WORKLOAD AND PHYSICIAN ACCUMULATION ACROSS CANADIAN HEALTH REGIONS

by

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Abstract

Primary care physicians serve an important role in the Canadian health care system, and the recruitment of primary care physicians is often an important policy and political goal. Wide disparities in both physician workload and access to health services exist between Canadian communities and — depending on the relationship between physician workload and migration — physician migration may either reduce or exasperate these disparities. This paper uses data on physician population characteristics, sub-provincial health region characteristics, and usage rates of primary health care services to estimate the relationship between physician workload and the rate of physician migration into a sub-provincial health region. I find that regions with higher average levels of physician workload are associated with a higher rate of physician inflow to the region. It is unclear whether this relationship is the result of physician workload preferences, or public policy decisions.

List of Abbreviations Used

CANSIM: Canadian Socio-economic Information Management System.

CIHI: Canadian Institute for Health Information.

CCHS: Canadian Community Health Survey (Statistics Canada).

GP: General Practitioner.

HWL: High Workload.

MD: Doctor of Medicine.

OLS: Ordinary Least Squares.

SDMCP: Supply, Distribution and Migration of Canadian Physicians (CIHI).

WL: Workload.

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Chapter 1

Introduction

The recruitment of medical professional is an ongoing political and practical policy goal in Canadian communities from coast to coast. As the initial point of access for most Canadians into the health care system, difficulty for a patient to access a primary care physician can shape health outcomes, health system efficiency, and how the public perceives the healthcare system as a whole.

Practically, in the Canadian health care system, primary care physicians take on important roles as gatekeepers to the broader medical system. In family practice clinics and walk-in and community clinics, general practitioners (GP) open the door to prescription pharmaceuticals; specialist treatment; specialist diagnostic care; and advanced diagnostic technologies, along with providing their own medical expertise. Research on the role of family doctors shows that they have an important role in improving efficiency in the healthcare system, both improving medical outcomes and reducing overall health system costs. Hollander, et al. [2009] find that for diabetic patients, a patient's relationship with their family doctor was the most important factor — more important than age — in determining annual hospitalization costs [11]. In hospitals, emergency departments, and by extension emergency department physicians, are the most important determinant of access to broader in-patient care. According to a 2005-2006 survey by the Canadian Institute for Health Information (CIHI), 60% of acute care hospitalizations came through emergency departments, accounting for 65% of in-patient days [9] [4]. Emergency departments account for the majority of hospital admittance in every province and territory, ranging from 56% of admittance in Nova Scotia and Alberta to 77% of admittance in Nunavut. Patients admitted through emergency departments are 30% less likely to exhibit no disease, compared to those admitted to hospital by other means, and twice as likely to exhibit the highest categories of disease severity.

Politically, an individual's inability to find a family doctor, or an experience with

long wait times in community clinics, can become a symbol of perceived failure of the broader health care system. Although Nova Scotia has more physicians per capita than any other province, and the second largest share of primary care physicians per capita in the country, access to primary health care still became a major campaign issue for all parties. Both major opposition parties included promises to recruit more primary care physicians as part of their platforms, while the incumbent governing party promised to reduce primary care wait times. Such political arguments can have particular resonance among politically important groups, including rural residents and seniors.

Important to the ability of patients to visit primary care physicians is the distribution of primary care physicians between Canadian communities. Between provinces, large differences exist in the number of general practitioners per capita. Within provinces, shortages of physicians exist in many Canadian rural communities, relative to average levels. At the same time, higher incidence of some health concerns, including obesity and accidental injury, often exist in these communities. While the total number of physicians within the country may be hard to change, guiding physician migration, and the targeted recruitment of new and immigrant physicians, may be able to improve efficiency and equity of care. Because there are likely different policy implications to an uneven distribution of physicians resulting from community characteristics; physician characteristics; or provincial policy; and resulting from a physician's expected workload, this paper will attempt to look at each effect separately. This paper is primarily interested in physician behavior with respect to physician workload: determining whether high or low workloads are attractive to migrating physicians, and why.

To measure the role of workload on physician accumulation or loss, I use OLS to regress net physician accumulation against estimates of physician workload; physician characteristics; province of practice; and community characteristics, at the health region level. The purpose of these regressions is to determine the roles that policy decisions and less malleable effects may have on physician migration. A positive relationship between physician workload and migration would indicate an easier policy environment, where physician levels were moving towards improved balance on their

own, while a negative relationship would indicate a worsening problem where financial incentives may or may not be an effective remedy. In this paper, I establish a positive relationship between average physician workload and net regional physician accumulation. Chapter 2 discusses some of the economic theory relevant to physician migration. Chapter 3 provides a review of the literature on physician workload and of the literature on physicians in rural health care, as well as a brief overview of the policy environment within which Canadian general practitioners operate. Chapter 4 provides an overview of the data sources used in this study. Chapter 5 describes the collected data, quantitatively. Chapter 6 describes the methodology and discusses some of the potential limitations of the methodology. Chapter 7 describes the results of the regression. Chapter 8 discusses the implications of the results of this study, as well as a discussion of policy implications for Canadian health regions.

Chapter 2

Theoretical Overview

Under normal market conditions, price mechanisms should balance physician levels according to supply and demand. In less desirable regions, one would expect physicians' wages to be bid up and the quantity of physicians in that region would be increased to some level not greater than average physician levels, but consistent with allocative efficiency. The market for health care; however, is anything but consistent with normal market conditions. In Canadian health care, for example, the principle of equity is more important than for most market goods. It is not politically acceptable for remote communities to be left without access to health care on the basis that they do not have the willingness or ability to pay a required premium to attract a physician to their community. Secondly, reimbursement rates and additional payments to physicians are negotiated centrally in each province, between provincial ministries of health and physicians' professional organizations, instead of individually on a physician-by-physician basis. Weaknesses in central planning may account for maldistribution of physicians across regions, theoretically fixable through improvements in policy.

Even if equity was not a priority and the market set physicians' wages, it's not entirely certain that higher wages would be able to attract physicians to under-served regions in any meaningful way. According to labour supply theory, if leisure and market goods are both normal goods, then a rational agent will want to allocate their time between work (which allows for the purchase of market goods) and leisure. As the wage rate increases, the substitution effect from the higher opportunity cost of leisure will push hours worked up, while the income effect from increased total wealth will push hours worked down. For most workers, the substitution effect will overtake the income effect and the net impact of an increase in the wage rate will be an increase in hours worked. For wealthy workers, such as Canadian physicians, the income effect may overtake the substitution effect and an increase in the wage rate would reduce

or have no effect on the number of hours worked.

Finally, there may be non-linearities in the demand for physicians. By definition, a worker who is underemployed would prefer to work more hours at their current wage, while a worker who is overemployed would prefer to work for fewer hours at their current wage. If the number of hours that are available for a physician to work, or that a physician would be required to work, vary by region, a physician may be attracted to the region with the most appealing workload, at any given wage. In most cases, Canadian physicians operate under a fee-for-service contract with provincial governments. In normal circumstances, this would allow physicians to choose their own hours to prevent overemployment and reduce the risk of underemployment; however, physicians may respond to an ethical code that makes them unwilling to turn away a patient in need of care. In the case of underemployment, this effect would be self-correcting: physicians will move to the regions with unmet demand for medical care to reduce their underemployment and, in the process, reduce the amount of unmet demand in regions with high unmet demand and increase the amount of unmet demand in regions with low unmet demand. In the case of overemployment, this effect would be self-reinforcing: physicians will move to regions low unmet demand, exasperating the problem of high unmet demand in regions with high unmet demand and further making those regions less attractive to overemployed physicians.

If physicians behave like they're underemployed, policy does not specifically have to respond to physicians' workload in recruitment. Flat-rate bonuses may be used to recruit physicians to unattractive regions, while increased fee-for-service payments should increase the rate by which physicians are already coming to the region. If physicians behave like they're overemployed, then at current fee-for-service rates, physician movement will be self-reinforcing; however, at higher fee-for-service rates, physician movement may reverse and become self-correcting. If the income effect on physicians' wages overcomes the substitution effect on their wages, then an increase in either fixed-rate payments or fee-for-service payments will be ineffective or will be self-reinforcing towards physician shortages. In this case, attracting physicians would require non-financial incentives.

Empirically, a positive relationship between physician workload and physician

accumulation in a health region would indicate an effect consistent with underemployment. Because a high level of workload for existing physicians in the base year signals the availability of additional work for potential migrating physicians the following year, these health regions should be especially attractive to underemployed physicians. On the other hand, a negative relationship between physician workload and physician accumulation may be consistent either with overemployment or a preference for leisure over labour in the relevant income range.

Because this paper does not use detailed physician salary data, I will not be able to separate traditional overemployment from the income effect beginning to dominate the substitution effect.

Differences in the distribution of specialist physicians are more acute than differences in the distribution of primary care physicians; however, the distribution of specialist physicians may also be related the presence of hospitals and medical equipment or attributable to a large minimum threshold population size required to support a specialist physician. For that reason, this paper will look specifically at primary care physicians: family doctors or general practitioners.

Chapter 3

Literature Review

While literature on Canadian physician migration is limited, quite a bit of attention has been paid to the recruitment and status of rural physicians in Canada. Over the last thirty years, there has been a general trend of physician migration away from rural communities, with physician recruitment in Canadian communities having more to do with immigration and education than the movement of established physicians. This section begins with literature analysing physician migration, followed by a look at issues and situations facing rural physicians.

Between provinces, Rajbhandary and Basu [2006] investigate the probability of physicians moving, between 1989 and 2000, after controlling for income [14]. While the vast majority of physicians did not move between provinces in any given year, there are regional differences in physician attachment to their provinces. Physicians in British Columbia and Alberta were least likely to migrate out of province, while physicians in the Maritime Provinces were most likely to migrate. Of physicians who did migrate between provinces, Ontario and British Columbia were the most common destination provinces. Physicians from the Western Provinces were most likely to migrate to British Columbia, while physicians from the Maritime Provinces and Quebec were most likely to migrate to Ontario. Physicians from Ontario and British Columbia were each most likely to migrate to the other province. Expected income in their destination province has a positive, statistically significant impact on physician migration from Ontario and Saskatchewan; however, the effect is small and not consistent across the country. A further explanation is not offered for differences in migration by province.

Within Manitoba, Roos [1983] examines the movement and workloads of physicians performing surgeries in rural communities [15]. The author finds that, between 1974 and 1978, new entrants to rural practice were overwhelmingly newly registered physicians in Manitoba: 60 to 80 physicians entered rural practice each year and only

one was not newly registered in the province. New entrants at the time were entirely recent graduates or immigrants. During the same period, "about half a dozen" physicians left rural practice for urban Manitoba and between 40 and 60 physicians "deregistered": leaving the province, retiring, or dying. In the small sample available, the departure of a physician precedes a large increase in workload while the arrival of a physician precedes a small decrease in workload, relative to the mean.

According to the 2004 National Physician Survey, among all physician age groups, more physicians report planning to reduce their workweek than increase their workweek within the following two years [1]. The survey also finds that physicians trained outside of Canada are more likely to practice outside of an urban setting than Canadian trained physicians, with a particularly high share of internationally-trained physicians practicing in Newfoundland & Labrador and Saskatchewan. Nationally, the number of practicing physicians has increased or remained constant, every year since 2003 [6, Table 23.0].

One subject that is touched on by a lot of research, and is the focus of Curran & Rourke [2004], is the role of medical school internships, curriculum, and recruitment on the communities where physicians end up practicing [8]. Students from rural communities, students training in rural care, and students trained in rural communities are more likely to practice in a rural community than other physicians. Although there is evidence that policy in medical education can have a positive effect on the likelihood of students to end up in rural practice, educational policy can be a slow and imprecise policy tool.

Consistent across the literature on rural practice are qualitative descriptions of differences in practice and working conditions between rural and urban physicians. A 2010 paper by Chauhan, Jong and Buske investigates issues surrounding recruitment and retention of rural physicians in Canada [2]. The paper finds that while most physicians practicing in rural communities report appreciating the "opportunity to practice [their] full skill set" and that they "liked the rural lifestyle," a larger share of younger and of internationally-trained physicians reported that financial incentives were an important factor in their decision to practice in a rural community. 14% of respondents reported that they were planning on moving within the following two years, with most listing "more reasonable hours of work," "availability of locum

tenens," and "availability of professional backup" as contributing factors. The importance of limited workload and locum tenens is consistent with a 2003 survey of rural family physicians and family medicine residents in Ontario that cites managing time on call and finding locum tenens as the first and second best ways to retain rural physicians [16].

A subset of the literature looks specifically at challenges facing physicians in some remote communities. In a survey, interviewing the spouses of 13 physicians in the Burin and Bonavista regions in rural Newfoundland & Labrador, Mayo and Mathews [2006] find that in addition to social isolation and an inability to find work, respondents list their physician spouses' high workload and inability to take time off as reasons they would want them to leave rural practice [12]. Canadian trained physicians reported being more satisfied with their rural communities, while internationally trained physicians often reported their rural practice as a stepping stone towards practice in another part of Canada. In a survey of British Columbia physicians eligible for the Northern and Isolation Allowance, Thommasen et al. find that 80% indicate moderate-to-severe emotional exhaustion and 31% indicate mild to severe depression [17]. As physicians indicating depression or emotional exhaustion were more likely to wish to relocate, mental illness is suggested as a possible mechanism between poor working conditions and physician attrition from rural communities.

Chiasson and Roy find that the roles of rural physicians are broader than the roles of urban physicians [3]. In a 1995 study of rural British Columbia; Alberta; the Yukon Territory; and the Northwest Territories, the authors found that 80% of hospitals used some general practitioners to provide surgery and that 27% used only general practitioners to provide surgery. 80% of surveyed hospitals used general practitioners to provide anesthesia, while 64% used only general practitioners to provide anesthesia.

Finally, some research has focused on the different health system structures between urban and rural communities. Kindig and Movassaghi determine that the average quantity of physicians in US rural communities is less than the quantity required to properly manage a health maintenance organization [10]. Similarly, the inability of rural physicians to join group practice is the subject of Ottensmeyer and Smith [13]. When group practice is impractical in a community, primary health care systems depend on either independent practice or alternative health care structures.

In a review of rural and isolated health care delivery models in Australia, Wakerman et al. discuss five categories of rural and remote primary health care models in a meta-analysis: Discrete services, usually in the form of traditional primary health care clinics; integrated services that prioritize access to a range of services; aboriginal controlled services, focused on access to care and non-medical determinants of health; outreach services, including care from visiting physicians and fly-in/fly-out care to communities that are otherwise unable to support a physician; and virtual medical services [18]. The paper finds that a minimum community population size of 2000-3000 residents is required to sustainably support a traditional system of primary health care services. For smaller population sizes, systems that combine populations usually must be used. The most extreme case of both physician shortages and rural conditions in Canada is Nunavut. According the CBC, only 20 physicians operated in the territory in 2008 [3]. Nine physicians were permanent residents of Nunavut and operated out of Baffin Island, while the remaining eleven physicians flew into the territory. At the time, Nunavuts director of medical services cited heavy workloads as the primary challenge in recruiting additional physicians. Health care systems in Nunavut include local, integrated medical clinics and fly-in/fly-out outreach services.

This paper expands on previous literature by investigating a nearly exhaustive set of Canadian sub-provincial health regions, allowing for variation both across provinces and within provinces, and including a broader set of control variables than is generally used. Unlike papers that have investigated the working conditions of rural physicians in a specific province or within specific regions, such as that of Roos; Mayo and Mathews; or Thommasen et al.,this paper takes a national geographic scope. This paper includes both rural and urban regions in every province, excluding only the Territories and three remote health regions in Northern Quebec. Because this paper includes data from a variety of communities and regions, I should be better able to separate the effects of my key independent variable, physician workload, from regional effects. Unlike Rajbhandary and Basu's analysis, which investigates physician migration on a provincial basis, this paper investigates physician migration on the basis of sub-provincial regions, allowing for different physician behavior between urban and rural communities within a province. Unlike much research on rural health care, or the migration of rural physicians, this paper does not depend on survey data to describe

the feelings or behaviour of physicians. Instead, provincial and federal government data on physician populations, physician characteristics, health system utilization, and Statistics Canada data on community characteristics are used to analyse the revealed behaviours of physicians. This may capture a more objective measurement of physician behavior than would be obtained from survey-based analyses. This paper takes a broader scope than many of the above analyses, allowing for variation on the basis of physician characteristics and community characteristics, in addition to workload and geography, reducing the risk of omitted variable bias.

Under the federal Canada Health Act, each province must establish and maintain a universal health care system; however, the governance of health care systems, including payment to physicians, is strictly a provincial responsibility. The average payment to a Canadian general practitioner for diagnostic visits and consultation is $40.51 over 2010-2011, ranging from $28.90 in Newfoundland Labrador to $54.06 in Alberta [6, Table B.3.1]. Average payments per service are higher in Quebec, Alberta, and British Columbia when procedures are included as well, but lower nationally. Data on average payment per billing is unavailable for PEI. Most payment to Canadian general practitioners is distributed on a fee-for-service basis, with the highest share of payments in British Columbia at 86.0% and the lowest share of payments in Quebec at 50.4% [6, Table A.3]. General practitioners receive a larger share of their income from fee-for-service payments than do specialists, in every province. Detailed data on alternative payment schemes is unavailable for Nova Scotia and Alberta. Five provinces report having paid rural incentives, (Prince Edward Island; Quebec; Ontario; Alberta; and British Columbia); however, other provinces offer additional rural incentives as well [6, Table A.2.3]. Rural incentives are paid at a fixed rate to all physicians meeting certain conditions within specified rural communities. Higher fee for service rates are paid for some visits by older patients, with services covered, age-premium rates, and patient age-thresholds varying by province.

Chapter 4

Data Sources

For each regression, the dependent variable is the amount of growth to a health region's population of primary care physicians, over a one year period. If a policy goal is to increase the number of physicians in a region, a higher value for this variable would represent a success.

Independent variables describe the level of workload facing physicians in a health region, the characteristics of those physicians, the year and province the observations were taken from, and the characteristics of the health region. Describing physician workload, I have a "workload" variable that estimates an average number of visits per physician, per year, and a "high workload" variable that describes the amount of very high workload patients per physician in the observed health region. Describing physician characteristics, there are variables for average physician age; the female share of physicians; the share of physicians trained in Canada; and the quantity of specialists per capita in a health region. Community and demographic variables are included to describe each of: The shares of the health region's population who are aboriginal; internal migrants within the last five years; immigrants; members of a visible minority; over 65 years old; under 20 years old; paying more than 30% of their income towards housing; or post secondary graduates, the health region's long term unemployment rate, the average income of the health region and the average share of that which comes from government transfers, and the health region's population density. Year dummies represent the initial year of data, of three sets: 2008-2009, 2009-2010, and 2010-2011. Provincial dummy variables represent the province that the health region is located in.

The workload variables are the independent variables most directly related to the theory discussed in the previous chapter. In a labour supply decision between work and leisure, a higher level of average physician workload in a health region should describe more time spent working for pay, and less time spent in leisure. Under

a traditional fee-for-service payment schedule, a higher workload represents more services at a fixed (or in some cases declining) payment rate per service, as opposed to more services at an increasing rate per service.

Physician variables serve as a control for different behaviour among physicians of different backgrounds. Each physician variable is somewhat correlated with physician workload, as discussed in the following section. For example, workload of female physicians tend to be lower than the physician population as a whole.

Provincial dummy variables are the most direct control for the effect of policy differences between health regions. In the Canadian health care system, ultimate regulatory and fiscal control over physicians and the health care system rests at the provincial level. Regulatory authority over physician behavior is devolved by provincial governments to provincial Physicians' Collages, which also serve as the body responsible for collective bargaining with provincial governments with respect to physicians' fee-for-service reimbursement rates. Because this is an indirect measurement of policy, effects will be confounded by regional trends that are unrelated to provincial health care policy.

Health region level community and demographic variables are included to control for the desirability of a health region as both a place to live and a place to work. These variables allow for physician accumulation to be higher in communities that physicians find more desirable, and reflect many of the characteristics used by Statistics Canada to describe health regions [6, Table A-4]. Some community variables, notably the share of the population over the age of 65, may also be correlated with the nature of physician workload and the rate at which physicians are compensated; therefore, relationships involving these variables should be interpreted carefully.

Importantly, I don't have variables to accurately control for physician compensation, beyond workload levels and provincial dummies. Within a province, workload will give a rough measurement of income that misses variance in physician income related to rural incentives, the composition of billed services, and expenses across a province. To the extent that income is correlated with workload, physician income will confound the effect of workload. To the extent that income is not correlated with workload, the effects of physician income will be lost, and may confound other variables. Between provinces, provincial dummy variables are an especially blunt

measurement of both regional trends and provincial-level policy, including physician payments. A more sophisticated analysis using physician-level microdata may be able to better separate the effects of workload, income, and policies. Notably, Rajbhandary and Basu included physician income in explaining physician migration within Canada; however, they did so only at the provincial level, and without controls for workload, physician characteristics, or community characteristics.

To construct the above variables, I use three key data sources: the "Supply, Distribution and Migration of Canadian Physicians" (SDMCP) publications from the Canadian Institute for Health information, using data from Scotts Medical Database and provincial sources; Canadian Community Health Survey (CCHS) public-use microdata files; and various Canadian Socio-economic Information Management System (CANSIM) tables. Data is presented in terms of health region years, for each health region across 2008-2009, 2009-2010, and 2010-2011.

4.1 Supply, Distribution and Migration of Canadian Physicians

Each annual Supply, Distribution and Migration of Canadian Physicians publication includes physician population totals, physician ratios per 100,000 population, average physician age, the female share of a physician population, and the Canadian-trained share of a physician population. From 2008, forward, SDMCP data is presented on the national, provincial or territorial, and health regional levels and accounts for general practitioners and specialists separately.

General practitioner flow is my dependant variable of interest. SDMCP data on health region general practitioner populations is used to calculate physician flow, defined as the net percentage increase or decrease of general practitioner population levels, year to year. Because general practitioner populations are available for four years, three flow measures can be constructed: 2008 to 2009, 2009 to 2010, and 2010 to 2011. The level of physician accumulation is expressed as a percentage of the health region's primary care physician population in the initial year of the observation. If a health region's physician population increased from 10 physicians in 2008 to 11 physicians in 2009, that increase would be expressed as 10% of the 2008 physician population level.

Physician workload is my primary independent variable of interest. The inverse

SDMCP ratios of physicians per 100,000 of population make an initial estimate of physician workload, equivalent to average patient base per general practitioner. In the case of the health region including Halifax, Nova Scotia "Zone 6", a general practitioner ratio of 143 per 100,000 of population in 2008 is equivalent to an average potential patient base of 699 patients per physician.

Controls for average physician age, female share of physician population, and Canadian-trained share of physician population are taken directly from SMDCP publications. Female share and Canadian-trained shares are percentages between 0 and 100, of physicians where sex or place of MD (Doctor of Medicine) graduation are known.

The effect of specialist physicians is controlled for using ratios of specialist physicians per 100,000 of population. Because some health regions in rural communities have no specialist physicians, the inverse measure or workload estimate cannot be used.

4.2 Canadian Community Health Survey

Canadian Community Health Survey data is used to augment physician workload estimates and create a more accurate estimate of physician workload. In the 2007-2008 CCHS microdata file, the variable HCUG02A records the grouped responses to the CCHS question HCU_Q02A:

> "[Not counting when you/he/she were/was an overnight patient, in the past 12 months/In the past 12 months], how many times have you seen, or talked on the telephone, about your physical, emotional or mental health with a family doctor (pediatrician) or general practitioner?"

Responses are coded as 0 through 30 for that number of visits over the last 12 months, 31 for 31 or more visits over the last 12 months, or as missing or unstated. In the 2009-2010 CCHS microdata file, the variable is renamed CHPG04.

Omitting missing or unstated responses, CCHS microdata responses are aggregated to the health region level to calculate the average number of visits with a general practitioner for each health region. I created a separate binary variable for responses in the 31 or more visits grouping. Aggregated, this variable represents

the percentage share of patients, in a given health region, who reported 31 or more primary care visits in the previous year. Aggregated values are the average of physician usage observations in the dataset, weighted by the corresponding scaling factors suggested by the publication.

The workload variable, used as the primary dependent variable, is constructed as the product of reported visits from the aggregated CCHS data and inverse physician ratios from SMDCP to estimate the average workload of physicians in terms of annual visits per physician. Workload is reported in thousands of visits. In the case of the health region including Halifax, in 2008, an average physician base of 699 patients per physician combined with an average 3.72 visits per patient in the 2007-2008 CCHS gives an estimated physician workload of 2.60 thousand visits per physician, per year.

2007-2008 CCHS data is used for 2008-2009 observations, 2009-2010 CCHS data is used for 2010-2011 observations, and average over both surveys is used for 2009-2010 observations.

4.3 CANSIM

Controls for health region population demographic information is largely drawn from CANSIM tables based on the 2006 census.

CANSIM Table 109-0300 provides aboriginal, 5-year internal migrant, immigrant, and visible minority shares of population; shares of population paying more than 30% of income towards housing; government transfers as a share of income; post secondary graduation rates; average income (age 15 and older); long term unemployment rates; and population densities from the 2006 census. Population densities I have included in the regression are adjusted based on postcensal population estimates from CANSIM Table 109-5325.

CANSIM Table 109-5326 provides controls for youth (under the age of 20) and seniors (65 years and older) for each year from 2006 to 2011. The control for population gender is derived from CANSIM Table 109-5325.

4.4 Health Regions

Each observation in regressions 1-4 represents a Canadian health region over a one-year period. Health regions are political divisions established by provincial governments to decentralize delivery and management of health care services. As health regions are entities under the jurisdiction of provincial governments, the structures, sizes, and roles of health regions differ across the country, and within provinces over time. Largely consistent across the country, however, each health region represents a specific sub-provincial geographical jurisdiction, generally reflecting recognizable sub-provincial regions.

In Nova Scotia, 9 Health Authorities are reduced to 6 health regions in SDMCP and CCHS, while both divisions are included in the CANSIM tables. To match the SDMCP dataset, data is presented from the 6 broader health regions.

Prince Edward Island only has one health region, but data from SDMCP and CANSIM tables 109-0300 and 109-5325 include data on the county level. To match the SDMCP dataset, data is presented on the county level. When only provincial data is available, the provincial value is used for each county.

In Quebec, CCHS data is unavailable for the Région du Nord-du-Québec, Région du Nunavik, and Région des Terres-Cries-de-la-Baie-James. Because no unbiased estimate for workload can be made in these regions, they are omitted from the regression.

In Ontario, SDMCP data is presented in terms of Health Integration Networks, while CCHS data is presented in terms of the smaller Health Units, and CANSIM data is presented in both forms. Because Ontario Health Units are not subsets of Ontarios Health Integration Networks, the provincial average of CCHS Ontario Health Units physician usage data is used to construct physician workload estimates for each Health Integration Network.

In Manitoba and Saskatchewan, some health regions are grouped in CCHS data. In these cases, the grouped CCHS value is used for each component health region presented in SDMCP.

In Alberta, health regions were amalgamated between 2009 and 2010; however, the new health regions each completely contained one or more of the older health regions. For the 2008-2009 observations, data is presented in terms of the older health regions

with data from the newer health regions being used for each component piece when necessary. For the 2009-2010 observations, data is presented in terms of the new health regions and SDMCP data from 2009 is calculated as a weighted average of component health regions.

Each territory consists of a single health region; however, territorial health regions are not included due to concerns about data availability, data quality, and lack of developed territorial health care systems.

Chapter 5

Descriptive Statistics

Across all three time periods, the median level of physician accumulation is 3.16% of base year physician population, while the mean accumulation is 4.09%. Of 282 year-region observations, the physician population increases in 198 observations or 70%. 61 observations (22%) demonstrate decreases in physician population while 23 observations (8%) demonstrate no net change in physician population. In the average of health regions, no province demonstrates negative net physician accumulation, with the lowest levels of physician accumulation in New Brunswick and Nova Scotia.

Averages of health region observations are in line with the Canada-wide average physician accumulation of 3.2%, 1.6%, and 4.0% in 2009, 2010, and 2011, respectively [6, Table 22.1]. Consistent with the averages of health region observations, no province has negative net physician accumulation over all three years; however, Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Alberta, and British Columbia each demonstrate physician loss in at least one year.

Over the full period, the average level of workload among health regions is 3.29 thousand visits per physician, with a median of 3.15 thousand visits. Physician workload ranges from 1.15 thousand in Gaspésie-Iles-de-la-Madeline, QC in 2010 to 7.80 in Sunrise RHA, SK in 2008. Mean workload decreases each year between 2008-2010, from 3.43 in 2008, 3.23 in 2009, and 3.20 in 2010.

Table 5.2 presents average health region workload by province. Workload is lowest in Quebec at an average of 1.81 thousand visits per physician per year, and highest in Prince Edward Island and Saskatchewan at averages of 4.27 and 4.71, respectively. Each other province is within the range of 2.97 (Newfoundland and Labrador) and 3.59 (Manitoba) thousand visits per physician per year. The low physician workload in Quebec appears to be both the result of a low number of visits per capita reported in each CCHS survey and a high ratio of physicians to the total population. In the

Table 5.1: GP Accumulation by Year (All Provinces), Province (All Years)

	Mean	**Standard Deviation**
GP Inflow - Overall	4.09	10.70
GP Inflow - 2008	4.00	8.26
GP Inflow - 2009	2.25	10.34
GP Inflow - 2010	6.01	12.87
GP Inflow - BC	2.53	4.69
GP Inflow - AB	2.37	3.74
GP Inflow - SK	10.94	23.53
GP Inflow - MB	4.40	8.28
GP Inflow - ON	5.14	2.36
GP Inflow - QC	1.66	3.13
GP Inflow - NB	1.64	5.13
GP Inflow - NS	1.31	6.55
GP Inflow - PE	7.41	9.57
GP Inflow - NL	1.21	6.74

Table 5.2: Workload per Physician by Year (All Provinces), Province (All Years)

	Mean	**Standard Deviation**
Workload - Overall	3.29	1.22
Workload - 2008	3.43	1.38
Workload - 2009	3.23	1.12
Workload - 2010	3.20	1.14
Workload - BC	3.13	0.77
Workload - AB	3.23	0.63
Workload - SK	4.71	1.39
Workload - MB	3.59	1.10
Workload - ON	3.58	0.82
Workload - QC	1.18	0.36
Workload - NB	2.78	0.37
Workload - NS	3.51	0.49
Workload - PE	4.27	2.03
Workload - NL	2.97	0.35

2007-2008 CCHS survey, the average physician usage across health regions in Quebec was 2.05 visits in the previous 12 months with the highest health region usage being 2.40 visits in the Capitale-Nationale region, as compared to the federal average of all health regions of 3.09 visits. In the 2009-2010 CCHS survey, Quebec health regions reported an average of 2.02 visits as compared to 3.08 visits federally. Across Quebec health regions, over all three years, there was an average of 120 physicians per 100,000 population, while federally there was only an average of 102 physicians. Saskatchewans health regions, in contrast, have a higher than average usage of 3.38 visits and a lower than average physician ratio at 77 physicians per 100,000 population. Saskatchewan's high physician workload is more closely explained by a shortage of physicians than an extraordinarily high usage.

Table 5.3: Mean Values (Full Period, All Provinces)

	Mean	**Standard Deviation**
GP Accumulation	4.1%	10.7%
Workload - Per Physician, Year	3.29	1.22
High Workload - Overall	0.0032	0.0023
GPs - Average Age	48.5	2.3
GPs - Female Share	34.9%	10.2%
GPs - Can. Trained Share	64.3%	23.5%
Specialists per 100,000	67.25	52.51
Region - Pop. Density - Per km^2	258.50	928.61
Region - Pop. Density (log)	2.41	2.47
Region - Female Share	50.1%	83.9%
Region - Share under 20	24.6%	4.9%
Region - Share over 65	14.6%	3.5%
Region - Aboriginal Share	10.4%	18.4%
Region - High Mortgage Share	14.8%	5.3%
Region - 5yr Internal Migration	15.3%	4.4%
Region - Immigrant Share	10.8%	12.4%
Region - Visible Minority Share	7.7%	12.8%
Region - Gov. Transfers/Income	14.6%	5.2%
Region - Post-Secondary Share	56.4%	8.7%
Region - Average Income	$32,375	$6,845
Region - Long Term Unemployment	4.4%	3.1%

Across health regions, the average of average physician age is 48.5 years. The

average female share of physicians is 34.9%, with a range of 0-55% female physician share. The average Canadian trained share of physicians across health regions is 64.3%, with foreign trained physicians making up more than half of Manitoba's GPs, but only 10% of Quebec's. Across the entire country, the average physician age was 50.5 years, 36.5% of GPs were female, and 73.9% of GPs were Canadian-trained [6, Table 22.1].

The median population density of health regions is $10/km^2$, while the mean is $258/km^2$, skewed heavily by a few high density health regions. For comparison, Ontario has a population density of $14/km^2$, and Nova Scotia has a population density of $17/km^2$.

Table 5.4: Correlations with Key Variables (Full Period, All Provinces)

	Correlation (GP Growth)	**Correlation (Workload)**
GP Accumulation	1.00	0.43
Workload - Per Physician, Year	0.43	1.00
High Workload - Overall	0.29	0.63
GPs - Average Age	0.08	0.09
GPs - Female Share	-0.22	-0.65
GPs - Can. Trained Share	-0.13	-0.49
Specialists per 100,000	-0.15	-0.54
Region - Pop. Density - Per km^2	-0.02	-0.18
Region - Pop. Density (log)	-0.11	-0.21
Region - Female Share	-0.05	-0.21
Region - Share under 20	0.22	0.42
Region - Share over 65	-0.05	-0.11
Region - Aboriginal Share	0.24	0.25
Region - High Mortgage Share	-0.03	0.04
Region - 5yr Internal Migration	-0.07	0.00
Region - Immigrant Share	-0.03	0.04
Region - Visible Minority Share	-0.03	0.05
Region - Gov. Transfers/Income	0.15	0.05
Region - Post-Secondary Share	-0.22	-0.44
Region - Average Income	-0.14	-0.10
Region - Long Term Unemployment	0.07	-0.07

Table 5.4 presents the correlations between workload and select variables. There is a positive correlation between variables for physician workload and average physician

age. The female share of physicians in a health region is negatively correlated with workload, or a positive correlation between the male share of physicians and workload. The Canadian-trained share of physicians is negatively correlated with workload, or alternatively, a positive correlation between the share of internationally trained physicians and workload. There is a negative correlation between the number of specialists in a health region and GP workload, indicating that physician workload is highest where and when specialists are in the shortest supply. There is a negative correlation between population density and workload, indicating higher workloads in rural communities. There is a negative relationship between the seniors' share of a health region's population and workload, indicating lower workloads in regions with more seniors. This final relationship is interesting, as seniors are responsible for a disproportionate share of total health care costs.

The directionalities of the correlations between physician variables; population density; and the senior share of the health region population, with physician accumulation, each match the directionalities of these variables with workload; however, each is more strongly correlated with workload than physician accumulation. Before any controls, there is a positive correlation between physician workload in a health region and physician accumulation.

As ilustrated in Table 5.5, this study uses a total of 282 health region—year observations, over three years and ten provinces. The total number of observed health regions changes between 2008 and 2010, from 97 to 93, due to health region amalgamation in Alberta. The number of health regions, and the size and characteristics of health regions, vary by province. In the following analysis, each health region is weighted equally.

Table 5.5: Observations by Year (All Provinces), Province (All Years)

	Count	**Share**
Year - 2008	97	34%
Year - 2009	92	33%
Year - 2010	93	33%
Province - BC	48	17%
Province - AB	18	6%
Province - SK	39	14%
Province - MB	30	11%
Province - ON	42	15%
Province - QC	45	16%
Province - NB	21	7%
Province - NS	18	6%
Province - PE	9	3%
Province - NL	12	4%
Total	282	100%

Chapter 6

Methodology

To estimate the effect of different factors on physician movement, in my primary regression, I use least squares to regress the net flow of physicians, against estimates of physician workload; a vector of physician characteristics; a vector of provincial dummy variables; and a vector of health region-level demographic controls. Physician workload is constructed outside the regression, as the product of average reported visits to a family doctor per person, over the previous twelve months, and the inverse ratio of physicians per 100,000 of population. This construction should cancel out population from both variables, leaving an estimate of reported consultations per physician over a twelve month period. While this is not a direct measurement of physician workload, it allows for both supply-side and demand-side variation to physician workload. A second physician workload variable, high workload, is constructed similarly, to reflect the average number of high-workload patients per physician. As health care policy is set at the provincial level, provincial dummies should capture the effects of policy differences between provinces. Demographic controls will capture the effects of physicians preferences about living in different types of communities. While this is not a complete set of demographic controls, they reflect the principle characteristics used by Statistics Canada in classifying health region peer groups for comparison purposes. The form of the regression is as follows:

$$\frac{GP_{(t+1),r} - GP_{t,r}}{GP_{t,r}} = \alpha + \beta_1 \left[\frac{\overrightarrow{Usage_{t,r}}}{\overrightarrow{Ratio_{t,r}}} * 100 \right] + \beta_2 \overrightarrow{Physician_{t,r}} + \beta_3 \overrightarrow{Province_{t,r}} + \beta_4 \overrightarrow{Demographic_{t,r}} + \epsilon_{t,r} \quad (6.1)$$

Where:

$$Workload = \left[\frac{Usage_{t,r}}{Ratio_{t,r}} * 100 \right]$$

The second regression shown suppliments the workload and high-workload terms with sets of year-workload interaction variables for each year. This allows the model

to report different workload coefficients for each of the three time periods examined, to investigate if there is evidence of change over time during the economic recovery following the 2008 recession or evidence of change over time more broadly.

$$\frac{GP_{(t+1),r} - GP_{t,r}}{GP_{t,r}} = \alpha + \beta_1 \overrightarrow{Workload} + \beta_2 \overrightarrow{Physician_{t,r}} + \beta_3 \overrightarrow{Year_{t,r}} + \beta_4 \overrightarrow{Province_{t,r}} + \beta_5 \overrightarrow{Demographic_{t,r}} + \beta_6 \left[\overrightarrow{Workload_{t,r}} * \overrightarrow{Year_{t,r}} \right] + \epsilon_{t,r} \quad (6.2)$$

The third regression shown suppliments the workload and high-workload terms with a full set of province-workload interaction terms. This allows the physician response to workload to vary by province, possibly reflecting physician response to fee-for-service schedules, and somewhat separating these effects from regional preferences.

$$\frac{GP_{(t+1),r} - GP_{t,r}}{GP_{t,r}} = \alpha + \beta_1 \overrightarrow{Workload} + \beta_2 \overrightarrow{Physician_{t,r}} + \beta_3 \overrightarrow{Year_{t,r}} + \beta_4 \overrightarrow{Province_{t,r}} + \beta_5 \overrightarrow{Demographic_{t,r}} + \beta_6 \left[\overrightarrow{Workload_{t,r}} * \overrightarrow{Province_{t,r}} \right] + \epsilon_{t,r} \quad (6.3)$$

The fourth regression supplements the primary regression with workload interaction variables for each physician variable, senior share of the population, and the log of population density at the health region level. This allows for a more sophisticated analysis of these variables, as it allows the interaction variables to operate in either the same or opposite direction as the uninteracted variables. If the interaction terms oppose the regular terms, this allows the calculation of a critical amount of workload where these variables can change from having net positive effects to net negative effects.

$$\frac{GP_{(t+1),r} - GP_{t,r}}{GP_{t,r}} = \alpha + \beta_1 \overrightarrow{Workload} + \beta_2 \overrightarrow{Physician_{t,r}} + \beta_3 \overrightarrow{Year_{t,r}} + \beta_4 \overrightarrow{Province_{t,r}} + \beta_5 \overrightarrow{Demographic_{t,r}} + \beta_6 \left[\overrightarrow{Workload_{t,r}} * \overrightarrow{Physician_{t,r}} \right] + \epsilon_{t,r} \quad (6.4)$$

The fifth and final regression is a historical check on the above, using provincial-level CIHI data over the period 1978-2011 [6, Table 22.1]. In this regression, annual

physician accumulation is regressed against physician workload, as estimated by a scaled inverse ratio of physicians to population. Controls for physician characteristics and community characteristics are unavailable for this dataset. By using a simplified dataset that extends from before the availability of health regional data on physician quantities, we can see if physicians respond similarly to workload on a provincial scale as on a regional scale and get a sense of external validity.

The structure of these regressions are designed to eliminate the concern of reverse causality. Based on the assumption that movement of physicians in one year cannot influence physician workload, physician characteristics, or demographic characteristics in previous years, the measurement of physician flow occurs after the values for all of the dependent variables. Because of this, we can interpret a statistically significant relationship between workload and physician flow as the effect of workload on physician flow. I cannot necessarily establish the mechanism of the relationship between physician accumulation and average physician workload, in a given region. If there is a negative relationship between physician workload and regional physician accumulation, it may be safe to assume that the cause is overemployment or an exceptionally powerful income effect; however, if the relationship is positive this may be caused by underemployment, stronger recruitment efforts as a policy response, or some combination.

Chapter 7

Results

Results from four regressions on my primary dataset are presented below, as well as the historical regression using provincial-level data. Results for each of the first four regressions are presented together, in their respective columns, continuing across tables 7.1, 7.2, and 7.3. Results are also presented individually in tables 7.4, 7.5, 7.6 and 7.7, and 7.8

The first four regressions compare the effects of physician workload; physician characteristics; year and provincial dummies; and controls for health region population characteristics on physician accumulation. Results for each regression are grouped by variable type, including workload variables (workload and high workload); physician variables (average age, female share, Canadian-trained share, and specialists per 100,000 of population); year dummies; provincial dummies; and demographic characteristics. Coefficient estimates are presented in tables with standard deviations. Dummy variables for the year 2009 and New Brunswick are omitted. Results for each of the first four regressions are presented in their respective columns, continuing across tables 7.1, 7.2, and 7.3.

Regression 1 presents workload in terms of two variables: a single variable for each of workload and high workload.

Regression 2 presents workload with interaction terms for 2008 and 2010, allowing the effects of workload to vary by year. 2009 is omitted. If the physician workload response was different following the 2008 recession, year-workload interaction terms will help control for this effect.

Regression 3 presents workload with interaction terms for each province, allowing the effects of workload to vary by province. New Brunswick is omitted. Provincial-workload interaction terms should control for varying fee for service reimbursement rates by province, and for policy decisions that are responsive to workload.

Regression 4 presents workload, with interaction terms with each of the physician

Table 7.1: Regression Results, Regressions 1-4, (1 of 3)

	Regression 1		Regression 2		Regression 3		Regression 4	
Workload (WL)	7.41	***	6.30	***	7.35		26.63	**
	(0.95)		(1.35)		(5.83)		(11.05)	
High Workload	579.10		600.40		214.50		769.30	**
(HWL)	(360.50)		(704.90)		(1535.00)		(345.80)	
WL*2008			0.16					
			(1.39)					
WL*2010			3.94	***				
			(1.43)					
HWL*2008			259.20					
			(789.80)					
HWL*2010			-219.90					
			(800.00)					
WL*Province					Not Significant			
HWL*Province					Not Significant			
HWL*PE					-20330.00	***		
					(6148.00)			
WL*GP Age							0.05	
							(0.23)	
WL*Female							-18.58	***
Share of GPs							(6.09)	
WL*Canadian							-4.26	*
Share of GPs							(2.55)	
WL*Specialists							0.06	***
per 100,000							(0.02)	
WL*Population							-1.19	***
Density (Log)							(0.37)	
WL*Age 65+							-0.28	**
Share of Population							(0.13)	
(Intercept)	-183.90	**	-184.50	***	-222.80	***	-162.20	**
	(72.06)		(71.03)		(84.92)		(76.05)	
Observations	282		282		282		282	
Adjusted R^2	0.3376		0.3619		0.3578		0.4473	

Significance levels: *: 10%, **: 5%, ***: 1%. Standard errors in parentheses. WL*Province and HWL*Province are not statistically significant at the 10% level, outside of HWL*PE. Workload*Year, Workload*Province, and Workload*Physician rows describe which workload interaction terms are included in a given regression.

Table 7.2: Regression Results, Regressions 1-4, (2 of 3)

	Regression 1		Regression 2		Regression 3		Regression 4	
GP Age	1.12	***	1.15	***	1.02	***	1.06	
	(0.33)		(0.33)		(0.37)		(0.91)	
Female Share of GPs	0.38	***	0.38	***	0.35	***	1.00	***
	(0.12)		(0.12)		(0.12)		(0.25)	
Canadian Share of GPs	-0.03		-0.01		-0.02		0.13	
	(0.05)		(0.05)		(0.06)		(0.11)	
Specialists per 100,000	0.06	***	0.07	***	0.05		-0.13	***
	(0.02)		(0.02)		(0.03)		(0.05)	
2008	1.07		-0.13		1.33		0.89	
	(1.30)		(3.70)		(1.33)		(1.19)	
2010	3.31	**	-8.68	**	3.22	**	2.75	**
	(1.30)		(3.88)		(1.32)		(1.20)	
BC	0.31		0.59		7.06		3.10	
	(4.10)		(4.05)		(18.24)		(3.98)	
AB	6.36		6.79	*	16.77		11.26	***
	(4.15)		(4.08)		(20.62)		(4.10)	
SK	-0.70		-0.52		-7.27		1.63	
	(4.21)		(4.15)		(17.47)		(4.01)	
MB	3.84		4.60		7.31		9.88	**
	(4.02)		(3.96)		(18.43)		(3.95)	
ON	1.74		1.70		10.64		7.84	**
	(3.57)		(3.51)		(18.94)		(3.89)	
QC	8.92	***	9.11	***	1.86		7.59	*
	(3.21)		(3.16)		(18.38)		(4.27)	
NS	-9.09	**	-9.64	**	18.24		-7.55	**
	(3.86)		(3.81)		(25.48)		(3.62)	
PE	1.88		1.51		-1.15		0.06	
	(4.35)		(4.30)		(19.47)		(4.34)	
NL	-2.78		-3.25		-23.89		0.05	
	(5.09)		(5.01)		(32.38)		(4.74)	
Workload * Year	NO		YES		NO		NO	
Workload * Province	NO		NO		YES		NO	
Workload * Physician	NO		NO		NO		YES	
(Intercept)	-183.90	**	-184.50	***	-222.80	***	-162.20	**
	(72.06)		(71.03)		(84.92)		(76.05)	
Observations	282		282		282		282	
Adjusted R^2	0.3376		0.3619		0.3578		0.4473	

Significance levels: *: 10%, **: 5%, ***: 1%. Standard errors in parentheses.

Table 7.3: Regression Results, Regressions 1-4, (3 of 3)

	Regression 1		Regression 2		Regression 3		Regression 4	
Population Density	-1.23	*	-1.27	*	-1.29		-0.05	
(log)	(0.70)		(0.69)		(0.78)		(0.70)	
Female Share	2.39		2.27		3.22	*	1.11	
of Population	(1.45)		(1.43)		(1.64)		(1.39)	
Under 20 Share	-1.34	**	-1.19	**	-1.16	*	-0.82	
of Population	(0.59)		(0.58)		(0.67)		(0.56)	
65+ Share	-1.12	*	-0.94	*	-1.02		0.31	
of Population	(0.57)		(0.56)		(0.63)		(0.76)	
Aboriginal Share	0.32	***	0.30	***	0.24	*	0.14	
of Population	(0.12)		(0.11)		(0.13)		(0.12)	
High Mortgage Share	0.02		0.07		-0.02		0.86	**
of Population	(0.37)		(0.36)		(0.42)		(0.36)	
5 Year Internal	0.39	*	0.39	*	0.40		0.06	
Migration Rate	(0.23)		(0.23)		(0.25)		(0.22)	
Immigrant Share	0.37		0.33		0.30		-0.08	
of Population	(0.30)		(0.30)		(0.36)		(0.30)	
Visible Minority Share	-0.31		-0.28		-0.21		-0.22	
of Population	(0.23)		(0.23)		(0.28)		(0.23)	
Government Transfers	1.09	**	1.02	**	0.90	*	0.17	
Share of Income	(0.45)		(0.45)		(0.50)		(0.45)	
Post Secondary, Share	-0.16		-0.16		-0.19		-0.17	
of Population	(0.22)		(0.22)		(0.23)		(0.21)	
Average Income	0.00		0.00		0.00		0.00	
Population	(0.00)		(0.00)		(0.00)		(0.00)	
Unemployment Rate	-0.38		-0.18		0.25		0.53	
(Long Term)	(0.65)		(0.64)		(0.73)		(0.61)	
Workload * Year	NO		YES		NO		NO	
Workload * Province	NO		NO		YES		NO	
Workload * Physician	NO		NO		NO		YES	
(Intercept)	-183.90	**	-184.50	***	-222.80	***	-162.20	**
	(72.06)		(71.03)		(84.92)		(76.05)	
Observations	282		282		282		282	
Adjusted R^2	0.3376		0.3619		0.3578		0.4473	

Significance levels: *: 10%, **: 5%, ***: 1%. Standard errors in parentheses.

variables; the log of population density; and the seniors' share of the population. This may help control for differing physician workload responses by age, gender, and country of origin; the relationship between workload and coordination with specialists; interaction between workload and population density; and a preference for younger or older patients.

Results from a secondary dataset are presented to give historical context and a check on the regressions from the primary dataset. A single regression from this dataset is included, comparing the effects of estimated workload (calculated as the inverse of physician to population ratios multiplied by a scaling factor) along with full sets of year and provincial dummy variables against annual, provincial-level physician accumulation. Years are grouped into seven time period groupings: 1978-1980, 1981-1985, 1986-1990, 1991-1995, 1996-2000, 2001-2005, and 2006-2010. 1978-1980 is omitted. This regression does not include controls for physician or population characteristics, reflect utilization of physicians, or contain data on sub-provincial regions; however, it includes a much longer time period for analysis.

7.1 Regression 1: Workload and Controls against Physician Accumulation

The results of Regression 1 are included in Column 1 of tables 7.1-3, as well as in table 7.4.

The key variable in this regression is the workload variable, where the workload coefficient can be interpreted as the impact of an additional thousand consultations per physician per year, in terms of a percentage of the base year physician population. This regression estimates that an additional thousand consultations is correlated to an annual physician accumulation of 7.4 percentage points per year. Over Halifax's physician population of 605, this increase would be equivalent to an increase of approximately 45 additional physicians. The coefficient estimate for high workload patients is not statistically significant under this specification; however it is positive, consistent with the workload variable, indicating that more complex patients most likely do not have an opposite effect to workload in general, and that the total workload response is likely greater than the estimated 7.4 percentage points.

Under this specification, physician characteristics appear to have an important

Table 7.4: Regression Results, Regression 1

	Coefficient	**Standard Deviation**	
Workload (WL)	7.41	0.95	***
High Workload (HWL)	579.10	360.50	
GP Age	1.12	0.33	***
Female Share of GPs	0.38	0.12	***
Canadian Share of GPs	-0.03	0.05	
Specialists per 100,000	0.06	0.02	***
2008	1.07	1.30	
2010	3.31	1.30	**
BC	0.31	4.10	
AB	6.36	4.15	
SK	-0.70	4.21	
MB	3.84	4.02	
ON	1.74	3.57	
QC	8.92	3.21	***
NS	-9.09	3.86	**
PE	1.88	4.35	
NL	-2.78	5.09	
Population Density (log)	-1.23	0.70	*
Female Share of Population	2.39	1.45	
Under 20 Share of Population	-1.34	0.59	**
65+ Share of Population	-1.12	0.57	*
Aboriginal Share of Population	0.32	0.12	***
High Mortgage Share of Population	0.02	0.37	
5 Year Internal Migration Rate	0.39	0.23	*
Immigrant Share of Population	0.37	0.30	
Visible Minority, Share of Population	-0.31	0.23	
Government Transfers, Share of Income	1.09	0.45	**
Post Secondary, Share of Population	-0.16	0.22	
Average Income, Population	0.00	0.00	
Unemployment Rate (Long Term)	-0.38	0.65	
(Intercept)	-183.90	72.06	**

Significance levels: *: 10%, **: 5%, ***: 1%.
Adjusted R-squared: 0.3376, N=282.

impact on physician accumulation. The coefficient estimates for average physician age, female share of physicians, and the number of specialist physicians are all statistically significant. A one percentage point difference in female share of physicians is correlated with a 0.38 percentage point increase in physician population, while a standard deviation difference in female share of 10.2 percentage points is correlated with an increase in physician population of 3.8 percentage points. A one-year difference in average physician age is correlated with a 1.12 percentage point increase in physician population, while a standard deviation difference in average physician age of 2.3 years would be correlated with an increase in physician population of 2.6 percentage points. One additional physician per 100,000 of population correlates with a 0.06 percentage point increase in physician population, while a standard deviation increase of specialists (although the number of specialists per capita is not normally distributed) of 52.5 physicians would be correlated with an increase in physician population of 3.2 percentage points. Compared to the median annual increase of 3.16 percent, each of these effects is of a noticeable size, although smaller (at a standard deviation of difference) than the effect of physician workload. The coefficient estimate for the Canadian share of physicians is negative (or the estimated effect of the non-Canadian share of physicians is positive), indicating higher physician accumulation in regions that have already attracted foreign-trained physicians; however, this effect is relatively small and not statistically significant.

There is no statistical significance in the provincial dummy variables, except for Quebec and Nova Scotia. Physician accumulation is statistically lower in Nova Scotia and statistically higher in Quebec, with New Brunswick omitted. Looking at all provincial coefficients, there is not clear evidence of a regional trend in provincial variables. Both Western and Atlantic Canadian provinces include both positive and negative estimates. Physician accumulation is statistically higher in 2010, with 2009 omitted.

Population controls are included primarily to control for omitted variable bias on the primary workload variables and causal mechanisms between them and physician accumulation are generally not presented; however, several are statistically significant. There is a weakly statistically significant, negative relationship between population density and physician accumulation, with less dense populations attracting

more physicians than denser populations. This relationship is consistent with the uncontrolled correlation between the two variables in the underlying data, suggesting a reversal of physician migration to cities. There are statistically significant, negative relationships between both the under 20 and over 65 shares of the population. This may reflect higher health expenditures for infants and seniors; however, health expenditures for those between 1-19 years old are strictly lower than any other age group [5, Figure 12]. There is a positive relationship between physician accumulation and the 5-year internal migration rate, indicating that, to some extent, physician population growth follows total population growth. Additionally there are statistically significant, positive coefficients for both quantities of government transfers and aboriginal shares of the population. This regression indicates that physicians may be moving towards regions with higher average incomes and lower average unemployment; however, these estimates are not statistically significant. Across these population controls, it's unclear whether physicians are moving towards or away from those most in need of health services.

7.2 Regression 2: Workload with Interaction by Year, and Controls, against Physician Accumulation

The results of Regression 2 are included in Column 2 of tables 7.1-3, as well as in table 7.5.

Regression 2 introduces workload interaction terms with the base years 2008 and 2010. The estimated impact of an additional thousand consultations is 6.30 percentage points of physician accumulation, which is not statistically different from the estimate of 7.41 in Regression 1. The workload interaction term with the base year 2010 is positive and statistically significant, indicating a stronger response to physician workload in that year. An additional 3.94 percentage points of physician accumulation is associated with workload in the base year 2010, which is as large as an additional 63% of the uninteracted workload estimate. Neither the high workload coefficient estimate, nor the high workload interaction coefficient estimates, are statistically significant. As above, the high workload estimate is positive, similar to the workload estimate.

Table 7.5: Regression Results, Regression 2

	Coefficient	**Standard Deviation**	
Workload (WL)	6.30	1.35	***
High Workload (HWL)	600.40	704.90	
WL*2008	0.16	1.39	
WL*2010	3.94	1.43	***
HWL*2008	259.20	789.80	
HWL*2010	-219.90	800.00	
GP Age	1.15	0.33	***
Female Share of GPs	0.38	0.12	***
Canadian Share of GPs	-0.01	0.05	
Specialists per 100,000	0.07	0.02	***
2008	-0.13	3.70	
2010	-8.68	3.88	**
BC	0.59	4.05	
AB	6.79	4.08	*
SK	-0.52	4.15	
MB	4.60	3.96	
ON	1.70	3.51	
QC	9.11	3.16	***
NS	-9.64	3.81	**
PE	1.51	4.30	
NL	-3.25	5.01	
Population Density (log)	-1.27	0.69	*
Female Share of Population	2.27	1.43	
Under 20 Share of Population	-1.19	0.58	**
65+ Share of Population	-0.94	0.56	*
Aboriginal Share of Population	0.30	0.11	***
High Mortgage Share of Population	0.07	0.36	
5 Year Internal Migration Rate	0.39	0.23	*
Immigrant Share of Population	0.33	0.30	
Visible Minority, Share of Population	-0.28	0.23	
Government Transfers, Share of Income	1.02	0.45	**
Post Secondary, Share of Population	-0.16	0.22	
Average Income, Population	0.00	0.00	
Unemployment Rate (Long Term)	-0.18	0.64	
(Intercept)	-184.50	71.03	***

Significance levels: *: 10%, **: 5%, ***: 1%.

Adjusted R-squared: 0.3376, N=282.

With such a short dataset, it would be difficult to suggest exactly why the physician accumulation response to workload was higher between 2010-2011 than other periods. 2010-2011 is the only one of three observed time periods that did not overlap with the year 2009, when the 2008 recession hit Canada the hardest. This may demonstrate the absence of a recession, lagged effects of the recession on labour supply, or unrelated effects.

The physician coefficients retain their directionality and significance from the previous regression, at similar magnitudes. Quebec and Nova Scotia maintain their signs and significance from Regression 1, while Alberta's positive coefficient becomes statistically significant. The population demographic controls each maintain their directionality and significance.

7.3 Regression 3: Workload with Interaction by Province, and Controls, against Physician Accumulation

The results of Regression 3 are included in Column 3 of tables 7.1-3, as well as in tables 7.6 and 7.7.

With the introduction of workload interaction terms for provincial dummy variables, there are no statistically significant relationships between regional physician workload and physician accumulation, excluding the high workload interaction term with Prince Edward Island. Although not statistically significant, this regression estimates an additional thousand consultations is correlated with a 7.35 percentage point increase in physician accumulation.

The relationships between physician accumulation and physician age and gender are very similar in directionality, significance, and magnitude as compared to the previous two regressions; however, under this specification the coefficient for the specialist ratio loses its statistical significance. The directionality of all variables remains the same.

One of the biggest changes between this regression and the two previous is that much of the statistical significance is lost in the provincial dummy variables and community demographic control variables. Compared to Regression 1, coefficients for Quebec and Nova Scotia; the log of population density; seniors' share of the population; and internal migration all lose their statistical significance, while the

Table 7.6: Regression Results, Regression 3 (1 of 2)

	Coefficient	**Standard Deviation**	
Workload (WL)	7.35	5.83	
High Workload (HWL)	214.50	1535.00	
WL*BC	-1.69	6.25	
WL*AB	-2.76	7.05	
WL*SK	0.82	5.91	
WL*MB	-1.40	6.12	
WL*ON	-5.43	8.01	
WL*QC	4.70	7.29	
WL*NS	-8.07	8.91	
WL*PE	6.85	6.59	
WL*NL	5.09	11.38	
HWL*BC	179.50	1694.00	
HWL*AB	41.13	1799.00	
HWL*SK	975.20	1699.00	
HWL*MB	1067.00	1821.00	
HWL*ON	3743.00	5225.00	
HWL*QC	-1505.00	2812.00	
HWL*NS	353.60	2096.00	
HWL*PE	-20330.00	6148.00	***
HWL*NL	730.60	2802.00	
GP Age	1.02	0.37	***
Female Share of GPs	0.35	0.12	***
Canadian Share of GPs	-0.02	0.06	
Specialists per 100,000	0.05	0.03	

Significance levels: *: 10%, **: 5%, ***: 1%.
Adjusted R-squared: 0.3376, N=282.

Table 7.7: Regression Results, Regression 3 (2 of 2)

	Coefficient	**Standard Deviation**	
2008	1.33	1.33	
2010	3.22	1.32	**
BC	7.06	18.24	
AB	16.77	20.62	
SK	-7.27	17.47	
MB	7.31	18.43	
ON	10.64	18.94	
QC	1.86	18.38	
NS	18.24	25.48	
PE	-1.15	19.47	
NL	-23.89	32.38	
Population Density (log)	-1.29	0.78	
Female Share of Population	3.22	1.64	*
Under 20 Share of Population	-1.16	0.67	*
65+ Share of Population	-1.02	0.63	
Aboriginal Share of Population	0.24	0.13	*
High Mortgage Share of Population	-0.02	0.42	
5 Year Internal Migration Rate	0.40	0.25	
Immigrant Share of Population	0.30	0.36	
Visible Minority, Share of Population	-0.21	0.28	
Government Transfers, Share of Income	0.90	0.50	*
Post Secondary, Share of Population	-0.19	0.23	
Average Income, Population	0.00	0.00	
Unemployment Rate (Long Term)	0.25	0.73	
(Intercept)	-222.80	84.92	***

Significance levels: *: 10%, **: 5%, ***: 1%.
Adjusted R-squared: 0.3376, N=282.

female share of the health region becomes statistically significant.

This specification does not provide evidence of regional trends in physician accumulation, regional trends in physician response to workload, or evidence of physician response to provincial policy. In addition to no provincial variables and no provincial workload interaction variables having statistical significance, there are both positive and negative provincial estimates and provincial workload interaction estimates, in both Western and Atlantic Canada.

7.4 Regression 4: Select Workload Interaction Terms against Physician Accumulation

The results of Regression 4 are included in Column 4 of tables 7.1-3, as well as in table 7.8.

Including workload interaction variables with physician variables, population density, and senior share of the population begins to show a more sophisticated view of physician accumulation among Canadian health regions. Under this specification, workload; high workload; and workload interaction terms with physician gender, physician country of training, specialists' ratio, population density, and seniors share of the population are all statistically significant. The primary workload variable is positive, consistent with previous estimates; however, in this specification the high workload variable is also positive and statistically significant.

One complexity revealed by this regression is conflicting effects between physician variables and their respective workload interaction variables. Under this specification, there is evidence that the effects of workload and physician characteristics on physician accumulation interact with each other.

In previous regressions, there was a positive relationship between the female share of the physician population and physician accumulation. In this regression, the coefficient estimates for female share of physicians and for workload are positive and statistically significant while the workload interaction with the female share of physicians is negative, indicating that the calculated physician accumulation response to workload decreases as the share of female physicians increases. While previous regressions suggested higher physician accumulation in health regions with more female physicians, this regression suggests that this effect is reduced as workload increases.

Table 7.8: Regression Results, Regression 4

	Coefficient	**Standard Deviation**	
Workload (WL)	26.63	11.05	**
High Workload (HWL)	769.30	345.80	**
WL*GP Age	0.05	0.23	
WL*Female Share of GPs	-18.58	6.09	***
WL*Canadian Share of GPs	-4.26	2.55	*
WL*Specialists per 100,000	0.06	0.02	***
WL*Population Density (log)	-1.19	0.37	***
WL*Age 65+ Share of Population	-0.28	0.13	**
GP Age	1.06	0.91	
Female Share of GPs	1.00	0.25	***
Canadian Share of GPs	0.13	0.11	
Specialists per 100,000	-0.13	0.05	***
2008	0.89	1.19	
2010	2.75	1.20	**
BC	3.10	3.98	
AB	11.26	4.10	***
SK	1.63	4.01	
MB	9.88	3.95	**
ON	7.84	3.89	**
QC	7.59	4.27	*
NS	-7.55	3.62	**
PE	0.06	4.34	
NL	0.05	4.74	
Population Density (log)	-0.05	0.70	
Female Share of Population	1.11	1.39	
Under 20 Share of Population	-0.82	0.56	
65+ Share of Population	0.31	0.76	
Aboriginal Share of Population	0.14	0.12	
High Mortgage Share of Population	0.86	0.36	**
5 Year Internal Migration Rate	0.06	0.22	
Immigrant Share of Population	-0.08	0.30	
Visible Minority, Share of Population	-0.22	0.23	
Government Transfers, Share of Income	0.17	0.45	
Post Secondary, Share of Population	-0.17	0.21	
Average Income, Population	0.00	0.00	
Unemployment Rate (Long Term)	0.53	0.61	
(Intercept)	-162.20	76.05	**

Significance levels: *: 10%, **: 5%, ***: 1%.
Adjusted R-squared: 0.3376, N=282.

In previous regressions, there was a positive relationship between the number of specialists in a health region and physician accumulation. Under this specification, the specialists' ratio is negative and statistically significant, while the workload interaction with specialists' ratio is positive and statistically significant. Instead of indicating that physician accumulation is higher in regions with more specialists, like in Regression 1, this specification suggests that until workload is sufficiently high, physicians will instead be less likely to accumulate in regions with more specialists. An increase in the number of specialists may be correlated with an increase in general practitioners when workload is below a certain level and a decrease in general practitioners when workload is above that level. Alternately, the effect of an increase in physician workload on physician accumulation increases as the number of specialists in the region increases.

Previous regressions estimated a negative, but not statistically significant, relationship between the Canadian-trained share of physicians in a region and physician accumulation. With the addition of workload interaction variables, the workload interaction term with the Canadian share of physicians is negative and statistically significant, along with a positive, but not statistically significant coefficient estimate for the Canadian share of physicians. This indicates that the physician response to workload decreases as the Canadian share of physicians increases, and that workload is more strongly related to physician accumulation in regions with fewer Canadian-trained physicians, or in regions with more internationally trained physicians.

The reaction to physician age loses its statistical significance under this specification; although, the estimate is similar in magnitude to previous regressions. The workload interaction variable with physician age is small and also not statistically significant. This may indicate that the effect related to physician age is more pronounced in regions with higher workload.

Under this specification, five provincial dummy variables are statistically significant: Alberta, Manitoba, Ontario, Quebec and Nova Scotia. The estimates for Alberta, Manitoba, and Ontario each increase in economic and statistical significance relative to Regressions 1 and 2, while the coefficients for Nova Scotia and Quebec each become less statistically significant and closer to zero. The largest provincial coefficient is in Alberta, where physician accumulation is higher by an estimated 11.3 percentage points. The coefficient for Nova Scotia is an estimated -7.56 percentage

points, with positive estimates for each other province.

The only demographic control that is statistically significant under this specification is the share of the population with high mortgage payments; however, the workload interaction terms with population density and the seniors' share of the population are both statistically significant. Physicians are more likely to move towards a higher workload in a region with a lower population density, than in a more urban setting. Alternatively, physicians are more likely to move to a rural community if workloads are high. Physicians are also more likely to move towards a higher workload if there are fewer seniors in the region.

The directionality and significance of workload interaction with population density and seniors' share of the population replaces non-interacted estimates for population density and seniors' share of the population in previous regressions.

Additional regressions, combining the above sets of workload interaction variables, did not result in substantially different results from the regressions above, and so are not included in detail. Including year workload interaction variables in a regression with physician characteristic workload interaction variables led to a statistically significant coefficient estimate for the year 2010, similar to regression 2. Including provincial workload interaction variables led to no statistically significant coefficients other than high workload in Prince Edward Island, similar to regression 3. In addition, the coefficient estimate for the long-term unemployment rate is positive and statistically significant. Including both year and provincial workload interaction variables, coefficient estimates for the year 2010, high workload with Prince Edward Island, and long term unemployment are all statistically significant. In all three regressions, the workload coefficient estimate is positive and statistically significant.

7.5 Historical Regression: Physicians per Capita against Physician Accumulation, by province, 1978-2010

The results of the historical regression are included in Table 7.9.

Over this historical regression, the workload coefficient estimate is small and not statistically significant, with 1978-1980 excluded; however, the workload interaction estimate for the most recent time period is both statistically significant and similar

Table 7.9: Physician Accumulation vs Workload (1978-2010)

	Coefficient	**Standard Deviation**	
Workload (WL)	0.37	1.16	
WL*1981-1985	2.93	1.50	.
WL*1986-1990	3.49	1.67	*
WL*1991-1995	3.05	1.86	
WL*1996-2000	3.90	1.78	*
WL*2001-2005	5.76	2.04	**
WL*2006-2010	6.63	2.03	**
1981-1985	-0.09	0.06	
1986-1990	-0.11	0.06	.
1991-1995	-0.12	0.07	.
1996-2000	-0.13	0.07	*
2001-2005	-0.18	0.07	*
2006-2010	-0.19	0.07	**
BC	0.03	0.01	**
AB	0.02	0.01	*
SK	-0.01	0.01	
MB	0.00	0.01	
ON	0.00	0.01	
QC	0.02	0.01	*
NS	0.02	0.01	.
PE	-0.02	0.01	.
NL	0.02	0.01	
(Intercept)	0.00	0.05	

Significance levels: *: 10%, **: 5%, ***: 1%.
Adjusted R-squared: 0.3032, N=330.

to the estimates in the above regressions. Over the 2006-2010 time period, 6.63 percentage points of physician accumulation is associated with an additional thousand visits per year. This estimate is not statistically distinct from the workload estimate in Regression 1. It appears that the relationship between workload and physician accumulation has strengthened over time, with a coefficient estimate of 2.93 percentage points over 1981-1985; 3.49 over 1986-1990; 3.90 over 1996-2000; 5.76 over 2001-2005; and 6.63 over 2006-2010.

Without interaction with workload, each time period is associated with a negative coefficient estimate. Each time period, other than 1981-1985, has a statistically significant estimate. The time period 1978-1980, along with the associated workload interaction variable, is excluded.

Over the full period, physician accumulation is statistically higher in British Columbia, Alberta, Quebec, and Nova Scotia and lower in Prince Edward Island. There does not appear to be a regional trend, with both positive and negative coefficient estimates in both Western and Atlantic Canadian provinces.

Chapter 8

Discussion

Consistent across all specifications is a positive relationship between physician accumulation and the preceding year's level of average physician workload. In the simplest analysis, the size of this relationship is estimated to be 7.4% physician accumulation per thousand physician visits and a statistically significant positive relationship holds in Regressions 1, 2, 4, and over most of the historical regression.

What is less clear is the causal mechanism between workload and physician accumulation. In contrast with this paper demonstrating physician migration towards higher workload regions, surveys have found an aversion to higher workloads and the importance of working conditions including hours worked and time on call. Simultaneously, policy makers and civil servants actively recruit physicians to underserviced (or politically significant) communities. Net physician migration is then the sum of both physician preferences, on the supply side of the market, and policy decisions; demand for health services; and private medical system structures, on the demand side.

The idea suggested as the theoretical basis of this paper is the relationship between physician accumulation and workload reflects physicians' utility maximizing labour-leisure tradeoff decision. A movement into a higher workload region reveals a preference for more hours of paid work, while a movement into a lower workload region reveals preference for fewer hours of paid work, under this framework. The positive relationship between physician accumulation and physician workload suggests that, in aggregate, the number of physicians moving in response to underemployment outweighs the number of physicians moving in response to overemployment.

One set of explanations for this result, on the labour-supply side of the market, is that the values for the workload coefficient describe the labour-leisure tradeoff decision. This is somewhat consistent with Rajbhandary and Basu, who find positive relationships, in some provinces, between physician income and migration; however,

it appears to be inconsistent with much of the other literature suggesting rural physicians want to somehow reduce their workloads [14]. While not addressing physician migration directly, Buske finds in his survey that more physicians were planning to reduce their workloads than increase them, and Chauhan; Jong; and Buske and Rourke find that working conditions, including workload, are important in determining physicians' planned outflow [1] [2] [16].

If this paper demonstrates underemployment among Canadian physicians, while previous papers have suggested overemployment among Canadian physicians, it may be that physician behavior has changed over time. The historical regression (Table **??**), does indicate growth in physician response to workload over time; however, the historical regression never indicates a negative response to physician workload, which would be consistent with overemployment.

If a physician is underemployed, in that there are not enough patients in the physician's community to support their preferred level of workload at the provincial FFS rate, then relocation may be the only solution to increase their workload to an equilibrium level. In contrast, if a physician is overemployed, she ultimately has more options to reduce her workload than just moving, and relocation may not even be a reasonable solution to overemployment. A professional or altruistic desire to ensure the health of those in need of medical care was suggested as an explanation for why overemployment might exist in the first place; however, in spite of any need for their services, physicians are ultimately their own bosses and can choose to work fewer hours. Furthermore, if physicians are allowing themselves to be overemployed through altruism, then that same altruism might prevent physicians from relocating or encourage them to relocate to an in-need community. If this asymmetry exists, this may explain the observed relationship between physician inflow and workload, in spite of what rural physicians say in surveys that they are doing, or planning to do. Additionally, asking physicians in a region if or why they are planning to stay or leave, artificially forces a one-sided outcome that cannot capture unobserved physicians outside of that community, planning to move in.

If a study is looking at the migration of physicians who were already practicing in Canada, or surveying the opinions of physicians who are currently practicing in rural communities, it will miss the two largest sources of regional physician accumulation:

new and immigrant physicians. This paper is designed to capture the total growth in health region physician populations from all sources; however, surveys and studies of the migration of existing physicians will fail to capture new entrants to the Canadian market. If new and immigrant physicians respond differently to workload than already practicing physicians, this may explain the inconsistency. Regression 4, including physician interaction variables with workload, does indicate a larger response to workload in health regions with more foreign-trained physicians, consistent with a stronger attraction to workload for immigrant physicians; however, the uninteracted workload coefficient remained positive (Column 4, Table 7.1). Immigrant physicians may appear to explain some, but not all of the difference between this paper and previous survey data.

Instead of reflecting physician workload decisions, the relationship between physician migration and workload may instead the demand-side of the physician labour market, born out of policy. If high physician workload is correlated with long wait times, barriers to access, or poor quality in physician services, then policy makers — who have at least some role in recruiting physicians to underserviced communities — will have an incentive to focus policy more strongly on regions with the worst effects of high workload and less on regions where high physician workload is not a barrier to care. Similarly, policy makers may focus on guaranteeing a minimum level of service to all communities, with general practitioners from family practice being responsible for emergency care in communities without a full service hospital emergency department.

If policy focuses specifically on achieving minimum levels of emergency care in rural communities, then the effects of physician recruitment policies as correlated with workload will diminish as population density increases. Under this assumption, response to workload will better reflect physician preferences in more dense communities and will better reflect policy goals in less dense communities. In Regression 4 the workload interaction coefficient with population density is negative and statistically significant, indicating a more positive physician accumulation response to workload in rural communities than in urban communities. This relationship is consistent with the above demand-side explanation for physician accumulation; however, it may also reflect a greater risk of underemployment in low-population communities.

Similarly, in regions with poor access to specialty medical care through specialist physicians, policy makers may want to recruit additional general practitioners to provide specialist services. If this is true, areas with high physician workload combined with low levels of specialists should see faster physician accumulation than regions with more specialist physicians. In Regression 4, the coefficient estimate for workload interaction with specialists per capita is positive, indicating that physician accumulation is higher in high workload regions with more specialists than with fewer specialists. Physician accumulation is lower in regions with more specialists, everything else held equal, indicating some amount of effective substitutability between specialists and general practitioners, yet this effective substitutability is highest in situations where specialists and general practitioners may be competing for patients, not where there is most evidence of a surplus of patients. This relationship is inconsistent with a demand-side explanation for low physician accumulation.

Workload interaction variables with the population share over the age of 65 are included because most provinces include fee for service bonuses to physicians for visits by and treatments for seniors, revealing a sort of policy goal. Regression 4 indicates a positive relationship between the senior share of the population and physician accumulation, although in Regressions 1-3 (each without a workload-over 65 interaction term) this estimate is negative. Regression 4 estimates a negative interaction coefficient between workload and the share of the population over the age of 65, or that workload is less correlated with physician accumulation in regions with more older residents. Overall, it the data appears to indicate that existing incentives are insufficient or incapable of making older populations as attractive to physician accumulation than less senior populations, at least in high workload regions; although, they may be effective when workload is low.

As health care policy is ultimately the responsibility of provincial governments, then differences in physician response by province might clarify the confounded roles of labour supply and labour demand forces in physician accumulation. Unlike the other potentially explanatory variables, however, there are not statistically significant differences in workload coefficients by province. This may indicate that provincial-level policy does not have a detectable impact on the relationship between workload and physician accumulation, or that policies are sufficiently similar between provinces.

There is limited evidence that provincial physician accumulation by workload rates are consistent with fee-for-service reimbursement rates. Quebec, which has the lowest average physician workload rates of any province and the highest average fee-for-service reimbursement, is among the highest provinces in terms of physician accumulation by workload [7, B.3.1]. Nova Scotia, which has the has the second lowest average fee-for-service rate, appears to have the lowest physician accumulation by workload, while Newfoundland — with the lowest average fee-for-service reimbursement rate — has the highest estimated physician accumulation by workload.

Regardless of the causal mechanism, the positive relationship between physician workload in a health region and that region's physician population growth rate is promising for the Canadian health care system. If this relationship is the result of policy, this indicates that current policy is successful in attracting physicians to where workload is highest, presumably improving access to health services in these regions and increasing regional equity in the health system. If this relationship is not the result of policy, this indicates that, through physician workload preferences, regional disparities in physician workload are self-correcting and not self-reinforcing. Because, in aggregate, the relationship between physician workload and regional physician inflow is consistent with underemployment, increased physician compensation appears to be unnecessary, but would not have a negative effect on physician accumulation.

Appendix: Regression Equations

$$\frac{GP_{(t+1),r} - GP_{t,r}}{GP_{t,r}} = \alpha + \beta_1 \left[\frac{\overrightarrow{Usage_{t,r}}}{Ratio_{t,r}} * 100 \right] + \beta_2 \overrightarrow{Physician_{t,r}} + \beta_3 \overrightarrow{Year_{t,r}} + \beta_4 \overrightarrow{Province_{t,r}} + \beta_5 \overrightarrow{Demographic_{t,r}} + \epsilon_{t,r} \quad (8.1)$$

Where:

$$Workload = \left[\frac{Usage_{t,r}}{Ratio_{t,r}} * 100 \right]$$

$$\frac{GP_{(t+1),r} - GP_{t,r}}{GP_{t,r}} = \alpha + \beta_1 \overrightarrow{Workload} + \beta_2 \overrightarrow{Physician_{t,r}} + \beta_3 \overrightarrow{Year_{t,r}} + \beta_4 \overrightarrow{Province_{t,r}} + \beta_5 \overrightarrow{Demographic_{t,r}} + \beta_6 \overrightarrow{Workload_{t,r}} * \overrightarrow{Year_{t,r}} + \epsilon_{t,r} \quad (8.2)$$

$$\frac{GP_{(t+1),r} - GP_{t,r}}{GP_{t,r}} = \alpha + \beta_1 \overrightarrow{Workload} + \beta_2 \overrightarrow{Physician_{t,r}} + \beta_3 \overrightarrow{Year_{t,r}} + \beta_4 \overrightarrow{Province_{t,r}} + \beta_5 \overrightarrow{Demographic_{t,r}} + \beta_6 \overrightarrow{Workload_{t,r}} * \overrightarrow{Province_{t,r}} + \epsilon_{t,r} \quad (8.3)$$

$$\frac{GP_{(t+1),r} - GP_{t,r}}{GP_{t,r}} = \alpha + \beta_1 \overrightarrow{Workload} + \beta_2 \overrightarrow{Physician_{t,r}} + \beta_3 \overrightarrow{Year_{t,r}} + \beta_4 \overrightarrow{Province_{t,r}} + \beta_5 \overrightarrow{Demographic_{t,r}} + \beta_6 \overrightarrow{Workload_{t,r}} * \overrightarrow{Physician_{t,r}} + \epsilon_{t,r} \quad (8.4)$$

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