibbald B. 2005/2004 National survey of General Practitioner job satisfaction. Final Report. May 2005. http://www.npcrdc.ac.uk/pr29

Whynes D, Ennew C, Feigham T. 1999. Entrepreneurial attitudes of primary health care physicians in the United Kingdom. *Journal of Economic Behavior and Organization*, **38**: 331-347.

Williams J, Petchey R, Gosden T, Leese B, Sibbald B. (2001.) A profile of PMS salaried GP contracts and their impact on recruitment. *Family Practice* **18**: 283-287.

Wordsworth S, Skåtun D, Scott A, French F. (2004.) Preference for general practice jobs: a survey of principal and sessional GPs. *Br J Gen Practice* **54**: 740-746.

Appendix Variable means and definitions for covariates (*N* = 21,657)

Variable	Mean	Definition
Female	0.334	Female = 1, 0 otherwise
Experience	2.235	Years since qualified/10
Experience squared	5.658	Years since qualified squared/100
Full time	0.804	Full-time contract = 1, 0 otherwise
Job share	0.016	Job share contract = 1, 0 otherwise
Part time	0.181	Part-time contract = 1, 0 otherwise
Qualified: UK	0.831	Qualified in UK = 1, 0 otherwise
Qualified: non–UK Europe	0.016	Qualified in Europe outside UK = 1, 0 otherwise
Qualified: rest of world	0.153	Qualified outside Europe = 1, 0 otherwise
List per GP/1000	1.856	Patient registrations per partner in practice/1000
Partnership size: 1	0.083	1 partner in practice = 1, 0 otherwise
Partnership size: 2	0.107	2 partners in practice = 1, 0 otherwise
Partnership size: 3	0.131	3 partners in practice = 1, 0 otherwise
Partnership size: 4	0.168	4 partners in practice = 1, 0 otherwise
Partnership size: 5	0.167	5 partners in practice = 1, 0 otherwise
Partnership size: 6	0.139	6 partners in practice = 1, 0 otherwise
Partnership size: 7	0.094	7 partners in practice = 1, 0 otherwise
Partnership size: 8	0.061	8 partners in practice = 1, 0 otherwise
Partnership size: 9	0.026	9 partners in practice = 1, 0 otherwise
Partnership size: 10	0.011	10 partners in practice = 1, 0 otherwise
Partnership size: 11	0.006	11 partners in practice = 1, 0 otherwise
Partnership size: 12	0.002	12 partners in practice = 1, 0 otherwise
Partnership size: 13	0.003	13 partners in practice = 1, 0 otherwise
Partnership size: 14	0.001	14 partners in practice = 1, 0 otherwise
Partnership size: 15	0.001	15 partners in practice = 1, 0 otherwise
Partnership size: 16	0.001	16 partners in practice = 1, 0 otherwise
Dispensing practice	0.146	Dispensing practice = 1, 0 otherwise
PMS practice	0.207	PMS practice = 1, 0 otherwise
Limiting long term illness rate	0.985	Standardised limiting longstanding illness rate
Ethnic minorities	0.082	Proportion of population from non-white ethnic groups
Population density	28.091	Persons per hectare
IMD 2000	23.917	IMD 2000 score
"Cities and Services"	0.241	ONS area: "Cities and Services" = 1, 0 otherwise
"Coastal and Countryside"	0.088	ONS area: "Coastal and Countryside" = 1, 0 otherwise
"London Centre"	0.023	ONS area: "London Centre" = 1, 0 otherwise
"London Cosmopolitan"	0.029	ONS area: "London Cosmopolitan" = 1, 0 otherwise
"London Suburbs"	0.051	ONS area: "London Suburbs" = 1, 0 otherwise
"Mining and Manufacturing"	0.150	ONS area: "Mining and Manufacturing" = 1, 0 otherwise
"Prospering UK"	0.419	ONS area: "Prospering UK" = 1, 0 otherwise

We also include controls for whether or not a tax return was made to HMRC in quarter 4, whether or not HMRC data were available or all GPs in the practice, and very small list size.