Rising Income and the Increased Share of Health Spending in Canada

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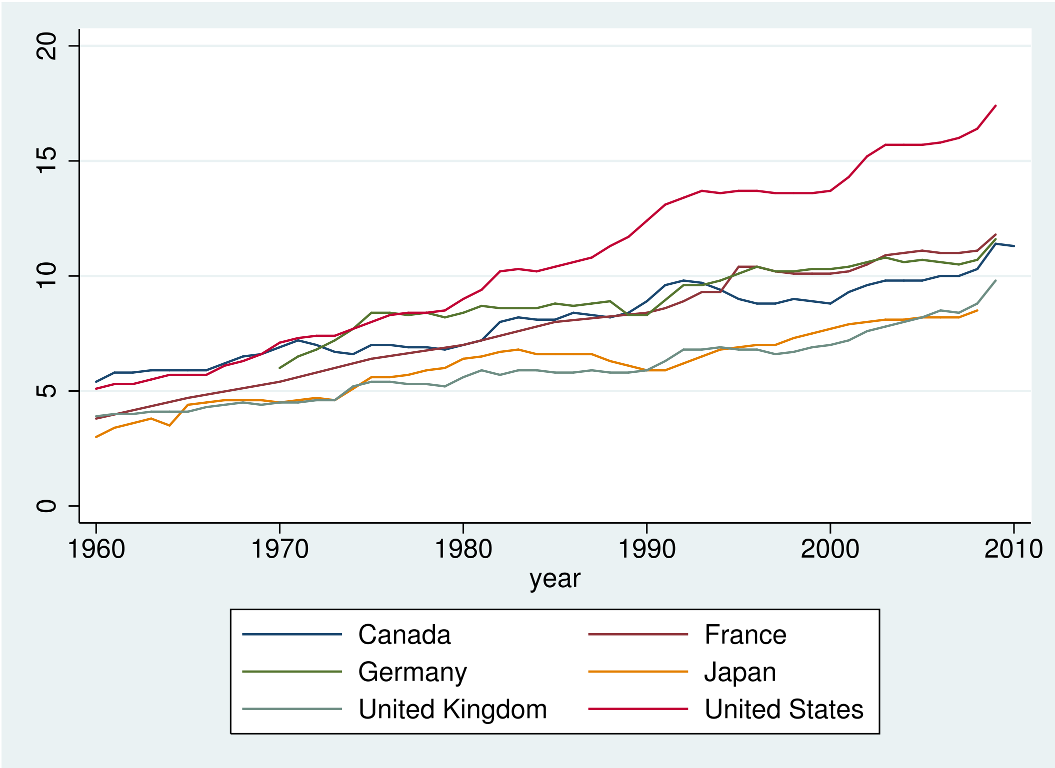
1 Introduction

The sustainability of the healthcare system is a fundamental problem facing policy makers in Canada. Costs are increasing more rapidly than our capacity to pay them. Healthcare expenditure is growing as a proportion of GDP, and now accounts for 50% or more of most provincial budgets (Di Matteo, 2010), putting pressure on the delivery of education, social services and all the other responsibilities of the public sector. This is not only a Canadian phenomenon but an international phenomenon as can be seen in figure 1. In OECD countries health care has risen as a share of GDP for 50 straight years (Acemoglu Finkelstein & Notowidigdo, 2011).

The standard reaction is to ask how we can constrain healthcare spending, what goods and services are "necessities" that should be provided publicly, and which are "luxuries" that can be omitted from the medicare bundle. That approach, however, leads to wrangling between interest groups, and neglects one very important possibility. Perhaps healthcare expenditure has grown because, as we have grown richer, Canadians have implicitly decided that they want to spend a larger proportion of their income on healthcare. From this perspective, increasing costs are not a problem but simply a reflection that policy makers are acting appropriately and meeting the demands of Canadians. Is this the case?

The answer to this conjecture is especially important within the public policy realm. The major implication of health being a luxury good is that cost control is not necessarily a problem. If health care is in fact a luxury good, it is likely that the large rise in health spending, both public and private, is optimal compared to former levels of expenditures. Since many Western governments are in charge of allocating their citizens spending on healthcare, determining whether the rise in health spending is optimal is important for determining the growth of health budgets. It may speak to how much government should be involved in the allocation of health care. Finally, calculating the income elasticity may help forecast how future health spending may change as incomes grow.

Figure 1: Health Spending as a Percent of GDP in several Developed Economies



The view of this paper is to provide a causal estimate of how rising incomes impact health utilization and spending. The emphasis on causality is important with health since there is the confounding issue of simultaneity that confuses simple correlational results provided by ordinary least squares (OLS). Health care may affect how productive workers are and therefore their income, but if health is a luxury good, income should also impact health utilization and spending. Similarly, the general health of a person will affect how much healthcare they consume, but the consumption of healthcare will affect how healthy they are. These issues of simultaneity plague many other studies. The empirical strategy will therefore require instrumental variables that are exogenous from health spending and utilization.

This paper concerns two sets of Canadian data evaluated at a regional level and provincial level. Using an instrumental variable regression the analyses find that the point estimate for the income elasticity of health care is 0.674 at the regional level and 0.828 at the provincial level. Further analysis is conducted at the provincial level that concludes that the higher "general equilibrium" estimate in this case is 0.95. The results suggest that health care in the Canadian context is not a luxury good.

2 Previous Literature

The theoretical background that posits that health is a luxury good is largely contained in *The Value of Life and the Rise in Health Spending* by Hall and Jones (2007). In their paper, the authors establish a microeconomic framework to evaluate how and why rising incomes would impact health spending. Their basic model establishes a utility function of a representative agent that depends on health spending and consumption over time. In the static case where consumption of other goods remains constant over time, additional healthcare spending extends the consumption of an individual by extending lifespan. Their model depends upon the idea that the income elasticity of consumption falls relative to the income elasticity of health and to this end they add a constant term to their utility function. The result is that people purchase more health care relative to income, as marginal utility of consumption declines more rapidly relative to the health production function. As Hall and Jones write, "whether health share rises over time is then an empirical question; there is a race between diminishing marginal utility of consumption and the diminishing returns to the production of health" (p.48).

Hall and Jones give some empirical support for their theoretical conclusions.They calculate how their theoretical set-up fares against the time series data that they have on the US from 1950 until 2000. They further predict how health spending will rise up until 2050. Their empirical expose relies on previous estimates of the value of life and its relatively high magnitude. The implication of this high value of health is that the marginal utility of consumption must then be smaller than the diminishing returns to production of health. The time-series they back test their model against shows similarities to their predictions. In addition, they predict that health care will consume 30% of GDP by 2050. They do not calculate an income elasticity to reinforce their prediction but their empirical evidence is suggestive (Hall & Jones, 2007).

The genesis of the empirical analysis of the income elasticity of healthcare began in 1977 with Newhouse and *Medical-Care Expenditure: A Cross-National Survey*. The analysis was static, as the authors argued that in the year that each country was analyzed (around 1970), the countries had approximately the same disease burden. The thirteen countries were all Anglo-European. The OLS regression only had GDP as an independent variable and did not control for any other factors. The elasticities that they calculated all exceed one, although as income rose, the elasticities they calculated dropped. The study suffered from small sample size, lack of controls and the correlational nature of the analysis (Newhouse, 1977).

As data became more available and of better quality, the question of healthcare's income elasticity was revisited. Blomqvist and Carter analyze a set of OECD time-series data spanning 1960 to 1991. Using ordinary least squares they show that the majority of countries in their sample have elasticities below one, indicating that health care does not seem to be a luxury. The wide confidence intervals that they calculate merit some observation since in many of the cases their estimates ranged significantly above and below their point estimates. In addition to this finding they perform several time-series tests to evaluate the appropriateness of pooling data. They found that it is not appropriate to treat all countries as having the same intercept and they even cast doubt upon the correction of including country dummies to allow individual intercepts. A point estimate representing income elasticities for all countries may be misleading (Blomqvist & Carter, 1996).

Another evaluation of OECD data was done by Sen (2005). He used ordinary least squares, generalized least squares, weighted least squares and an instrumental regression to evaluate the impact of rising incomes on national expenditure on health care. The OLS regression found an income elasticity of approximately 1.2. He finds that in all other specifications, the estimates are significantly below unity except the IV regression, which is the only one performed that does not have a statistically significant result. He also includes time and country fixed effects in his regression. The conclusion that Sen came to was that after correcting for auto-correlation and heteroskedasticity, and including fixed effects healthcare becomes a necessity rather than a luxury (Sen, 2005).

Moscone and Baltagi and Moscone and Tosetti examined cross-national and regional data in two similar papers written in 2010. OECD data and data comparing American states are the basis of their analyses. In both papers they control for unobserved heterogeneity and cross-section dependence, a significant step above other analyses that exclude these crucial econometric steps. Their results show that at both the cross-national and regional level, health care is a necessity (Moscone & Tosetti, 2010; Moscone & Batalgi, 2010).

At a regional level, one of the most recent papers that's tests the theoretical implications of the Hall and Jones paper is *Income and Health Spending: Evidence from Oil Price Shocks* by Acemoglu, Finkelstein and Notowidigdo (2011). Using American hospital data they aggregate health spending at an economic sub-region level to evaluate how it is affected by increases in income. They find an income elasticity of health spending to be approximately 0.7 indicating that it is a necessity and not a luxury good. At the high end of the 95% confidence level the elasticity is approximately 1.1. This can only account for 0.5% of the growth in health spending in the US over 45 years. The impact of income rises concentrates in one area of health spending in their data. Payroll expenditures seem to see the greatest impact with some effects coming through in skill upgrading (Acemoglu, Finkelstein, & Notowidigdo, 2011).

Within the Canadian context, there is some relevant literature written by Livio Di Matteo. Di Matteo looks at the ratio of public to private spending using a log-log OLS regression. The dependent variable in this case is the ratio of spending and how it relates to the explanatory variables. His analysis shows that private health care has a higher elasticity of income than public health care and this, he argues, is the reason for the gradual decline of the public sector in health provision. This effect is small however as a rise in GDP of 1% will see a fall of public sector health provision by .25%. In addition he found that the elasticity of provincial health expenditures is 0.77 (Di Matteo, 1998; Di Matteo & Di Matteo, 2003; Di Matteo, 2010).

Finally a meta-analysis was conducted by Costa-Font, Gemmill, and Rupert (2009) in an attempt to evaluate the body of research as a whole. One finding that emerged is that there seems to be publication bias where previous findings influence current research. Another was that fixed effects and time effects are important, and in the earlier literature, are often overlooked. Once these factors are corrected for the elasticity of health falls to the point where it is no longer a luxury. Their estimate is that the income-elasticity of health care is between 0.28 and 0.8 (Costa-Font, Gemmill & Rubert, 2009).

To a large extent the finding that health is a luxury good has occurred at the cross-country level, whereas regional level studies have found elasticities that indicate that they are necessity goods. This may be an effect of aggregated data or what has been referred to above as the "general equilibrium effect". In particular, some have argued that regional analysis does not capture responses to technology adoption, information externalities, or institutional changes that are associated with health care. As an example, Finkelstein (2006) finds that the adoption of the new institution of medicare in the United States was associated with approximately 50% of the increase in health spending. The widespread nature of this change allowed hospitals to overcome the massive fixed costs that are associated with health care (Finkelstein, 2006) and a general increase in income should have the same effect if health is a luxury.

The conclusion that can be derived from the previous literature is that aggregation matters. It has a major impact on the resulting income elasticity for health care. At a cross-national level these national equilibrium effects may be picked up but the pooling of cross-national data also hides institutional and other important national set ups (Glaeser, Sacerdote, & Scheinkman, 2002). At a more disaggregated level, there may be an underestimation of the elasticity because the major global effects that come from rising incomes can not be discerned. These results must inform the methodology of any research that attempts to derive income elasticities of health care, especially when using disaggregated data.

3 Data and Methodology

The following theoretical background is similar to the Hall and Jones model (2007) concerning health utility and informs the econometric methodology. It also borrows heavily from Acemoglu et al (2011). Given a representative agent i that has the utility function

$$\pi(Q_{jt}e_{ijt})u(c_{ijt}) \tag{1}$$

where j denotes the region where the agent is located and t denotes the time period. Q denotes the quality of health care and e is individual health expenditure. Consumption utility is referenced by c. The budget constraint of the agent is

$$c_{ijt} + e_{ijt} \leq y_{ijt} \tag{2}$$

and the solution to this optimization problem is then characterized by the ratio

$$\frac{e_{ijt}}{y_{ijt}} = \frac{\eta_{\pi_{ijt}}/\eta_{u_{ijt}}}{1 + \eta_{\pi_{ijt}}/\eta_{u_{ijt}}} \tag{3}$$

where η denotes income elasticities. Taking the log of the above equation and approximating the Taylor expansion yields

$$log(e_{ijt}) = \psi log(Q_{jt}) + \beta log(y_{ijt}) + u_{ijt} \tag{4}$$

which is the basis for the partial equilibrium regressions in the Acemoglu et al. paper and other analyses of health elasticities. The general equilibrium effects on the health consumption of an area would manifest itself in the adoption of expensive technologies or in other large scale capital expenditures. This large barrier is overcome when there are general increases in a given regions level of income. This is captured in the following equation:

$$log(Q_{jt}) = \bar{\sigma_j} + \psi_0 log(y_{jt}) + \psi_1 log Y_t + \kappa_t \tag{5}$$

where y_{jt} is the area's income, Y_t is the national income capturing full general equilibrium effects, σ_j is an area specific effect that affects quality of health care, and κ_t is a time effect that encapsulates the global research and development improvements in health care.

3.1 Regional Data

The two data sets used in these analyses are split by the regional levels of aggregation they represent. The first data set is an amalgam of data collected from different sources but its level of aggregation is at a regional health level. In Canada, regional health authorities are responsible for the direct provision of healthcare to patients, and these regions are the basic unit of analysis. They are administrative areas as defined by provincial health ministries and the sample consists of 107 such health regions. At the time of the administration of the survey instrument there were 141 health regions in total. The set is composed of two years, 2001 and 2006, which are controlled for via a time dummy.

Health Utilization Variables: The measure of health utilization is taken from the Canadian Community Health Survey (CCHS). The CCHS is a cross-sectional survey that has been conducted at the regional health level since 2001 and its main focus is on collecting health related data. It is a micropanel survey, but it was possible to aggregate up the average number of times that people in a region visited family physicians. Average visits were also derived for physiotherapists, dentists, chiropractors, and psychologists. These variables are denoted by n_{jt}. The latter three professional services are, for the most part, privately provided in Canada (Health Canada, 2011).

Health Cost Variables: The utilization variable is augmented by cost data taken from several sources. Physician fee-for-service data is taken from CIHI's National Grouping System Categories Report for 2000-2001 and 2004-2005. Data for psychotherapy was also used from these reports to proxy the cost per visit to a psychotherapist. Data for physiotherapists is similarly proxied by the fee schedule for physicians who have a speciality in physical medicine. This speciality is employed to deal with chronic health issues in hospitals. Recommended fees for chiropractors and dentists were taken from their respective provincial association fee reccomendations. Only fee schedules for British Columbia, Alberta, Saskatchewan, Manitoba, and Nova Scotia could be found for chiropractors. Only fee schedules for dentists in Ontario, Nova Scotia, British Columbia, Saskatchewan, and Manitoba were located. These fee schedules were usually the most recent fee schedule that could be found, not the one that corresponded to the year of observation of other variables and these fee schedules are not rigidly adhered to. That these prices are only varied at the provincial level may be a cause for concern. Additionally, the sketchiness and ad-hoc nature of the collection of this data should make readers skeptical of these results but as presented later they are reinforced by results from the provincial level. These fee-for-services were multiplied by the per capita visits mentioned in the last paragraph to give a total cost per capita for each of the specialities. They are denoted as η_{jt}

Income Variables: The variable of interest, average income, was taken from the Statistics Canada - CANSIM database. This variable was derived from the 2006 and 2001 censuses. It is an average income over the health region and logged to approximate the normal distribution. This variable is denoted as y_{jt}.

Demand Controls-D_{jt}: These are a list of variables that induce people to demand health care, income being equal. The first control is a measure of the age of a population. As the proportion of people in a health region gets older, they are at increased risk of health issues and will utilize health care at an increased rate. This variable is constructed as a ratio of the population aged 65 and older to the total population and is denoted by a_{jt}. The source of this age variable is the CANSIM database compiled by Statistics Canada. The second demand control is a measure of the general health of a population given that unhealthy people should demand healthcare more. Derived from the CCHS, it is a ratio of people who report being in "good to full" health as a proportion of the population. This is denoted by h_{jt}.

Supply Controls-S_{jt}: Since the Canadian health care system and primary care especially, is mainly supply driven it stands to reason that there should be some control for this (Steinbrook, 2006). Included are two supply control variables in the regression. The first is the ratio of general practitioners to population, denoted by d_{jt}. The second is a quality measure of specialist doctors to total doctors in the population, denoted as q_{jt}. Although used differently, this quality measure is set up in a similar way to the

Acemoglu et al. paper where they proxy quality by ratio of registered nurses to total nurses in the region (2011). These variables are taken from the Canadian Institute for Health Information (CIHI) indicators database. As well as these two supply variables, there are dummy variables for each province that control for the direction that provincial health ministries provide. It is denoted as p_j.

The Canadian health delivery system poses several unique problems to the data that American data sets avoid. Canadian health care is delivered via a public conduit and almost all medical care is paid for by the government. Health budgets are set by the provincial authorities which may allow for cross-provincial comparisons of health provision. At this level it is possible to evaluate how income affects health spending using the theoretical model set up above. Regional health authorities are responsible for the administration of health care systems at a more local level but as there is no monetary cost to patients, except through taxes, the normal way of calculating income elasticities will not work here (Health Canada, 2011). The Hall and Jones theoretical background may not work in a disaggregated context because there is no free market for medical care in Canada and so no spending data exists. It may be possible to exploit this fact, however. This market imperfection often manifests itself as wait times to see doctors, which is the implicit price. This means that the budget of the representative agent remains

$$\bar{e}_{ijt} + c_{ijt} \leq m_{ijt} \times w_{ijt} = y_{ijt} \tag{6}$$

where w is the wage of the worker, m is the amount of time worked, and $\bar{e}$ is a tax levied to pay for public health care. The remaining variables are defined as in the previous budget constraint. The agents time constraint changes to become

$$l_{ijt} + m_{ijt} + (z_{ijt} \times n_{ijt}) = t \tag{7}$$

where l is the leisure the worker takes, z is the amount of leisure time that workers take to visit health care providers, and n is the number of times that they visit the doctor. If the cost of visiting a doctor, z, is fixed then the way for people to demand more health care is in additional visits to the doctor. Assuming a fixed wait time per visit, the true elasticity is estimated by

$$log(n_{ijt} \times w_{ijt} \times z) = \psi log(Q_{jt}) + \beta log(y_{ijt}) + \gamma_t + u_{ijt} \tag{8}$$

Given the data set containing regional visits and the costs of medical practitioners this may be the best way to calculate elasticities at a lower level of aggregation. This necessarily assumes that the price paid to the practitioner is the same as the opportunity cost of leisure given up. The main stage regression is then

$$log(n_{jt} * \zeta_{jt}) = p_j + \beta log(y_{jt}) + D_{jt} + S_{jt} + \gamma_t + u_{jt} \tag{9}$$

where ζ_{jt} is the price of the medical practitioner, γ_t is the fixed effect controlling for time and u is the error term.

An issue that has been mentioned previously is that when trying to discern the impact of income on health, there is simultaneity. It is unclear whether health utilization leads to higher incomes or higher incomes induce more health utilization. It is therefore important to instrument income with a variable that is exogenous to the variable that concerns health consumption. Additionally if the general health of the region's population is to be controlled for, this is clearly not exogenous from health utilization. This must be instrumented for as well. The correlational nature of much of the previous literature cannot properly address what the income elasticity of health care is since the coefficient estimates will be biased. More importantly it is ambiguous what way ordinary least squares is biased. Should income and health be correlated, and consequently people lower their health consumption, then ordinary least squares will be biased downwards. If income is correlated with increased usage of health services (since wealthy people can afford cars, baby-sitters etc.) then the bias will go in the opposite direction. A two-stage regression where the endogenous variables are instrumented for will correct this bias.

Instruments: There is a necessity for two instruments in this regression because of simultaneity relating to dependent variable. One would think that both the health of a region h_{jt} and its income y_{jt} would be functions of the regions health utilization n_{jt}.

Both variables then explain and are explained by health utilization. Instrumenting for income is a ratio of the number of people in the population who have completed post-secondary education. This is denoted as e_{jt} and is derived from the Canadian census. Education is unlikely to be theoretically correlated with health utilization. Instrumenting for the stock of health of the regional population is the number of persons in a region who are moderately active or active as a ratio of the total population. As an environmental factor physical activity is unlikely to cause the health utilization of a region. This variable is derived from the CCHS and is denoted as k_{jt}.

The two first stage regressions are then specified as

$$log(y_{jt}) = p_j + \gamma_t + \delta log(e_{jt}) + D_{jt} + S_{jt} + u_{jt} \tag{10}$$

$$log(h_{jt}) = p_j + \gamma_t + \sigma log(k_{jt}) + D_{jt} + S_{jt} + z_{jt} \tag{11}$$

where u_{jt} and z_{jt} are the error terms associated with the first stage regressions and the other variables are defined as above.

3.2 Provincial Data

As has been noted the overall demand for healthcare in a region may shape and change healthcare policy in ways that partial equilibrium effects do not, especially within the Canadian healthcare system. In the American healthcare system, higher incomes induce healthcare providers to enter the market despite having to overcome the considerable fixed costs associated with entry (Glaeser et al. 2002). This manifests itself in the creation of new hospitals and more expensive medical technologies. If it is the case that health is a luxury good then, in the Canadian context, provincial governments should respond to general equilibrium effects associated with regional increases in income. This increase in demand would manifest itself, in the case of family doctors, in a greater number of visits per person to their physician as mentioned above.

The issue with the primary data set is that it may not take into account these general equilibrium effects. Variables in this data set are measured in per capita terms and this does not take scale into account. If, for example, a region has a high average income (and high average demand if health is a luxury good), but low population, it might not have sufficient demand to get additional technologies or hospitals. The region may not be able to overcome the fixed costs inherent in practicing medicine (Finkelstein, 2006; Acemoglu, Finkelstein, & Notowidigdo, 2011). This may not be an issue as the regional data concerns itself with family physicians and other relatively inexpensive medical professionals. While family doctors are expensive to pay they do not have many fixed costs like hospitals. Nevertheless it may bias the results of the regional data, hence the additional analysis on a more aggregated data set.

The second data set consists of provincial level data to test the robustness of the regional level results. The data in the main-stage regression is over 12 years from 1996 to 2008 and only concerns public health expenditures. In this case both total spending on health and specific spending on health sectors can be examined. Total health spending is denoted as S_{jt}. The specific sectors include physician, hospital, public health, capital, drug, administration, and other health-related expenditures. Life expectancy is used as a variable to control for the general health of the population; this is taken from the Canadian Human Mortality Database and is denoted as H_{jt}. Control variables include the amount of funding that the federal government provides to the provinces through the Canadian Health and Social transfer and the dependency ratio of a province. These are denoted as T_{jt} and D_{jt}. The latter variable is defined as the percentage of the population below 15 and above 65 years of age. Both variables are taken from the CANSIM. Provincial GDP is also taken from the CANSIM and is denoted as Y_{jt}. The main-stage regression is then specified as

$$\log(S_{jt}) = \beta log(Y_{jt}) + X_{jt} + \psi_t + \omega_j + u_{jt} \tag{12}$$

where ψ_t is the fixed effect controlling for time ω_j is the fixed effect controlling for province, X_{jt} is the vector of control variables and u_{jt} is the error term.

The provincial regressions still require two instruments to deal with the same simultaneity issues that income and health had in the regional regressions. Instrumenting for health is a lagged infant mortality ratio taken from CIHI's indicator database. The variable is lagged by 15 years and is denoted as I_{jt}. The reasoning for this is that the instrument is a decent proxy for the health of the very young. Early health outcomes have been shown to be persistent over time and so will effect the life-expectancy of a province many years later (Case, Fertig, & Paxson, 2005). Current life expectancy should not have any effect on the instrument and there is no reason to think that infant mortality 15 years prior should affect the current level of health spending except through unhealthy people. Two variables are used to instrument for provincial GDP. Taken from the CANSIM, they are the number of workers in the natural resources sector and average wage in the natural resources sector. The former variable is transformed into a ratio of workers to total population to proxy the abundance of a provinces natural resources. The wage of the worker proxies for the worth of the natural resources. These are denoted as N_{jt} and W_{jt} respectively. The first-stage regressions are then

$$log(Y_{jt}) = \beta_1 log(N_{jt}) + \beta_2 log(W_{jt}) + X_{jt} + u_{jt} \tag{13}$$

$$log(H_{jt}) = \sigma log(I_{jt}) + X_{jt} + z_{jt} \tag{14}$$

where z and u are error terms and X is a vector of control variables.

There are some benefits to having care that is government mandated. The fact that healthcare is distributed based upon need in Canada negates some of the issues that American datasets have. The Canadian Social and Health transfer is an attempt to guarantee a certain level of care for Canadians across the country and so affects quality indicators such as wait times. There is an explicit attempt to guarantee equality of quality that, at a cross-provincial approximation, means that controlling for provincial effects there should be little variation in quality of care. This assumption then negates the need to use a quality term in the provincial level regression.

The assumption of equality of quality is tested using an omitted variable test. The proxy for quality are variables that measure readmission rates for heart attacks and asthma attacks. These two variables measure the percent of patients that have to be readmitted to hospitals because of an error in initial medical treatment. The latter variable is rejected by the OV test and the former is only significant at the 10% level (p=0.098) and so neither are used.

4 Results

4.1 Regional Results

Table 1 documents the first-stage results for the instrumentation of the control variable and variable of interest in the first data-set. The results show that the first-stage regressions have fairly high R^2 and the instruments predict well how the health and income of a region will develop. The first stage of the alternate instrument is also presented and shows good fit and a good F-statistic.

Table 1: First-Stage Regional Regressions

Dependent Variable:	**Health**	**Income**
log(physical activity)	0.429	
log(education)		0.790
Partial R^2 of Instruments	0.3487	0.5997
F-Test of Instruments	47.91	89.38
Model R^2	0.5186	0.8691
F-Stat	14.83	91.40
log(physical activity)	0.488	
log(language)		0.0546
Partial R^2 of Instruments	0.2982	0.3462
F -Test of Instruments	38.46	47.92
Model R^2	0.5312	0.8128
F-Stat	12.16	63.41

The main stage regressions are presented in Table 2. The first is a simple OLS regression that attempts to show the correlations between income and health utilization. The coefficient is positive but not significantly different from zero. If the point estimate is to be believed it indicates that health care is a necessity and that as income rises by 10% there should be a increase in utilization by 0.74%. As has been mentioned, bias should be expected arising from the issue of simultaneity. Additionally, this estimate is not statistically different from zero.

The instrumented regressions are presented below the OLS regressions. The OLS estimates are significantly biased downwards compared to the instrumented regressions.

A z-test confirms that the point estimate in the IV regression is statistically different from the OLS point estimate. The coefficient for the income elasticity of health is estimated in the IV regression as 0.674, meaning that for every 10% increase in income there is a 6.74% increase in family doctor utilization. This would indicate that, while a normal good, healthcare is not a luxury good. At the high end of the 95% confidence interval the estimation of the income elasticity is 1.1.

Table 2: Main-Stage Regressions for Regional Data

OLS Regression Results			
Variable	**Coefficient**	**(Std. Err.)**	**P-Value**
Average Income	0.0737	(0.0885)	0.407
Health	0.0973	(0.0871)	0.266
Age Ratio (over65/total pop)	0.181	(0.390)	0.644
Specialist Ratio	-0.0822	(0.0695)	0.239
General Physician Ratio	0.0004	(0.0004)	0.354
Time Dummy	-0.117	(0.0252)	0.000
N	197		
Centered R^2	0.7709		
$F_{(14,186)}$	43.74		
IV Regression Results			
Variable	**Coefficient**	**(Std. Err.)**	**P-Value**
Average Income	0.674	(0.217)	0.002
Health	-0.175	(0.256)	0.493
Age Ratio (over65/total pop)	2.279	(0.790)	0.004
Specialist Ratio	-0.197	(0.087)	0.024
General Physician Ratio	-0.000134	(0.0004)	0.770
Time Dummy	-0.2517	(0.0507)	0.000
N	196		
Centered R^2	0.7143		
$F_{(13,.)}$	35.57		

The fairly large discrepancy between the point estimates of the OLS regression and IV regression requires some explanation. As can be seen the OLS estimates are substantively biased downwards. Running regressions while only instrumenting for one variable will help to locate the source of this bias. Instrumenting only for income yields an elasticity of 0.515 while instrumenting only for health yields an elasticity that is not significantly different from zero. This would suggest that the bias is largely caused by a lack of instrumentation for income. Further, this should indicate that health spending at the regional level is negatively correlated with income that is not related to the control variables and education. Why would this be the case? It may be the case that health regions with higher incomes have easier access to health care. There was no controlling for urbanization of a region and this would be correlated with income. Places like cities with better access can substitute away from health care to other goods since they can get more health care for a cheaper opportunity cost. They then allocate less spending to health.

The estimates for the income elasticities of other health professionals are presented in Table 3 and they exhibit a range of values but most are under unity. None of the categories could be considered a luxury good. Only dentists and chiropractors have statistically significant income elasticities at 0.795 and -1.684 respectively. Dentists have an income elasticity that is similar to family doctors but is marginally higher. The result that chiropractors are inferior goods is quite surprising and one for which this analysis has few explanations. It may be that this particular model omits key variables on chiropractors and so suffers from model misspecification. Additional explanations are also presented in the discussion.

Table 3: Other Health Services Regional Elasticities

Dependent Variable:	**Dentists**	**Chiropractors**	**Physiotherapists**	**Psychologists**
Income Elasticity	0.795	-1.68	0.687	0.513
Standard Error	(0.165)	(0.712)	(0.520)	(.836)
P-Value	0.00	0.018	0.187	0.539
R^2	0.842	0.681	0.666	0.589
F-Test	60.87	27.23	25.0	18.34
N	123	139	179	180

An additional instrument for income is tested, since there is a valid argument that education and health may be correlated. Similarly it may be argued that education and income may have a causation reverse of what the instrument assumes. Better educated people may know more about their health and so utilize health care more when they become sick. Alternately, people with more income may demand more education rather than education leading to more income. Instead of education, the proportion of people whose mother tongue is not an official language is used as an instrument. This would be a relevant instrument as the ability to get a job, run a business, or derive any sort of personal income is predicated on the ability to speak the local language. It stands to reason that the impact of not knowing english or french as a first language on health utilization would then be through income. The results are shown in Table 4. The point estimate for income elasticity is lower than in the previous specification at 0.652, and it is valid at the 1% level. Health remains a necessity in this different specification.

Table 4: Regional IV Regression with Alternate Income Instrument

Variable	**Coefficient**	**(Std. Err.)**	**P-value**
Average Income	0.652	(0.210)	0.002
Health	-0.164	(0.223)	0.462
Age Ratio	2.242	(0.759)	0.003
Specialist Ratio	-0.192	(0.0886)	0.030
General Physician Ratio	0.0001	(0.0004)	0.767
N	196		
R^2	0.714		
$F_{(15,.)}$	35.57		

4.2 Provincial Results

Moving on to the analysis of the provincial data, the first stage regressions for the provincial data are presented in Table 5. The instruments show decent explanatory power. The values of the coefficients are as expected and help confirm the validity of the instruments.

Table 5: First-Stage Provincial Regressions

Dependent Variable	**Life Expectancy**	**GDP per Capita**
Infant Mortality	-0.0115	
Resource Wage		0.0868
Resource Workers		0.0146
Partial R^2 of Instruments	0.1717	0.0846
F Test of Instruments	7.20	3.20
Model R^2	0.7637	0.8036
F-Test	56.04	70.92

Table 6 shows the results for the income elasticity of total health spending as the estimated coefficient for provincial GDP. Both OLS and IV results are presented. The income elasticity is estimated as 0.83 in the instrumented case. The point estimate of this coefficient is not above unity providing additional evidence that health spending is not a luxury good. Additionally the estimates are not that dissimilar to Di Matteo's

OLS estimates although the model specification is different and as previously mentioned OLS estimation should be biased in this case.

Table 6: Main-Stage Regressions for Provincial Data

OLS Regression Results			
Variable	**Coefficient**	**(Std. Err.)**	**P-Value**
log(GDP per Capita)	0.467	(0.054)	0.00
log (Life Expectancy)	-1.877	(0.722)	0.10
Dependency Ratio	-0.007	(0.002)	0.00
Federal Transfers per Capita	815.752	(45.524)	0.00
N	132		
R^2	0.819		
$F_{(4,127)}$	144.028		
IV Regression Results			
Variable	**Coefficient**	**(Std. Err.)**	**P-Value**
Log(GDP per Capita)	0.829	(0.422)	0.022
Log(Life Expectancy)	6.481	(2.836)	0.050
Dependency Ratio	-0.038	(0.013)	0.003
Federal Transfers per Capita	99.578	(74.669)	0.182
N	120		
R^2	0.949		
$F_{(14,.)}$	479.001		

Additional elasticities are presented in Table 7 for specific categories of provincial health spending. The only categories of health spending that have statistically significant coefficients are hospital spending and capital expenditures at the 5% level and other personnel expenditures at the 10% level. All three categories of spending have elasticities above unity, indicating that they are luxury goods. They also may be driving much of the rise in health spending relative to other categories, given an overall elasticity under unity.

While the previous income elasticities have been in per capita form, I have argued earlier that this may underestimate the actual value. The best way to correct for this general equilibrium effect is to specify a regression without an adjustment to per capita variables. This regression is shown in Table 8. The income elasticity is 0.946, meaning that for every 10% rise in income health spending should only rise by 9.5%. Even taking into account these global effects, health care is still a necessity.

Table 7: Provincial Health Spending Elasticities

Dependent Variable:	Hospital Spending	Physicians	Drugs	Administration
Income Elasticity	1.24	0.186	-1.159	-1.763
Standard Error	(0.534)	(0.533)	(1.009)	(1.252)
P-Value	0.020	0.727	0.251	0.810
R^2	0.8923	0.9194	0.8773	0.7538
F-Test	225.41	301.59	195.91	82.60
Dependent Variable:	**Other Personnel**	**Capital Expenditures**	**Other Institutions**	**Public Health**
Income Elasticity	2.249	10.552	-1.505	0.669
Standard Error	(1.347)	(4.146)	(1.284)	(0.872)
P-Value	0.095	0.011	0.241	0.443
R^2	0.5313	0.0713	0.5320	0.8803
F-Test	5.63	11.95	37.86	190.23

Table 8: General Equilibrium Provincial Regression

Variable	Coefficient	(Std. Err.)	P-value
Log(GDP)	0.946	(0.361)	0.009
Log(Life Expectancy)	6.119	(2.777)	0.028
Dependency Ratio	-0.041	(0.013)	0.001
Federal transfers	0.000	(0.000)	0.259
N	120		
R^2	0.952		
$F_{(14,.)}$	506.084		

It must also be noted that there are some surprising non-results that emerge from this analysis. Drug expenditures, for example, seem to be an inferior good although this estimate is not statistically significant. The data are concerned with public expenditures only and this may explain this phenomenon because most drug expenditures in Canada are private expenditures. It may be indicative of a trend that as incomes grow the government shifts many of these expenditures to the private sector.

Perhaps the most interesting result and contrary to the Acemoglu et al. findings is that there is weak evidence of technology upgrading as a response to rising incomes. The capital expenditures category relates to equipment, machinery, and construction expenditures at hospitals and other institutions and the point estimate for this is both significant at the 5% level and much greater than unity. This result should be taken with caution for several reasons. First, the level of aggregation does not allow for a definitive evaluation of technology adoption or hospital entry; it may be that these are new hospital buildings, additional units of the already adopted technology or replacements for depreciated capital.

Second there may be an omitted variable bias. The R^2 value is very low, which does not necessarily imply omitted variable bias but in tandem with the econometric models lack of specificity to capital expenditures strongly suggests this is the case. Capital expenditures in health care can be fairly "lumpy" and time dependent, meaning that large capital projects can concentrate at certain points in time (Di Matteo & Di Matteo, 1998). One of the major factors that might influence this result was the Canadian federal budget-balancing just prior to the data period. It is possible that with the slashing of fiscal transfers, to the provinces there was a pent-up demand for capital projects in certain provinces as health budgets returned to normal after the fiscal retrenchment.

If this is true, then the high elasticity of demand should disappear as the evaluation period progresses further away from the period of fiscal retrenchment. Restricting the evaluation period to after 2003 yields an elasticity of 5.141 that is not statistically significant at the 10% level. Removing the years 1998, 1999, and 2000 drops the elasticity to 7.05 significant at the 5% level. This period corresponds roughly to the period of time after the Canadian fiscal retrenchment ended. This change suggests that this high elasticity is at least partially due to these time specific effects that would not be captured by the time variables included in the regression.

5 Discussion

The period analyzed was a period from 2001 to 2006. During this time health spending as a percentage of GDP rose from 9.3% to 9.5%. Returning to the point-estimate for the elasticities shown in Table 1 of the results section, the income elasticity calculated for family doctors is 0.674. This result suggests that health care is a necessity and health spending should decline as a percentage of GDP over time. The decline over the 5 year period in question would reduce health spending as a percentage of GDP from 9.3% to 9.1%. At the upper end of the 95% confidence interval, the estimate is 1.1 which would suggest that it can account for an increase of only .1% from 9.3% to 9.4%. This increase can explain approximately 50% of the actual increase in health spending as a percentage of GDP.

Examining the alternate specifications of the model that regard other health services the analysis finds some evidence corresponding to an increase in private health care spending compared to public health care spending. Higher income elasticities are found for dentists relative to family physicians. This greater elasticity should mean that a greater share of health care will be allocated to these sectors than publicly funded family doctors as incomes rise. This provides some indirect support for the Di Matteo thesis.

The alternate models concerning other health professionals give very interesting results. The highly inferior nature of chiropractors was especially surprising and not something that is easily explainable at first pass. It may be that since chiropractic is an alternative medical field it may have reputational concerns and so as incomes rise people substitute towards less risky, and perhaps more effective medical care. Physiotherapy may be this substitute (although making any inferences about it is sketchy due to its lack of statistical significance). The specific types of injuries that each practice deals with may also effect the clientele. Chiropractors deal largely with back and spinal injuries and many of these could be caused by job-related stresses. The types of jobs that are subject to these back injuries may be low-income labour jobs. This omitted variable may explain the supposed connection between income and chiropractic use. Empirical evidence from the United States does back up this estimated elasticity. From 1997 to 2002 chiropractic use dropped from 9.9% to 7.4% (Tindle et al. 2005).

Turning to the provincial level data, the point elasticity for that data set is 0.828 indicating that a 10% increase in GDP would boost health spending by 8.28%. The closeness of this value to the value derived in the previous data would seem to validate the findings at the regional level. Over the period of observation, health spending rose as a percentage of GDP from 8.8% to 9.8%. This elasticity means that over the 12 years of health spending, there should have been a decline in the percentage of GDP devoted to health spending from 8.8% to 8.5%.

An argument can be made that the partial equilibrium response to rising incomes will be less than the general equilibrium response, as there are tremendous fixed costs for entry into the medical services market, especially for hospitals. As the previous two regressions are in per capita terms, they only capture a partial equilibrium effect. While the analysis cannot be done with the regional level, the provincial data can be aggregated to give a general equilibrium result. A regression without the per capita adjustment yields the point estimate of the income elasticity at 0.95. This result was significant at the 1% level. This upper bound would then reduce health spending as a share of GDP to 8.7% over the period of observation.

The provincial level data clashes with one of the results that the Acemoglu et al. paper (2011) finds, namely that hospital expenditures have a similar elasticity to all health spending. The results of this analysis seem to suggest that hospital spending is in fact a luxury good, contradicting these previous results. It seems in Canada that hospital spending should increase as a proportion of GDP as income increases. This is problematic as there is no way to evaluate the global general equilibrium effects that are associated with the high income elasticity of capital expenditures. Although this may not be a problem with utilization of health professionals dealt with in the regional data it may have an impact on the provincial data. This general equilibrium bias should be smaller than what would otherwise be expected since the lack of free-market health care means less pressure on providers to upgrade their technology or services. This lack of market discipline may be part of what is restricting Canadian health spending relative to American consumption although it by no means implies that this restriction is optimal.

For the sake of clarity, there are several flaws in this analysis that must be discussed. The first is the major supposition that in a non-market setting the estimate elasticity is the true elasticity of health for what people desire. In the regional data this issue arises in the calculation of elasticity. The number of visits n_{ijt} multiplied by the price of the health providers service is used as the implicit way that people "buy" visits to a family doctor, but it does not take into account the wage that workers give up to visit a doctor. An increase in income has two competing effects: the first is that people will increase their consumption of health care if they gain utility vis a vis the Hall and Jones theory; the second is that the implicit price of health care increases as the income of the agent increases, meaning that they should cut back on health consumption given time constraints. The IV regression assumes that this price is the same for all agents (controlling for provincial prices) by only using number of visits as the cost and implicitly assuming the wage of all workers is the same. For those whose wage is higher than the free market price, they should under consume healthcare relative to the free market scenario. This should mean that the estimate will be biased downwards in the sense that the free market elasticity, with costless family physician visits (in terms of time), will be higher since the only cost to consumers is financial. Alternately if the implicit price of visiting a doctor is lower than what it would be in the free market setting eg. the wage given up is less than the free market price, the agent will overconsume the good. This should bias the estimate upwards. These issues do not even address the fact that there are substantial questions about the accuracy of some of the data collected to determine price.

The same assumption of market efficiency of Canadian health delivery also applies to the provincial data, but in a different way. The implicit assumption in this part of the analysis is that the government is responsive to consumers needs concerning health care. To examine this the income variable was lagged to take into account policy lags associated with a government response that is less than optimal. Lagged by one year, the income elasticity is greater than unity and is significant at the 1% level. Lagged further the elasticity becomes less than unity but insignificant. Arguably, the latter estimates are more relevant since the provincial elections occur approximately every four years and these elections are where major health care policy is usually set to be carried out until the end of the term.

To further test the robustness of the model against this flaw the original provincial regression is augmented by a variable that marks when provincial elections occur. The variable is the number of years since a provincial election with zero years denoting an election year. The results are presented in Table 9 and introducing this variable only reduces the income elasticity of healthcare. The magnitude and significance of the variable is interesting in that while small, it is negative, indicating that governments tend to respond to healthcare demands immediately after elections.

Table 9: Augmented Provincial Regression with Election Variable

Variable	Coefficient	(Std. Err.)	P-value
Log(Life Expectancy)	5.998	(2.683)	0.025
Log(GDP per Capita)	0.767	(0.412)	0.063
Dependency Ratio	-0.042	(0.012)	0.001
Transfers per Capita	97.825	(71.993)	0.174
Years from Election	-0.009	(0.004)	0.038
N	120		
R^2	0.952		
$F_{(15,.)}$	410.639		

The validity of the instruments in the first regression may also be called into question. The health instrument in particular may be an issue. If people are very sick, they may not exercise properly, which reverses the causation of the instrument. Rather than poor physical activity leading to bad health, bad health leads to poor physical activity. The question is how this will impact utilization of family doctors. Arguably those who are in such poor health, and as a result cannot be physically active, will not be seeing family doctors but rather specialists for their particular condition. This means that it can be expected that they will not see a family doctor at all. This may bias the health of a region's impact on utilization upwards implying that there is a more negative relationship than estimated by this analysis.

Additionally there has been research that has linked education directly to health outcomes. This would invalidate the use of education as an instrument for income. While education plays a role in its impact on income and occupation, and through these effects health, there is some evidence that education is itself a factor in causing healthy people. Lleras-Muney (2005) found that an additional year of schooling decreased ten year mortality rates by 3.6%. One of the explanations for this is the types of lifestyles that the less educated often participate in. The less educated are more likely to smoke, to be overweight, and to chronically use drugs. They are also less likely to use preventative care such as vaccines and diagnostic tests (Cutler & Lleras-Muney, 2006). These behavioural differences seem to account for one third of the differences in health outcomes. Income seems to account for an additional third of the effect of education on health. The effect of behavioural change may not be so pronounced in the Canadian system as the better educated will have better incomes and then avoid family physicians because of the time costs associated with visiting; nevertheless the inclusion of the second instrument should mitigate any concerns about this.

6 Conclusion

This paper's analysis has focused upon how rising incomes have impacted health spending in Canada. The results do not lend support to the idea that health care is a luxury good, but rather it is a necessity with an income elasticity below one. The results are important because they suggest that incomes rises do not explain the increasing share of GDP devoted to health care. This raises more questions concerning what is driving this secular rise in health spending, and if it is, in fact, optimal.

Using two data sets, this paper has attempted to determine the causal impact of income on health spending. Instrumental variables were necessary to determine causation because of the reverse causality inherent in the data. In the regional data, the instrumentation used education and physical activity to estimate the confounding relationships. While potentially exogenous from health utilization this strategy may have neglected global equilibrium effects that aggregate data would better detect.

Using the additional provincial data set, the analysis instrumented for health and income by using a lagged health variable and a measure of natural resource intensity in the local economy. This alternate data found a similar elasticity to the regional data. These instruments had the benefit of both being exogenous and picking up a global equilibrium effect that is associated with the economic impact of natural resources.

The estimates that this paper has found for the income elasticity are between 0.7 and 0.95. Using these figures, it was determined that health spending should have fallen over the period of time analyzed. The actual rise in spending, it seems was not due to income, but to another source. Several alternate hypotheses to source this rise include the role of health institutions such as insurance (Finkelstein, 2006), or increased use of technology or technology upgrading (Bodenheimer, 2005). Both of these explanations must be tested to see how they have affected the rise of health spending over the past 50 years.

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