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Abstract

To date, there has been little data or empirical research on the determinants of doctors' earnings despite earnings having an important role in influencing the cost of health care, decisions on workforce participation and labour supply. This paper examines the determinants of annual earnings of general practitioners and specialists using the first wave of the Medicine in Australia: Balancing Employment and Life (MABEL), a new longitudinal survey of doctors in Australia. For both GPs and specialists, earnings are higher for men, for those who are self-employed, who do after hours or on-call work, and who work in areas with a high cost of living. GPs have higher earnings if they work in larger practices, in outer regional or rural areas, and in areas with lower GP density, whilst specialists earn more if they are a fellow of their college, have more working experience, spend more time in clinical work, have less complex patients, or work in inner regional areas. Overall, GPs earn about 32% less than specialists. The returns from on-call work, experience, and self-employment are higher for specialists compared to GPs.

JEL-Classification: I11, J30, I18
Keywords: earnings, general practitioners, hedonic regression, specialists

1. Introduction

The earnings of doctors have an important influence on doctors' labour supply decisions and on overall health care costs. The level of earnings is determined partly by the institutional setting, including the method of remuneration, the existence of bargaining agreements with third party payers, the existence of monopsony power, fee controls, and the ability to charge co-payments to patients. These influence the flexibility of earnings in response to changes in market conditions. Where earnings are flexible, the theory of compensating wage differentials hypothesises that earnings are influenced by the relative advantages and disadvantages of jobs, including job characteristics as well as the characteristics of geographic areas, such as a high cost of living (Rosen, 1986). The degree of competition may also influence earnings. This depends on the strength of the demand side, which is usually assumed to be relatively weak in health care due to asymmetry of information between doctors and patients. Earnings also differ by medical specialty, which can influence doctors' choice of specialty. 'Procedural' specialties, such as surgery, typically command higher earnings than 'cognitive' specialties such as general or family practice, and these differentials can exacerbate shortages of general practitioners. Doctors' own experience, sector of work, reputation, preferences, practice style, are also likely to influence earnings conditional on the institutional and specialty setting.

There have been only a handful of studies examining the determinants of doctors' earnings. In a recent paper, Morris *et al.* (2010) examined the determinants of general practitioner (GP) wages in the England and found that net income and wages depend on gender, experience, the length of GPs' patient lists, partnership and employment type. The earnings of doctors have also been analysed in the context of the effect of earnings on hours worked (Rizzo and Blumenthal, 1994; Baltagi *et al.*, 2005); earnings and job satisfaction on hours worked (Ikenwilo and Scott, 2007); earnings on choice of work in the public or private sector (Sæther, 2005); and gender differences in the earnings of doctors (Ohsfeldt and Culler, 1986; Gravelle and Hole, 2008). There are few studies comparing the relative earnings of doctors in different specialties, in particular GPs and medical specialists, and the differential effects that doctors' personal and work characteristics may have on earnings.

In Australia, total expenditure on medical services[1] was $18 billion and accounted for 18.7% of total recurrent health expenditure in 2007-08 (Australian Institute of Health and Welfare (AIHW), 2009). From 2003-04 to 2007-08, the cost of medical services, which comprises largely of payments to doctors through Medicare, grew 4.2% in real terms per year.[2] Although some information is available on the salaries of doctors working in public hospitals[3], very little is known about the earnings of GPs and medical specialists in private practice who are remunerated on a fee-for-service basis. There are no reliable data on the personal annual or hourly earnings of these doctors, especially after deducting practice costs and expenses. Hourly earnings net of practice costs and expenses are however the most likely factors influencing the labour supply decisions of doctors.

Doctors in Australia work in both public and private sectors and in a variety of settings such as private practices, hospitals, community health centres, laboratories and radiology facilities. Their earnings are partly determined by the different sources of funding for doctors' services. Doctors in private practice in Australia include most GPs and medical specialists who work outside of public hospitals and who charge patients a fee for each visit or procedure performed. Doctors can charge patients what the market will bear, and either doctors or patients can claim a fixed rebate from Medicare as set out in the Medicare Benefit Schedule (MBS). The MBS details the range of consultations, procedures and tests that are funded under Medicare and the corresponding MBS benefit or rebate. GPs and specialists in private practice are free to set the level of their fees at or above the MBS rebate with patients paying the difference between the fees charged and the MBS rebate. In addition to Medicare, doctors derive income through a variety of Commonwealth, State and Territory government programs such as services provided through the Department of Veterans Affairs and WorkCover authorities. For GPs, additional sources include the practice incentives program (PIP) and payments that are associated with activities such as after hours care, management of patients with complex and chronic conditions, the provision of care in rural and

[1] Medical services are "services provided by, or on behalf of, registered medical practitioners that are funded by the Medicare Benefits Schedule (MBS), DVA, compulsory motor vehicle third party insurance, workers compensation insurance, private health insurance funds, Australian Government premium rebates allocated to medical services, Medicare copayments and other out-of-pocket payments" (AIHW, 2009).

[2] From June 2003 to June 2007, the average wage level of the general population grew by 19.9% and the consumer price index increased by 11.5% (Australian Bureau of Statistics 2004, 2007). This would result in a substantially lower real wage growth for the general population compared with the medical profession.

[3] Medical practitioners working in public hospitals make up 42% of the medical workforce (AIHW, 2009a)

remote locations, and teaching. Medical specialists who work in private hospitals are paid income from fees from patients, who are eligible to claim back the fixed rebates from Medicare. Medical specialists in public hospitals are usually paid a salary or by contract, with this being determined by State bargaining agreements. In addition, some salaried specialists have rights to private practice. This means that additional income can be earned from seeing private patients, either in a public hospital or private setting.

In this paper, we analyse the determinants of annual earnings of qualified GPs and medical specialists using the first wave of the Medicine in Australia: Balancing Employment and Life (MABEL), a new longitudinal survey of doctors. We estimate a hedonic earnings model for GPs and specialists using the usual human capital variables (e.g. experience and qualifications) in addition to job characteristics and geographical variables. Given that earnings and working hours are likely to be jointly determined, we also address the issue of endogeneity of working hours using an instrumental variable approach. Our results indicate that doctors' earnings are associated with gender, experience, the size of the GP practice, employment type, specialty and the characteristics of doctors' location of work in Australia. We also examine the differential in earnings between GPs and medical specialists conditional on observable characteristics.

The paper is organised as follows: Section 2 discusses the data while Section 3 describes the variables and methods used. Section 4 presents the descriptive statistics of dependent and explanatory variables, followed by the results on the endogeneity of the hours variable and the earnings regressions. Section 5 contains a discussion of the results and highlights some potential policy implications.

2. Data

This study uses data on qualified GPs and specialists from the first wave of the MABEL survey. MABEL is a prospective cohort study of workforce participation, labour supply and its determinants among Australian doctors. The population of interest is all doctors providing clinical medical services in Australia. The sampling frame of the study is the Australian Medical Publishing Company's (AMPCo) Medical Directory, a national database managed by the Australian Medical

Association (AMA).[4] In the first wave, a total of 54,750 doctors across four broad groups within the clinical medical workforce (this is the full population of doctors in Australia) were invited to participate. The four groups are general practitioners, medical specialists, specialists-in-training and hospital non-specialists. Data collection for the first wave was conducted from June to December 2008. The survey questionnaire covered topics such as job satisfaction and attitudes to work; characteristics of work setting (public/private hospital, private practice); workload (hours worked, on-call); finances (income, income sources); geographic location; demographics (including specialty, qualifications); and family circumstances (partner and children).

The overall response rate for the first wave of the survey was 19.36% with a total of 10,498 doctors in the baseline cohort. This includes 3,906 GPs (which includes 226 GP registrars), 4,597 specialists, 1,072 specialists-in-training and 924 hospital non-specialists. The cohort was found to be nationally representative with respect to age, gender, geographic location and hours worked. The methods of the study and characteristics of the baseline cohort are discussed in more detail in Joyce *et al.* (2010).

3. Methods and description of variables

3.1 Econometric model

We first estimate a hedonic earnings model for GPs and Specialists separately using log linear estimation. GPs and specialists were asked to provide their gross (before tax) and net (after tax) personal total earnings in all the work they do as a doctor, either at an annual or fortnightly level. The measure of doctors' remuneration of interest in this study is the annual gross personal earnings.[5] Although many studies on doctors' earnings (e.g. Langwell, 1982; Ohsfeldt and Culler, 1986) use hourly wages (total earnings divided by total hours worked) to measure doctors' earnings, an earnings model where the hourly wage is the dependent variable is misspecified when earnings are not proportional to hours and if the number of hours worked is omitted as an explanatory

[4] The AMPCo database is updated regularly using a number of sources. In addition to receiving updates directly from doctors, AMPCo also conducts bi-annual telephone surveys, checks medical registration board lists, AMA membership lists, and Medical Journal of Australia subscription lists to maintain accuracy.

[5] The income question asked in the survey was: "What are your (approximate) total personal earnings from all of the work you do as a doctor? (If possible, base this on your last personal income tax return or payslip)". Doctors were then given the option of reporting either annual or fortnightly earnings, both before and after tax was taken out.

variable (Gravelle and Hole, 2008). When choosing annual earnings instead of hourly wages as the dependent variable, the number of hours worked is required as an explanatory variable in the earnings function since income increases with hours worked. The measure of the number of hours worked by doctors defined in this study is the total hours worked per year across a variety of settings.[6] This is calculated as the product of the total weekly hours worked and the number of weeks worked per year. The number of weeks worked per year is calculated as 52 weeks minus the number of weeks of maternity leave and weeks off work for other reasons stated in the survey.[7] We take the natural logarithm of earnings and hours so that the coefficient on hours measures the percentage change in earnings resulting from a one percent change in hours.

Hours worked are jointly determined with annual earnings because doctors are likely to have opportunities to work flexible hours. If the hours variable is endogenous, the estimation of the earnings regression using ordinary least squares (OLS) may result in biased estimates. To address the problem of endogeneity in the hours variable, we estimate the earnings function using both OLS and two stage least squares (2SLS) regressions. A binary variable indicating whether the respondent has children under the age of 5 years is used as instrument. For the regression model for GPs, observations are clustered by GPs' work postcode to account for correlation in earnings and hours within local areas that reflect the unobservable characteristics of these areas and standard errors are adjusted accordingly.[8]

In addition to the separate earnings regressions, we estimate three OLS regression models that pool the data for GPs and specialists. These models allow us to directly examine the differences between the earnings of GPs and specialists whilst adjusting for observed characteristics. In the first pooled regression model, we include a dummy variable indicating whether the doctor is a GP (=1) or specialist (=0), in addition to the explanatory variables that are common across both doctor types.

[6] The categories of work settings in the GP survey are private medical practitioner's room or surgery, community health centre or state-run primary care organisation, deputising service of after-hours care, public hospital (including psychiatric hospital), private hospital, residential/age-care health facility, tertiary education institution and other. The work-setting choices in the specialist survey are similar to those for GPs except that community health centres and deputising services are not relevant choice options.

[7] The effect of hours worked on annual earnings would be underestimated if doctors are entitled to paid maternity or parental leave. This is not likely to have any significant effect on the results. In the sample analysed, only 23 GPs and 21 specialists had taken more than 12 weeks of maternity and paternity leave in the year prior to the survey.

[8] Unlike GP practices where patients are likely to visit GPs in their local area, hospital patients potentially come from further away. Hence the standard errors in the specialists' regression model are not clustered by postcode as for GPs.

In the second pooled model, we create a categorical variable for each specific specialty (using GPs as the baseline category). In the third pooled regression model, in addition to adding the GP dummy variable, we interact all explanatory variables with the GP dummy variable to examine whether the determinants of doctors' earnings different for GPs and specialists.

3.2 Individual characteristics of GPs and specialists

Doctors' earnings are expected to be influenced by human capital variables (Mincer, 1997) such as their education and professional qualifications, experience and field of specialty. We included variables that indicate whether doctors completed their basic medical training in Australia or overseas, attained fellowship of specialty colleges, and the number of postgraduate medical qualifications other than fellowships. Work experience, defined as the number of years since the completion of the basic medical degree less time spent out of clinical practice, is also included as an explanatory variable. For medical specialists, a set of 18 binary variables that represents doctors' primary clinical specialty was included to capture variations in earnings arising from differences in the type of, and demand for, services provided by doctors. Two additional separate binary variables that indicate the gender of the doctor and whether the doctor is on a temporary work visa are included.

3.3 Employment type, work setting and practice characteristic

How doctors are paid will also influence their earnings. The earnings of self-employed doctors may be more flexible as most will be paid by fee-for-service or have locally negotiated contracts. Indicators for employment type and remuneration mode of doctors were constructed using information on doctors' business relationship with their medical practices (e.g. principals/partners, associates, salaried and contracted employees, locums) and hospital remuneration arrangements (e.g. fee-for-service/direct billing, fixed payments, salary with or without rights to private practice). These modes were assigned based on whether the doctor's primary work environment is within a hospital (both public and private) or outside of a hospital (e.g. private rooms, community health centres).[9] GPs were grouped into two employment type categories: (i) *Principals, Associates, Independent Contractors and Solo Practitioners* and (ii) *Salaried and Contracted employees and*

[9] The primary work environment is defined by the work setting (e.g. private rooms or public hospital) in which the doctor spent the majority of weekly work hours.

Locums. GPs in the former category are either owners of GP practices or are generally considered as being self-employed. For specialists, information on doctors' relationships with their medical practice, hospital remuneration types and work settings were combined to form eight employment type and work setting categories: self employed (i) *hospital* and (ii) *non-hospital specialists*; *employed hospital specialists on* (iii) *fixed payment*, (iv) *salaried without rights to private practice* (*RPP*), (v) *salaried with RPP*; employed non-hospital specialists on (vi) *contracts*, (vii) *salary;* and (viii) hospital and non-hospital specialists who are *locum or other*. We also included a set of binary variables that describe the number of full-time and part-time doctors working in a practice to examine how practice size influences doctors' income.

3.4 Job characteristics

The central theme in the theory of compensating differentials is that in a well-functioning labour market where wages are flexible, the equilibrium market wage will reflect the relative advantages and disadvantages of jobs (Rosen, 1986). In the medical profession, non-pecuniary job characteristics such as unpredictable working hours, work stress and the degree of social and geographical isolation that comes with working in a remote area may influence doctors' earnings. Self-reported measures of doctors' job characteristics were included in the earnings equations for GPs and specialists. These measures include the extent to which doctors agree (i) that the patients they see have complex health and social problems; (ii) that their work hours are unpredictable and; (iii) that their partners/spouses have good employment opportunities in their location of work. Also included is a variable that measures the opportunity for social interaction in doctors' location of work on a three-point scale (very limited, average, very good). To capture the effect of after-hours work and on-call on earnings, a binary variable on whether doctors do after-hours work and on-call is included.

3.5 Local area characteristics

Advantages and disadvantages of jobs also include the characteristics of the local area of work (Elliot *et al.*, 2007). The MABEL survey was linked to a dataset of local area characteristics. This included a standardised GP to population ratio measured at the level of the Statistical Local Area

(SLA)[10] in which GPs work to capture the effect of competition and patients' access to health care on earnings. As earnings may also be influenced by the socioeconomic status of patients in the area, the 2006 Index of Relative Socio-economic Advantage and Disadvantage in deciles in GPs' work location is also included.[11] To capture factors such as the cost of living, we included 2008 median house prices in the postcodes of doctors' area of residence. We also included state and territory binary variables as well as a three-category measure (*Major city*, *inner regional* and *other*) of remoteness based on the Australian Standard Geographic Classification (ASGC) (Australian Bureau of Statistics, 2003). The latter captures the higher cost of practicing in a rural or remote area.

4. Results

4.1 Descriptive statistics and sample selection

Table I presents the summary statistics of variables described in Section 3. The means (and standard deviations) of annual gross personal earnings of GPs and specialists were $177,883 ($103,633) and $316,570 ($197,525) respectively. The mean annual hours worked (and standard deviation) was 2,042.34 (763.86) for GPs and 2,335.80 (724.38) for specialists. The mean weekly hours worked for GPs and specialists are 39.4 (14.54) and 45.14 (13.71) hours respectively.[12] Both GPs and specialists worked on average 51.6 weeks per year. 44.4% of GPs and 27.5% of specialists were female. 49.4% of GPs and 44.9% of specialists were self-employed. Anaesthetics (16%) and psychiatry (11%) are the two largest specialty groups. The majority of GPs (69.9%) and specialists (83.9%) were located in major cities.

For our analysis sample, observations were excluded if there were missing data on either the earnings, hours or other independent variables. 29.9% of GPs and 28.0% of specialists have missing data on earnings. To remove outliers, the top and bottom 1% of the earnings distribution of the individual GP and specialists samples were trimmed, as were those working less 4 or more

[10] The construction of the GP to population ratio requires information on the population size and number of GPs working in designated local areas. Data on population size at the level of the postal area is first obtained from the 2006 Census usual residence dataset. Information on the number of GPs working in each postal area is constructed using the postcodes in GPs postal addresses recorded in the 2008 AMPCo database of all Australian doctors. These data were aggregated to each SLA using the 2006 Statistical Local Area Concordance file provided by the Australian Bureau of Statistics.

[11] The index of relative socioeconomic advantage and disadvantage, where higher values represent a more socioeconomically advantageous area, is derived using Census information such as low income households and people with tertiary education. (Australian Bureau of Statistics, 2008)

[12] The descriptive statistics of the weekly hours worked and weeks worked per year are not reported in Table 1.

than 100 hours per week. Observations were excluded where the sum of reported hours across the different work settings did not equal the reported total hours, and where the number of weeks worked per year was less than 26. The number of observations available for analysis is 2,369 GPs and 3,018 specialists.

4.2 Endogeneity of hours

The endogeneity of the hours variable in both the GP and specialist earnings equations was tested with 2SLS regressions using a binary variable indicating whether the respondent has children under the age of 5 years as an instrument.[13,14] The instrument was significant in the first stage regression of both the GP ($F=81.73$, $p<0.000$) and specialist ($F=44.12$, $p<0.000$) models. The endogeneity of the hours variable was examined using the Hausman test (Baum *et al.*, 2003). In the GP regression, the test result rejected the null hypothesis that the hours variable is exogenous ($\chi^2 = 8.853$, $p=0.003$). In the specialist regression, however, the null hypothesis could not be rejected ($\chi^2 = 0.520$, $p=0.471$). The magnitude and statistical significance of coefficients in the OLS and 2SLS regressions for specialists were similar. In the discussion of the results, we present the 2SLS estimates for the GP regression and the OLS estimates for the specialist regression.[15]

4.3 General Practitioners

The results from the 2SLS regression of log annual earnings for GPs are presented in columns 2 and 3 in Table II. The coefficient on log weekly hours worked for GPs is significantly less than one

[13] We also estimated 2SLS regressions for GPs and specialists using a set of binary variables indicating whether respondents were living with a partner (or spouse) and the partner's employment status in combination with the child under 5 variable, but this set of instruments failed the over-identification test. We tested subsets of these instruments using the "difference-in-Sargan" statistics (see Hayashi, 2000 pp. 218-21), and the *C* statistics indicate that the partner and partner's employment status variables are not valid instruments. Hence, we used only the child under 5 binary variable as an instrument in both regressions.

[14] For the 2SLS estimation for specialists, we used a slightly smaller sample that contains 2,748 observations compared with 3,018 observations as reported in Table I. This is because 270 observations have missing information on respondents' partners and children. In the first wave of the MABEL survey, a malfunction in the internet-based survey application occurred in which a section of the survey on doctors' family circumstances was not presented. Hence, information on doctors' partners and children was not captured for respondents who chose to do the survey online. In wave 2 of the survey, doctors' were asked to provide retrospective information about their family situation one year ago and these responses, where available, were combined with the first wave data. The characteristics of the respondents in both samples are very similar and the OLS regression results from the smaller sample are very close to those reported in Section 4.4.

[15] The results from the 2SLS regression for specialist are available from the authors upon request.

which suggests that earnings are not proportional to hours worked.[16] This suggests that for every 1% increase in hours worked, earnings increase by 0.44%. Female GPs earned on average 25.0% less than male GPs.[17] The earnings of GPs who completed their basic medical degree in Australia are 4.7% lower than those who completed their medical degree overseas. Neither fellowship status (e.g. fellowship of the Royal Australia College of General Practitioners) nor the number of other postgraduate qualifications is significantly associated with earnings. The earnings of GPs who are on temporary work visas and are required to work in regions experiencing medical workforce shortages are not different from GPs who do not face such constraints in their location of practice. The coefficients on the experience variables suggest a slightly positive gradient which reaches a peak at 20 to 29 years of experience but this relationship is not statistically significant. The earnings of GPs with 40 or more years of experience, however, is 20.3% lower than GPs with less than 10 years of experience.

Self employed GPs earned on average 27.6% more than GPs who are salaried or on contracts. This is expected as the earnings of self employed GPs reflect returns on managerial responsibilities and capital investments made to the practice. GPs working in larger practices earn significantly more than solo practitioners where the magnitude of this difference is largest for practices with 10 or more doctors. This is according to expectation given that the size of the medical practice affects the doctor's operating costs as doctors in larger practices can share the cost of capital equipment and administrative overheads.

For the self reported job characteristics, GPs who undertake after-hours and/or on-call work earn 6.0% more than those who do not. GPs who indicated that their work hours are unpredictable have lower earnings than those who indicated otherwise. Earnings are not associated with the complexity of patients' health and social problems or whether the practice location restricts opportunities for social interactions. However, GPs who indicated that their location of practice offers good employment opportunities for their partner have lower earnings.

[16] The Wald test statistic for the null hypothesis that the coefficient on annual hours is equal to 1 strongly rejects the null (F=23.18, p=0.000).
[17]This is calculated by computing (exp(coefficient)-1)*100% = (exp(-0.287)-1)*100% = -24.95%.

Earnings do not vary significantly by State of work except for GPs in Tasmania who earned on average 14.6% less than their counterparts in New South Wales. The earnings of GPs who practice in outer regional, rural and remote Australia are 11.5% higher than GPs working in major cities. Earnings are lower for GPs who work in areas that are socio-economically more advantageous and where there is a higher concentration in the number of GPs relative to the size of the population. Finally, earnings are higher for GPs residing in regions with higher median residential house prices.

4.4 Specialists

The results from the OLS regression of log annual earnings for specialists are presented in columns 4 and 5 in Table II. The estimate of the coefficient on log hours is 0.63 which is again significantly lower than one which indicates that earnings are not proportional to hours worked.[18] Female specialists earned on average 16.6% less than their male colleagues while specialists who are fellows of specialty colleges earned about 8.65% more than specialists without fellowships. Earnings are increasing in the number of years of experience with the earnings-experience profile reaching the maximum at 20 to 29 years of experience. Specialists who devote more of their time to clinical work earned slightly more than those who undertake proportionally more non-clinical work such as administration, management and education activities.

The income of specialists varies significantly with employment type and work settings. Compared with hospital-based salaried specialists with no rights to private practice (RPP), the annual earnings of self-employed hospital-based and non-hospital-based specialists are approximately 26.8% higher. As with the case of GPs, this reflects returns to entrepreneurship and risk bearing by those who are self employed as business owners, independent contractors or solo practitioners. The coefficient on the binary variable denoting salaried specialists with RPP is positive which is as expected given that specialists on these contracts typically either receive an additional private practice allowance on top of their salary or retain a portion of their earnings generated through private practice in hospitals. The estimate however is not statistically significant. Overall, the income of employed specialists does not vary much across the different types of employment contracts.

[18] As in the case for GP, the Wald test statistic for the null hypothesis that the coefficient on annual hours is equal to 1 strongly rejects the null (F=219.13, p=0.000).

The income of specialists varies considerably by the field of specialty. Earnings are the highest for diagnostic radiologists, followed by orthopaedic surgeons, other surgeons (other than general or orthopaedic), obstetricians and gynaecologists, intensive care specialists, anaesthetists, ophthalmologists, pathologists, general surgeons, gastroenterologists, emergency medicine physicians, cardiologists, internal medicine specialists (other - e.g. geriatrics, endocrinology and medical oncology), general medicine specialists, psychiatrists and finally paediatricians and thoracic medicine specialists.

The results also indicate that earnings vary by doctors' job characteristics and work environment. Specialists who undertake after-hours and/or on-call work earned about 15.7% more than those who do not. Earnings are approximately 9.7% lower for specialists who indicated that their patients have complex health and social problems. Specialists who practice in geographic locations which provide good employment opportunities for their partners earned comparatively more than those who indicated otherwise.

The remuneration of medical specialists varies significantly across states and territories. Compared with specialists who are based in NSW, specialists from WA and QLD earned about 7.3% and 14.6% more respectively. As in the case of GPs, the earnings of specialists in Tasmania are about 12.9% lower compared to their NSW counterparts. In terms of geographic remoteness of specialists' work locations, specialists practicing in inner regional areas within Australia earn approximately 5.9% more than their colleagues in major cities. Earnings are also higher in residential areas where median house prices are higher.

4.5 Pooled GPs and Specialists

The results from the pooled OLS regression of GPs and specialists are reported in Table III. Under Model 1 presented in columns 2 and 3, controlling for other factors that influence the earnings of GPs and specialists, the coefficient on the GP binary variable indicates that the earnings of GPs are on average 31.7% lower than specialists.[19] Under Model 2 where specialty type binary variables are included as regressors, the results presented in columns 4 and 5 shows that the GPs earnings are

[19] The assumption that is implicit in this model specification is that the returns on doctors' characteristics such as hours worked, gender and experience etc. are constant for across the doctor types. This assumption is relaxed under Model 3.

the lowest of all specialty types. For example, compared with GPs, the earnings of paediatricians are 10.0% higher while the earnings of diagnostic radiologists double the earnings of GPs.

In Model 3, we estimated a pooled regression where the explanatory variables are interacted with the GP binary variable. These coefficients are presented in columns 6 and 7 of Table III. For the coefficients on the interaction terms, only those that are statistically significant are presented in the table. Overall, these results suggest that the determinants of earnings for GPs and specialists are different, and are broadly consistent with the results of the separate regression models presented in Table II. A direct comparison with Table II is not possible because of differences in the explanatory variables that were included, and because of the use of instrumental variables in the GP earnings equation in Table II. The models in Table II also do not account for the endogeneity of specialty choice, and there are likely to be unobservable doctor characteristics resulting in bias in the size of the GP-specialist earnings differential. Nevertheless, the results in the pooled models do give a broad indication of the size of the differential, and of whether the differences in the returns to characteristics between GPs and specialists are statistically significant. On average, specialists receive higher returns to experience, self-employment, on-call work, unpredictable hours, working in Queensland, and from living in a high cost area. GPs received higher returns relative to specialists for working more hours, having more postgraduate qualifications, and having more patients with complex health and social problems. In addition to hours worked and the number of postgraduate qualifications, the incremental effect of experience differs considerably for GPs compared with specialists. For example, the earnings of specialists with 10 to 19 years of experience are 29.0% higher than specialists with less than 10 years of experience whereas for GPs, this difference is not statistically significant.[20] The returns to self employment for specialists (31.5%) are also higher than for GPs (18.1%). It is interesting to note that the coefficient of the GP binary variable is not significantly different from zero in the interaction model compared with Model 1 which suggests that the earnings differential between GPs and specialists is driven by the differences in returns to the observed factors that influence earnings such as hours, experience and self employment.

[20] This is calculated via the -*lincom*- command in Stata 10.1 using the coefficient on the 10-19 years variable and the 10-19 years*GP interaction term. The result on the returns to self employment that follows is also calculated using this procedure.

5. Discussion of results and policy implications

This paper is the first to examine the determinants of earnings of doctors in Australia. Our results show that doctors' earnings are associated with gender, experience, the size of the GP practice, employment type, specialty and the characteristics of doctors' location of work. GPs earn 38% less on average than specialists, and the differences between GPs and specialists are largely due to differences in the returns to observed job characteristics.

Some interesting observations arise from our results. First and foremost, our results show that the earnings of female GPs and specialists are roughly 17% to 23% lower than male doctors. This finding is in agreement with Bashaw and Heywood (2001) who found that the annual earnings of female doctors are 20% to 22% lower than male doctors in US. In Gravelle and Hole (2008), the difference in annual earnings of male and female GPs in the UK is 38.3%.[21] Although an examination of earnings differentials should ideally be based on a decomposition approach (see Oaxaca, 1973), our results provide cursory evidence that gender differences in earnings exist for doctors in Australia. Secondly, the results show significant differences in earnings by employment type. For GPs and specialists, the earnings of self-employed doctors are 25% to 26% higher than for employed doctors, with these returns being higher for specialists. The earnings of self-employed doctors can be separated into two components: the returns to labour inputs as well as the returns to ownership of practice. Headen (1990) estimated the value of the return on entrepreneurship and found that this accounts for 16.2% of net income for self-employed US physicians in general/family practice or internal medicine. This estimate would be the difference between the earnings of self employed and employed doctors if one would hold constant the returns to labour inputs across the two employment types. Thirdly, our results indicate that the earnings of GPs in larger practices are higher compared with solo practitioners. Morris *et al.* (2010) showed that UK GPs in solo practice worked longer hours and had the highest annual net incomes[22] but found no difference in the hourly wages by practice size.

Finally, we observe significant variation in remuneration across the different specialties. These variations are likely to arise from differences in the cost and length of the requisite training in each

[21] The estimates of the gender differential in annual earnings in Bashaw and Heywood (2001) and Gravelle and Hole (2008) were obtained through using the Oaxaca decomposition analysis and controlling for the number of hours worked.
[22] The authors did not include the number of hours worked in the regression equation for annual income.

specialty, the complexity of skills required, the market conditions for specialist services, and historical relativities in the Medicare Benefits Schedule.[23]

In the full sample of 3,906 GPs and 4,597 specialists, 539 (13.8%) GPs and 806 (17.5%) specialists did not provide any information on their income. We conducted an analysis, using separate probit regressions for GPs and specialists, to examine the variables that are associated with non-response to the personal income question asked in the survey. The outcome variable of interest is a binary variable which assumes the value of 1 if the doctor answered either the annual or fortnightly, before- or after-tax income questions. Table IV presents the estimated marginal effects from this probit regression that analyses the probability of responding at least to one of the earnings questions. GPs and specialists with more experience and who are self employed were less likely to reveal their income. GPs living in postcodes where the median house prices are higher were also less likely to answer the income question although the relationship is statistically significant only for GPs. The results also indicated that there are significant variations across the different states and territories in the propensity to respond to the earnings question by GPs. These results suggest that older doctors and those with potentially higher incomes (as indicated by years of experience and self employment status) were less likely to reveal information on their earnings.

This study has some limitations. First, the data on earnings and hours worked are self reported and may suffer from reporting errors (such as under- or over-reporting) which are common in surveys of individuals and households (Moore *et al.,* 2000). Reporting errors which are systematically related with the explanatory variables can lead to biased results. Unfortunately, we do not have independent sources of doctors' earnings data to validate the self-reported measures in the MABEL data. Furthermore, our probit model suggested that those who did not respond to the earnings questions may have had higher earnings, which has implications for the validity of the results for doctors in general. It was not possible to account for this in a selection model as no instrumental variables could be identified that influenced response to the earnings question but not earnings. In terms of the self-reported hours worked, Joyce *et al.* (2010) found that the distribution of hours worked by age groups in the MABEL baseline cohort is nationally representative. Also in the data

[23] Sloan (1970) estimates the returns to investment from different medical specialty trainings in the US using data on lifetime earnings, length of residency training and cost of tuition and fees.

preparation prior to analysis, extensive checking and cross validation of earnings and hours were carried out to maximise the accuracy of the data. However, we acknowledge that reporting error may still be present in the data despite our best efforts. Second, in addition to the hours variables, explanatory variables such as self employment and the self-reported job characteristics are likely to be endogenous. For example, if selection into self-employment is based on unobservable characteristics and if these unobservable factors also influence earnings, the estimates on the returns to self-employment may be biased. A number of studies have examined earnings differentials in self-employment versus salaried employment and the role it plays in influencing decisions between the two employment types. This literature generally finds no evidence of self selection.[24] A thorough investigation of the potential endogeneity of the self employment and job characteristics variables is beyond the scope of this paper, and will be deferred to future work.

Although the estimates do not have causal interpretations, the results in this paper have potential policy implications and indicate avenues for further research on the medical workforce in Australia. The large gender differential has implications for health care costs, as the proportion of female graduates is now around 55%. However, explaining the source of this differential requires further research. GPs in non-metropolitan areas are eligible for a variety of payments through government incentive schemes, and this is reflected in the results. A lower number of GPs per capita also leads to higher earnings, which has implications for the role of competition in GP markets. There were significant differences in earnings between GPs and specialists, and across different medical specialties. It would be of interest to explore whether the pay differentials between specialties are in line with demand for these specialties (and potential shortages), or whether they are mainly driven by the cost of training and complexity of required skills. If pay differentials are out of line with demand for the relevant services, this might be another research area of interest for policy makers.

Though we do not have detailed data on the characteristics of patients, the influence of patient and population characteristics on earnings was captured by some of the area-level variables, and a question on whether the doctor perceived their patients to have 'complex health and social

[24] See Le (1999) for a review of the empirical literature.

problems'.[25] An effective remuneration system that leads to improvements in population health would imply that earnings were higher in areas of, or for patients with, high 'need' for health care. Though it is difficult to interpret area-level measures, GPs working in affluent areas had lower earnings. However, using the more direct measure of patient complexity, the earnings of GPs were unrelated to the perceived complexity of patients, while specialists earned more if their patients were considered to be less complex. We used a rudimentary measure of patients' complexity and so further research into the relationship between earnings and the characteristics of patients is necessary. Overall, further research is required to examine the evolution of earnings over time and their effects on labour supply decisions and the mobility of doctors in Australia.

[25] An earlier version of the model included the number of patients seen per week, but this was not statistically significant in any of the models once other factors had been controlled for.

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Table I. Descriptive statistics of variables (in % unless indicated otherwise)

	GPs (N=2,369)		Specialists (N=3,018)	
Variable	Mean	Std. dev.	Mean	Std. dev.
Annual gross earnings ($)	177,883	103,633	316,570	197,525
Annual hours	2,042.34	763.86	2,335.80	724.38
Female	44.4		27.5	
Child under 5 years	0.15		0.20	
Australian medical school	79.4		82.6	
Fellowship	60.0		96.2	
Num. postgrad.	0.58	0.79	0.25	0.55
Visa	0.019			
Experience: < 10 years[1]	7.7		16.0	
Experience: 10-19 years[2]	22.9		16.7	
Experience: 20-29 years	38.2		34.6	
Experience: 30-39 years	23.4		23.1	
Experience: ≥ 40 years	7.8		9.6	
Hospwork	0.23			
Clinical work %			77.07	23.44
Self empl. GPs	49.4			
Self empl. hosp. spec.			16.5	
Self empl. non-hosp. spec.			28.4	
Empl. hosp. spec: Fixed			3.0	
Empl. hosp. spec: Sal. no *RPP*[3]			13.7	
Empl. hosp. spec: Sal. with *RPP*			27.6	
Empl. non-hosp. spec: Contract			3.7	
Empl. non-hosp. spec: Salary			5.5	
Empl. hosp. & non-hosp spec: Other			1.6	
GP Practice Size: Solo	8.1			
GP Practice Size: 2 to 3 doctors	18.6			
GP Practice Size: 4 to 5 doctors	20.9			
GP Practice Size: 6 to 9 doctors	31.4			
GP Practice Size: ≥ 10 doctors	15.5			
GP Practice Size: Missing	5.5			
Do A/H and On-call work	52.6		80.3	
Complex hlth/soc problems	67.1		60.9	
Unpredictable	25.5		38.9	
Limited Social	0.11		0.17	
Employ Opp. Gd	0.55		0.53	
Cardiology			0.016	
Paediatric medicine			0.063	
Gastroenterology			0.022	
General medicine			0.026	
Internal medicine - Other			0.13	
Thoracic medicine			0.019	
Intensive Care – Int. Med.			0.016	
Pathology			0.04	
General surgery			0.044	
Orthopaedic surgery			0.031	
Surgery: Other			0.05	
Anaesthesia			0.16	

Diagnostic radiology			0.049	
Emergency Med.			0.054	
Psychiatry			0.11	
Obstetrics/Gynaecology			0.052	
Ophthalmology			0.028	
Specialty: Other			0.094	
ASGC: Major City	69.9		83.9	
ASGC: Inner Regional	18.1		12.7	
ASGC: Other	12.0		3.4	
Std GP density	0.52	1.16		
SEIFA: Adv/Disadv.	7.07	2.59		
Log of Median House Price	13.1	0.54	13.37	0.53

[1]For specialists, the first experience category is < 15 years.
[2]For specialists, the second experience category is 15-19 years.
[3]*RPP*: Rights to private practice.

Table II. Earnings regression for GPs and specialists

	GPs 2SLS		Specialists OLS	
Variable	**Coefficient**	**t-stat**[a]	**Coefficient**	**t-stat**[a]
Log annual hours	0.440***	3.78	0.627***	24.90
Female	-0.287***	-8.22	-0.182***	-8.93
Australian medical school	-0.046*	-1.71	-0.016	-0.74
Fellow	0.014	0.64	0.083*	1.91
Num. postgrad.	-0.0038	-0.29	-0.023	-1.51
Visa	-0.114	-1.58		
Experience (reference is <10 years for GPs and <15 years for specialists)				
10-19 years (15-19 for spec)	-0.034	-0.95	0.131***	4.64
20-29 years	0.024	0.72	0.142***	5.68
30-39 years	-0.021	-0.58	0.086***	3.12
≥ 40 years	-0.227***	-3.51	-0.067*	-1.89
Hospwork	0.037	1.25		
Clinical work %			0.002***	6.16
Self empl. GPs	0. 244***	8.06		
GP Practice Size (reference is solo practice)				
2 to 3 doctors	0.081	1.62		
4 to 5 doctors	0.120**	2.45		
6 to 9 doctors	0.126***	2.62		
≥ 10 doctors	0.202***	4.24		
Missing	0.189***	3.04		
Employment type (reference is Empl. hosp. spec: Salary without RPP)				
Self empl. hosp. spec.			0.238***	7.08
Self empl. non-hosp. spec.			0.237***	7.69
Empl. hosp. spec: fixed			-0.080	-1.55
Empl. hosp. spec: sal. with *RPP*			0.037	1.31
Empl. non-hosp. spec: contract			0.024	0.50
Empl. non-hosp. spec: salary			-0.00022	-0.01
Empl.spec: other			-0.052	-0.77
Specialty type (reference is Paediatric medicine)				
Cardiology			0.216***	3.01
Gastroenterology			0.297***	4.67
General Medicine			0.118**	1.99
Intensive Care – Int. Med.			0.440***	6.18
Thoracic Med.			0.087	1.31
Int. Med: Other			0.125***	3.23
Pathology			0.364***	6.83
General surgery			0.333***	6.54
Orthopaedic surgery			0.522***	9.21
Surgery: Other			0.447***	9.11
Anaesthesia			0.408***	10.15
Diagnostic radiology			0.561***	11.18
Emergency Med.			0.230***	4.73
Obstetrics/gynaecology			0.443 ***	9.10
Ophthalmology			0.379***	6.37
Psychiatry			0.111***	2.74
Other			0.242***	5.85

Table II. Continued

	GPs 2SLS		Specialists OLS	
Variable	**Coefficient**	**t-stat[a]**	**Coefficient**	**t-stat[a]**
A/H and On-call work	0.058**	2.25	0.146***	6.42
Complex hlth/soc problem	-0.023	-1.01	-0.102***	-5.41
Unpredictable	-0.045*	-1.66	0.030	1.67
Limited Social	-0.0001	-0.00	-0.032	-1.40
Employ Opp. Gd	-0.043**	-1.98	0.036*	2.16
State of work (reference is NSW)				
VIC	0.00060	0.02	-0.024	-1.14
QLD	0.041	1.20	0.136***	5.31
SA	-0.036	-1.01	-0.0017	-0.05
WA	0.049	1.36	0.070**	2.15
TAS	-0.158**	-2.95	-0.121**	-2.23
ACT	0.115	1.43	0.0038	0.06
NT	-0.0049	-0.05	-0.087	-0.75
ASGC (reference is major city)				
Inner regional	-0.023	-0.74	0.056*	1.80
Other	0.109***	2.74	0.056	1.07
Std GP density	-0.019**	-2.12		
SEIFA: Adv/Disadv.	-0.020***	-3.51		
Log of Median House Price	0.054**	2.07	0.059***	3.06
Constant	7.973***	8.69	6.098***	18.49
N	2,369		3,018	
R-squared	0.478		0.499	

*** p<0.01, ** p<0.05, * p<0.1

[a]t-statistics calculated using robust standard errors

Table III. Pooled earnings regression

	Model 1		Model 2		Model 3[a]	
Variable	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**
Log annual hours	0.682***	38.85	0.687***	40.28	0.604***	24.41
Log annual hours*GP					0.163***	4.64
Female	-0.214***	-14.35	-0.199***	-13.76	-0.231 ***	-11.25
Australian medical school	-0.016	-1.01	-0.015	-0.95	-0.0081	-0.36
Fellow	0.051***	2.84	0.053***	3.10	0.053	1.20
Num. postgrad	-0.030***	-3.13	-0.015	-1.63	-0.061***	-4.02
Num. postgrad*GP					0.056***	2.88
Experience (reference is <10 years)						
10-19 years	0.054*	1.76	0.052*	1.75	0.255***	4.42
10-19 years*GP					-0.258***	-3.75
20-29 years	0.097***	3.16	0.086***	2.92	0.319***	5.52
20-29 years*GP					-0.311***	-4.56
30-39 years	0.040	1.25	0.033	1.08	0.251***	4.27
30-39 years*GP					-0.288***	-4.08
≥ 40 years	-0.102**	-2.78	-0.107***	-3.01	0.077	1.23
≥ 40 years*GP					-0.198 **	-2.48
Self employed	0.238***	18.28	0.216***	16.42	0.274 ***	15.79
Self employed*GP					-0.108***	-4.02
GP	-0.381***	-23.99			-0.504	-1.05
Specialty type (reference is General Practice)						
Cardiology			0.351***	5.37		
Gastroenterology			0.420 ***	7.42		
General Medicine			0.249***	4.87		
Inten. Care – Int. Med.			0.533***	8.18		
Paediatric Medicine			0.095***	2.77		
Thoracic Med.			0.173**	2.84		
Int. Med: Other			0.210***	8.07		
Pathology			0.441***	10.36		
General surgery			0.464***	11.51		
Orthopaedic surgery			0.656***	13.90		
Surgery: Other			0.598***	15.40		
Anaesthesia			0.571***	23.37		
Diagnostic radiology			0.694***	18.25		
Emergency Med.			0.302***	7.96		
Obstetrics/gynaecology			0.585***	15.30		
Ophthalmology			0.547***	10.76		
Psychiatry			0.213***	7.69		
Other			0.334***	11.46		
A/H and On-call work	0.089***	5.98	0.086***	5.97	0.163***	7.32
A/H and On-call work*GP					-0.124***	-4.12
Complex hlth/soc problem	-0.153***	-11.77	-0.074***	-5.50	-0.225***	-13.05
Complex hlth/soc problem*GP					0.186***	7.11
Unpredictable	0.013	1.00	-0.020	-1.46	0.065***	3.67
Unpredictable*GP					-0.153***	-5.45
Limited Social	-0.014	-0.78	-0.013	-0.73	-0.012	-0.53

Table III. Continued

	Model 1		Model 2		Model 3[a]	
Variable	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**
Employ Opp. Gd	-0.00078	-0.06	0.0020	0.16	0.027	1.54
Employ Opp. Gd*GP					-0.050**	-1.94
State of work (reference is NSW)						
VIC	0.0038	0.24	-0.0012	-0.08	-0.016	-0.77
QLD	0.105***	5.48	0.093***	5.03	0.155***	5.93
QLD*GP					-0.115***	-3.01
SA	0.021	0.88	0.013	0.55	0.029	0.93
WA	0.071***	3.01	0.072 ***	3.12	0.057*	1.71
TAS	-0.093**	-2.43	-0.114***	-3.06	-0.126**	-2.31
ACT	0.011	0.23	0.014	0.31	-0.0014	-0.02
NT	-0.060	-0.78	-0.062	-0.84	-0.095	-0.83
ASGC (reference is major city)						
Inner regional	0.042**	1.98	0.032	1.55	0.083***	2.64
Other	0.085***	3.03	0.073***	2.67	0.092*	1.72
Log of median House Price	0.044***	3.01	0.031**	2.17	0.074***	3.82
Log of median House Price*GP					-0.057*	-1.94
Constant	6.516***	26.91	6.236***	26.91	6.444***	19.63
N	5,733		5,733		5,733	
R-squared	0.536		0.571		0.552	

[a]For the coefficients on the interaction terms, only those that are statistically significant are presented in the table.

*** p<0.01, ** p<0.05, * p<0.1

Table IV. Probit regression on the probability of response to income question

	GPs		Specialists	
Variables	**Marg. Eff**	**t-stat[a]**	**Marg. Eff**	**t-stat**
Log annual hours	0.000013	1.48	-0.000017**	-2.27
Female	-0.011	-0.83	-0.0016	-0.13
Australian medical school	0.00026	0.019	-0.0070	-0.52
Fellow	0.0059	0.48	-0.0031	-0.11
Num. postgrad.	-0.0075	-1.12	0.0150	1.49
Visa	-0.0040	-0.082		
Experience (reference is <10 years for GPs and <15 years for specialists)				
10-19 years (15-19 for spec)	-0.040	-1.23	0.0061	0.32
20-29 years	-0.062**	-2.04	-0.028	-1.57
30-39 years	-0.081**	-2.14	-0.064***	-2.97
≥ 40 years	-0.087*	-1.71	-0.029	-1.12
Hospwork	-0.011	-0.67		
Clinical work %			-0.00030	-1.24
Self empl. GPs	-0.028**	-2.20		
GP Practice Size (reference is solo practice)				
2 to 3 doctors	0.030*	1.75		
4 to 5 doctors	0.021	1.15		
6 to 9 doctors	0.024	1.29		
≥ 10 doctors	0.012	0.55		
Missing	0.036*	1.75		
Employment type (reference is Empl. hosp. spec: Salary without RPP)				
Self empl. hosp. spec.			-0.085***	-2.78
Self empl. non-hosp. spec.			-0.050**	-2.14
Empl. hosp. spec: fixed			-0.060	-1.39
Empl. hosp. spec: sal. with *RPP*			0.0062	0.32
Empl. non-hosp. spec: contract			0.0061	0.20
Empl. non-hosp. spec: salary			-0.0020	-0.070
Empl.spec: other			-0.0102	-0.20
Specialty type (reference is Paediatric medicine)				
Cardiology			0.040	1.25
Gastroenterology			-0.023	-0.54
General Medicine			0.048*	1.84
Intensive Care – Int. Med.			0.040	1.16
Thoracic Med.			-0.039	-0.82
Int. Med: Other			0.0017	0.071
Pathology			0.0193	0.66
General surgery			-0.006	0.20
Orthopaedic surgery			0.0077	0.26
Surgery: Other			0.026	1.11
Anaesthesia			0.043**	2.24
Diagnostic radiology			-0.024	-0.72
Emergency Med.			0.060***	2.87
Obstetrics/gynaecology			0.0092	0.35
Ophthalmology			-0.030	-0.78
Psychiatry			0.013	0.57
Other			-0.014	-0.51

Table IV. Continued

Variables	GPs Marg. Eff	t-stat[a]	Specialists Marg. Eff	t-stat
A/H and On-call work	0.0097	0.81	0.028*	1.93
Complex hlth/soc problem	-0.0067	-0.58	0.015	1.32
Unpredictable	-0.0024	-0.19	-0.0035	-0.31
Limited Social	-0.040*	-1.93	-0.022	-1.46
Employ Opp. Gd	-0.011	-0.94	-0.013	-1.22
State of work *(reference is NSW)*				
VIC	0.011	0.83	-0.0043	-0.34
QLD	0.0090	0.52	-0.016	-0.97
SA	0.0310*	1.92	0.0012	0.059
WA	0.043***	3.05	0.016	0.85
TAS	0.059***	3.61	0.014	0.38
ACT	0.011	0.33	0.030	0.93
NT	-0.0076	-0.13	-0.028	-0.26
ASGC (reference is major city)				
Inner regional	-0.0177	-0.89	0.017	0.95
Other	-0.0190	-0.78	0.0456*	1.90
Std GP density	-0.0048	-1.03		
SEIFA: Adv/Disadv.	0.0045	1.62		
Log of median House Price	-0.0256*	-1.95	-0.015	-1.29
N	2,743		3,579	

*** p<0.01, ** p<0.05, * p<0.1

[a]t-statistics calculated using robust standard errors

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