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Endogenous Work Hours and Practice Patterns of Canadian Physicians

Christopher Ferrall
Queen's University

Allan W. Gregory
Queen's University

William G. Tholl
Canadian Medical Association

Department of Economics
Queen's University
94 University Avenue
Kingston, Ontario, Canada
K7L 3N6

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Christopher Ferrall, Allan W. Gregory, and William G. Tholl

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Abstract

Using an extensive survey of Canadian physicians, this paper studies how physician practice patterns are shaped by demographic characteristics, physician specialty, and government policy. We model the simultaneous determination of group size, primary source of professional income (fee-for-service or salaried position), weekly hours of direct patient care, and total weekly hours of work. Using a method of maximum simulated likelihood, the coefficients are precisely identified. Hours of work peak after about twenty years of practice and the probability of having a solo practice rises steadily with experience. With all else constant in the model, physicians who work under fee-for-service see patients 5.9 more hours each week than physicians who are primarily salaried, and yet fee-for-service physicians work 5.5 hours less per week in total. After controlling for physician characteristics significant differences remain across provinces in all aspects of practice patterns. This suggests that physician response to changes in compensation policies may be substantial.

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Ferrall and Gregory, Department of Economics, Queen's University and Tholl, Queen's Health Policy and Department of Health Policy and Economics, Canadian Medical Association. The authors would like to thank Owen Adams, Chris Auld, Charles Beach, Glen Brimacombe, Lynda Buske, Martin Gaynor, Steve Kaliski, Tom MacKenzie, Gregor Smith, the associate editor Steve Jones, and two referees for comments. We thank the Canadian Medical Association for making their survey data available. We also benefited from comments by seminar participants at the Winter Econometrics Society meetings in San Francisco, the International Health Economics Association meetings in Vancouver, the Toronto Labour Workshop, Guelph, and Laval. The first two authors acknowledge financial support from the Social Sciences and Humanities Research Council of Canada. The opinions expressed in this paper are solely those of the authors.

I. Introduction

A major reorganization of the health care system is currently underway in most industrialized countries. Policymakers engaged in this restructuring require quantitative information regarding the response of key participants in health care to such changes. Of particular importance on the provider side are the determinants of physician practice setting. For instance, both in Canada and the United States there has been much discussion of and some movement towards salary compensation for physicians rather than fee-for-service. One aim of this restructuring is to contain health care costs by restricting the billing opportunities of individual physicians. Policymakers contemplating such changes need to understand how changes to practice settings might influence other decisions made by physicians.

Using an extensive survey of Canadian physicians, this paper studies how the joint decisions of practice setting and hours of work made by physicians are shaped by demographic characteristics, physician specialty, and provincial considerations. We model physician practice as four variables under the physician's control: group size, primary source of professional income (fee-for-service or salary), weekly hours of direct patient care, and total weekly hours of work.

Three special features of the Canadian health care system facilitate the modeling of physician behavior from a survey of physicians. First, although health care in Canada is mandated by the federal government, the provinces are responsible for running the systems within their borders. Consequently, large differences in hospital capacity, fee schedules, and other aspects of physician compensation exist across provinces and these differences provide variation against which to measure physician responses. Second, the provincial health ministries and provincial medical associations are (almost) exclusively responsible for setting fee schedules and reimbursing physicians for their services. Gross wage rates are therefore essentially exogenous to physician characteristics after controlling for province and medical specialty. Third, the free, comprehensive and universal nature of health insurance in Canada limits the variation in demand for physician services across provinces.

The primary data source is the 1990 Canadian Medical Association's (CMA) Physician Resource Questionnaire (PRQ), which is sent to all licensed physicians in Canada. Our sample of physicians in active medical practice contains 57% of all Canadian physicians. The survey includes a number of questions about practice patterns as well as a large number of demographic and specialty information. Our econometric analysis is based upon a system of simultaneous limited-dependent variable equations estimated using the method of maximum simulated likelihood (MSL). The equations are related by both correlated error terms and the appearance of indicator variables for group size and compensation system in the equations for hours of work. Importantly, in the setting of work hours, we control for a direct treatment effect of group size and the type of compensation, as well as the endogenous choice of those variables.

Our main results are as follows. With everything else held constant, physicians who work under fee-for-service see patients 5.9 more hours each week than physicians who are primarily salaried, but fee-for-service physicians work 5.5 hours less per week in total. Physicians locating in smaller groups work more hours (22 hours more per week for solo versus large group), and male physicians devote nearly 5 hours more per week to direct patient care than do females. Across the lifecycle, contact hours and total work hours rise steadily until reaching a peak roughly 12 and 14 years respectively out of medical school. Compared to G.P.'s, medical specialists spend substantially less time with patients (the exception being radiologists and anesthetists). Physicians in Quebec work significantly fewer hours (total and contact hours) than physicians in any of the other province and are more likely to work in large groups and for a salary. In comparison, Manitoba physicians also tend to work in larger groups under salaries but they spend more time with their patients and work more total hours than any other province. The data do not allow us to identify the causal factors to explain these differences, but we conduct a simple simulation to determine the how responsive physician behavior may be to alternative provincial physician compensation policies and institutions.

There is an extensive empirical literature that has examined various aspects of physician practice patterns. Gaynor (1993) provides both an excellent survey on physician behavior and some additional data analysis on U.S. physicians. The primary empirical research on physician behavior includes: (i) estimating physician supply curves and calculating rates of return to medical degrees (see for example, Burstein and Cromwell, 1985; Sloan, 1974; Noether, 1986; and Rizzo and Blumenthal, 1994); (ii) investigating the existence and prevalence of physician "induced demand" (some recent references are: Hay and Leahy, 1982; Headen, 1990; Hickson, Altemeier and Perrin, 1987; Hughes and Yule, 1992; Hurley, Labelle and Rice, 1990; Labelle, Stoddart and Rice, 1994; and McGuire and Pauly, 1991 and 1994); and (iii) determining the factors in forming physician groups and the relative rates return from solo or self-employed physicians (Gaynor and Gertler, 1992; Gaynor and Pauly, 1990; Getzen, 1984; Hamilton, 1993; Lee, 1990; and McGuire, 1983).

The principal contrasting feature in our research from this literature is the simultaneous treatment of the practice setting (solo versus group practice and fee-for-service versus salary) and hours worked (direct patient care and total hours worked) in a single-payer fully-insured environment (the Canadian health care system). Most other work concerning physician behavior has been based on single-equation or two-stage least squares estimates. The differences between our single and simultaneous equation estimates for hours of work suggest that controlling for the joint decision of practice pattern and hours of work is crucial for understanding the responses of doctors to changes in the organization of health care.

One serious limitation in our study is the lack of data on physician income that is linked to the CMA data survey. Below we discuss the implication of this omission, arguing that several elements of the Canadian Medicare system reduce the impact of not observing physician income.

The organization of this paper is as follows. In Section II we briefly outline the Medicare system in Canada, paying particular attention to the differences across the provinces. The data and econometric model are described in Section III and the results are presented in Section IV. We close the paper in Section V with some concluding remarks.

II. Physicians in the Canadian Health System

The federal government does not administer the Canadian health care system but ensures that the provinces adhere to national standards (*e.g.* universal comprehensive coverage and portability of benefits across provinces) via conditional block funding. In all provinces, there is a single payer responsible for paying medical services. With some exceptions, similar medical services are covered from province to province. Operating under the federal mandates, the provinces are free to develop their own health care systems and more importantly, with respect to this study, design their own physician reimbursement procedures.

Policies toward physicians in Canada vary greatly over time and across provinces. Typically, provincial health ministries and medical associations negotiate global allocations to the medical care sector. Province-wide fees usually depend only on the specialty of the physician providing the service. For example, Figure 1 illustrates differences in fees across time, specialty and some provinces for an initial consultation. Individual circles represent specialty and the size of the circle indicates the relative frequency of consultations provided. The larger circles for all provinces are for G.P.'s. British Columbia tends to have the highest fees for consultations, the widest variation across specialty, and the smallest variation over time. On the other hand, Saskatchewan's fees for initial consultation are uniformly low with little variation across specialty or time. Ontario registered some of the lowest fees and like Nova Scotia, Manitoba and Alberta, shows a rising fee structure for all specialties during the 1980's.

While fee schedules differ greatly, the private nature of physician practice in Canada limits the extent to which these differences capture differences in implicit physician wage rates. The physician must use the fee to cover costs incurred in providing the service, including staff, supplies, and office space. (Hospitals receive global allocations to cover most of their costs.) The fee schedule is therefore a gross wage that does not control for the quality of the service nor for the doctor's efficiency in providing the service.

In response to rising health care budgets provinces have attempted to limit the yearly increases in fee schedules. Notwithstanding the relatively slow growth in fee schedules, a large increase in utilization (billing per doctor) defeated most provincial cost-cutting measures prior to the adoption of global medical budgets. During the 1980's five provinces (British Columbia, Saskatchewan, Manitoba, Ontario and Quebec) representing over 80 percent of the population, set fee schedule increases that took into account increases in budgets in previous years. That is, real fees were effectively adjusted downwards to offset partially the dollar volume increases. In some provinces, this involved protracted legal and arbitration procedures. From the point of view of the physician, however, for our 1990 sample period, current individual income was restricted only in one province. In 1976 Quebec initiated caps on individual income of general practitioners that continue today. Higher incomes were permitted as a policy tool to encourage physicians to move to more remote regions of the province (see Bolduc, Fortin and Fournier, 1993).

In order to control health budgets, several provinces have recently adopted non-linear income thresholds as well as global caps on aggregate funds going to physicians. For instance, in 1992 Ontario instituted a system in which doctors billing more than $400,000 have their fees scaled back by one third. Table 1 summarizes differences across those provinces in which there are non-linear thresholds to individual physician compensation as of 1993 and the year that our sample covers, 1990. The label *Rate* refers to the portion of billing received by the physician (i.e., 100% implies the doctor receives the entire bill). Common to all compensation schemes is the rather sharp decline in the billing rate once the first income threshold level is reached. Some provinces impose the billing limits at quarterly and even monthly intervals, presumably to ensure an even delivery of medical services over the year.

Since provincial health systems are characterized by differing fee schedules, health needs, populations and physician densities, we might reasonably expect there to be large differences in physician income across provinces. Published reports of physician income are not available on a provincial basis for 1990, but Table 2 summarizes average net professional income in 1985 for general practitioners and specialists for several provinces. This table confirms that there is considerable variation in average net income for both general practitioners and specialists. Quebec physicians have the lowest average income in both categories, with Saskatchewan having the second highest income for general practitioners and the first for specialists. Newfoundland's general practitioners earn 78% of what their average specialist earns and this ratio is 5% higher than in any other province.

The PRQ does not ask physicians about their income. On the one hand, this severely limits the information available to us about wages of individual doctors. On the other, not asking about income perhaps explains the high response rate to the CMA survey which makes it a representative snapshot of the medical profession. By comparison, the National Society of Professional Engineers (NSPE) in the U.S. conducts a similar survey of its members that does ask about salary. The response rate to the 1988 NSPE survey was 23% compared with 74% for the PRQ.

Because fee schedules capture gross rather than net wages, and because the fee-for-service system contains several constraints on physician billing, we use dummy variables for province and specialty intended to control for wages. In 1990 it was illegal in all provinces for doctors to charge patients directly (balanced billing), so there is little difference in gross wage rates beyond what is captured by these dummy variables. Of course, dummy variables for province and specialty do not completely isolate wage effects on physician behavior since they also capture differences in technology and demand for physician service. The universal nature of health insurance in Canada, however, places limits on the differences in demand across regions. The main determinant of demand for an individual physician's services is the number of residents per physician in the area. Some authors have found that physician density plays a role in affecting physician behavior (see for example, Bolduc, Fortin, and Fournier, 1993 for Canada; Headen, 1989; and Hughes and Yule, 1992 for the United States). We use physician location (urban or rural) and the density of physicians by specialty and province to control for differences in demand for physician services. The estimated coefficients on the province and specialty indicators are therefore purged of the effect of physician density.

III. Data and Econometric Model

The Physician Resource Questionnaire (PRQ) is sent to all licensed physicians in Canada. Our sample, which is restricted to physicians in active medical practice with a coherent and consistent set of responses in the PRQ, contains 29,317 physicians, or roughly 57% of Canadian physicians. Precise variable definitions and the sample selection criteria are provided in the Appendix.

Table 3 reports some summary statistics of the PRQ data. Approximately 84% of the physicians receive most of their professional income from the fee-for-service system. The remaining 16% are primarily salaried employees, including those paid directly by provinces to work in under-serviced areas, those working in special arrangements within clinics or groups, administrators, researchers, and teachers. Forty percent of Canadian physicians are in solo practices, and about 30% work in groups of six or more doctors or in a hospital or clinic. Doctors report on average 37 hours spent a week on direct patient care and 48 hours of work in total. The variance in hours is quite large: a one standard deviation range around the mean covers 32 hours a week for both direct patient care and total hours worked.

Sixty percent of the physicians in the sample are from either Ontario or Quebec. Fifty percent of the doctors report their specialty as general practitioner (G.P.) or family practice, which is much higher than the one-third figure in the United States. One-in-five doctors is female and the average years since receiving the M.D. is slightly over 20.

Table 4 shows the population per physician by specialty and province. The number of people per G.P. is quite uniform across the provinces (roughly 1000 per G.P.) and, except for Newfoundland, so is the number of surgeons (approximately 5000 per surgeon). However, there are pronounced differences in specialist concentrations. Newfoundland, New Brunswick and Saskatchewan have the most people per specialist whereas Ontario, British Columbia and Quebec enjoy the highest specialist density.

We model physician practices as a system of four equations. First, doctors choose the size of the group in which to practice and we index group sizes by the variable y_{1i}. If physician i has a solo practice, then $y_{1i} = 1$. If i works in a group with one other doctor then $y_{1i} = 2$; if in a group with two to five other doctors $y_{1i} = 3$; if with six or more other doctors then $y_{1i} = 4$. When physician i works in a hospital, clinic, or other institution, we set $y_{1i} = 5$.

The group-size reported by physician i is determined by

$$y^{\star}_{1i} = X_i\beta_1 + \epsilon_{1i}, \tag{3.1}$$

where X_i is a vector of exogenous characteristics of physician i (listed in the Appendix), β_1 is an unknown parameter vector, ϵ_{1i} captures unobserved characteristics of doctor i, and $y^{\star}_{1i}$ is a latent (unobserved) index for physician i. The index $y^{\star}_{1i}$ captures the extent to which physician i prefers to link his or her practice to the practice of other physicians within an organization. For instance, we might expect that general practitioners rely much more on their relationship with individual patients to generate income than, say, radiologists. This translates into a lower value of $y^{\star}_{1i}$ for a family practitioner than a radiologist, all else constant. Presumably, young doctors in the process of building their practice have larger values of $y^{\star}_{1i}$ than older doctors.

The continuous index $y^{\star}_{1i}$ determines the observed group size for physician i as an ordered probit. For $y_{1i} < 6$

$$\bar{y}_{k-1} < y^{\star}_{1i} \leq \bar{y}_k,$$

with $k = 0, 1, \ldots, 5$, $\bar{y}_0 = -\infty$, $\bar{y}_5 = \infty$, and the threshold values in between are estimated parameters. Some doctors report that they worked in a group but do not specify its size. We code this case as $y_{1i} = 6$, and assume that doctors fail to report group size randomly (*i.e.*, the decision to not report the group size is unrelated to the size of the group). That is, $y_{1i} = 6$ when

$$\bar{y}_1 < y^{\star}_{1i} \leq \bar{y}_4.$$

Next, we model the choice of primary compensation scheme under which to work, fee-for-service or salary. The former includes physicians reporting sessional work while the latter includes physicians who work under a capitation arrangement. We choose this split for compensation as a first pass and discuss other extensions in our closing remarks. The choice of compensation method by physician i is denoted y_{2i}. For salary physicians, $y_{2i} = 0$, while for fee-for-service physicians $y_{2i} = 1$. The choice of y_{2i} is modeled as an ordinary probit

$$y_{2i} = \begin{cases} 1 & \text{if } y^{\star}_{2i} \geq 0 \\ 0 & \text{if } y^{\star}_{2i} < 0, \end{cases}$$

where

$$y^{\star}_{2i} = X_i\beta_2 + \epsilon_{2i}. \tag{3.2}$$

We can think of the discrete values of y_{1i} and y_{2i} as describing the practice setting of physician i. Given their practice setting, doctors must allocate their most valued variable resource, their time. We distinguish between time allocated to direct patient care and other professional duties such as teaching, research, and administration. Since a non-negligible number of physicians report zero contact hours with patients (full time administrators), we model time spent with patients as a left-censored variable

$$y_{3i} = \begin{cases} 0 & \text{if } y^{\star}_{3i} \leq 0 \\ y^{\star}_{3i} & \text{if } y^{\star}_{3i} > 0, \end{cases}$$

where

$$y^{\star}_{3i} = X_i\beta_3 + Y_i\gamma_3 + \epsilon_{3i}. \tag{3.3}$$

We assume that the same variables explain the decision to spend time with patients or not and also the total time to spend with them (see Fen and Schmidt, 1984 for a test of this restriction). Besides depending on the exogenous controls contained in X_i (which also appear in (3.1) and (3.2)), contact hours depend upon the endogenous choices of group size and compensation method. These choices are summarized by the (6×1) vector Y_i. The first five elements of Y_i indicate physician i's reported group size (solo practice is the default or excluded case). The sixth element indicates a salaried physician (fee-for-service is the default). A physician choosing among group sizes and between fee-for-service and salary recognizes that the various combinations provide different incentives for spending time with patients. The coefficients in γ_3 measure the relative effect of those incentives. The feedback from endogenous work hours on the choice of practice setting is embedded in the estimated coefficients β_1 and β_2. As an example, suppose the group size indicators in γ_3 are negative, indicating that contact hours are smaller in group practices than solo practices, and suppose that the coefficient on an indicator for rural physicians in the group size equation (3.1) is negative. This coefficient captures any direct reasons why rural physicians would prefer a smaller group size than urban physicians (perhaps because sharing patients is more difficult in rural areas). It also captures any tendency for urban physicians to prefer seeing patients less and to do this by locating in larger groups in the first place.

Finally, we consider total hours of work each week, including contact hours and all other professional activities (except on-call hours). We restrict the sample to doctors that report total positive hours of working (see Appendix for details). Total hours ($y^{\star}_{4i}$) are a simple linear regression

$$y^{\star}_{4i} = X_i\beta_4 + Y_i\gamma_4 + \epsilon_{4i}. \tag{3.4}$$

The vector Y_i is also included in (3.4) for the same reasons as (3.3). Of the four simultaneous equations (3.1)-(3.4), three contain latent or censored dependent variables and two contain endogenous regressors on the right-hand side.

Notice that patient contact hours ($y^{\star}_{3i}$) and total hours worked ($y^{\star}_{4i}$) are excluded from the practice setting equations (3.1) and (3.2). These variables are excluded because such a specification would not be identifiable following the usual arguments of insufficient excluded exogenous variables (see Maddala, 1976, pp. 208-10). However, the two hours equations (3.3) and (3.4) have no such identification problems with the endogenous group size (y_{1i}) and compensation (y_{2i}) variables included. In this way we view (3.1) and (3.2) as a quasi reduced form with the endogenous hours effects 'solved' out of the practice pattern equations.

Define

$$\epsilon_i = \begin{pmatrix} \epsilon_{1i} \\ \epsilon_{2i} \\ \epsilon_{3i} \\ \epsilon_{4i} \end{pmatrix},$$

as the vector of the individual error terms. We assume that $\epsilon_i \sim N(\bar{0}, \Sigma)$, where $\bar{0}$ is a (4×1) vector of zeros. Based on marginal distributions, the first equation is an ordered probit, the second equation is an ordinary probit, the third equation is a Tobit, and the fourth is an ordinary linear regression. Identification requires that the variance-covariance matrix of ϵ_i be restricted to take the form:

$$\Sigma = E(\epsilon_i \epsilon_i') = \begin{pmatrix} 1 & \sigma_{12} & \sigma_{13} & \sigma_{14} \\ \sigma_{12} & 1 & \sigma_{23} & \sigma_{24} \\ \sigma_{13} & \sigma_{23} & \sigma_{33}^2 & \sigma_{34} \\ \sigma_{14} & \sigma_{24} & \sigma_{34} & \sigma_{44}^2 \end{pmatrix}.$$

If Σ is a diagonal matrix, then the equations (3.1)-(3.4) are stochastically independent and can be estimated efficiently equation-by-equation by maximum likelihood. If Σ is not diagonal, and some elements of γ_3 and γ_4 are non-zero, then the single-equation maximum likelihood estimates of the two hours equations, (3.3) and (3.4), are not consistent due to the presence of endogenous regressors.

The estimated parameters include: the coefficient vectors γ_3, γ_4, and $\beta_j \quad (j = 1, 2, 3, 4)$; the Cholesky decomposition of Σ; and the set of threshold values for the group size $\bar{y}_k$ $(k = 1, 2, \ldots, 5)$. Identification of all five threshold values requires that no constant term appears in X_i, which is achieved by setting the first coefficient in β_1 to 0. The parameters of the four-equation model are estimated in two ways: (i) single equation maximum likelihood (which for consistency requires that Σ is diagonal) and (ii) simulated maximum likelihood for the system with non-diagonal Σ.

The joint likelihood for a single observation (physician) $i = 1, \ldots, N$, is built up through a series of conditional probabilities (starting from regression equation (3.4)). That is, the simulator uses the identity

$$\text{Prob}(A_1, A_2, \ldots A_n) = \text{Prob}(A_1 | A_2, A_3, \ldots, A_n) \times \text{Prob}(A_2 | A_3, \ldots, A_n) \ldots \times \text{Prob}(A_n),$$

where the A's are random events. In our case, the events correspond to the different outcomes of the limited-dependent variables in the system of equations.

One simulation of the likelihood (evaluated at a set of estimates and simulated random variables denoted by ˆ) is computed as follows. For the standard regression equation (3.4), the residual (which is constant over the number of replications) is computed for each observation

$$\hat{\epsilon}_{4i} = y^{\star}_{4i} - (X\hat{\beta}_4 + Y_i\hat{\gamma}_4).$$

The contribution to the likelihood function is the marginal density of ϵ_{4i}

$$L_{4i} = f(\hat{\epsilon}_{4i}),$$

where f denotes the normal density and ϵ_{4i} has a mean of zero and a variance equal to σ^2_{44}. For equation (3.3), observations can be censored or non-censored. Let $I_{3i} = 1$ if $y_{3i} > 0$ and $I_{3i} = 0$ if $y_{3i} = 0$. For censored observations, an error term that is consistent with censoring is simulated. Let u^r_{3i} be a random variable uniformly distributed over [0,1] drawn during the r^{th} replication of the simulated likelihood function ($r = 1, \ldots, R$). Using u^r_{3i} a value of ϵ_{3i} consistent with $y_{3i} = 0$ is drawn from the appropriate conditional distribution,

$$\hat{\epsilon}^r_{3i} = F^{-1}\Big(\hat{u}^r_{3i}F(-(X\hat{\beta}_3 + Y_i\hat{\gamma}_3) \mid \hat{\epsilon}_{4i})\Big|\hat{\epsilon}_{4i}\Big) \qquad \text{if } I_{3i} = 0,$$

where F denotes the cumulative normal distribution and F^{-1} denotes its inverse. The implied mean is $(\sigma_{34}/\sigma_{44})\hat{\epsilon}_{4i}$ which equals the mean of ϵ_{3i} conditional upon $\hat{\epsilon}_{4i}$. The implied variance is $\sigma^2_{33} - \sigma^2_{34}/\sigma^2_{44}$ which is the conditional variance of ϵ_{3i}. The error term is constant over replications for non-censored observations

$$\hat{\epsilon}^r_{3i} = y^{\star}_{3i} - (X\hat{\beta}_3 + Y_i\hat{\gamma}_3) \qquad \text{if } I_{3i} = 1.$$

The contribution of equation (3.3) to the likelihood function is

$$L^r_{3i} = I_{3i}f(\hat{\epsilon}^r_{3i} \mid \hat{\epsilon}_{4i}) + (1 - I_{3i})F\Big(-(X\hat{\beta}_3 + Y_i\hat{\gamma}_3) \;\Big|\; \hat{\epsilon}_{4i}\Big).$$

All observations of equation (3.1) and (3.2) have limited dependent variables. Let u^r_{2i} denote another uniform random variable (independent of u^r_{3i}). The contribution of (3.2) is

$$L^r_{2i} = \Big(F(-X\hat{\beta}_2 \mid \hat{\epsilon}_{4i}, \hat{\epsilon}^r_{3i})\Big)^{y_{2i}}\Big(1 - F(-X\hat{\beta}_2 \mid \hat{\epsilon}_{4i}, \hat{\epsilon}^r_{3i})\Big)^{1-y_{2i}}$$

Then

$$\hat{\epsilon}^r_{2i} = F^{-1}\Big(\hat{u}^r_{2i}F(-X\hat{\beta}_2 \mid \hat{\epsilon}_{4i}, \hat{\epsilon}_{3i}) \;\Big|\; \hat{\epsilon}_{4i}, \hat{\epsilon}_{3i}\Big) \qquad \text{if } y_{2i} = 0$$

and

$$\hat{\epsilon}^r_{2i} = F^{-1}\Big(\hat{u}^r_{2i}\Big(1 - F(-X\hat{\beta}_2 \mid \hat{\epsilon}_{4i}, \hat{\epsilon}_{3i})\Big) \;\Big|\; \hat{\epsilon}_{4i}, \hat{\epsilon}_{3i}\Big) \qquad \text{if } y_{2i} = 1.$$

Define $Z_{ik} = 1$ if y_{1i} falls in category $k = 1, \ldots, 6$ and 0 otherwise. The contribution of equation (3.1) is

$$L^r_{1i} = \prod_{k=1}^{5} [F(\bar{y}_k - X\hat{\beta}_2 \mid \hat{\epsilon}_{4i}, \hat{\epsilon}^r_{3i}, \hat{\epsilon}^r_{2i}) - F(\bar{y}_{k-1} - X\hat{\beta}_2 \mid \hat{\epsilon}_{4i}, \hat{\epsilon}^r_{3i}, \hat{\epsilon}^r_{2i})]^{z_{ik}}$$
$$\times F(\bar{y}_4 - X\hat{\beta}_2 \mid \hat{\epsilon}_{4i}, \hat{\epsilon}^r_{3i}, \hat{\epsilon}^r_{2i}) - F(\bar{y}_1 - X\hat{\beta}_2 \mid \hat{\epsilon}_{4i}, \hat{\epsilon}^r_{3i}, \hat{\epsilon}^r_{2i})]^{z_{i6}}.$$

Again the mean and variance of the normal distributions are conditional upon the error terms already calculated or simulated. There is no need to simulate a value of ϵ_{1i}. If more limited-dependent equations were added to the system, then ϵ_{1i} would be simulated and the recursive calculation of conditional probabilities would continue.

The simulated log-likelihood function is

$$\mathcal{L} = \sum_{i=1}^{N}\Big[\ln \sum_{r=1}^{R} \frac{L^r_{1i} L^r_{2i} L^r_{3i}}{R} + \ln L_{4i}\Big]. \tag{3.5}$$

Maximizing (3.5) leads to consistent and efficient estimates as long as $R = c\sqrt{N}$ for some $c > 1$ (see Hajivassiliou, 1993 for a full discussion of the statistical properties of this approach). When the number of equations is below five, numerical integration is generally feasible. However, simulated likelihood based on recursive truncation still retains two advantages. First, the code is quite simple. All that is required are routines to compute and invert the one dimensional cumulative normal distribution and a routine to update the conditional variance of each equation's error term. Second, adding equations to the system simply involves another round of recursion. Numerical integration with more than two equations requires a reduction in the order of integration. This implies that the form of the integrand depends on the number of equations in the system. Using ordinary Monte Carlo integration to estimate a model with limited-dependent variables creates steps in the likelihood function, since a small change in an estimated coefficient results in discrete changes in the likelihood for some observations. In contrast the simulated likelihood function (3.5) based on recursively truncated simulated errors is smooth over the estimated parameters. We set the number of replications R to 40, using 20 draws of $(\hat{u}^r_{2i}, \hat{u}^r_{3i})$ and their antithetic values $(1 - \hat{u}^r_{2i}, 1 - \hat{u}^r_{3i})$. Simulation error introduces extra variance in the estimates, so standard errors computed from the outer product of the gradient matrix are scaled up by $1 + 1/R$.

Formal identification of the system follows from excluding the hours variables from the practice pattern equations, but there is important exogenous variation in the data that allows us to interpret the estimates as more than reduced-form estimates. Variables such as experience, gender, and local physician density are clearly exogenous to physician i, but several of the variables that we include in the vector X_i are not exogenous. The most obvious examples are location (both province and urban or rural) and physician specialty. The variables that we treat as endogenous, however, are aspects of their medical practices that physicians can alter almost immediately. In particular, in response to changes in government policy physicians can reduce work hours, consolidate or separate practices, and re-arrange their compensation arrangements in hospitals and private practice. Eventually physicians can also move locations and change specialties by incurring a loss in their most important stock variable, their goodwill and visibility among their patients. The large differences in fees, physician compensation policy, physician income, and physician density across provinces reported in Figure 1 and Tables 1, 2, and 4 suggest that physicians are not mobile in location and specialty for a relatively long horizon. The presumption that Canadian physicians are, at least in the short term, immobile because of their fixed base of patients is re-enforced by the fact that underlying demand differences across provinces are limited by the free and universal nature of health insurance in Canada.

IV. Results

In Table 5 we present single (labeled Single ML) and simultaneous (Simul. MSL) equation estimates of the four practice setting equations. We have organized the findings into four panels: Panel 5A contains the constants and provincial dummies, Panel 5B the specialty dummies, Panel 5C the specialty population densities, gender and urban dummies and Panel 5D physician experience, group practice and compensation variables. As we might expect with just under 30,000 observations, most coefficients are estimated with a high degree of precision regardless of the estimation method. We focus primarily on the simultaneous equation estimates but discuss and interpret the differences with the single equation maximum likelihood estimates. These differences are particularly relevant in the hours equations (3.3) and (3.4) where the consistency of the single equation approach is an issue.

Perhaps the most striking finding is that after controlling for their joint determination, practice setting has a significant effect on work hours (Panel 5D). Working under the fee-for-service system adds an average of 5.9 more hours per week on direct patient care but reduces by 5.5 the total hours worked. These estimates control for the fact that doctors choose the compensation system to work under. Once we account for the selectivity in the simultaneous system, the direct estimated impact on patient contact hours from fee-for-service falls from 11 hours of work to 5.9 hours.

There is a decreasing monotonic relationship between physician group size and hours worked. Doctors in larger groups (and hospitals or clinics) work fewer total hours and spend less time treating patients. For instance, a doctor in a 6^{+} group spends 22 fewer hours seeing patients each week than a solo doctor which evidently is completely reflected in their total hours worked. The effect of group size on hours worked is much larger in magnitude in the simultaneous estimates than in the single equation ones. Doctors who have above-average work hours tend to work in larger groups not smaller ones. In other words, while the direct 'treatment' effect of group size is negative, as is predicted in free-riding or capital-sharing models of organizations, self-selection mitigates this effect.

Significant differences exist among the provinces in hours and practice setting (Panel 5A). For instance, all else constant, physicians in Manitoba work 7.3 hours per week more than Ontario physicians, who in turn work 2.3 hours per week more than physicians in Quebec. Most of the difference in total hours are accounted for by differences in patient contact hours. For example, contact hours in Manitoba and Quebec differ by 8.9 hours each week. Doctors in provinces other than Ontario tend to work in larger groups and with the exception of New Brunswick, Alberta and British Columbia are also more likely to work for a salary. These tendencies offset the higher hours in Manitoba and other provinces, but amplify the total difference between Quebec and Ontario.

Female doctors spend 6.7 fewer total hours a week (Panel 5C) than otherwise identical male doctors, with over two-thirds of the difference due to lower contact hours (5.0 hours per week). In addition, women work in larger groups and are more likely to work under salary arrangements. Since salaried physicians in large groups tend to work less, this leads to even larger differences in hours worked between female and male doctors as reflected in the larger coefficients on Female in the single equation estimates of hours compared to the simultaneous equation estimates. As expected, urban doctors are more likely to be in larger groups (there may not be an opportunity in a rural setting to form partnerships) but their tendency to be in salaried positions is statistically insignificant. City doctors work a total of 2.53 hours more than the country doctors but only about a third of this difference is in seeing patients (0.84 hours).

After controlling for three years of residency (0-2 years experience), contact hours and total hours peak at approximately 12 and 14 years of experience, respectively. This is earlier than the single-equation estimates of 14 and 16 years, respectively. The propensity to work under fee-for-service falls with experience and bottoms out after 33 years, which is near age 60 for most physicians. Doctors just out of medical school are much more likely to work for salary, undoubtedly indicating residency positions. After two years of working mostly in large groups or hospitals, physicians tend to enter smaller practices so that group size falls monotonically with experience.

Comparing practice patterns across medical specialties is complicated by the presence of physician density interaction terms reported in Panel 5C. Holding density constant and looking at the direct effect of specialty in Panel 5B, we see that specialists tend to work fewer hours and to spend much less time seeing patients after controlling for group size and compensation method. The effect on total hours is significant only for psychiatrists and pediatricians, whereas the effect on patient hours is highly significant for all specialists but radiologists and anesthetists. In the raw data specialists work more total hours than family physicians, but this time differential is not due to additional patient contact hours. Most specialists work in smaller groups than family physicians although the effect is significant only for Ob/Gyn doctors and surgeons. Locating in smaller group sizes offsets some of the effect specialty status has on work hours. Ob/Gyn doctors and surgeons are also more likely to work under fee-for-service than family physicians although the effect is insignificant. Only psychiatrists, who tend to work in salaried positions, exhibit significant differences with respect to compensation method.

The coefficients on the interaction between specialty and density are negative (and generally significant) under Simul MSL but positive and/or insignificant under Single ML. Increased population-per-physician significantly decreases total work hours for G.P.'s, radiologists and anesthetists, and surgeons and decreases contact hours for G.P.'s, radiologists and anesthetists, pediatricians and other specialists. Note, however, that higher density also tends to lower group size and increase the proportion of fee-for-service doctors.

The large differences between the single and simultaneous estimates suggests strong correlation across equations. Table 6 (Panels 6A and 6B) confirms this. All the off-diagonal elements in the Cholesky decomposition of Σ are significantly different from zero at the five percent level. Furthermore, the likelihood-ratio test reported in Table 7 strongly rejects the single-equation estimates. In Table 7 we also present the estimated threshold values for the group-size equation (3.1) and the estimated standard deviations for the hours equations (3.3) and (3.4).[1]

As a measure of goodness-of-fit, we conduct a simple simulation exercise. For each doctor ($i = 1, \ldots, 29,317$) we generate 5000 random errors using the distributions estimated from MSL. A single prediction for each doctor is obtained by averaging over the 5000 individual predictions that come from adding the generated errors to the estimated equations using the doctor's characteristics. Individual predictions for group size, fee-for-service, and patient contact hours are determined according to the estimated critical values (Table 7), the probit variable, and the left-censored variable respectively. We then aggregate the predictions for number of doctors, contact hours, and total hours in the categories of group size, salary and fee-for-service. These predictions and the actual values for the physicians in our sample are reported in Table 8. The estimated model appears to fit the data quite well in correctly predicting doctors' behavioral decisions in choosing group size and fee-for service. With the exception of hospital and 6^+ doctor groups, the predictions of contact hours and total hours are also reasonable for fee-for-service physicians. For fee-for-service physicians in hospitals, we overpredict their contact and total hours and for the 6^+ doctor groups we underpredict. The predictions for salaried physicians are not as good as the fee-for-service ones with both over and under predictions for contact and total hours. Nevertheless, if we aggregate over all groups, the predictions of patient contact hours and total hours are quite accurate for both salary and fee-for-service doctors.

The results clearly indicate that there are important provincial differences. For instance, Quebec physicians have lower contact and total hours worked compared to other provincial doctors. It seems plausible that at least part of this shortfall in Quebec is due to the caps on individual billing and the development of primary care centers employing salaried physicians. However, factors such as reduced opportunities based on language to migrate to the U.S. or other provinces are also likely playing some role.

Although we cannot identify specific factors causing provincial differences, it is worthwhile to give some range of potential responses under alternative provincial arrangements. Therefore, we consider a simple simulation experiment for all doctors in Canada by repeating twice the procedure used to generate the predicted values in Tabel 8: once replacing the provincial effect and constant term in each equation with the estimated coefficient on Quebec and once using the estimated coefficient on Manitoba. In Table 8 we record the results of

[1] At the suggestion of a referee, we estimated the model for general practitioners alone. None of the statistically significant coefficients changed sign. These results are avalable upon request.

these simulations (labelled Hypoth. Quebec and Hypoth. Manitoba). We loosely interpret this exercise as imposing the institutional structure of Quebec and Manitoba on the rest of Canada and then predicting the endogenous change in behavior (as measured against the actual values).

The most striking results from applying Quebec sand Manitoba coefficients to the rest of Canada is the increase in the numbers of doctors in larger groups with salary compensation. As expected given the estimates from Table 5C, for those doctors than are under fee-for-service total hours worked per physician falls (rises) with the Quebec (Manitoba) estimates. Interestingly, despite Manitoba having higher contact hours than the rest of Canada, the higher propensity of Manitoba physicians to organize in large groups under salary actually lowers the total contact hours for those physicians predicted to be in fee-for-service (9088 hours predicted versus an actual of 9640).

In column E of Table 8 we take the percent change difference from Manitoba and Quebec normalized by the model's predictions from the simulation experiment in column B. This provides a sense of just how large the response by physicians can be under alternative provincial institutional structures. For example, the model predicts a 56% increase in contact hours for fee-for-service physicians using the Manitoba estimates over the Quebec ones for physicians in groups of 6^+.

This simulation exercise draws attention to the very complicated reactions that can take place under alternative provincial arrangements. However, it should be kept in mind that there are other factors (demand conditions, other sources of income, hospital capacity, and so on) that we cannot control for that may, in part, be able to account for these rather large provincial differences. Even though we are unable to attribute these differences to any particular factor or policy initiative, the findings do suggest that policy or institutional changes are likely to have a substantial impact on how physicians work and organize their practices.

V. Concluding Remarks

This paper has examined the determinants of practice setting and work hours of physicians in Canada. Our point of departure from earlier studies is the joint approach to modeling the decision of group size and fee-for-service versus salary and its interaction with hours of contact with patients and total hours of work a physician chooses. We find that the estimates from the simultaneous equation method that reflect these endogenous choices can be substantially different from the single-equation estimates. On occasion, the single equation methods can be extremely misleading. In addition, the model seems to fit the data reasonably well.

Both Canada and the United States are considering moves towards allocating health care resources based upon defined population groups with fixed salary arrangements for physicians practicing within these groups. Our calculations point to some potential effects of strategies aimed at decoupling compensation from the amount and kind of services rendered by the physician. The evidence presented here suggests, among other things, that salaried doctors organized into large groups will choose to reduce both their patient contact hours and total hours worked.

Clearly, considerable care must be given to account for the response of physicians to these kinds of institutional changes. Our evidence is based upon differences in physician behavior across Canadian provinces that follow very different policies in setting fees for physician services rather than observing differences in behavior before and after a policy change. At the least, our results suggest that any forecasts concerning the total supply of medical services under new policy initiatives should take into account potentially large changes in the amount of services supplied per physician.

We estimated the model for G.P.'s alone but there are, of course, potentially many other sources of heterogeneity that could be examined. These include gender differences, other provincial effects other than fixed, salary versus hospital workers, newly trained versus older physicians, capitation versus salaried doctors and so on. Clearly such distinctions would provide a more comprehensive picture and we leave that to further study. However, we acknowledge that this is quite a formidable task given the apparent need to do full systems estimation.

The greatest impediment to understanding physician behavior in Canada is the lack of data linking details of physician practice setting with individual and household physician income. Ideally this income would include both earnings from practicing medicine as well as income from other sources. Such information would need to be linked to the Canadian Medical Association survey. Since this would require approval from the ten provincial governments, as well as the federal one, we are not overly optimistic about the chances of this in the near term.

Appendix

Variable Definitions

TOTAL HOURS	Weekly hours spent in patient care, research, administration, teaching activities, and "other" professional activities, excluding on-call time.
PATIENT HOURS	Weekly hours spent in direct patient care, excluding on-call time.
FEE	0 if salary is main income source (over 50% of professional income) 1 if fee-for-service was main income source Note: For only 10% of the observations was the maximum percentage from income sources less than 75%. Over 75% report a maximum above 95%, indicating that an overwhelming proportion of doctors specialize in one source of income.
GROUP SIZE	1 if solo practice 2 if 2-doctor group 3 if 3-6 doctor group 4 if 6+ doctor group 5 if hospital, clinic, other 6 if group, but size unspecified Dummy variables for cases 2 to 6 are included in the hours equations.
GENERAL	Indicates physician reports specialty as general or family practice or reports no specialty
PSYCHIATRY	Indicates specialty reported as psychiatry or neurology/psychiatry
RADIOLOGY	Indicates specialty reported as radiology or anesthesiology
OBSTETRICS	Indicates specialty reported as obstetrics or gynecology
SURGERY	Indicates specialty as general or specialized surgery
INTERNAL	Indicates one of 26 internal medicine specialties (e.g. cardiology and dermatology)
PEDIATRICS	Indicates specialty as pediatrics (excludes pediatric surgery or cardiology)
OTHER	Indicates 15 remaining specialties (e.g. emergency medicine and pathology)

EXPERIENCE	Year since receipt of M.D.
URBAN	1 if postal code is in urban area 0 if postal code is non-urban area.
DENSITY	$\frac{\text{Population in the province}}{\text{number physicians in specialty in province}}$ (Computed from Health and Welfare Canada statistics for 1990.)

Sample Selection

The PRQ is sent to all doctors licensed to practice medicine in Canada. In 1990 the overall response was 74%. Sanmartin and Snidal (1993) report that respondents were similar to non-respondents in terms of sex and medical specialty.

Our sample includes physicians reporting level of professional activity as full time, part time, or semi-retired. (This excludes retired and temporarily not practicing physicians.) Other observations were excluded for the following reasons:

- ▹ Physicians in Prince Edward Island and the Northwest Territories due to small samples (188 observations).
- ▹ Records missing age (262 observations) or year of graduation from medical school (8 observations).
- ▹ Records reporting main source of income as "other" (14 observations).
- ▹ Records reporting "not in practice" (488 observations).
- ▹ Records reporting shares of professional income by sources that sum to more than 110% or less than 90% (1613 observations)
- ▹ Reporting more than 116 total weekly work hours (1523 observations).

The resulting sample of 29,317 physicians represents 57% of all Canadian physicians.

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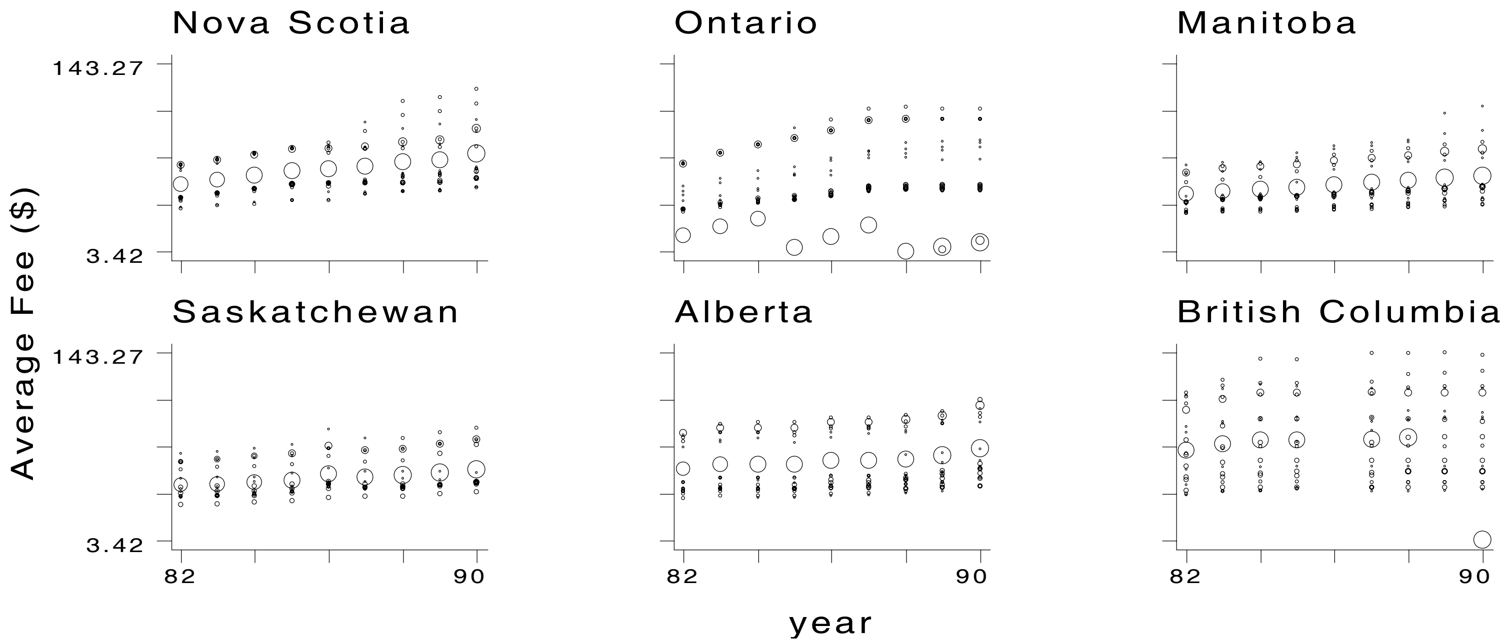
Figure 1.
Fees for Initial Consultations by Province, Specialty and Year



Note: Each circle represents a specialty. The size of the circle indicates the relative number of consultations provided. The outlier in B.C. in 1990 is the fee for medical residents.

Source: Medical Care Data Bank, National Grouping System. Data for other provinces are not publicly available.

Table 1.
Prorating of Physician Fees by Province, Specialty and Year

Province (Year)	General Practitioners Billing ($K)	General Practitioners Rate	Specialists Billing ($K)	Specialists Rate
Newfoundland (1992)	0-300	1	0-400	1
	300-350	0.67	400-450	0.67
	350+	0.33	450+	0.33
	monthly thresholds			
	no threshholds in 1990			
Prince Edward Island (1992)	0-350	1	0-400	1
	350-375	0.75	400-425	0.75
	375-400	0.5	425-450	0.5
	400+	0.25	450+	0.25
	no threshholds in 1990			
Nova Scotia (1992)	0-(x+1.8s)	1	0-(x+1.8s)	1
	(x+1.8s)+	0	(x+1.8s)+	0
	quarterly thresholds			
	no thresholds in 1990			
New Brunswick (1990)	0-250	1	0-350	1
	250+	0	350+	0
	Eliminated in November 1990.			
Quebec (1992)	0-180	1	none	
	180+	0.25		
	quarterly threshholds			
	similar schedule in 1990			
Ontario (1992)	0-400	1	0-400	1
	400-450	0.67	400-450	0.67
	450+	0.33	450+	0.33
	no prorating in 1990			
	remote ares exempt			

Source: CMA, "A Review of the Current Capping, Dollar Threshold and Utilization Formulae" as of July, 31, 1992." Other provinces have no individual thresholds, but several provinces have imposed global caps on physician reimbursement. x = average billing in specialty group; s=standard deviation of billing inside speciality group (five groups defined).

Table 2.
Average Net Income of Canadian Physicians in 1985

Province	General Practicioners: Total Doctors	General Practicioners: Avg. Net Income ($K)	Specialists: Total Doctors	Specialists: Avg. Net Income ($K)
Newfoundland	192	90.3	124	115.4
Prince Edward Island	60	77.2	35	109.6
Nova Scotia	511	86.3	315	135.2
New Brunswick	291	77.8	176	120.9
Quebec	3521	65.8	3926	94.3
Manitoba	455	76	426	104.1
Saskatchewan	494	89.8	201	143.4
British Columbia	1951	82	1403	127.7

Source: Health and Welfare Canada, "Earnings of Physicians and Dentists in Canac
Values for Alberta and Ontario are not available.

Table 3.
Summary of PRQ Variables

Variable	Mean	Std. Dev.
Fee-for-Service	0.84	0.37
Solo	0.41	
Group (Unspecified)	0.03	0.18
2 Doctor Group	0.09	0.28
3-6 Doctor Group	0.17	0.38
6+ Doctor Group	0.21	0.40
Hospital/Institution	0.09	0.29
Weekly Patient Hours	36.71	16.36
Weekly Total Hours	47.52	16.13
Ontario	0.40	
Newfoundland	0.02	0.13
Nova Scotia	0.04	0.19
New Brunswick	0.02	0.15
Quebec	0.23	0.42
Manitoba	0.04	0.19
Saskatchewan	0.03	0.18
Alberta	0.09	0.28
British Columbia	0.14	0.35
G.P./Family Practice	0.51	
Psychiatry	0.06	0.24
Radiology/Anesth.	0.08	0.27
Ob/Gyn	0.03	0.18
Surgery	0.12	0.33
Internal Med.	0.11	0.31
Pediatrics	0.04	0.19
Other Specialties	0.05	0.21
Female	0.19	0.40
Experience (Yrs Since M.D.)	20.49	11.38
Urban	0.89	0.32

Source: CMA Physician Resource Questionaire 1990.
See Appendix for Definitions.

Table 4.
Population Per Physician by Specialty and Province

Province	G.P & Family	Psychiatry	Anesth. & Radiology	OB/GYN	Surgeons	Internal Specialities	Paediatrics	All Other Specialties
Nfld	921	19,722	10,999	24,867	8,056	8,411	17,873	16,341
N.S.	928	10,325	5,833	19,528	4,654	6,153	14,036	9,659
N.B.	1239	22,650	10,355	24,994	5,252	10,818	32,946	21,318
Quebec	988	7,860	6,590	16,341	4,034	4,448	14,167	6,339
Ontario	962	6,823	6,406	15,629	4,582	5,274	13,360	8,532
Manitoba	1062	9,156	7,620	16,763	5,503	6,020	9,729	9,996
Sask.	1046	23,635	9,454	29,196	5,874	9,637	23,635	15,756
Alberta	1084	13,385	7,427	20,349	5,807	6,501	14,899	9,305
B.C.	894	8,868	6,187	19,953	4,206	6,436	16,456	7,583

Source: Health Personnel in Canada 1990, Health and Welfare Canada.

Table 5. Estimates of Labor Supply and Practice Setting Equations

Panel 5A. Provincial Effects

Variable	Group Size Ordered Probit				Fee vs. Salary Probit				Patient Contact Hours Tobit				Total Hours Regression			
	Single ML (1)		Simul. MSL (2)		Single ML (3)		Simul. MSL (4)		Single ML (5)		Simul. MSL (6)		Single ML (7)		Simul. MSL (8)	
Constant					2.34	*	2.07	*	33.87	*	52.89	*	49.77	*	71.07	*
					(0.31)		(0.32)		(2.99)		(3.63)		(2.94)		(3.85)	
Newfoundland	0.50	*	0.49	*	-0.69	*	-0.71	*	3.67	*	6.93	*	1.27		4.71	*
	(0.05)		(0.05)		(0.06)		(0.06)		(0.71)		(0.83)		(0.70)		(0.89)	
Nova Scotia	0.22	*	0.22	*	-0.08		-0.09		1.10	*	2.79	*	0.77		2.60	*
	(0.04)		(0.04)		(0.05)		(0.05)		(0.47)		(0.56)		(0.47)		(0.57)	
New Brunswick	0.05		0.05		0.23	*	0.19		1.64		2.29	*	1.06		1.80	
	(0.07)		(0.06)		(0.09)		(0.09)		(0.86)		(0.99)		(0.84)		(1.04)	
Quebec	0.25	*	0.24	*	-0.22	*	-0.28	*	-3.16	*	-1.37	*	-4.10	*	-2.28	*
	(0.02)		(0.02)		(0.02)		(0.02)		(0.24)		(0.32)		(0.24)		(0.32)	
Manitoba	0.70	*	0.68	*	-0.29	*	-0.34	*	2.09	*	7.55	*	1.47	*	7.33	*
	(0.04)		(0.04)		(0.05)		(0.05)		(0.51)		(0.64)		(0.50)		(0.65)	
Saskatchewan	0.41	*	0.39	*	-0.15	*	-0.20	*	2.80	*	5.93	*	2.26	*	5.66	*
	(0.04)		(0.05)		(0.06)		(0.06)		(0.60)		(0.73)		(0.59)		(0.73)	
Alberta	0.37	*	0.37	*	0.19	*	0.14	*	0.42		3.66	*	0.97	*	4.51	*
	(0.03)		(0.03)		(0.04)		(0.04)		(0.42)		(0.51)		(0.42)		(0.51)	
British Columbia	0.08	*	0.07	*	0.08	*	0.09	*	1.00	*	1.71	*	-0.39		0.39	
	(0.02)		(0.02)		(0.03)		(0.03)		(0.30)		(0.35)		(0.29)		(0.36)	

Panel 5B. Medical Speciality Effects

	Group Size Ordered Probit		Fee vs. Salary Probit		Patient Contact Hours Tobit		Total Hours Regression	
	Single ML	Simul. MSL	Single ML	Simul. MSL	Single ML	Simul. MSL	Single ML	Simul. MSL
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Psychiatry	-0.70 *	-0.70 *	-0.93 *	-0.68 *	-4.37	-10.30 *	-3.49	-9.97 *
	(0.22)	(0.21)	(0.31)	(0.32)	(2.93)	(3.44)	(2.89)	(3.52)
Radiology/Anesth.	0.28	0.22	-0.47	-0.41	0.94	3.02	-0.52	1.78
	(0.23)	(0.24)	(0.37)	(0.37)	(3.16)	(3.66)	(3.12)	(3.93)
Ob/Gyn	-1.01 *	-0.94 *	0.42	0.72	-1.20	-7.92	-0.11	-7.20
	(0.29)	(0.28)	(0.44)	(0.48)	(3.85)	(4.41)	(3.80)	(4.28)
Surgery	-0.87 *	-0.85 *	-0.12	0.11	-1.73	-8.01 *	1.87	-5.01
	(0.23)	(0.23)	(0.36)	(0.37)	(3.07)	(3.63)	(3.02)	(3.66)
Internal Med.	-0.33	-0.31	-0.52	-0.31	-4.51	-7.18 *	0.50	-2.36
	(0.23)	(0.22)	(0.31)	(0.33)	(2.98)	(3.46)	(2.93)	(3.52)
Pediatrics	-0.41	-0.39	-0.85 *	-0.55	-11.27 *	-14.90 *	-5.89	-9.90 *
	(0.26)	(0.25)	(0.34)	(0.37)	(3.42)	(3.82)	(3.38)	(3.95)
Other Specialties	-0.16	-0.11	-0.44	-0.26	-15.52 *	-15.41 *	-2.88	-3.52
	(0.23)	(0.22)	(0.34)	(0.31)	(3.06)	(3.53)	(3.01)	(3.69)

Panel 5C. Physician Density and Specialty Interactions, Gender

	Group Size Ordered Probit		Fee vs. Salary Probit		Patient Contact Hours Tobit		Total Hours Regression	
	Single ML	Simul. MSL	Single ML	Simul. MSL	Single ML	Simul. MSL	Single ML	Simul. MSL
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
G.P X Density	-0.58 *	-0.58 *	-0.99 *	-0.75 *	-3.41	-8.83 *	-5.27	-11.30 *
	(0.23)	(0.22)	(0.32)	(0.33)	(3.02)	(3.50)	(2.98)	(3.62)
Psych. X Density	-0.00	0.00	-0.04 *	-0.04 *	0.10	0.01	-0.03	-0.14
	(0.01)	(0.01)	(0.01)	(0.01)	(0.11)	(0.14)	(0.11)	(0.14)
Rad. X Density	-0.07 *	-0.06 *	-0.01	-0.00	-0.72 *	-1.28 *	-0.72 *	-1.35 *
	(0.02)	(0.03)	(0.04)	(0.02)	(0.33)	(0.39)	(0.33)	(0.42)
Ob/Gyn X Density	0.00	0.00	-0.05 *	-0.05	-0.09	-0.14	-0.08	-0.15
	(0.01)	(0.01)	(0.02)	(0.05)	(0.16)	(0.17)	(0.16)	(0.16)
Surgery X Density	-0.05	-0.05	-0.06	-0.10 *	-0.04	-0.57	-0.39	-0.95 *
	(0.03)	(0.03)	(0.05)	(0.02)	(0.41)	(0.46)	(0.40)	(0.45)
Intern. X Density	-0.05 *	-0.05 *	-0.11 *	-0.03 *	0.07	-0.50	0.10	-0.54
	(0.02)	(0.02)	(0.02)	(0.01)	(0.23)	(0.28)	(0.23)	(0.27)
Ped. X Density	-0.01	-0.01	-0.03 *	-0.19 *	0.45 *	0.33 *	0.29 *	0.15
	(0.01)	(0.01)	(0.01)	(0.01)	(0.14)	(0.15)	(0.14)	(0.15)
Other X Density	0.05 *	0.05 *	-0.19 *	-0.19 *	0.62 *	0.68 *	-0.15	-0.07
	(0.01)	(0.01)	(0.02)	(0.01)	(0.17)	(0.20)	(0.16)	(0.22)
Urban	0.14 *	0.15 *	-0.05	-0.02	-0.37	0.84 *	1.25 *	2.53 *
	(0.02)	(0.02)	(0.03)	(0.03)	(0.29)	(0.34)	(0.29)	(0.35)
Female	0.15 *	0.15 *	-0.28 *	-0.28 *	-5.93 *	-4.98 *	-7.70 *	-6.74 *
	(0.02)	(0.02)	(0.02)	(0.02)	(0.23)	(0.30)	(0.23)	(0.30)

Panel 5D. Experience and Group Practice

	Group Size Ordered Probit				Fee vs. Salary Probit				Patient Contact Hours Tobit				Total Hours Regression			
	Single ML		Simul. MSL		Single ML		Simul. MSL		Single ML		Simul. MSL		Single ML		Simul. MSL	
Variable	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
Experience	-0.00		-0.00		-0.01	*	-0.01	*	0.43	*	0.38	*	0.70	*	0.65	*
	(0.00)		(0.00)		(0.00)		(0.00)		(0.03)		(0.04)		(0.03)		(0.04)	
Exper^2/100	-0.02	*	-0.02	*	0.02	*	0.02	*	-1.53	*	-1.61	*	-2.17	*	-2.26	*
	(0.00)		(0.00)		(0.01)		(0.01)		(0.06)		(0.07)		(0.06)		(0.08)	
Experience <= 2	0.53	*	0.53	*	-0.70	*	-0.68	*	7.22	*	10.86	*	3.43	*	7.39	*
	(0.07)		(0.06)		(0.08)		(0.08)		(0.94)		(1.02)		(0.93)		(1.09)	
Group (Unspecified)									-3.60	*	-18.26	*	-2.04	*	-17.83	*
									(0.50)		(0.91)		(0.50)		(0.83)	
2 Doctor Group									-1.04	*	-9.53	*	-1.37	*	-10.51	*
									(0.34)		(0.58)		(0.33)		(0.51)	
3-6 Doctor Group									-1.91	*	-14.17	*	-1.67	*	-14.86	*
									(0.26)		(0.99)		(0.25)		(0.86)	
6+ Doctor Group									-2.70	*	-21.70	*	-1.32	*	-21.81	*
									(0.26)		(0.99)		(0.25)		(0.86)	
Hospital/Institution									-10.32	*	-39.80	*	-3.60	*	-35.90	*
									(0.37)		(1.43)		(0.36)		(1.23)	
Fee for Service									11.36	*	5.86	*	1.01	*	-5.51	*
									(0.28)		(1.19)		(0.28)		(1.48)	

Notes: N=29,317. Estimated asymptotic standard errors in parentheses. "*" denotes significance at 5% level. Single Equation Estimates based on maximum likelihood and numerical integration. Simultaneous Equation Estimates based on maximum simulated likelihood using GHK simulation (20 replications for each observation and antithetic variates). Standard errors for MSL estimates multiplied by (1+1/40)

Table 6.
Estimated Cholesky and Variance Matrices

Panel 6A: Cholesky Matrix

Equation	Group Size		Fee/Salary		Patient Hrs		Total Hrs	
Group Size	1.00		0.00		0.00		0.00	
Fee/Salary	-0.57	*	0.82		0.00		0.00	
	(0.01)							
Patient Hrs	9.47	*	3.71	*	13.95	*	0.00	
	(0.57)		(0.57)		(0.11)			
Total Hrs	10.13	*	4.44	*	9.00	*	10.17	*
	(0.51)		(0.79)		(0.18)		(0.18)	

Estimated Standard Errors in parentheses. "*" = significant at 5% level.

Panel 6B: Variance-Covariance Matrix

Equation	Group Size	Fee/Salary	Patient Hrs	Total Hrs
Group Size	1.00			
Fee/Salary	-0.57	1.00		
Patient Hrs	9.47	-2.40	298.00	
Total Hrs	10.13	-2.18	237.98	203.40

Table 7.
Estimates of Auxillary Parameters

	Single ML		Simul. MSL	
Group size critical values				
solo practice	-0.64	*	-0.64	*
	(0.22)		(0.23)	
2-Doctor group	-0.39		-0.39	
	(0.22)		(0.23)	
3-6 Doctor group	0.11		0.12	
	(0.22)		(0.23)	
6+ Doctor	0.96	*	1.01	*
	(0.22)		(0.23)	
$\sigma 3$	14.99	*		
	(0.06)			
$\sigma 4$	14.81	*		
	(0.06)			
-Ln Likelihood	283884.5		277037.7	
Chi-squared (6 dof)			13693.6	

Estimated standard errors in parentheses.
"*" = significant at 5% level.

Table 8.
Predicted and Actual Work Hours and Practice Settings

Group Size	Value	Salary Actual (A)	Salary Predicted (B)	Salary Hypoth. Quebec (C)	Salary Hypoth. Manitoba (D)	Salary % Change (E)	Fee-for-Service Actual (A)	Fee-for-Service Predicted (B)	Fee-for-Service Hypoth. Quebec (C)	Fee-for-Service Hypoth. Manitoba (D)	Fee-for-Service % Change (E)
Solo	Doctors	5.6	4.3	5.8	2.5	-76	113.4	114.4	102.8	64.1	-34
	Contact Hrs.	141.9	126.6	155.2	80.5	-59	4583.5	4657.8	3895.8	2809.3	-23
Group	Doctors	2.3	1.6	2.2	1.9	-16	7.6	8.7	8.5	9.7	14
(Unspec)	Contact Hrs.	55.3	40.4	47.1	55.0	20	285.1	308.9	279.1	366.0	28
2 Doctor	Doctors	2.2	2.5	3.5	1.9	-61	23.0	22.8	22.1	19.3	-12
	Contact Hrs.	68.5	64.7	81.8	50.9	-48	912.6	911.2	820.1	800.4	-2
3-6 Doctor	Doctors	6.8	7.5	9.9	7.2	-36	44.1	43.2	41.8	44.0	5
	Contact Hrs.	195.0	188.6	225.8	196.8	-15	1727.6	1683.6	1507.5	1799.6	17
6+ Doctor	Doctors	11.6	17.2	22.6	22.0	-3	48.9	43.7	43.3	61.1	41
	Contact Hrs.	300.2	433.9	519.0	605.7	20	1862.2	1654.7	1520.3	2439.3	56
Hospital	Doctors	19.0	14.8	18.7	31.6	87	8.7	12.5	12.1	27.8	126
	Contact Hrs.	361.2	285.8	314.5	689.4	131	269.3	361.0	317.1	874.3	154
Total	Doctors	47.5	47.9	62.6	67.1	9	245.7	245.3	230.5	226.0	-2
	Contact Hrs.	1122.1	1140.1	1343.4	1678.4	29	9640.2	9577.2	8339.8	9088.9	8
	Per-Doctor	23.6	23.8	21.5	25.0	15	39.2	39.0	36.2	40.2	10
Salary & FFS	Contact Hrs.	10762.3	10717.3	9683.3	10432.3	7					
Combined	Per-Doctor	36.7	36.6	33.0	35.6	7					

Doctors equal sample totals in hundreds. Contact Hours are sample totals expressed in hundreds-of-hours per week.
Values in (B)-(D) based on 5000 draws of the epsilon vector for each observation.
(A) actual values from the sample.
(B) Predicted values from the SML estimates applied to the sample observations on the exogenous characteristics of physicians.
(C) The same as (B) except the coefficient on Quebec replaces constant term in each equation, all other province effects = 0.
(D) The same as (C) except the Manitoba coefficient is used in each equation.
(E) = 100 * [(D) - (C)] / (B)