Is There a Roemer's Law for Physicians?
Physician Numbers As a Driver of Provincial Government Health Spending

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Introduction

The most recent release of *National Health Expenditure Trends* (2011) by the Canadian Institute for Health Information puts total health expenditure in Canada at 192.9 billion dollars in 2010 and 200.5 billion in 2011 – annual increases of 5.9 and 4.0 percent respectively. This release was accompanied by a report titled *Health Care Cost Drivers: The Facts (2011)* which finds the period from 1998 to 2008 as one in which public health care spending grew at an average of 7.4 percent annually - double the rate of government revenue.

Physician spending was highlighted as one of the fastest growing public sector health categories of recent years, with half of the growth attributable to increases in physician fee schedules. Economists are not necessarily surprised that physician spending has grown during a period of physician shortages, as they should have been able to negotiate substantial fee increases. However, it should be noted that the period since 2003 has also seen a rebound in the number of physicians in Canada due to higher medical school enrollment and the immigration of international medical graduates.

The role of physicians as a cost driver for the public health care system is an important policy issue. According to Roemer's Law, generally expressed as "A built bed is a filled bed", there is a direct correlation between health system capacity and utilization and by extension expenditures. While Roemer's Law was applied to hospital expenditures, it can by extension be applied to physician expenditures. One can argue that a licensed physician is a billing physician. Indeed, one of the arguments used to restrict medical school admissions in Canada in the early 1990s was that physicians were a primary cost driver in the health system because of their role as gatekeepers. Reduce the number of physicians and replace them with nurse practitioner teams and it was felt that cost savings would automatically ensure.

This paper examines the role of physician supply as a cost driver in provincial government health expenditures using annual province level data to estimate a regression model of health expenditure determinants with physician supply as a key variable while controlling for demographics, income, inflation and time trend as a proxy for technological change. More importantly, separate regression models are run by health expenditure category to examine the differential effect of physician numbers across health expenditure categories. The results pinpoint the expenditure categories where physician numbers have had their greatest impact on the provincial government system of health expenditures. The results suggest that while physician numbers are indeed a positive and significant driver of provincial

[1] The research assistance of Radostina Panova-Todorova is acknowledged.

government health care spending after controlling for other factors, the overall contribution is relatively small for most provinces.

Physicians as Cost Drivers in the Health Care System

Provincial government health spending has grown across Canada 's provinces over the period 1975 to 2011. According to data from the CIHI national health expenditure data,[2] provincial and territorial governments' health expenditure per capita is expected to average $3,778 in 2011. The highest per capita spending among the provinces is projected to be in Newfoundland and Labrador ($5,077) and Alberta ($4,528), while the lowest is forecast to be in Quebec ($3,407) and British Columbia ($3,604). As Figure 1 illustrates, the upward trend in real per capita spending has occurred in three phases – a period of increase from 1975 to 1990, a period of retrenchment from 1990 to 1996 and then a period of even steeper increases since 1996.

Physician spending is generally the second largest component of provincial government health spending after hospitals and over the period 1975 to 2009 averaged 20 percent of spending. In 1997 dollars, real per capita provincial government spending on physicians averaged 374 dollars in 1975 and reached 637 dollars in 2009. As Figure 2 shows, growth in real per capita provincial government physician spending over time parallels that for total provincial government health spending but there are substantial variations across the provinces. Ontario and British Columbia have traditionally been the largest per capita spenders on physician services but over the last decade Ontario's spending has soared and Alberta and Saskatchewan have moved into second and third place while British Columbia and Quebec have become the lowest per capita spenders.

According to the Canadian Institute for Health Information, physician spending has been among the fastest-growing health categories in recent years, increasing at an annual rate of 6.8% per year from 1998 to 2008 with more than half of this growth attributable to increases in physician fee schedules.[3] In 2009 there were 68,101 physicians across Canada[4]. The increase in supply of physicians, increases in Fee-for-Service (FFS), Alternative Payment Programs (APPs) expenditures, and the increasing utilization of health care per capita are recognized as important factors driving expenditure for physician services.

For the United States, Koenig et al., (2003) use regression analysis to identify and rank the key contributors to health care costs using state level physician cost data and find that between 1990 and 2000 nominal physician expenditures per capita grew 4.7% annually. Forty- two percent of this growth was attributable to general price inflation measured by the gross domestic product price deflator. Next were

[2] Canadian Institute for Health Information, *National Health Expenditure Trends* (2011)
[3] CIHI, Health Care Cost Drivers: The Facts, 2011.
[4] CIHI, National Physician Database Release, 2009-2010.

general economic variables and at 17%, followed by physician supply and provider structure (12%) and technology and treatment patterns (11%). The remaining 18 percent was contributed by operating costs, health status, healthcare regulation, and health insurance benefit and product design.

Physician supply has been identified as a driver of health care costs. One of the arguments used to restrict medical-school admissions in Canada in the early 1990s was that physicians were a primary cost driver in the health system because of their role as gatekeepers leading to reductions in medical school enrolment. However, the 1990s saw a perception of widespread physician shortages though the only provinces with declines in the per capita number of physicians were Ontario, British Columbia, Alberta, Prince Edward Island and Nova Scotia (See Figure 3) and by 2009 these declines turned into marked increases in most of these provinces in terms of both the number of physicians as well as expenditures (See Figures 4 and 5).

In 1975, the average number of total physicians per 10,000 of population across the ten provinces was 12.7. This grew to 17.0 by 1990 and increased to only 17.8 by 2000. Growth resumed after 2000 and reached an average of 20.0 in 2009. In 1975, the total number of physicians per 10,000 of population ranged from a high of 15.7 in British Columbia to a low of 10.0 in Prince Edward Island. By 2009, the high was 23.1 in Nova Scotia and a low of 16.5 in both Prince Edward Island and Saskatchewan. Real per capita provincial government expenditure (1997 dollars) on physicians rose from an average of 214 dollars in 1975 and reached 499 dollars in 2009 – an increase of 133 percent – while the average for real per capita total provincial government health spending rose from 1,149 dollars to 2,718 dollars – an increase of 137 percent. Figure 6 plots real per capita provincial government health expenditures versus the total number of physicians per 10,000 of population and fits a linear trend. The results show a positive relationship between per capita health spending and per capita physician numbers.

The focus on the number of physicians as a cost driver is linked to the argument that physicians are able to influence the demand for their services.[5] Supplier induced demand is an important theme in health economics and the provision of professional services. The classic expositions by Shain and Roemer (1959) and Roemer (1961) argued that hospital beds that are built are occupied regardless of whether there are few or many beds per capita. These papers found positive correlations between short-term general hospital beds per 1000 population and hospital days per 1000 population. This phenomenon was interpreted as "a bed built is a bed filled" and the effect became known as Roemer's Law.

[5] According to McGuire (2000), there are really three mechanisms whereby physicians affect the quantity of care provided to patients. These are: quantity setting of a non-re-tradeable service, influencing demand by setting the level of a non-contractible input (“quality”), and, in an asymmetric-information context, taking an action to influence patient preferences. The third mechanism is known as “physician-induced demand.”

The principle of Roemer's Law was thought to also apply to physician services and the general term applied was "supplier induced demand". Supplier induced demand is where health care providers have and use their superior knowledge to take advantage of the information gap between health care professionals and their patients and thereby influence demand for the purposes of self-interest. The underlying notion can be understood as an agency problem in that reliance of the patient on a physician gives the physician a degree of discretionary influence.

Folland, Goodman and Stano (2010:299-304) provide a simple supply and demand model of supplier induced demand. Assume in the accompanying Diagram 1 there is a market for physicians where P is the price of physician services or fee while Q is the quantity of services. The intersection between D1 and S1 represent the initial equilibrium.

Suppose the supply curve shifts right (increases) to S2. One view would argue that as the supply of physicians increased, we would move to the equilibrium of P3,Q3 and total spending would therefore increase or decrease depending on the elasticity of the demand curve. Another view is that in response to the fall in price, physicians would use their discretionary influence to raise the demand for medical services to D2. If the induced increase in demand is sufficiently large - we could go to P*2,Q*2 which would increase total expenditure immensely as well as raise price above the original equilibrium.

The new equilibrium fee could be higher or lower but the case where the equilibrium fee is higher has come to be called the Uwe Reinhardt "fee test" of inducement. Under this test, evidence that fee increases follow increases in supply is interpreted as support for supplier induced demand. However, most of the early empirical support for SID comes not from Reinhardt-type tests but from studies showing a positive correlation between physician availability and utilization rates as well as studies that look at geographic variations in surgery rates.

For example, Escare (1993) finds that 43 percent of variation in rates of cataract surgery is explained by socio-economic variables of income, educational level and number of physicians but attributes the remainder of the variation to a residual which is ascribed to physician practice style. Norresgaard et al., (1998) using international data also found differences in cataract surgery rates and ascribe the differences to socio-demographic differences, access to care, patient demand and surgeon's willingness to operate.

There have been more direct studies of the phenomenon internationally. Delattre and Dormont (2003) examine the existence of physician-induced demand (PID) for French physicians using a representative sample of 4500 French self-employed fee for service controlled fee physicians over the 1979–1993 period. They show that physicians experience a decline of the number of consultations when they face an increase in the physician to population ratio. However this decrease is very slight and physicians counterbalance the fall in the number of consultations by an increase in the volume of care delivered in each encounter providing support for the existence of PID in the French system for ambulatory care. Filippini et al., (2006) find the density of medical practices is a positive and significant determinant of outpatient antibiotic consumption along with an assortment of other socio-economic variables. Crivelli et al., (2006) using regional data for 26 Swiss cantons find that a larger share of old people tends to increase health costs and that physicians paid on a fee-for-service basis swell expenditures, thus highlighting the presence of supply-induced demand.

An approach relating the supply of physicians to both utilization and expenditures is certainly relevant in the Canadian case as physician fees and compensation are highly regulated in Canada thus making a simple demand and supply analysis with price rigidities a more appropriate model. As well, there has been more change and experimentation in the manner in which physicians are compensated in Canada in recent years. This has also been accompanied by changes in the nature of the physician workforce.

Recent studies suggest, that Canadian physicians have changed hours of patient care substantially in the last few decades. For example, in 2003, physicians under the age of 45 spent 20 percent less time providing direct patient care than they did in 1982[6]. The increasing proportion of female physicians, who work on average fewer hours than male physicians, can account for some of the trend over this period, but more important was reductions in hours of direct patient care by male physicians.[7] More recently, the 2007 National Physician Survey (2008) revealed that 27.7 percent of Canadian family doctors (FP/GPs) reduced their work hours between 2005 and 2007 and that 33.9 percent of them (37 percent of males, 29.1 percent of females) planned further reductions in their weekly work hours between 2007 and 2009, while only 8.1 percent planned to increase their weekly working hours.[8]

Physician fees rather than physician numbers have become a target for expenditure control in Ontario in the wake of the Drummond Report and the spring 2012 provincial budget. Freezing or reducing physician fees may reduce the rate of physician expenditure growth, yet some researchers argue that it may cause rapid increases in the number of services physicians provide, because under fee for service system physicians can regulate their own work patterns and budgets.[9] Thus, greater government control over the levels of physicians spending can be achieved with alternative payment mechanisms for physicians such as salary or capitation. A concern with capitation payment is the potential that physicians would work less without the incentives of FFS.

[6] Buske L. (2004)
[7] Crossley, Hurley, and Jeon (2008)
[8] Jeon and Hurley (2010)
[9] M.L. Barer, R.G. Evans, and R. Labelle (1988)

While salaried mechanisms do reduce the likelihood that unnecessary services will be delivered, they also increase the risk that necessary services may be withheld.[10] Nassiri and Rochaix[11], suggest that when physicians are paid per service provided, they provide more services than when they are given a fixed total payment. Moreover, they study physician's behaviour and reaction to financial incentives and results show that physicians are sensitive to financial considerations. In order to defend their income, they are prepared to adjust both quantitatively and qualitatively their choice of consultation type. Ferrall et al. estimated, that physicians paid by fee-for-service work 5.5 fewer hours per week on direct patient care than those paid by salary. But fee-for- service physicians see patients for 5.9 more hours per week than do salaried physicians.[12]

Model and Estimates

To estimate the impact of physician numbers of health expenditures, regression analysis is used to regress health expenditure across a number of categories on physician numbers as well as other confounding factors. A pooled time-series cross-section regression[13] model is estimated for each provincial government health expenditure category of the form:

$$(1)\ H_{it} = f(PHY_{it}, Y_{it}, z_{1it}, z_{2it}, \ldots z_{nit})$$

where H_{it} is real per capita government health expenditures of the i-th province at period t, PHYit is the number of physicians of the i-th province at time t, Y_{it} is the per capita income of the i-th province at time t, and z_1 to z_n represent a vector of social, demographic, economic and policy variables of the i-th province/territory at time t which are determinants of H_{it}. These determinants of expenditure are essentially expenditure-drivers and the literature has identified these key drivers to include population growth, population aging, income growth, inflation and enrichment factors such as technological change as proxied by time trend.[14]

For the regression analysis in this paper, the determinants of real per capita government health spending are real per capita GDP, population, time trend[15], the

[10] John T. Blake, Michael W. Carter (2003)
[11] Nassiria A, Rochaix Lisa (2006)
[12] Ferrall C, Allan W. Gregory, William G. Tholl (1998)
[13] The pooled regression is preferable to single province estimates because pooling allows for a larger sample and more degrees of freedom.
[14] See Constant, et.al., (2011).
[15] A time trend (YEAR) is sometimes used to account for technological change's impact though modelling the impact of technological extension on health care spending can be a complicated issue. If new techniques generate cheaper health procedures, there could be expenditure reductions associated with technological change. Cutler et al., (1998) report that between 1983 and 1994, the real quality-adjusted price of heart attack treatments declined at an annual rate of 1.1 percent. At the same time, with expensive new treatments, technological change can be associated with rising health expenditures. Given that

proportion of population aged 65 to 69 years, 70 to 74 years, 75 to 79 years and the proportion aged 80 years and over,[16] real per capita federal cash transfers[17] and real per capita provincial debt interest.[18] [19] As well, a set of transfer regime dummy variables is also specified to capture the onset of new federal transfer regimes and programs and a dummy variable for the onset of the Canada Health Act in 1984.[20] As well, the private share of health spending is included to capture the effect of changing private shares on real per capita spending. Inflation is accounted for in all these regressions by using real data (in 1997 dollars).

The variable for physician numbers is the number of physicians per 10,000 people. The intent is not to capture the effect of the total number of physicians on provincial government health spending but the effect of physician deepening. In other words, what is of interest is not extensive growth in the number of physicians but intensive growth. As the number of physicians per capita increases, is more spent per capita as a result of the greater relative supply of physicians. The incentives for supplier induced demand should be stronger if physician numbers increase faster than population – a deepening of physician stock.[21] Moreover, two physician number

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technological change occurs over time, a time index is a way to control for the effect of technological change on health expenditures but it is an imperfect one.

[16] An aging population is a source of some debate as to its importance as a health care expenditure driver. For a sample of papers for Canada, see Denton and Spencer (1995), Hogan and Hogan (2002) and Seshamani and Gray (2004). While aging is seen as a factor in rising health expenditures, its contribution has recently been determined to be relatively small compared to factors such as rising care expectations, time to death, rising input prices and technological extension. There is also a vast international literature on the importance of an aging population on health expenditure impact, which has reached similar conclusions. See Palangkaraya and Yong (2009), Bryant et al., (2004), Spillman and Lubitz (2000), Getzen (1992).

[17] Federal cash transfers are important operating revenue sources for Canada's provincial governments but vary across provinces and time. About half of federal transfers are specifically marked for health. However, general-purpose transfers like equalization can be applied to health. It is difficult to separate out the extent of health transfers given the large amount of change in transfer arrangements over time both in dollar amounts as well as institutional arrangements.

[18] Balanced budgets after the mid 1990s opened up a fiscal dividend that enabled provinces to spend more on health, even while lowering income and corporate taxes. See Landon et al.,(2006).

[19] For an excellent survey of the international health expenditure determinants literature, see Gerdtham and Jonsson (2000). The first generation of such determinants studies often used international data. See Leu (1986), Parkin, McGuire and Yule (1987), Brown (1987), and Gerdtham et al (1992). See also Hitiris and Posnett (1992), Barros (1998), Gerdtham, Jonsson, MacFarlan and Oxley (1998), Di Matteo and Di Matteo (1998) and Ariste and Carr (2003).

[20] Over the years a number of regime changes have occurred with respect to transfers. In 1977, there was the onset of Established Program Financing (EPF), which replaced federal-provincial cost-sharing on health with a block grant. In 1984 there was the onset of the Canada Health Act (CHA) which tied the receipt of federal transfers to running a health care system that met basic conditions. In 1996, EPF and the Canada Assistance Plan, which funded income support, were collapsed into one transfer (and the cash portion reduced by one-third). This new transfer was called the Canada Health and Social Transfer (CHST). Finally, in 2005 the CHST was broken up into two transfer payments – the Canada Health Transfer and the Canada Social Transfer.

[21] Another way to assess the impact of physicians as a cost driver would be to estimate the multiplicative effect of physician expenditures on total health expenditures via their role as gatekeepers. Thus total provincial government health spending (H) would be equal to aP where P is provincial government expenditure on physicians and a is the physician expenditure multiplier. Over the period 1975 to 2009, the

variables are specified – one for family physicians and the other for specialist physicians in order to separate out any potential differences in effects on expenditures.

Province dummies are also included in the regressions for the provinces and the territories to capture time invariant regional effects not captured by other variables in the model. Changes in physician labour market characteristics, fee schedules and payment methods invariably complicate the analysis of the effect of physician numbers of spending and the changes can vary across the provinces making provincial fixed effects important considerations.

The variables are defined in Table 1. The data for these regression variables were obtained from the National Health Expenditure database constructed by the Canadian Institute for Health Information and also from CANSIM-Statistics Canada and the Federal Fiscal Reference Tables. More specific details on the variable sources are available in Di Matteo (2010), Appendix II.

The estimation package is STATA 11 and testing was conducted on the data. Normality plots of the key variables at the provincial level found real per capita GDP and transfers to be highly normally distributed while population and the proportion aged 65 and over were less likely to be so. Levin-Lin-Chu and Harris-Tzavalis[22] unit root tests for panel data with panel means and time trend both included and excluded were conducted for the variables in the data set and the variables exhibited a high degree of stationarity with the null hypothesis of a unit root being rejected for most of the variables. [23] Box-Cox testing found the linear specification for real per capita total provincial government health spending to be more suitable than log-linear.[24] A Ramsay-Rest test on the same variables used in the Box-Cox test could not reject the null hypothesis that the model has no omitted variables. Hausman test statistics supported use of fixed-effects versus a random effects model and therefore a specification with province dummies was retained.

The actual estimations are pooled time series cross sections using GLS, assuming heteroskedastic panels with cross-sectional correlation and panel specific ar(1) and the results are presented in Table 2. Key positive and significant determinants (at the 5% level) of real per capita provincial government health expenditures include

value of "a" has averaged between 5 and 6 across the provinces with a slight decline over time. However, "a" would be multiplying the effect of fees, the volume of services as well as the number of doctors. As a result, a physician per capita variable is a more appropriate approach to isolating the effect.

[22] The Levin–Lin–Chu test requires that the ratio of the number of panels to time periods tend to zero asymptotically and does not suit datasets with a large number of panels and relatively few time periods. The Harris–Tzavalis test assumes that the number of panels tends to infinity while the number of time periods is fixed. This data set has a small number of panels (10) and a fixed number of time periods.

[23] As well, Westerlund (2007) tests for co-integration in panel data were performed earlier on for the provincial specifications and the null hypothesis of no co-integration was rejected, meaning that there was co-integration and the regressions were not spurious

[24] Box-Cox testing was performed by regressing a real per capita health expenditure variable on the variables of the model. Value of theta was 0.31.

real per capita GDP, time trend, and the proportions of population aged 65 to 69 and 85 years and over. Key negative and significant determinants include the real per capita amount of provincial debt interest, the onset of the Canada Health and Social Transfer and the private share of health spending. These determinants are of assorted significances across the other health expenditure categories and are consistent with other studies of the determinants of health expenditures

The number of family and specialist physicians per 10,000 of population is a positive and significant determinant of provincial government health spending for total spending, hospital and physician spending. It is not a positive and significant factor for the other categories of spending. Adding one family physician per 10,000 of population adds 12.21 in real per capita total health spending while one specialist physician is associated with an increase of almost 25.92 dollars in real per capita spending. The real per capita amounts are smaller when it comes to the separate categories of hospital and physician expenditure but the greater impact of specialist physicians is replicated.

Based on the value of these coefficients and the actual increases in real per capita provincial government health spending, it is possible to calculate the percent contribution of physicians to provincial government health spending over the period 1975 to 2009. Between 1975 and 2009, real per capita total provincial government health expenditures rose from an average across the ten provinces of 1,149 dollars in 1975 to 2,718 dollars in 2009 – an increase of 1,568 dollars. The average amount of the increase due to the increase per 10,000 of population of family physicians was $42.57 while that of specialists was $95.38 for a total of $137.95 due to physicians. This represents 8.8 percent of the increase. As Figure 8 illustrates, this contribution raged from a low of 5.0 percent for Manitoba to a high of 10.4 percent for Newfoundland & Labrador.

The relative contributions are larger for the separate categories of physician and hospital expenditure. Figure 9 plots the results for hospitals while Figure 10 plots the results for physicians. The contribution of physician numbers to real per capita provincial government hospital spending averages 11.0 percent and ranges from a low of 6.8 percent in Manitoba to a high of 29 percent in Quebec. Meanwhile, the contribution of physician numbers to physician spending averaged 20.4 percent across the provinces and ranged from a low of 9.8 percent in Ontario to a high of 55.5 percent in British Columbia.

These results suggest that after controlling for factors such as income, time trend, an aging population and other variables, physician supply deepening – that is an increase in the number of physicians per 10,000 of population – is indeed associated with increases in real per capita health expenditures. This indeed provides support for a physician version of Roemer's Law – expansions in the supply of physicians and physician capacity can in of itself be a driver of health system expenditures. However, the contribution of physician numbers to the increase in overall real per capita health spending is relatively modest at 8.8 percent of the increase. This means that other factors account for 91.2 percent of the increase in spending.

The contribution is larger for the separate categories of physician expenditures and hospitals and also varies across provinces but the contribution to overall spending is modest. As for those provinces that have the largest contributions to hospital and physician spending by physician numbers – British Columbia for physician spending and Quebec for hospital spending – those two provinces over the period 1975 to 2009 also had the lowest increases in real per capita provincial government health expenditures.

Conclusions

Since 1975, the increase in Canadian physician numbers has been accompanied by increases in provincial government health expenditures. Roemer's law applied to physicians implies that increases in the number of physicians can result in increases in health expenditure as physicians have the power to induce demand for their services. This paper has attempted an estimate of this relationship through regression models of real per capita provincial government health spending on variables that include the number of physicians per 10,000 of population.

After other confounding factors such as income, time trend, and aging, the deepening of physician supply – that is an increase in the number of physicians per 10,000 of population – is indeed positively correlated with increases in real per capita health expenditures. This provides support for a physician version of Roemer's Law – expansions in the supply of physicians and physician capacity can in of itself be a driver of health system expenditures. However, the contribution of physician numbers and by extension, induced demand to the increase in overall real per capita health spending is relatively modest at 8.8 percent of the increase. This means that factors other than physician numbers account for 91.2 percent of the increase in spending.

Current public policy in Canada is focusing on physician fees and costs as important variables in reducing the growth of public health care spending. Ontario in particular has decided to tackle its 16 billion dollar provincial deficit in part by imposing fee cuts and freezes for Ontario physicians. These results suggest that physician numbers per se have been a statistically significant but relatively modest factor in the rise of health care spending. Reducing or freezing their fees will also provide relatively modest savings, which in Ontario's case are estimated at 338 million dollars out of total provincial health spending for 2012-13 of 48 billion dollars.

The provincial government in Ontario has not moved to actually implement a cap on OHIP spending or reduce the number of services provided which raises the possibility that physicians could try to recover lost income via induced demand. However, given the lack of evidence for a strong quantitative induced demand impact of physician numbers on spending, there are unlikely be concerted efforts to recover income via induced demand. This reality may explain why provincial governments in general have not been even more aggressive with respect to physicians.

Provincial governments are likely aware that the drivers of public health care spending are a complex interaction between physician decision-making, diagnostic and drug technologies, population growth, aging, the cost and deployment of human resources, provincial health system institutions and the role of demand side economic variables such as incomes. Focusing on physicians in a high profile manner given their modest role as expenditure drivers and the modest savings the fee reductions provide represents a solution undertaken for political reasons given the high profile that physicians have within the public health care system.

Diagram 1
Market Demand and Supply Model for Physician Services

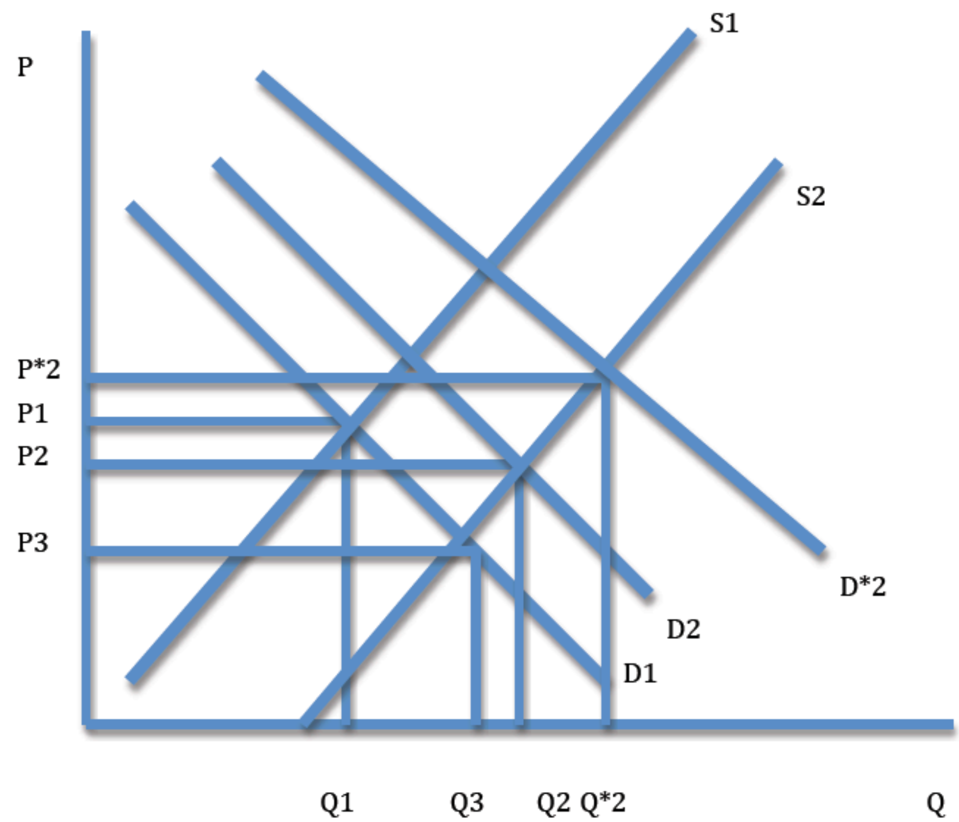


Figure 1: Real Per Capita Provincial Government Health Expenditures, 1975-2009 (Data source: CIHI)

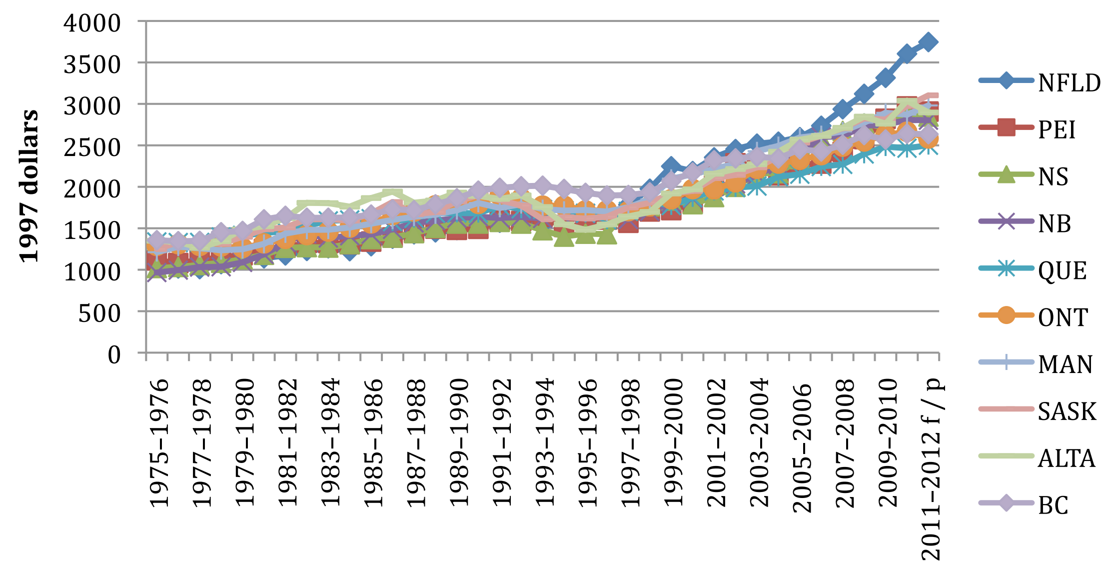
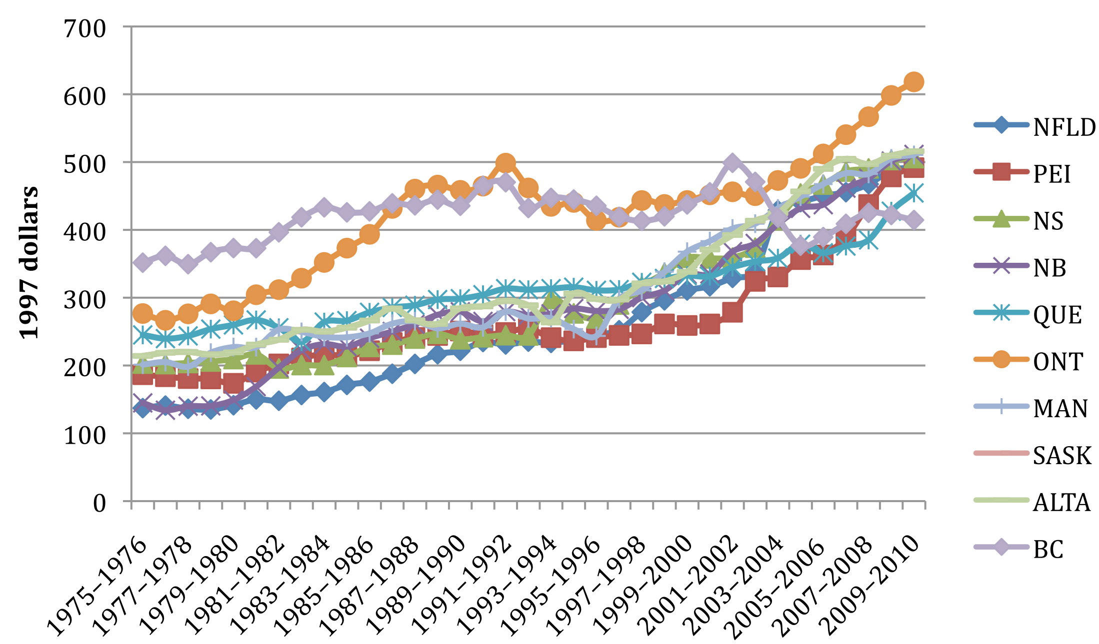


Figure 2: Real Per Capita Provincial Government Physician Spending: 1975-2009 (Data source: CIHI)



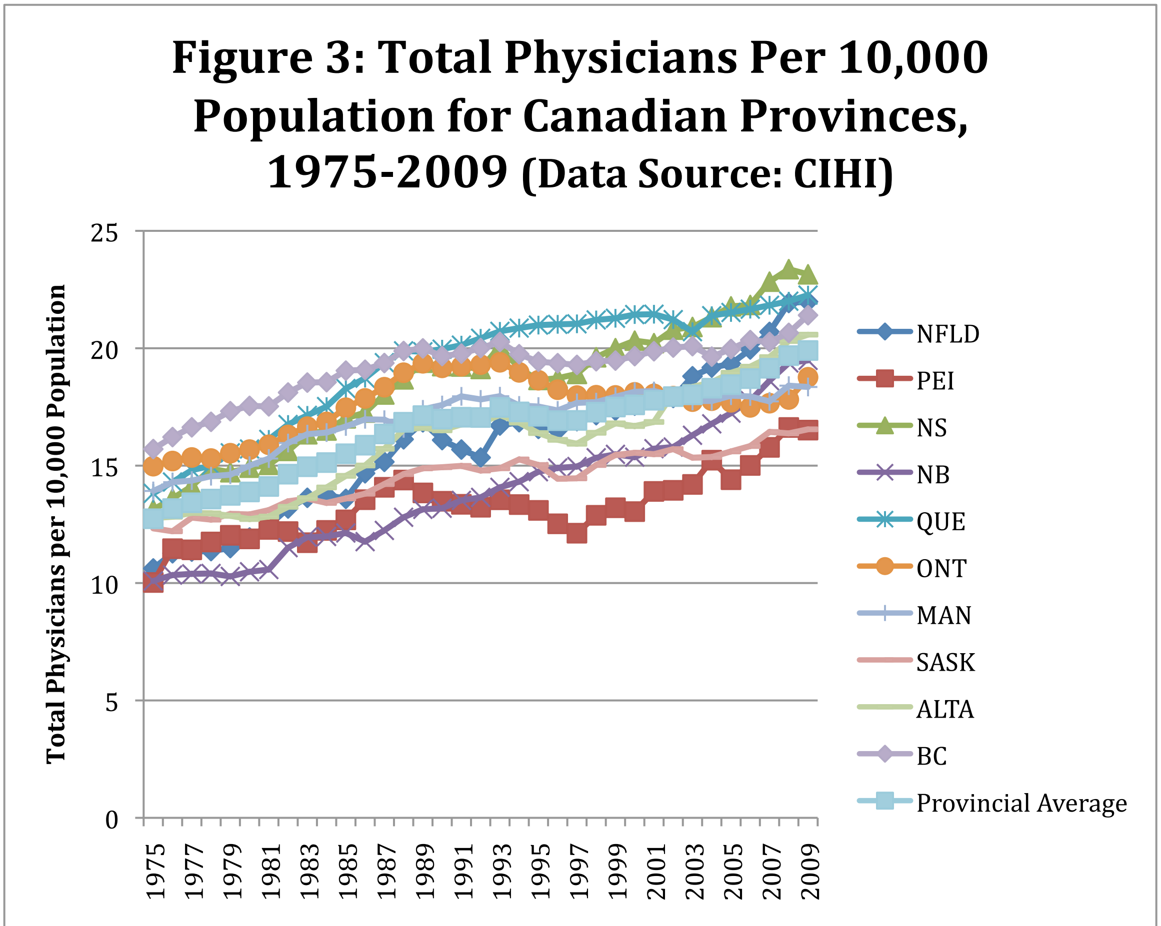


Figure 3: Total Physicians Per 10,000 Population for Canadian Provinces, 1975-2009 (Data Source: CIHI)
Total Physicians per 10,000 Population
25
20
15
10
5
0
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
NFLD
PEI
NS
NB
QUE
ONT
MAN
SASK
ALTA
BC
Provincial Average

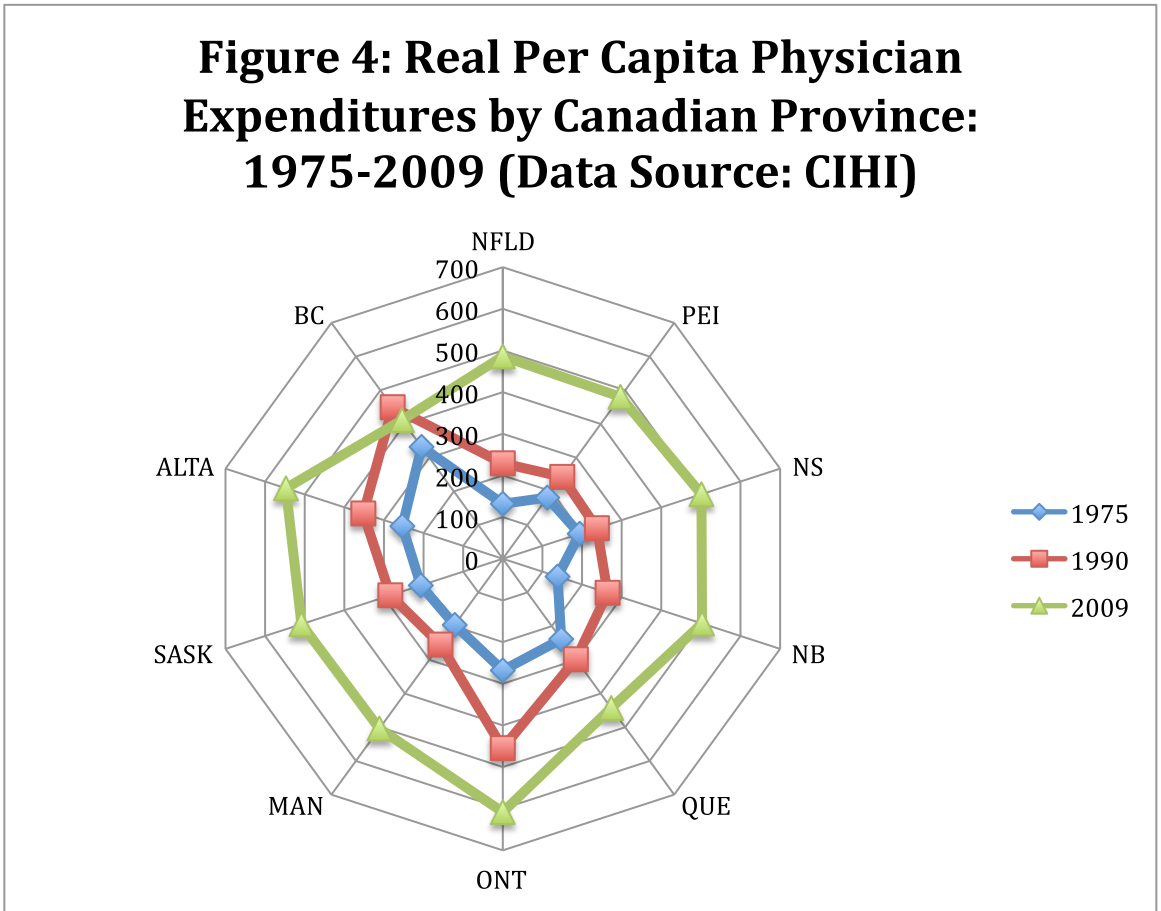


Figure 4: Real Per Capita Physician Expenditures by Canadian Province: 1975-2009 (Data Source: CIHI)
NFLD
PEI
NS
NB
QUE
ONT
MAN
SASK
ALTA
BC
700
600
500
400
300
200
100
0
1975
1990
2009

Figure 5: Total Physicians Per 10,000 Population: Canadian Provinces 1975-2009

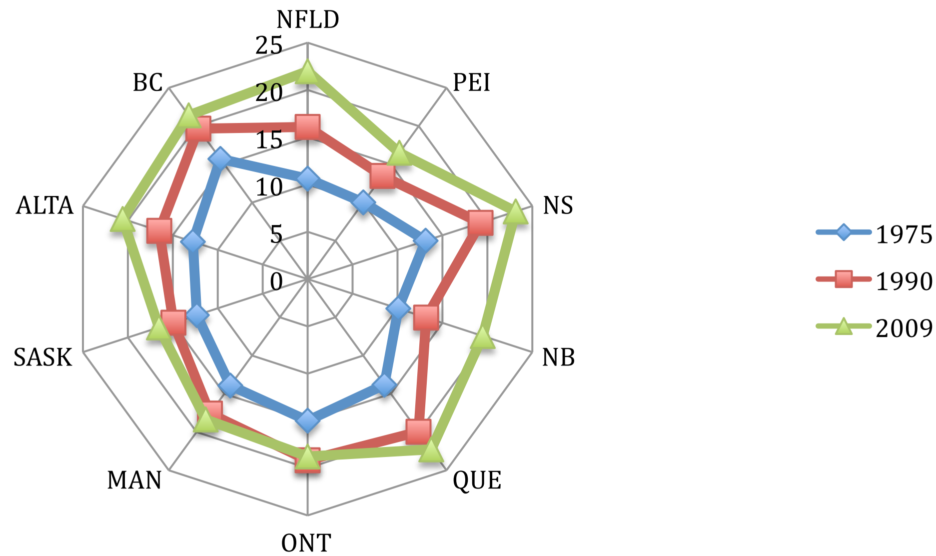


Figure 6: Real Per Capita Provincial Government Total Health Expenditure Versus Total Physicians per 10,000 Population: 1976-2009 (with linear trend)

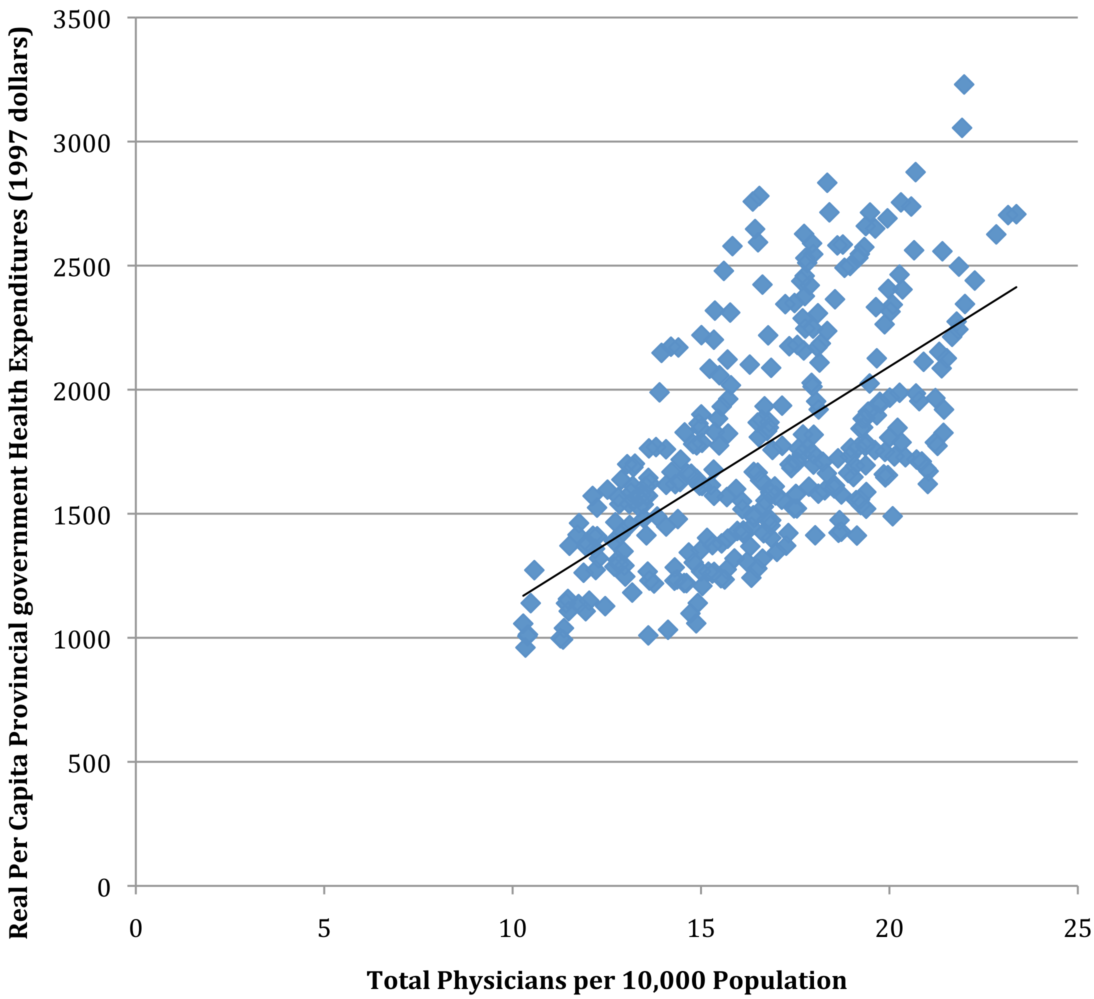


Figure 7
Actual Real Per Capita Provincial Government Health Expenditures (rpgtothltc) Vs Fitted (rpgtothltcfit) By Province (Prov) for 1975-2009 from Regression Results Table 2

NFLD-1
PEI-2
NS-3
NB=4
QUE-5
ONT-6
MAN-7
SASK-8
ALTA-9
BC-10

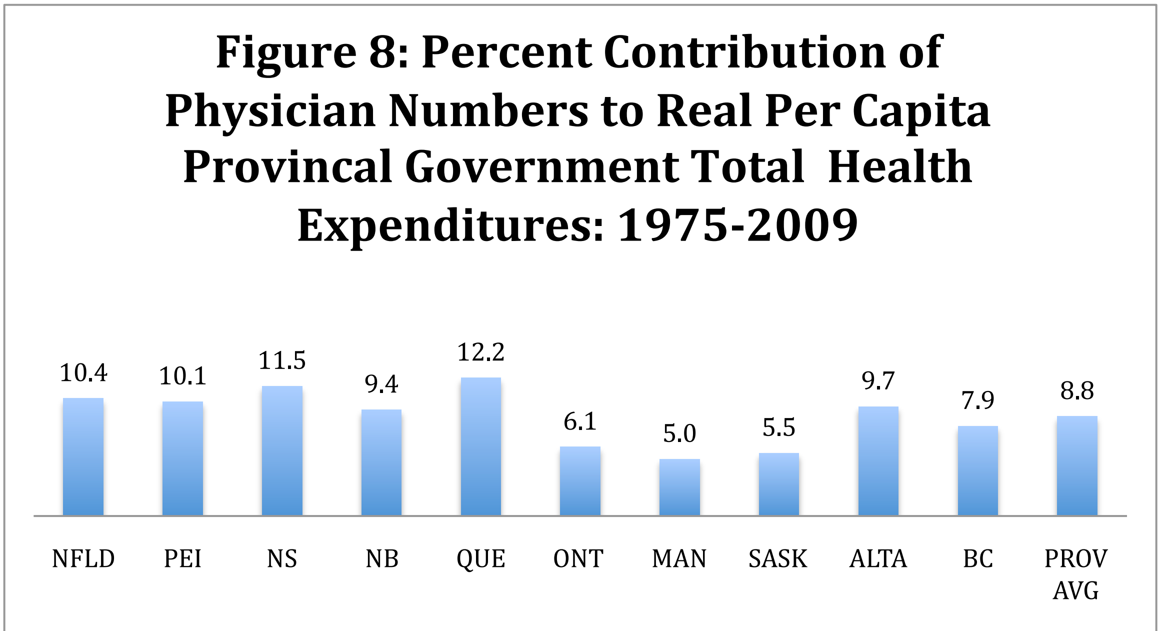


Figure 8: Percent Contribution of Physician Numbers to Real Per Capita Provincal Government Total Health Expenditures: 1975-2009
10.4
10.1
11.5
9.4
12.2
6.1
5.0
5.5
9.7
7.9
8.8
NFLD
PEI
NS
NB
QUE
ONT
MAN
SASK
ALTA
BC
PROV AVG

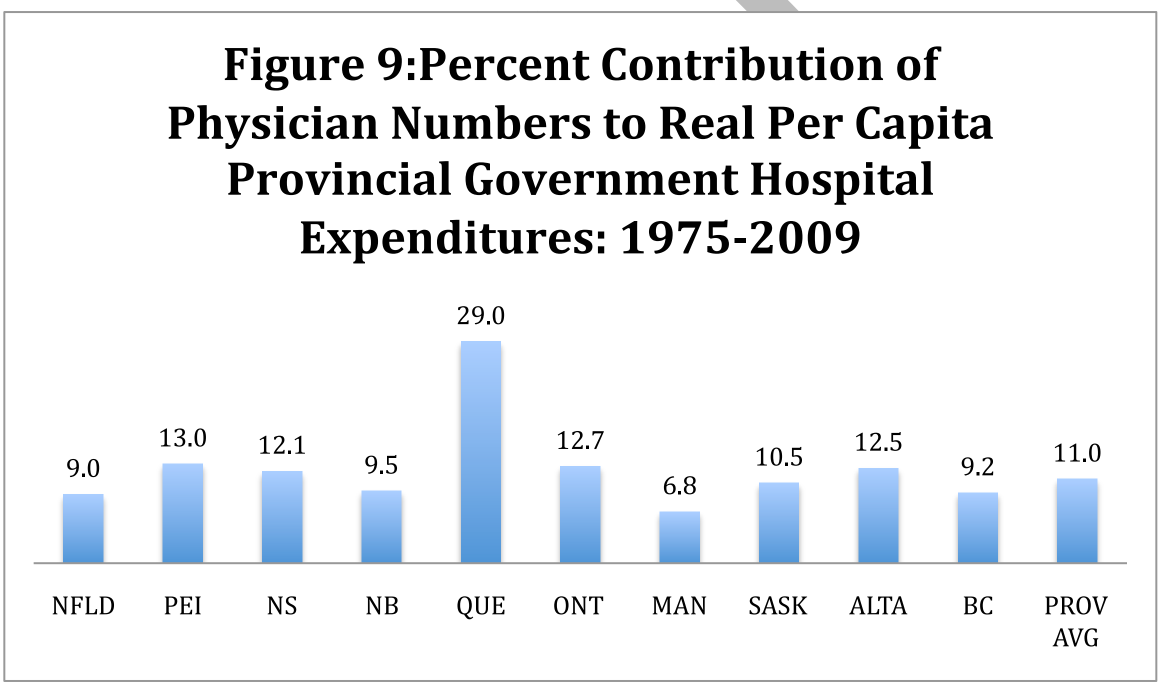


Figure 9:Percent Contribution of Physician Numbers to Real Per Capita Provincial Government Hospital Expenditures: 1975-2009
9.0
13.0
12.1
9.5
29.0
12.7
6.8
10.5
12.5
9.2
11.0
NFLD
PEI
NS
NB
QUE
ONT
MAN
SASK
ALTA
BC
PROV AVG

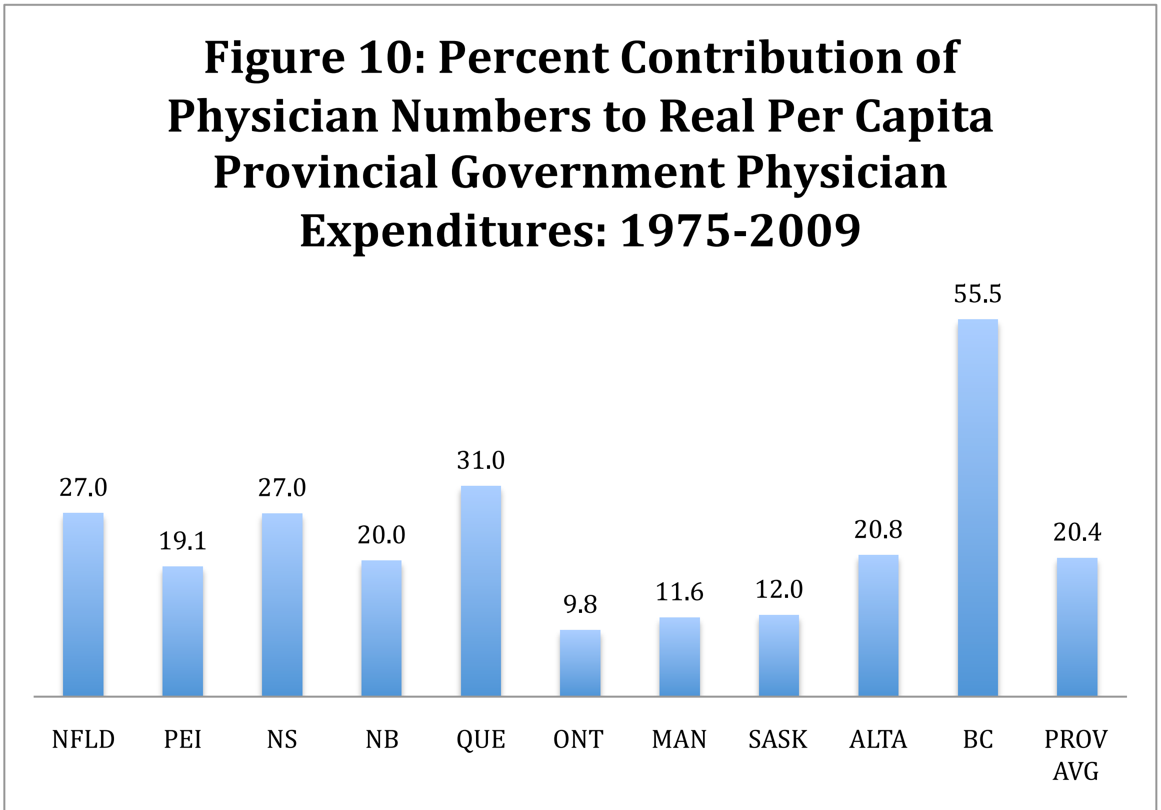


Figure 10: Percent Contribution of Physician Numbers to Real Per Capita Provincial Government Physician Expenditures: 1975-2009
27.0
19.1
27.0
20.0
31.0
9.8
11.6
12.0
20.8
55.5
20.4
NFLD
PEI
NS
NB
QUE
ONT
MAN
SASK
ALTA
BC
PROV AVG

Table 1
Regression Variable Definitions

Dependent Variables

Real per capita provincial government health expenditures in 1997 dollars deflated using the Government current Expenditure implicit Price Index.

Rpgtothltc	Total.
Rpghospc	Hospitals.
Rpgothinstc	Other institutions.
Rpgphysc	Physicians
Rpgothprofc	Other professionals.
Rpgdrugsc	Drugs.
Rpgcapitalc	Capital.
Rpgpubhltc	Public health.
Rpgadminc	Administration.
Rpgothltc	All other health.

Independent Variables

rgdpc	Real per capita gross domestic product in 1997 dollars. Deflated using the Government Current Expenditure Implicit Price Index.
rpgfedtransc	Real per capita federal cash transfer revenues. In 1997 dollars, deflated using the Government Current Expenditure Implicit Price Index.
nfld	1 if Newfoundland, 0 otherwise.
pei	1 if PEI, 0 otherwise
ns	1 if Nova Scotia, 0 otherwise.
nb	1 if New Brunswick, 0 otherwise.
que	1 if Quebec, 0 otherwise.
ont	1 if Ontario, 0 otherwise.
man	1 if Manitoba, 0 otherwise.
sask	1 if Saskatchewan, 0 otherwise.
alta	1 if Alberta, 0 otherwise.
bc	1 if British Columbia, 0 otherwise.
prop6569	Proportion of population aged 65 to 69
prop7074	Proportion of population aged 70 to 74
prop7579	Proportion of population aged 75 to 79
prop8084	Proportion of population aged 80 to 84
prop85plus	Proportion of population aged 85 or greater.
Totphysc10000	Number of physicians per 10,000 population.
Famphysc10000	Number of family physicians per 10,000 population.

Specphysc10000	Number of specialist physicians per 10,000 population.
Rprovdebtintc	Real per capita provincial government debt interest. (1997 dollars)
Rpgownrevc	Real per capita provincial government own source revenue (1997 dollars)
Pop	Total provincial population.
year	Year
privshare	Private share of total health expenditure.
epf	1 if Established Program Financing in effect (1977-1995), 0 otherwise.
cha	1 if Canada Health Act in effect (1984-2009), 0 otherwise.
chst	1 if Canada Health and Social Transfer in effect (1996-2004), 0 otherwise.
chtcst	1 if separate Canada Health Transfer and Canada Social Transfer in effect (2005-2009), 0 otherwise.

Table 2: Regression Results

	rpgtothltc	z	rpghospc	z	rpgothinstc	z	rpgphysc	z	rpgothprofc	z
famphysc10000	12.20719	1.54	6.275947	1.44	0.9153326	0.46	6.212573	3.75	0.4623269	1.69
specphysc10000	25.91908	2.57	9.376133	1.63	1.020414	0.4	9.935124	4.52	-0.1580423	-0.44
rgdpc	0.0058218	2.5	0.0019025	1.5	-0.0008311	-1.53	0.0004652	1.03	0.0001185	1.32
rpgfedtransc	-0.001814	-0.13	-0.0048199	-0.67	0.0128338	3.61	0.0014489	0.54	-0.0003567	-0.81
rpgownrevc	0.0024688	0.29	0.0053668	1.22	0.0029525	1.29	-0.0017173	-0.97	-0.0003412	-0.93
rprovdebtintc	-0.1715454	-4.24	-0.0793284	-3.92	-0.0136126	-1.31	-0.0635455	-7.73	0.0061042	3.74
prop6569	17720.1	4.94	13326.86	7.35	2632.243	2.77	1776.671	2.38	697.5633	5.25
prop7074	-8879.959	-1.8	1215.461	0.46	1553.038	1.31	-1072.958	-1.04	-3.455195	-0.02
prop7579	-4061.057	-0.64	-6366.398	-1.89	5396.585	3.6	-933.5926	-0.72	-321.0371	-1.4
prop8084	23709.84	3.07	9298.548	2.22	7240.015	3.52	1965.187	1.23	-1369.964	-4.35
prop85plus	-0.0019014	-2.16	-0.0022535	-3.79	0.0002697	1.07	-0.0005131	-1.95	-0.0001071	-2.27
nfld	151.6284	0.79	123.0445	0.84	-277.5302	-4.32	-114.1589	-1.35	41.86585	3.48
pei	-64.86203	-0.32	-44.9893	-0.3	-433.271	-6.1	-114.4053	-1.31	55.78983	4.54
ns	-113.7725	-0.63	-10.41818	-0.07	-381.766	-5.21	-110.346	-1.36	47.1361	4.2
nb	-53.36114	-0.28	26.86586	0.19	-426.1092	-6.36	-90.17531	-1.09	38.3381	3.3
que	-84.96083	-1.18	-21.02423	-0.38	-94.42461	-3.45	-114.8838	-3.66	17.99719	4.25
man	43.89874	0.25	-1.017713	-0.01	-325.9226	-5.2	-82.41469	-1.04	49.7107	4.48
sask	23.37069	0.13	-97.2511	-0.7	-361.0947	-5.1	-54.91774	-0.69	64.11633	5.66
alta	96.26117	0.58	53.22935	0.44	-254.7698	-5.05	-71.69546	-1.02	62.07954	5.63
bc	-12.42532	-0.09	-78.32506	-0.72	-336.2089	-4.19	168.7081	1.78	52.03888	5.99
pop	0.0183798	0.67	0.0159858	0.78	-0.0421028	-4.8	0.0055583	0.5	0.0063618	3.88
privshare	-816.7248	-4.71	-157.1413	-1.77	-152.3214	-3.78	-33.46852	-1.04	-7.710771	-1.32
cha	-4.610675	-0.19	6.124449	0.53	-7.08931	-1.76	-4.072887	-0.93	0.4271405	0.65
epf	-32.84952	-1.35	-20.56304	-1.83	-0.3204858	-0.08	-11.92591	-2.84	0.9425405	1.49
chst	-103.5143	-2.9	-60.27225	-3.74	9.937489	1.68	-13.63236	-2.25	0.3603748	0.39
chtcst	-52.69109	-1.17	-49.59837	-2.42	13.00609	1.74	-4.747737	-0.61	-0.8809792	-0.74
year	36.04347	11.65	11.38669	7.26	1.540881	1.89	7.237475	11.17	-0.0097819	-0.08
_cons	-70737.93	-11.77	-22384.81	-7.36	-2810.681	-1.79	-14127.28	-11.13	-20.3236	-0.08
Wald chi2(27)	1577.27		1226.69		662.38		3102.9		481.64	

	rpgdrugsc	z	rpgcapitalc	z	rpgpubhltc	z	rpgadminc	z	rpgothhltc	z
famphysc10000	0.0048508	0.01	-0.3889502	-0.14	-0.7319273	-0.61	-0.1127917	-0.25	-0.7546072	-0.9
specphysc10000	-0.5480541	-0.63	-7.511322	-1.92	-0.9807417	-0.57	-0.1209523	-0.18	-0.126233	-0.11
rgdpc	-0.0002528	-1.4	0.0030967	3.65	0.0023437	6.35	0.0000871	0.77	0.0008072	3.27
rpgfedtransc	0.0027529	2.7	-0.0135797	-2.16	0.0001854	0.09	0.0010451	1.51	-0.0044029	-3.06
rpgownrevc	0.0024123	3.3	-0.0040516	-1.17	-0.0033791	-2.27	0.0007811	1.7	-0.0029897	-3.02
rprovdebtintc	-0.0282428	-7.12	-0.0117058	-0.78	-0.0358387	-5.44	-0.001892	-0.9	-0.0038798	-0.96
prop6569	741.444	2.27	-298.0587	-0.3	-2189.223	-4.09	186.5004	0.8	-906.478	-2.32
prop7074	116.061	0.28	-1732.165	-1.25	-948.4422	-1.26	-442.3436	-1.5	-3367.606	-6.27
prop7579	813.2215	1.56	301.7786	0.15	128.3679	0.14	-168.793	-0.43	1275.016	1.98
prop8084	2004.005	2.98	560.6151	0.21	-3465.797	-2.81	245.0378	0.54	-1829.384	-2.16
prop85plus	0.0004582	4.94	0.000516	2.32	0.000686	4.37	-0.0002682	-4.04	0.0002031	1.7
nfld	36.69966	1.51	10.84446	0.18	50.04076	1.39	-10.56864	-0.53	-138.276	-3.35
pei	-10.59153	-0.42	17.60559	0.29	104.9399	2.71	12.7627	0.6	-113.7824	-2.72
ns	36.4529	1.37	24.78491	0.49	50.14889	1.45	6.94808	0.32	-116.0386	-3.03
nb	18.35982	0.77	14.9073	0.26	58.58015	1.67	-6.653359	-0.34	-90.91902	-2.24
que	16.55344	1.63	28.55871	1.4	26.7169	2.05	8.073607	1.04	-54.02955	-3.54
man	8.954563	0.39	-15.02908	-0.3	91.05324	2.77	-0.6084201	-0.03	-58.77918	-1.56
sask	23.41856	0.91	-25.22556	-0.45	140.1831	3.97	-12.59315	-0.49	-73.60461	-2
alta	24.9175	1.23	-14.49654	-0.26	50.55142	1.69	-10.47606	-0.64	-111.3191	-3.19
bc	20.26404	1.06	-4.753156	-0.12	62.23431	2.37	6.423475	0.42	-29.2262	-0.78
pop	0.0004335	0.13	-0.0081522	-1.08	-0.001578	-0.31	0.0027144	1.04	-0.0138685	-2.82
privshare	-12.15712	-0.91	-289.7831	-4.72	-13.27963	-0.43	-13.36616	-1.4	18.62101	1.04
cha	-1.250478	-0.62	-4.296794	-0.84	-1.535986	-0.68	-0.5139318	-0.49	-0.6420162	-0.44
epf	-3.924229	-2.06	-2.753932	-0.55	2.750573	1.22	-1.419428	-1.34	0.1463264	0.1
chst	-8.363121	-2.98	-14.77413	-1.99	2.695596	0.83	-1.872783	-1.22	-3.121508	-1.48
chtcst	-5.073788	-1.42	-7.359585	-0.78	10.39273	2.47	-1.296415	-0.67	-4.725374	-1.77
year	3.875827	14.44	3.471299	2.88	4.612941	8.5	0.8293185	3.41	5.468121	12.81
_cons	-7714.184	-14.9	-6679.368	-2.88	-9028.139	-8.64	-1611.419	-3.44	-10567.22	-13.03
Wald chi2(27)	2697.89		319.82		2414.77		325.6		1804.26	

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