UNIVERSITY OF CALGARY

An Empirical Analysis of Canadian Public health Care Spending and Health: 1975-1996

by

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A THESIS SUBMITTED TO THE FACULTY OF GRADUATE STUDIES IN

PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE

DEGREE OF MASTER OF ARTS

DEPARTMENT OF ECONOMICS

CALGARY, ALBERTA

DECEMBER, 2001

ABSTRACT

The marginal productivity of public health care spending in Canada has been questioned in the presence of pressures from continuous increase in the spending. This thesis empirically estimates the effects of public health care spending on health outcome indicators such as gender specific infant mortality rates, age-standardised mortality rates, and life expectancies at birth. The econometric method employed explores the simultaneous relationship between public health care spending and health using annual data collected from the ten Canadian provinces for 1975-1996. The results suggest that a decrease in public health care spending has statistically significant negative effects on population health. The effect of public health care spending on public health is more than twice that found in previous studies which do not account for the simultaneous relationship. Overall, the effects are greater on infant mortality rates than age-standardised mortality rates and life expectancies at birth, and are greater for males than for females.

ACKNOWLEGEMENTS

This thesis took not only the compilation of lots of numbers, but it also required much encouragement and support from my friends and family.

I would like to thank my supervisor Dr. M. Christopher Auld for his patience, insightful guidance, and unending encouragement. I would also like to thank Dr. Cam Donaldson for his support and encouragement. I also wish to acknowledge Dr. Daniel Gordon and Dr. Rollin F. Brant for their comments and suggestions.

I want to thank my family for showing me so much love and for sharing their lives with me.

A special thank you goes out to James A. Rossmanith for his endless love and care.

To my parents

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CHAPTER ONE: Introduction

Health care has been one of the most discussed issues in Canada. Many Canadians are proud of Canada's public health care system. However, growing public health care spending has been putting pressures on politicians and tax payers, while out-cries for more resources have been getting louder. According to a recent survey by the Canadian Medical Association, the vast majority of those polled, 82% believe that long-term sustainable funding is the key to improving the health system, and more than half of respondents think government spending on health should increase even if it means higher income taxes (Globe and Mail, 2001). More health resources will allow more health goods and services to be available to Canadians. However, an unlimited amount of public funding to the health system is certainly not a viable solution nor a possible option since health is not the only concern for welfare of Canadians. Public funding should be allocated across fields including the health system to maximize the welfare of Canadians and involve prioritization for the best allocation.

Total health care spending accounted for 10.2% of Gross Domestic Product (GDP) in 1992 and went down to 9.5% of GDP in 1996. The 1996 nominal total health care spending[1] in Canada was $72.2 billion, or $2,510 per capita. About 70% of total health care spending comes from public sector funding while the remaining

[1] According to Health Canada, hospitals, physician fees, other professionals, and drugs took 34.2%, 14.4%, 8.8%, and 14.4% of total public health expenditures, respectively in 1996. Summary statistics of provincial per capita number of civilian physicians are presented in Table 3.1. Even though there were small fluctuations in the level of the spending in the last two decades, an increasing trend of total health care spending was continued until 1992. Since 1992 real per capita total health care spending (in 1992 dollars) followed a decreasing trend up to 1996. However, post-1992 real per capita total health care spending was comparable to pre-1992 real per capita total health care spending as both were about 43% greater than that of 1975.

30% is financed privately through supplementary insurance, employer sponsored benefits or directly 'out-of-pocket'[2] (Health Canada 2000). As public health care spending takes about 70% of total health care spending, public health care spending in Canada also has been continuously increasing parallel to the increase of total health care spending, and about one third of provincial program expenditures have been spent on public health care in last two decades.

Given the importance of public health care spending in the Canadian economy and the growing public concern, this study attempts to analyse the question: Does more public health care money lead to better health for Canadians? The question regarding the contribution of public health care and medicine towards the health of the population, especially at the margin, has an important implication for policy decision making regarding the optimal allocation of available fiscal resources. If marginal public health care spending yields no or little benefit, should other public concerns such as education be instead financed with the marginal spending? Establishing the relationship between public health care spending and health will allow us to analyse the impacts of amount changes in public health care spending on health of the population. While contradictory findings about the relationship exist, this thesis will examine the relationship between public health care spending and health using a simultaneous equations model employing instrumental variable (IV) estimation.

Most existing regression analyses take the level of health care spending, in this case total health care spending, as an explanatory variable and the dependent

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[2] For the public sector funding, British Columbia and Alberta utilize health care premiums (Health Canada 2000)

variable of health, primarily using only single-equation estimation. They assume health care spending and other factors determine health, but health care spending is independently or exogeneously determined, thereby ignoring the endogeneity involved in the relationship between health and public health care spending. It is possible that health outcomes are determinants of level of health care spending along with other factors, not just vice versa.

It is most likely that health and public health care spending are simultaneously determined. Populations with a lower health status would demand more health care goods and services, thus increasing health care spending to improve its low health status. On the other hand, populations with higher health status would demand less of them, thus spending less money for health care.

At the same time, it is likely that greater public health care spending results in improved population health, and this will be followed by a decrease in public health care spending as demand for health services and goods would decrease. Once again, it is likely that a decrease in public health care spending would result in deterioration of population health due to insufficient amounts of health services and goods provided, and this will be followed by increase in the spending for the reason described above, and so on. Thus, health and public health care spending are simultaneously determined. If public health care spending is determined by other various factors, as well as by health, multiple-equation techniques may lead to more accurate and robust estimation of the effects of public health care spending on health by accounting for the endogeneity. In this thesis, a methodology considering the simultaneity is examined to choose more adequate econometric estimation to establish the relationship between them.

This thesis consists of six chapters. Previous empirical literature analyzing the relationship between health and public health care spending and their determinants are outlined in Chapter Two. Chapter Three presents details for data used in this study. In Chapter Four, econometric model used to estimate the relationship between health and public heath spending is outlined, and the estimation of empirical model is also discussed. Results from the empirical study are presented in Chapter Five, followed by Chapter Six with a discussion and the conclusion.

CHAPTER TWO: Literature Review

2. Introduction

An analysis of the relationship between health and public health care spending must face the difficulty of defining health and selecting reliable health outcome indicators. Therefore, studies on health outcome indicators are reviewed in section 2.1 prior to the review of studies focusing on the relationship in this chapter.

There are few studies that examine the possible bi-directional relationship between health and public health care spending in the analysis of these two factors. Most studies attempt to analyse the relationship without considering the possible simultaneity. While a set of studies focuses on the relationship between health and public health care spending, the other set focuses on the determinants of public health care spending. These two sets of studies are analysed to find the best specification of empirical model and estimations. In section 2.2 and 2.3, Canadian and international studies examining the relationship between health and health care spending will be reviewed. Section 2.4 will present the review of studies on determinants of public health care spending. In the final section, problems involved in methodologies employed in the existing studies will be discussed.

One of the most recent empirical studies about the relationship between health care spending and health outcomes by Cremieux *et al.* (1999) finds lower total health care spending is associated with a statistically significant increase in infant mortality rates and a decrease in life expectancies in Canada (Cremieux *et al.* 1999). On the other hand, Filmer and Pritchett (1999) find no statistically significant impact of public spending on health in their cross-national study. They conclude that public health care spending is not a powerful determinant of mortality rates while variations in mortality rates across countries can be well explained by national income per capita, inequality of income distribution, extent of female education, level of ethnic fragmentation, and predominant religion (Filmer and Pritchett 1999).

2.1. Health Outcome Indicators

Studies on health and public health care spending are faced with the problem of defining health (or health outcomes). The definition of health can be very broad. Consequently, there is a lack of available data for comprehensive health indicators, especially for a large population at aggregate level. Thus, these studies use proxies such as age-standardized mortality rates, infant mortality rates and life expectancies at birth. Hadley (1982) observes that the construction of a health status index faces two major difficulties in the attempt to develop an index incorporating a broad definition of health and to designate a single item as an indicator or proxy for the health of a population. One is the lack of a precise, unambiguous, and operational definition of health. The other is the lack of requisite data. However, mortality is a clearly defined event. There is no need to determine duration, intensity or severity; all of which would have to be specified for various morbidity measures. The techniques for defining and reporting mortality rates data have been standardized to a point unmatched by methods for defining and reporting morbidity data (Hadley 1982). Waaler and Sterky (1984) recognise infant mortality rate as a useful indicator of the health status for infants as well as for the whole population. They also consider it as a good indicator of the socio-economic conditions under which they live. Annual life expectancies at births are calculated based on mortality rates, yet give us somewhat different interpretation than mortality rates[3].

For the reasons described above, single item indicators such as infant mortality rates and life expectancies are generally recognized in the literature as the best available proxy for health outcomes (Leu 1986). More importantly, mortality rates data is comparatively simple and widely understood by both policy makers and the general population (Hadley 1982).

2.2. Studies Finding a Statistically Significant Relationship between Health and Health Care Spending

2.2.1. Wolfe (1986)

Barbara Wolfe (1986) finds a link between greater medical health care spending and improved health status. To identify the link, she first identifies the real increases in medical spending and accounts for negative lifestyle changes that worsen health status and increase medical care utilization. For the period of 1950 through 1980, health status (infant mortality rates, life expectancies at birth and at age 60), lifestyle (tobacco consumption, number of persons injured in road accidents per million, percentage of labour force in risky industries, percentage of labour force toward safe industries), and total health care spending (total health care spending as a percentage of GNP) variables across six OECD countries (Germany, France, the Netherlands, Sweden, U.K., and U.S.A.) are analysed using comparison of graphs with data points for every 10 years. Looking at health

[3] Annual life expectancies at births are calculated and provided by François Nault at Statistics Canada with his kind courtesy.

indicators such as infant mortality rates, life expectancies at birth and at age 60, Wolfe finds a consistent positive relationship between total health care spending and improvements in health status. Assuming that lifestyle changes are exogenous in aggregate, (i.e., they are independent of changes in total health care spending), a decision to increase medical spending is expected to lead to some improvement in health status. She concludes that there are costs involved from foregone health status improvements in reducing total health care spending.

2.2.2. Cremieux *et al.* (1999)

While Wolfe examines international data and found a negative link between mortality rates and health care spending, Cremieux, Ouellette and Pilon (1999) examine the link using Canadian provincial data. Cremieux and his co-authors find a statistically significant negative relationship between gender specific infant mortality rates and total health care spending, and a statistically significant positive relationship between gender specific life expectancies and total health care spending in a single equation model with provincial fixed affects. The model was estimated by Generalized Least Squares (GLS) estimation correcting for hetroskedasticity and autocorrelation. They argue that the inherent heterogeneity associated with cross-country studies is a reason why the previous studies found an insignificant relationship between mortality rates and total health care spending. Cross-sectional and time series data for ten Canadian provinces (Newfoundland, Price Edward Island, Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, and British Columbia) for 1978 to 1992 is used for their estimation to limit both specification bias and data heterogeneity. They take five groups of independent variables that are expected to explain the variations in infant mortality rates as well as life expectancies at birth by sex: (1) health and economic variables; (2) socio-demographic variables; (3) lifestyle variables; (4) nutrition variables; and (5) provincial variables. They estimate a linear model of the form,

$$Y_{it} = \alpha_i + X_{it}\beta + \varepsilon_{it},$$

where Y is infant mortality rates (or life expectancies at birth) by sex, and X is a vector of exogenous variables which include health care and economic (total health care spending per capita, number of physicians per capita, GDP per capita), socio-demographic (number of post high school graduates per capita, poverty rate, population density), lifestyle (percentage of smokers and alcohol consumption per capita), and nutritional (separate weekly spending on meat and fat) variables for province i (i = 10) and time t (t=15). α_i is a vector of provincial dichotomous variables which is constant over time. A province-specific income variable is included as an exogenous variable to control for the wealth effect of health on total health care spending. A linear model of the same form with a vector of year dichotomous variables is also performed as well as a log-log model of the same form to calculate elasticities of health to total health care spending by province (Cremieux *et al.* 1999). Including the year variable resulted in statistical insignificant coefficients of some exogeneous variables except those of the level of public and private health care spending on life expectancies and infant mortality rates. Except for the dependent variable for male infant mortality rate, the health care spending coefficients were unaffected and stayed statistically significant. They conclude that lower health care spending in Canada is associated with a statistically significant reduction in life expectancies at birth and an increase in infant mortality rates. A 10% reduction in health care spending is associated with 0.5% and 0.4% higher male and female infant mortality rates, and a 6 months and 3 months lower male and female life expectancies at birth, respectively. They also argue that these significant findings result from eliminating the inherent heterogeneity in cross-country data as well as specification bias by using Canadian provincial data that considered holding homogeneity in terms of its definition and measurement.

2.2.3. Hitiris and Posnett (1992)

Using Ordinary Least Squared (OLS) estimation using a sample of 560 pooled time-series and cross-section observations, Hitiris and Posnett (1992) find that mortality rates are positively correlated with GDP per capita and negatively correlated with per capita health care spending for developed countries. The most important determinant of differences in crude mortality rates appears to be the proportion of the population 65 and older. Hitiris and Posnett (1992) not only examine effects of health care spending on mortality rates, but also the determinants of health care spending in developed countries. The 560 observations cover twenty OECD countries for the 28 years (1960 - 1987). They confirm the importance of some non-income variables, although the direct effect of these factors on population health appears to be small. The proportion of the population 65 and older shows a significant coefficient with the expected positive sign. The inclusion of the public finance share variable adds nothing to the explanatory power in the regression of real per capita total health care spending (converted by exchange rates) on per capita GDP, proportion of population 65 and older, public finance share in total heath spending, and two shift dummies to capture country-specific fixed effects. The finance share variable itself proves not to be significant and income elasticity of the model remains significant and around unity (Hitiris and Posnett 1992).

2.3. Studies Finding a Statistically Insignificant Relationship between Health and Health care spending

2.3.1. Filmer and Pritchett (1999)

Filmer and Pritchett (1999) use cross-national data to examine the impact of both public spending on health and non-health factors (economic, educational, cultural factors) on child (under 5 years old) and infant mortality rates for cross country studies. Forty-five countries are categorized into five groups: the East Asia and Pacific; Latin America and the Caribbean; Middle East and North Africa; South Asia; Sub-Saharan Africa in 1990. From an 'aggregate health production function' that assumes that a country's health outcomes depend on its income, knowledge, and social capability, they derive an equation,

$$\ln(M_i) = \beta_1 \ln(GDP_i / N_i) + \beta_2 \ln(H_i / GDP_i) + \beta_3 \ln(X_i) + \upsilon_i$$

where M is the (natural) log of child or infant mortality rates, ln(GDP/N) is the log of the mean per capita income, ln(H/GDP) is the log of the share public spending as a fraction of GDP, and ln(X) is the log of the level of female education and a variety of other socio-economic variables such as income inequality, ethno-linguistic, % of urban area, and access to safe water. In addition to the OLS method, the equation is also estimated using instrumental variable (IV) estimation to account for the endogeneity between mortality rates and public health care spending as well as measurement error in health care spending. They employ the average public sector health care spending as a share of GDP, and the average defense spending as a share of GDP of a country's geographic neighbors as instruments for their IV estimation.

Filmer and Pritchett find that the impact of public spending on health is quite small across the countries, with a coefficient being numerically and statistically insignificant at conventional levels. Inequality of income distribution, extent of female education, level of ethnic fragmentation, and predominant religion together explain 95% of cross-national variation in mortality rates in their study employing multivariate regression of country level health outcomes on socioeconomic characteristics and public spending on health.

2.3.2. Gravelle and Backhouse (1987)

Grevelle and Backhouse (1987) discuss the problems arising with the statistical investigation of mortality rates using international cross-section data for 1977. The problems are simultaneity bias between mortality rates and the number of doctors, multi-collinearity and selection problem of input variables, fixed effects and omitted variables, and data difficulties as well as lagged relationships between the mortality rates and their determinants. The simultaneity between the mortality rates and number of doctors is examined by running a regression of the number of doctors on mortality rates. When income is included in the regression, not only does the income coefficient become highly significant, but also the mortality rates coefficient changes its sign to positive and becomes statistically significant. The authors argue that this results from taking into account the reduction in demand of doctors associated with low incomes (pg. 429). With the coefficient of mortality rates being statistically significant, they conclude that the simultaneity is present. As a possible solution to the simultaneity, a system of equations is suggested which relates mortality rates to consumption, health service inputs and other variables postulated to affect health, and consumption to exogenous variables such as prices and incomes (pg. 430). Grevelle and Backhouse conclude that more elaborated data than international cross section data is necessary to reveal the true relationship between these factors.

2.4. Studies on Factors Determining Health Care Spending

2.4.1. Di-Matteo and Di-Matteo (1998)

L. Di-Matteo and R. Di-Matteo (1998) examine the determinants of Canadian provincial government health care spending for 1965 – 1991 using pooled time-series cross-section regression analysis. Their study is one of the most recent empirical Canadian provincial studies focusing on the determinants of provincial government health care. From the Box-Cox test for functional form, they found the following log-log pooled time-series cross-section regression as the best specification:

$$\ln(HE_{it}) = \delta_{it} + X_{it}\eta + \varsigma D_{it} + \sigma_{it},$$

where ln(HE) is the log of real per capita provincial government health care spending in 1986 dollars, X is a matrix containing vectors of logged exogenous variables such as real per capita provincial income (GDP), proportion of population 65 and older, real per capita federal transfers, and D is a vector of interaction terms between the provincial dummies and income, the proportion of the population 65 and older, the federal transfer revenue variables as well as ones between the provincial dummy and the Established Programs Financing (EPF) variables. EPF system was initiated in 1977 to link the cash grant for health and post-secondary education to provincial income and population growth in order to eliminate the direct link between provincial health care spending and the federal cash contribution (Boadway and Hobson 1993)[4]. They estimate the regression model using OLS assuming no cross-sectional dependence in the error terms and find that real provincial per capita income, the proportion of the provincial population 65 and older, and real per capita federal transfer revenue as key determinants of real per capita provincial government spending on health care over the period of 1965 through 1991. Established Program Financing dummy variable is found to have a negative and significant impact on real per capita provincial government health care spending in Newfoundland and Quebec. They find that real per capita provincial government health care spending is a necessary good rather than a luxury good as they find an income elasticity of 0.77. If income elasticity of a good is greater than 1 then the good is defined as a luxury good. The authors argue that an income elasticity greater than one found in international literature is from the income

[4] Note that federal health transfers consist of federal cash contribution, tax credit, and special programs (Health Canada 2000). Therefore, the direct link between provincial health care spending and federal health transfers is not eliminated by the EPF.

coefficient capturing differences in both quantity and the relative cost of medical services across countries (Di-Matteo and Di-Matteo, 1998).

2.4.2. Gerdtham *et al.* (1992)

In "An econometric analysis of health care expenditure: A cross-section study of the OECD countries," Gerdtham *et al.* (1992) estimate and evaluate the effects of aggregate income and institutional and socio-demographic factors on health care expenditures using OLS estimation. The independent variables are the GDP per capita adjusted by GDP Purchasing Power Parities (PPPs), the ratio of PPPs for medical care to GDP PPPs, the number of physicians per 1,000 people, a share of inpatient expenditure in total health care (as proxy for public provision), dummies for fee-for-service and global budgeting in hospital care, female participation (as proxy for substitution of formal care for informal care), the share of total health care expenditure used on public expenditure, ratio of population 65 years old and over to population 15 - 64 years old, and % of population living in towns with over 500,000 inhabitants (Gerdtham *et al.* 1992). They find GDP per capita, urbanization, public financing, a share of inpatient expenditures in total health care expenditure, and a fee-for-service dummy variable are statistically significant. They also investigate issues involved in regression analysis of aggregate health care expenditures, such as the functional form of the estimated equations, discrimination between competing models, and whether or not the statistical assumptions underlying the linear regression model are satisfied (Gerdtham *et al.* 1992).

Gerdtham and his co-authors found it difficulty to interpret the negative relationship between urbanization and health care expenditures, even though economies of scale might be a possible explanation for high health care expenditures for countries with lower urbanization rates. The constant elasticity for GDP per capita was 1.33, and significantly greater than one. The elasticities of public financing and proportion of inpatient in total patients were -0.52 and 0.22, respectively. Fee-for-service for outpatient care increased health care expenditure by 11% (Gerdtham *et al.* 1992).

2.4.3. Murillo, Piatechy, and Saez (1993)

As in the previous studies, the study done by Murillo, Piatechy, and Saez (1993), also finds a significant relationship between health expenditures and income using OECD-CREDES database that contains information for 1960-1990 for OECD countries in Europe. Real per capita health care expenditure is deflated by the sectional health purchasing power parities (PPPs) to express health care in common quantities across countries. From analysing the regression of real per capita health care expenditure on total demand, i.e., income (per capita expenditure based GDP deflated by GDP PPPs), relative price (sectoral health price index divided by the implicit deflator of GDP), and a dummy variable reflecting structural break points such as economic recession, they find that health care expenditure and income controlled by the relative prices are co-integrated in variance although they do not have a co-integrating relationship in mean. The estimated OLS long-run income elasticities of health care expenditure are between 1.251 and 1.834.

Maximum likelihood estimation of the elasticity increases the divergence between countries. Additionally, the estimates give evidence for a probable relationship between the income elasticity and the level of income: greater income, smaller income elasticity (Murillo *et al.* 1993). This implies that wealthier counties have more steady (i.e., less elastic) health care expenditures against variations in their income.

2.5. Discussion

The study by Cremieux and his co-authors takes an important position in a discussion of the relationship between health and total health care spending in Canada and provides useful insights about the relationship. They find a statistically significant negative relationship between health and total health care spending. However, in their study it is assumed that an inclusion of income variable in their health equation would correct simultaneity between health and total health care spending. They argue that after accounting for income differences and other confounding effects, if a positive correlation is present, then one might believe that health outcomes and total health care spending are related (Cremieux *et al.* 1999). However, the inclusion of income variable does not account for the simultaneity, but controls for wealth effects on total health care spending and health status. Inclusion of number of physicians as an explanatory variable is another concern arising as number of physicians is very highly correlated with total health care spending. In our data, the correlation between the number of civilian physicians per 1,000 population and real per capita public health expenditures (RCPUHEX) and real per capita provincial government health expenditures (RCPGOVHEX) are 0.6330 and 0.6050, respectively. This relatively high correlation suggests that multicollinearity will result from its inclusion in health production equation. It is also conceptually problematic to fix the number of physicians by including it as one of explanatory variables in our model, even ignoring the collinearity problem since changes in public health care spending generally involves changes in the number of physicians. That is, to estimate the impact of changes in public health care spending on health we should allow the number of physicians to change along with the changes in the public health care spending. The results found by Hitiris and Posnett (1992) also suffer from the same problem of ignoring the possible simultaneity between health and health care spending in addition to having data heterogeneity associated with across-country studies. Consequently, their conclusion of a negative relationship between mortality rates and health care spending has little support.

While other studies fail to deal with possible simultaneity between health and health care spending, Filmer and Pritchett (1999) employ IV estimation to account for simultaneity between mortality rates and public health care spending as well as a measurement error in health care spending. However, it is suspected that Filmer and Pritchett found the impact of public spending on health to be statistically insignificant across the countries because of problems inherent to cross-national data. Their results are also limited by cross section data analysis that could be overcome by using cross-section time series data. Validity of employed instruments such as the average public sector health care spending as a share of GDP, and the average defense spending as a share of GDP of a country's geographic neighbors is also questionable.

Gravelle and Backhouse (1987) explicitly examine the simultaneity between the mortality rates and number of doctors by running a regression of number of doctors on mortality rates and find that the simultaneity is present. As a possible solution to the simultaneity, they suggest a system of equations that relates mortality rates to health service inputs and other variables acknowledged to affect health, and consumption to exogenous variables such as prices and incomes. Doctors per capita is employed as an instrumental variable for health service inputs variable in the system of equations using Two Stage Least Squares (2SLS) estimation. They find no statistically significant relationship between infant mortality rates and other explanatory variables such as alcohol, cigarette, sugar consumption per capita, GDP per capita, public shares in health care spending, and population density. They also examine prenatal and adult cohort mortality rates as dependent variables with those explanatory variables described above and find no significant relationships. The results from 2SLS and OLS are found to be similar. Even though estimating the system of equations using 2SLS is plausible in the presence of simultaneity between a dependent and an explanatory variable, it is debatable whether the instrument is valid. Once the focus is on the simultaneity between health and health care spending, it is clear that the number of doctors would not be a valid instrument for the health variable in the health production equation. The number of doctors would not only have effects on health through health care spending, but also have direct effects on health as it is found in their simultaneity investigation. It is sensible to think that a greater number of physicians with the same quality would result in better health outcomes of patients, holding all other variables constant, since the physicians would be able to deal with fewer number of patients in more timely fashion and, thus provide better care (Cremieux *et al.* 1999).

So far no consistent results have been found in analyses of the relationship between health and health care spending regardless whether simultaneity between health and health care spending is considered.

CHAPTER THREE: Data and Descriptive Statistics

3. Introduction

Primary sources of the data used in this study are the National Health Expenditure Data Base from the Canadian Institute for Health Information (CIHI) and Statistics Canada's publications for 1975-1996. Gender specific infant mortality rates, age-standardized mortality rates for all age groups, life expectancies at birth are employed to take gender differences into account. As explained in the previous section, infant and age-standardized mortality rates for all age groups, and life expectancies at birth are considered to be the best health indicators that are available. Thus, they are taken as a dependent variable in our health (production) equation to analyse health determined by various factors. The sample includes 220 observations for all variables for 1975-1996, except meat and fat consumption variables with observations of 177 covering 1978-1992. All the variables are specified by province. During the period of study, population health has improved according to the health indicators, and public health care spending also has increased. There are clear trends in both health and public health care spending variables. This chapter will examine the trends in detail. A complete listing of variables and summary statistics are presented in Table 3.1.

3.1 Health Outcome Indicators

Throughout the period of 1975-1996, there were clear trends for the health outcome indicators. Both gender specific infant and age-standardized mortality rates decreased while gender specific life expectancies at birth increased. Infant mortality rates by sex are defined by deaths per 1,000 live births. Average male and female infant mortality rates in all provinces during 1975 -1996 were 10.06 and 8.00 per 1,000 live births, respectively. There were great fluctuations in the infant mortality rates for both sexes in Prince Edward Islands compared to all other provinces. This must be due to the small population size in Prince Edward Islands (PEI). Its total population in 1996 was 136,188 consisting 0.46% of total Canadian population and increased by 2,600 from 1995 to 1996. Average male and female infant mortality rates for all provinces decreased by 61.23% and 61.11% from 1975 to 1996, respectively. Average male infant mortality rates for all provinces in 1975 and 1996 were 16.38 and 6.35, respectively, while average female mortality rate for all provinces were 14.27 and 5.55 for the same years. Age-standardized mortality rates show a smoother negative trend compared to infant mortality rates. During 1975–1996, average age-standardized mortality rates for male and female were 9.98 and 5.82 per 1,000 population, respectively. On average, the male age-standardized mortality rate was higher than the female age-standardized mortality rate by 4.16. That is, about four more infant deaths occurred per 1,000 male population compared to female.

During the same period, there was a 23.12% and 21.64% decrease in average age-standardized mortality rates in all provinces for both male and female, respectively. The female age-standardized mortality rate was the highest in Newfoundland since 1982. Quebec had the highest male age-standardized mortality rate during 1984–1988, while either Newfoundland or PEI had the highest during 1989-1996. Not surprisingly, relatively greater fluctuations were shown in PEI, reflecting its population size. During 1975 to 1996, both male and female life expectancies at birth steadily increased. From 1975 to 1996, male and female life expectancies at birth increased by 6.94% and 4.62% respectively. Average male life expectancy at birth in all provinces was 70.29 years in 1975, and 75.17 years in 1996. In 1975, average female life expectancy at birth in all provinces was 77.50 and was 81.08 years in 1996. On average, female life expectancy at birth was about 6.89 years higher than male life expectancy.

Overall, the population in British Columbia had the highest life expectancies at birth while population in PEI, Newfoundland, and Nova Scotia had the lowest during the period. Reflecting the fluctuations in both infant and age-standardized mortality rates in PEI, there were also greater fluctuations for the life expectancy in PEI. A difference in life expectancies at birth between a province with the highest and the one with the lowest is about 2 years throughout the period.

3.2. Health Care Spending and Economic Variables

Real per capita public health and provincial government expenditures

The focus of this thesis is the relationship between public health care spending and the health of the population. Both real per capita public health expenditures (RCPUHEX) and real per capita provincial government health expenditures (RCPGVHEX) are employed as a public health care spending variable, separately. RCPUHEX includes health care spending by all levels of governments and government agents. To avoid double counting, national public health expenditures are reported based on the principal of responsibility of payments rather than on the source of the funds, except provincial government health transfers to municipal governments that are included in the provincial government health expenditures (CIHI 2001). Both nominal per capita public and provincial government health expenditures are calculated by dividing nominal public and provincial health expenditures by provincial population. Then they are deflated using 1992 consumer price index for health goods and services to be converted into real term. Real per capita provincial income (GDP) is calculated in the same manner using 1992 consumer price index for all items. Average RCPUHEX and RCPGVHEX are $1580.40 and $1468.11 for all provinces during 1975 – 1996. The average RCPUHEX for all provinces were $1242.80 in 1975 and $1667.26 in 1996. This reflects an increase of 34.15% from 1975 to 1996. RCPUHEX shows a consistent positive annual % change during 1975 to 1991. Since 1992 there were overall negative annual % changes in RCPUHEX for all provinces, except the only positive change of 0.01% in 1995. The greatest negative change of –3.20% for all provinces occurred in 1993. That is, RCPUHEX decreased by $56.04 in 1993 from the previous year. At provincial level, the greatest negative annual % changes occurred in Saskatchewan and Alberta. There was a 7.76% drop in Saskatchewan in 1993. In 1994 and 1995, RCPUHEX dropped by 7.38% and 7.94% in Alberta, respectively. These two provinces show greater fluctuations in RCPUHEX along with Nova Scotia compared to the other provinces. Not surprisingly, RCPUHEX and RCPGVHEX show a very similar trend which is self-explanatory by their definitions. The correlation between RCPUHEX and RCPGVHEX is 0.802. Average RCPGVHEX for all provinces were $1157.46 in 1975 and $1525.59 in 1996. It increased by 31.81% from 1975 to 1996. During 1991 – 1996, average RCPGVHEX for all provinces decreased every year. The greatest drop during the period was -3.28% in 1993. It was $56.04 less in 1993 compared to the previous year. Similar to RCPUHEX, the greatest annual drops at provincial level occurred in Saskatchewan and Alberta. It dropped by 8.74% in Saskatchewan in 1993. In Alberta, the drops were 9.29% in 1994 and 7.39% in 1995. Alberta's RCPGVHEX increased by 1.19% in 1996. This is equivalent to $16.38 increase in provincial government health expenditure for each individual. Alberta had the greatest fluctuations in the level of RCPGVHEX through out the period followed by Saskatchewan.

Real per capita federal health transfers

While real per capita total federal transfers (RCFEDTTR) have a high correlation of -0.8313 with real per capita provincial GDP, real per capita federal health transfers (RCFEDHTR) have a relatively low correlation of 0.0328 with real per capita provincial GDP. PEI received RCFEDTTR of $2530.10, while Ontario and Alberta received $677.44 and $808.22 on average during 1975–1995[5]. PEI received the most amount of annual RCFEDHTR of $601.12 on average while Ontario got the least amount of $575.56 during 1975–1996. Alberta received $586.88 during the same period. RCFEDTTR show great provincial differences while RCFEDHTR show almost no provincial differences during the pre-1996 period. This can be explained by the fact that the federal contribution for insured health services, which was combined with one for post-secondary education since 1996, was based on an equal per capita entitlement. The equal per capita entitlement was calculated

[5] Total federal transfers data is currently available only up to 1995 at Statistics Canada.

independently of provincial cost and annually adjusted according to changes in Gross National Product (Health Canada website: Canada's Health System 1999).

The differences in RCFEDHTR across provinces are relatively small until 1995. There was a big increase in RCFEDHTR in 1996 for all provinces. This is due to a methodology change in the calculation of data. From April 1, 1996 the Canada Health and Social Transfer (CHST) replaced all health transfers under the Canada Assistance Plan (CAP) and Established Programs Financing (CIHI website 2001 and Health Canada website: Canada's Health System 1999). This resulted in a big increase in data point as it includes not only the federal health transfers, but also the social transfers as well. The change in the definition of data will be taken into account in estimation using a dummy variable for 1996.

Real per capita provincial GDP

Income has been considered one of the most important variables in studies on factors determining population health in both international and national studies. One of the most commonly used income variables is the national gross domestic product. In this study, province specific real per capita expenditure based Gross Domestic Products (RCPGDP) is used as an income variable for ten Canadian provinces. Greater real per capita provincial income will assure that more basic needs such as adequate housing, good nutrition and health care that are not covered by social insurance are met, which would be associated with better health outcomes (Cremieux *et al.* 1999). Average RCPGDP for all provinces through 1975–1996 is $21,356.27. Average RCPGDP at provincial level is below the national average in Newfoundland, Prince Edward Island, Nova Scotia, New Brunswick, and Manitoba while it is the highest in Alberta with $31,852.93, followed by Ontario and British Columbia during the period. Annual average RCPGDP for all provinces was $18,621.62 in 1975 and $22,809.91 in 1996, which reflects a 22.49% increase from 1975 to 1996. Correlation between RCPGDP and other health care and economic variables such as RCPUHEX, RCPGVHEX, RCFEDTTR, and RCFEDHTR to provinces are 0.5662, 0.5461, -0.8313, 0.0328, respectively.

Unemployment rates

As GDP has been considered as one of the most important factors determining population health, unemployment rate also has often been treated in the same manner in many studies. GDP and unemployment rates certainly have a high correlation and it is found to be –0.5720 in our data. The unemployment rate variable is chosen as an instrument for the public health care spending variable in our initial specification. The average unemployment rate during 1975 – 1996 was 10.38% across all provinces. During the same period, Newfoundland had the highest average unemployment rate with 17.12% while Saskatchewan had the lowest with 6.30%. In 1995 and 1996, average unemployment rates in all provinces dropped by 5.96% and 9.97% from the previous year, respectively.

3.3. Social and Demographic Variables

As the socio-demographic as well as the geographic characteristics of a province is an important determinant of a population's health, social and demographic variables such as the proportion of population 65 and older, poverty rates, and the number of university graduates per 1,000 population are included in our specification as explanatory variables for health, following Cremiuex *et al.* (1999).

Proportion of population 65 and older

If a province has a greater proportion of population 65 and older (POP65) it will require a greater amount of per capita health care spending to produce the similar health outcomes compared with other provinces (Cremiuex *et al.* 1999). The average POP65 for all provinces were 9.00% and 12.36% with respect to total population in 1975 and 1996, respectively. The proportion of the senior population in all provinces increased by 37.35% on average from 1975 to 1996. PEI, Manitoba and Saskatchewan have a relatively big senior population with more than 12% of their total population being 65 and older. Newfoundland and Alberta have the lowest proportion of senior population as the proportions are 8.53% and 8.17%, respectively. During 1975–1996, POP65 showed a consistent positive trend.

Poverty rates

Considering a high number of infant deaths occurring among low income families (Centers for Disease Control and Prevention 1995) and the poor having less access to basic needs including health care, despite programs and social insurance designed to help them, poverty rates in each province give us information beyond what average provincial income does (Cremieux *et al.* 1999). For these reasons, it is important to account for the provincial poverty rates in the study on determinants of population's health. Provincial poverty rates are defined as incidence of low income among families. Low income units from other family units are delineated using a low income cut-offs. These income limits were selected on the basis that families with incomes below these limits usually spent 62% or more of there income on food, shelter and clothing for 1975-1978 data and 58.5% or more for post 1978[6] (Statistics Canada 1982). During 1975–1996, on average, Newfoundland had the highest poverty rate with 18.54% while Ontario had the lowest with 11.04%. Average poverty rate was 12.99% for all provinces during the period. From 1975 to 1996, average poverty rate for all provinces increased by 6.95%.

Number of graduates per 1,000 population

As education level will not only present how effectively the person can use available health care services and information and how well he/she will be aware of potential health risks, but also environments that he/she lives in. The number of bachelor's and first professional degrees granted per 1,000 people for all fields of study (BAMF1K) by province is chosen as an education measurement as its definition is consistent across provinces unlike high school graduation rates and some other measures. Thus, it is thought to be the most reliable available measure of educational level across provinces in Canada (Cremuiex *et al.* 1999).

[6] Base years changed during the period. More details regarding the definition of data are available upon request.

The average BAMF1K for all provinces during 1975–1996 is 3.66. Nova Scotia had the highest average number of graduates with 5.36 per 1,000 people while Ontario had the second highest with 4.54. British Columbia had the lowest with 2.48, followed by PEI with 2.78. Alberta had an average of 3.22. There was a 19.69% drop in the average number of the graduates for all provinces in 1995 from the previous year, which was the biggest drop during this period. It dropped further by 2.33% in 1996.

Population

Population size, population density, and the proportion of urban and rural populations could define socio-demographic characteristics of the population. The socio-demographic characteristics of a country's or province's population along with its geographic characteristics are important determinants of the health of the population. Greater population density is often thought to bring two opposing effects to the population's health. Greater population density might result in lower per capita health care spending due to economies of scale. Thus, more health care goods and services would be available to the population given health resources, which will result in better population's health outcomes. It is also possible that the greater density leads to delays in receipt of adequate health care, resulting in worse health outcomes (Cremieux *et al.* 1999).

During 1975-1996, Canada's total population increased by 28.14%. During the same period, British Columbia and Alberta experienced the most dramatic population growth as their populations increased by 55.31% and 53.74%

respectively. In 1996, Ontario and Quebec consisted of 37.54% and 24.60% of the total Canadian population and showed less dramatic increase in provincial population during the period. Weighting with respect to provincial population will be employed to account for provincial differences in population size in the model. Provincial fixed effects will be employed in our econometric model to capture the geographic as well as other provincial socio-demographic characteristics that are not captured by other explanatory variables in the model.

3.4. Lifestyle and Nutrition variables

It is well recognized that tobacco and alcohol consumption negatively affect health in various ways such as damaging lungs, the liver, and increasing the risk of heart diseases (Klatsky *et al.* 1992 and Warner 1989). To control for behavioral differences, per capita alcohol consumption in liter and gender specific smoking rates are included as explanatory variables. Even though the effects of tobacco and alcohol consumption are not contemporaneous, due to unavailability of the earlier data, contemporaneous tobacco and alcohol consumption data are taken as proxies for the earlier rates for the consumption (Leu 1986 and Cochrane *et al.* 1978).

During the period of study, males overall had higher smoking rates than females in all provinces. Among the provinces, Quebec had the highest smoking rates for both sexes during the period. Until 1988, there was a steady decrease in both male and female smoking rates with relatively small fluctuations. However, since 1988 there were relatively greater fluctuations in the smoking rates and the trend became unclear. Average male and female smoking rates during 1975-1996 were 35.16% and 28.2% in all provinces, respectively. Per capita alcohol consumption in liter steadily decreased during the period in all provinces. Average alcohol consumption of 124.17 liters per person in 1975 dropped to 95.32 liters per person in 1996. British Columbia had the highest per capita alcohol consumption in 1996 followed by Quebec and Alberta. While all nutrition sources would affect health, only meat and fat are taken as nutrition variables in our initial specifications. They are considered important determinants of cardiovascular disease as they affect cholesterol level (Cremuiex *et al.* 1999). However, in our final specifications they are excluded due to the data unavailability for the study period and difficulties in the interpretation of their effects.

3. 5. Overview of the Data

There are gender differences in both infant and age-standardized mortality rates for all age groups, as well as in life expectancies at birth. Both infant and age-standardized mortality rates for all age groups are lower for females than for males. Accordingly, life expectancies at birth for female are higher by about seven years on average for the period. In addition to provincial differences, time trend is also seen in health expenditures, income level, infant and age-standardized mortality rates for all age groups as well as life expectancies at birth. Since 1975 RCPUHEX and RCPGVHEX have been gradually increasing with relatively small variations while the real per capita private health expenditures (RCPVHEX) have shown moderate increases with greater variations across provinces. RCPUHEX and RCPGVHEX show almost an identical trend. RCFEDHTR was highest for all the provinces in

1989. RCPGDP in Alberta has been highest for the entire research period except 1988-1989 when it was highest in Ontario. In the early 1990s, real per capita GDP ranged from $16,000 to $27,000 across provinces, which showed its less variation in all the provinces compared with pre-1990s. Both infant and age-standardized mortality rates for all age groups have a negative trend through out the period. Infant mortality rates have been fluctuating more than the age-standardized mortality rates for all age groups. They also have been experiencing more dramatic reduction than the age-standardized mortality rates for both sexes. Corresponding to the negative trend of both mortality rates, life expectancies at birth for both sexes showed a gradual increase during the period.

CHAPTER FOUR: Econometric Methodology

4. Introduction

Since it is thought that population health is produced through a 'health production function' which links various socio-economic factors to the population health in a structured manner, the health production function is taken as a loose theoretical underpinning to explain the link between health and public health care spending in this thesis. An econometric model as well as estimations built on the basis of the theoretical underpinning and the existing empirical studies are presented in this chapter. Since Cremieux *et al.* (1999) and Di-Matteo and Di-Matteo (1998) present the most commonly used empirical methodologies by encompassing major ideas from other existing studies and develop models for population health and health care spending in a Canadian provincial-level panel context, we use their specification as a basis and extend their analysis by simultaneous estimation.

A methodology accounting for simultaneity between health outcomes and public health care spending is employed in this thesis. Employing the methodology allows us to obtain consistent estimators. These estimators are, however, biased and inefficient since auto-correlation and hetroskedasticity in error terms are not corrected for.

In Section 4.1, the econometric model used to estimate the relationship between health outcomes and public health care spending is discussed. The three health outcome indicators used are infant, age-standardized mortality rates and life expectancies at birth by sex. Two different types of provincial specific public health care spending variables, RCPUHEX and RCPGVHEX, are employed. However, only the details of results from employing RCPUHEX are discussed due to similarity in the results, unless otherwise specified.

In Section 4.2, the employed estimation is discussed in detail along with a discussion on the inadequacy of econometric techniques that often have been used for this issue. The appropriateness of the assumption of simultaneity and the validity of employed instrumental variables are examined through specification tests in Section 4.3. Section 4.4 discusses the limitations of the employed model and closes this chapter.

4.1. The Econometric Model

It is believed that the health of the population is determined by various socio-demographic and economic factors. One of the factors that interests policy makers most is public health care spending. Finding a way to maximize the health of the population with a given level of public health care spending or minimize the level of public health care spending for a given level of health for the population can be described as an optimization problem. The problem is to be set with a health production function and a function for society's choice (indifference curve) which represents its preferences over health subject to fiscal budget constraints. Since the society has choices other than health, it chooses a level of health that can be represented by a choice function determining an optimal level of health to maximize the society's utility with the constraints along with the health production function. That is, the chosen level of health that reflects preferences of the society determines the level of public health care spending through the choice function, while the level of public health care spending determines health of the population through the health production function. Thus, health and public health care spending are simultaneously determined. Spending more money for health care would result in better health outcomes up to a certain point holding all other factors constant, as more and better health goods and services become available. A healthier population would need to spend less for health care, compared to a population with low level of health status that would require more health goods and services.

Adopting the model by Grevelle and Backhouse (1987), our model is written as;

$$(1) H_{it} = X_{it}\beta + \varphi HE_{it} + v_{it}$$

$$(2) HE_{it} = Z_{it}\gamma + \delta H_{it} + u_{it},$$

where H_{it} and HE_{it} are the health of the population and public health care spending in province *i* at time *t*. X_{it} is a matrix containing vectors of exogenous variables thought to affect health, while Z_{it} is a matrix containing those thought to affect public health care spending. v_{ti} and u_{ti} are stochastic error terms. As discussed in the previous section, infant and age-standardized mortality rates for all-age groups and life expectancies at birth by sex are taken as health variables since they are the most reliable health indicators available. For public health care spending variables both RCPGVHEX and RCPUHEX are considered.

Following Cremieux *et al.* (1999) and Di-Matteo and Di-Matteo (1997), the vectors of exogenous variables (Z_{it}), in public health care spending equation (2) include POP65, RCFEDHTR, in addition to all the exogenous variables included in health equation (1). X_{it}, the matrix of vectors of exogenous variables in health equation (1) includes socio-demographic and economic variables indicating RCPGDP, incidence of low income families, number of bachelor's and first professional degree awarded per 1,000 people, and provincial dummies, as well as lifestyle variables indicating smoking rates by sex and alcohol consumption in liters per capita. Considering large standard errors from the inclusion of DOC1K variable signals multicollinearity between the number of physicians and public health care spending. It is also inadequate to employ DOC1K as an instrumental variable for public health care spending since it is directly correlated to health of population. For example, long waiting times for an appointment with doctors and treatments could result from an insufficient number of physicians, which will reduce the quality of health care, and therefore its effectiveness (Cremieux *et al.* 1999). Nutrition variables indicating deflated household weekly spending on meat and fat are excluded in the final model specification due to limited number of observation as well as difficulties in interpreting their aggregate affects on health. In our initial model specification, they were found to be insignificant. POP65 and RCFEDHTR variables are employed as instruments for a public health care spending variable in our simultaneous equations model and are tested for validity. HCPI is also employed as an instrument, as it is believed to affect the level of public health care spending, but not directly affect population health.

Di-Matteo and Di-Matteo use unemployment rates as an explanatory variable for RCPGVHEX. However, the unemployment rate variable is not chosen to be one of the instruments in the final specification, since it is empirically shown that unemployment rates are directly correlated with population health in various studies such as an empirical study done by Christopher Ruhm (1996). Ruhm concludes that unemployment rates and population health are positively correlated based on estimation results from a fixed model using state level data in the United States from 1972-1991. In our initial model specification the unemployment rate is found to be an invalid instrument.

There are nine provincial indicators for province specific fixed effects to capture the geographic characteristics: Newfoundland, Prince Edward Island, Nova Scotia, New Brunswick, Manitoba, Quebec, Ontario, Saskatchewan, and British Columbia. To avoid perfect multicollinearity (or dummy variable trap) amongst the provincial indicators Alberta is chosen as the excluded category; and therefore, the others will be interpreted relative to Alberta. Instead of provincial population densities, a weighting option with respect to provincial population is chosen in our final estimation to account for size differences in population across provinces. Weighting led to more sound estimation results in the final model specifications. One might think that this is because weighting moderates dramatic fluctuations in observations in provinces with small population. For instance, one more female infant death in Prince Edward Island and British Columbia will result in very different changes in female infant mortality rates as two provinces have a big difference in population size.

Inclusion of a time trend variable (i.e., year variable) in both health and public health care spending equations can be thought of as an inclusion of an aggregate factor capturing the impact of a set of underlying quasi-monotonically increasing or decreasing variables, such as increased public health care spending or decreased smoking rates (Cremieux *et al.* 1999). However, the time trend variable is excluded in the final econometric model specification due to inconsistent results in terms of signs and significance of coefficients. The inconsistent results signals the problem of high frequency information. Explanatory variables such as a proportion of a population 65 and older are thought to capture the time trend. Thus, we are able to obtain low frequency information in data without a time trend variable in our model.

Difficulties in finding valid instruments for public health care spending in simultaneous equations model of health and public health care spending is discussed in Grevelle and Backhouse (1987). It is possible that the relationship between health and public health care spending was found statistically insignificant because of the invalid instrument employed in the estimation. Unlike Grevelle and Backhouse suggest, the number of doctors would be directly correlated to the health of the population as well as public health care spending; thus, it cannot be a valid instrument. It is likely that RCFEDHTR, HCPI and POP65 would be directly correlated to public health care spending, but perhaps not to the health of the population. These variables are taken as instruments for public health care spending in the simultaneous equations model of health and public health care spending. Through specification tests it will be determined whether these are valid instruments and whether the 2SLS methods are better than the OLS methods to obtain consistent estimators.

4.2. Econometric Methods

If there is simultaneity between health and public health care spending it must be taken into account to produce consistent results in estimating the effects of public health care spending on health. If simultaneity is present an error term in the equation is correlated with the explanatory variable that is simultaneously determined with the dependent variable. That is, when the random error term v_{it} changes, H_{it} changes in equation (1). As H_{it} changes, HE_{it} changes through equation (2). Thus, HE_{it} is correlated with v_{it}. Similarly, H_{it} and u_{it} are correlated with each other in equation (2). Two Stage Least Squares (2SLS) can be used for the simultaneous system (Maddala 1992)[7].

To estimate this simultaneous system, the instrumental variables procedure is used. A variable that is highly correlated with the variable that is questioned to be endogenous, but not with the error term can be an appropriate instrument. It is thought that HCPI and RCFEDHTR are highly correlated with RCPUHEX or RCPGVHEX, but not directly with population health variables such as infant mortality rates, age-standardized mortality rates and life expectancies at birth by sex. Thus, it is thought that they are not correlated with the error term in the health equation. POP65 is also employed as an instrument as it would be highly correlated with public health care spending, but not to infant mortality rates. However, whether it is directly related to age-standardized mortality rates and life expectancy is questionable. The variables in Z_{it} are used as instruments for HE_{it}. Z_{it} includes

[7] 2SLS and instrumental variables (IV) estimation techniques are equivalent estimation procedures on the condition that the first stage of two-stage least squares involves all predetermined variables in the system, and that the instrument used in the instrument-variables procedure is the fitted value of the first-stage regression (Pindyck and Rubinfeld 1991, pp. 300).

candidates for valid instrumental variables in addition to all the predetermined variables in X_{it}. To find the most appropriate instruments, six sets of candidates for valid instruments are separately employed for estimation. Y_{it}^1 denotes the vectors of all the variables in X_{it}, HCPI, POP65, and RCFEDHTR while Y_{it}^2 denotes the vectors of all variables in X_{it}, HCPI and RCFEDHTR. Y_{it}^3 denotes the vectors of all the variables in X_{it}, POP65 and RCFEDHTR. Y_{it}^4 denotes the vectors of all the variables, HCPI and POP65. The last two sets are Y_{it}^5 and Y_{it}^6 consisting of RCFEDHTR and HCPI, respectively.

The first step in estimating the simultaneous system is to estimate each of following equations using Ordinary Least Squares method:

$$(3) HE_{it}^{j} = Y_{it}^{j}\gamma_{j} + u_{it}^{i},$$

where Y_{it}^j, j = 1 notes the first set of instruments. Here j = 1, 2, ..., 6. From the above estimation we get the following predicted values of health,

$$(4) HE_{it}{}^{*j} = Y_{it}{}^{*j}\gamma_{j}.$$

The second step is to substitute the public health care spending variable with the predicted value of public health care spending in the health equation (1)

$$(5) H_{it} = X_{it}\beta_{j} + HE_{it}{}^{*j}\delta_{j} + \tau_{it}, j = 1,2,...,6,$$

where HE^{*j} , j=1, 2, .. 6 denote the predicted value of public health care spending from using the six sets of instruments. Equation (5) is estimated using the OLS method, which will give us consistent estimates of δ. The results of the estimations are presented in Table 5.1 - 5.28. Before we interpret the results we will determine whether the employed instruments are valid, and whether endogeneity exists between health and public health care spending through specification tests.

Strength of valid instruments will also be discussed prior to the interpretation of the results.

4.3. Specification Tests

Since the IV procedure (2SLS) is used for our estimations under the assumption that there is simultaneity (or endogeneity) between public health care spending and health, it is necessary that we determine whether the simultaneity really exists between them using appropriate tests. A Hausman test is performed to test a null hypothesis that there is no simultaneity between the two variables. When simultaneity exists, IV estimators are consistent while OLS estimators are not. The Hausman test examines whether there is a statistically significant difference between the IV and the OLS estimators. If there is a significant difference, then the null hypothesis of no simultaneity is rejected. However, even if we fail to reject the null hypothesis, it does not mean there is no simultaneity at all since the Hausman test does not confirm the non-existence of simultaneity between two variables. Failing to reject the null hypothesis rather means that the endogeneity problem is not severe (Kennedy 1999). Since the Hausman test assumes that instruments are valid, it is important that valid instruments are employed in 2SLS. Additionally, unless the instruments are valid, consistent estimators cannot be obtained even if the 2SLS is used to account for the simultaneity. Thus, it is sensible to test for the validity of exclusion restrictions first, then perform the Hausman test. These tests are followed by test for the strength of instrumental variables.

4.3.1. Test of the Validity of Exclusion Restrictions

To be valid instruments for public health care spending, they should satisfy three conditions. First, they should be correlated with a public health care spending variable. Second, the measurement error in the instrument(s) should not be correlated with the measurement error in public health care spending on health. Finally, the instrument should not directly be correlated with health, but only indirectly through public health care spending (Filmer and Pritchett 1999). In other words, instruments are invalid if they are correlated with a stochastic term of the equation in the second stage of the 2SLS method. When one or more of the instruments directly explain(s) the dependent variable in the equation of the second stage, they are also invalid. The test for validity of exclusion restrictions tells us whether instruments are valid. It does not, however, give us a cause for why instruments are invalid (Kennedy 1999).

The first step for the exclusion restriction test is to save predicted residuals, U_{it}^{j} from the regression (5). That is, to save the predicted residuals from the simultaneous equations model using the 2SLS. The second step is to run a regression of U_{it}^{j} on instrumental variables that are denoted by Y_{it}^{j},

$$(6) U_{it}^{j} = Y_{it}^{j}\mu_{j} + \varepsilon_{it}^{j}, \; j = 1,2,\ldots,6.$$

The last step of the test is to perform a hypothesis test under the null,

$$NR^{2} = N(1 - SSR/TSS) \sim \chi^{2}_{l-k},$$

where N is the total number of observation, SSR and TSS are the sum of squared residuals and the total sum of squares from the regression of U_{it}^{j} on Y_{it}^{j}, respectively. l is the total number of exogenous variables in the system and k is the total number of coefficients to be estimated in the second stage. l - k is the degrees of freedom.

If a Chi-square statistic is greater than a Chi-square critical value at 99% significance level, we reject the null hypothesis that the employed instruments have no explanatory power to U_{it}^{j}. If we reject the null hypothesis then the restrictions are invalid. That is, the instruments are invalid since they are either correlated to U_{it}^{j} or directly explain the dependent variable in the equation of the second stage of our estimation.

According to the exclusion restrictions test results, HCPI and RCFEDTR together were found valid instruments for both male and female infant mortality rates in the final model specification while no valid instruments were found for male age-standardized mortality rate and both male and female life expectancies at birth. However, POP65 and RCFEDHTR were not too far from being valid instruments together for male age-standardized mortality rate and both male and female life expectancies at birth as the Chi-statistic for them were slightly greater than Chi-critical. POP65 and RFFEDHTR were valid instruments together for female age-standardized mortality rate.

4.3.2. Hausman Test

The artificial regression approach is used to perform the Hausman test as described in Davidson and MacKinnon (1993). The first step for the test is to regress the public health care spending variable that is suspected to be endogenous against the health variable(s) on the valid instruments:

$$(7) HE_{it} = Y_{it}\psi + \zeta_{it},$$

where ζ_{it} is a random error term. Estimating the equation (7) gives us an estimated value of public health care spending, HE_{it}^{*}. The second step is to regress a health variable on all the exogenous variables except the instruments, and the estimated value of public health care spending, HE_{it}^{*} in addition to the public health care spending variable. That is,

$$(8) H_{it} = X_{it}\beta + HE_{t}\phi + HE_{it}{}^{*}\lambda + \omega_{it}.$$

In a T-test under the null hypothesis of exogeneity, i.e., no simultaneity, if we reject the null hypothesis we conclude that there is a simultaneity problem. That is, λ is significantly different from zero, which implies that the OLS and the IV estimators are significantly different from each other. Regardless of which health outcome indicator was used as a health variable, the Hausman test rejected the null hypothesis of no simultaneity between health and public health care spending at 99% significant level when the valid instruments are employed. Results of the Hausman test are presented in Table 4.1.

4.3.3. Test of the Strength of Instrumental Variables

F test is used to find out strength of instrumental variables by regressing a public health care spending variable on the instrumental and all other exogenous variables. HCPI and RCFEDHTR together are found to be strong instrumental variables as F statistic of the regression of RCPUHEX on them is 68.37(P <

0.0001)[8]. That is variations in RCPUHEX are relatively well explained by HCPI, RCFEDHTR and the exogenous variables. POP65 and RCFEDHTR are also found to be strong instruments together as F statistic of the regression of RCPUHEX on POP65, RCFEDHTR and the exogenous variables is 7.98 ($P < 0.0006$).

4.4. Discussion

From the exclusion restrictions and the Hausman tests performed for the simultaneous equations model of population health, we have found two sets of valid instruments for the final model specifications: HCPI and RCFEDHTR, and POP65 and RCFEDHTR. We have also found the existence of the simultaneity between health and public health care spending.

The 2SLS using the valid instruments gives us consistent estimators as it accounts for endogenous relationship between the two variables if there are no other violations of assumptions of classical linear regression models (Maddala 1983). The results from estimation will be discussed in the next section and the effects of public health care spending on population health will be analysed along with the effects of the other factors on population health.

[8] F statistic of the regression of real per capita provincial government health expenditures on HCPI and RCFEDHTR is 61.03 ($P < 0.0001$) and that of the regression of real per capita provincial government health expenditures on POP65 and RCFEDHTR is 6.3 ($P < 0.0023$).

CHAPTRE FIVE: Results

5. Introduction

The mechanism determining the level of public health care spending through the society's choice function intuitively supports the result of the Hausman test which confirms the existence of simultaneity between public health care spending and population health. A provincial government's decisions regarding the level of health care spending are affected by the health of its provincial population since there would be more demand for health goods and services if the health status of the population is low. Conversely, the demands will be less if the health status of the population is better. Differences and fluctuations in the level of provincial real per capita health care spending are mainly up to the provincial government's decisions, since the federal contribution to provincial public health care spending is currently based on an equal per capita entitlement. The capita entitlement is adjusted annually according to changes in GNP and calculated independently of provincial costs (Health Canada 2000). The econometric results are presented in Table 5.1 - 5.29. These results will be discussed and interpreted in this chapter. The first section will discuss the validity of instruments. The second section will discuss the effects of public health care spending on population health outcomes focusing on public health care spending elasticity of health and will be followed by a discussion on the effects of income on health in Section Three. Socio-demographic and lifestyle effects on health are examined in Section Four. Section Five discusses provincial differences and other unobserved factors. Conclusions will be made in the final section.

5.1. Valid Instruments for Public Health Care Spending

It must be noted that the soundness of the interpretation of the IV estimation results is subject to the validity of the employed instruments. As discussed, if the instruments directly explain variations in the dependent variable of the system of equations, then they are invalid. Sets of instruments containing unemployment rates, POP65 and RCFEDHTR are found invalid for a public health care spending variable regardless of which health variable is used as a dependent variable in the system. Only two sets of instruments, HCPI/RCFEDTR and POP65/RCFEDHTR, were found valid for gender specific infant mortality rates and female age standardized mortality rate. No other instruments were found valid for gender specific life expectancies at birth and male age standardized mortality rate. However, POP65 and RCFEDHTR were very close to being a valid set of instruments for life expectancies at birth and male age standardized mortality rates, since their Chi-statistic was only slightly greater than Chi-critical at 99% significance level.

It is not apparent that which variable amongst HCPI and POP65 is a source of invalidity for the sets of instruments: HCPI/RCFEDHTR, and POP65/ RCFEDHTR. It is possible that one or more of the instruments are directly correlated with the life expectancies at birth and male age-standardized mortality rates, and that their measurement errors are correlated with the measurement errors in public health care spending on health. The unemployment rate is found valid for none of health variables. According to the test results, it could be directly correlated with population health as Ruhm (1996) concludes. Thus, it is eliminated as an instrument in the final specification. Real prices of health services and goods that are captured by HCPI would affect both supply and demand sides, thus amount of public health care spending. Yet, HCPI affect population health only indirectly through the spending, but not directly. Therefore, we conclude HCPI is only indirectly correlated with population health and a valid instrument for public health care spending.

5.2. Effects of Public Health Care Spending

The effect of health care spending on population health is found to be statistically significant at conventional levels and has an expected sign regardless of model specification. This is similar to the results of Cremieux and his co-authors, who concluded that there was a statistically significant negative relationship between total health care spending and health of Canadians during 1978-1992 [9] and that greater public health expenditures are correlated with lower infant and age-standardized mortality rates and higher life expectancies at birth. They also argue that one might believe that greater the public health care spending gives easier access to health goods and services, and helps the population to maintain better health.

Overall, the public health care spending elasticity of health is 2 - 6 times greater than the ones found by OLS or FGLS estimations in our estimation. It is thought that the results come from accounting for the simultaneity between health and public health care spending by using IV estimation. The results suggest that previous studies which fail to control for simultaneity understates the efficacy.

[9] The summary of results is available upon request.

According to the public health care spending elasticity of health, the impact of changes in public health care spending is found to be greater on infant mortality rates compared to the ones on age-standardized mortality rates and life expectancies at birth. Health outcomes such as age-standardized mortality rates and life expectancies would be greatly affected by more complex and broader decisions and factors affecting health through out one's lifetime, beyond available health care technology and services (Cremieux *et al.* 1999). On the other hand, the availability and quality of health care would play a more direct and important role on infant mortality rates than age-standardized mortality rates and life expectancies.

Public health care spending elasticity of health for male and female infant mortality rates are –2.2 and –2.1 when HCPI and RCFEDHT are employed as instruments. That is, as RCPUHEX increase by 10%, infant mortality rates decrease by about 20%, which is equivalent to saving an extra 2.2 male and 1.7 female infants per 1,000 live births. When POP65 and RCDEDHTR are employed as instruments, the elasticities are between –3.5 and -4.1 for male and female infant mortality rates, respectively. The choice of health care spending variable does not change the elasticity much since both RCPUHEX and REPGVHEX give very similar estimation results. The elasticities for male and female infant mortality rates are around –1.0 and –0.9, respectively, when OLS and FGLS estimations are used. For female age-standardized mortality rates, POP65 and RCFEDHT are valid instruments together when RCPGVHEX is used as health care spending variable. The elasticity is –1.1, which implies a 10% increase in RCPGVHEX is correlated with an approximately 11% decrease in age-standardized female mortality rates.

The elasticity for age-standardized female mortality rates by OLS and FGSL estimation is –0.16 and –0.18, respectively. The health care spending elasticity of age-standardized female mortality rates is about six times greater when IV estimation is used. When POP65 and RCFEDHTR are instruments, regardless of which health care spending variable is employed in the model, the elasticity for male age-standardized mortality rates is –1.2. The elasticity for male age-standardized mortality rates by IV estimation is about five times greater than the one by OLS and FGSL estimations. For male and female life expectancies at birth, the elasticity is 0.06 and 0.03 by OLS and FGLS estimation, respectively. Employing POP65 and RCFEDHTR as instruments gives the elasticity for male and female life expectancy at birth is 0.3 and 0.2, respectively. Once again, the choice of public health care spending variable barely changes the elasticity, yet employing both public health care spending variables provides robustness to the estimation results. A 10% increase in RCPUHEX is correlated with 12% decrease in male age-standardized mortality rates. That is a 10% increase in RCPUHEX correlated with a reduction of 1.2 deaths per 1,000 people. 10% of RCPUHEX in 1996 is equivalent to $166.73 in 1992 constant dollars. Effects of changes in public health care spending on life expectancies at birth are relatively moderate, as the elasticity for male and female life expectancies at birth implies that 10% increase in RCPUHEX is correlated with 3% and 2% increases in life expectancies at birth for males and females, respectively. During the study period, average male and female life expectancies at birth were 73 and 80 years, respectively.

5.3. Effects of Income

A province with a sound economy such as Alberta is able to spend more money for health care and also attract a younger and healthier population to meet labour demands resulting in better health outcomes for the population, which reflects a wealth effect. In our model, the wealth effect is controlled by the income variable. Effects of income on health outcome have been examined by many studies on both international and national levels and different conclusions have been drawn. In most of our IV estimation results, the income variable is statistically insignificant at the conventional level and has an unexpected sign. When the income variable is statistically significant, higher provincial income is correlated with higher infant and age-standardized mortality rates and lower life expectancies at birth for both sexes. For instance, a $2,000 increase in GDP per capita is correlated with one more death of male infant and 0.3 years of decrease in male life expectancy at birth, holding all other factors constant. In many studies focusing on the effects of income on population health it was found that income had a positive effect on the population's health. The results of our estimation contradict the findings of most previous studies, but are analogous with the findings by Christopher J. Ruhm (1996). His study examines the relationship between economic conditions and health and finds that the predicted relationship between personal income and health is quite weak and is sensitive to the choice of model specifications. The possible importance of cyclical variations in the time costs of medical care or healthy lifestyles, and of the negative health effects of job-holding are suggested (Ruhm 1996). In under-developed and developing countries, it is likely that a higher level of income will definitely be correlated with better health outcomes as it will better cover basic needs such as food and shelter. As all Canadian provinces have relatively high income, variations in provincial income would not be heavily associated with meeting the basic needs (Cremieux *et al.* 1999). In provinces with better economic conditions employment rates will be higher and it is possible that there are negative health effects of job holding, which could explain the unexpected sign of income variable in the estimation.

5.4. Socio-demographic, Lifestyle and Nutritional Effects

For socio-demographic variables, statistically insignificant coefficients have, in general, unexpected signs. The number of graduates per 1,000 people and poverty rates are statistically insignificant and have unexpected signs. Greater number of graduates and lower poverty rates are associated with higher mortality rates and lower life expectancies at birth. Intuitively, it is expected that greater number of graduates would be correlated with better health outcomes, as the population would be more knowledgeable regarding healthy lifestyles and better aware of available health care services and technology. On the other hand, it is also possible that BA graduates have higher employment rates, which can be associated with negative health effects of job-holding as explained in the previous section.

Lifestyle variables have expected signs when they are statistically significant. Higher smoking rates and greater alcohol consumption are correlated with higher mortality rates and lower life expectancies at birth. However, unexpected signs are found even when lifestyle variables are statistically significant in some cases when OLS and FGSL estimations are used.

The coefficient of proportion of male smokers is statistically significant and has the expected sign for all health variables when HCPI and RCFEDHTR are employed as instruments. Its coefficient is statistically insignificant, but still has the expected sign when POP65 and RCFEDHTR are instruments. The coefficient on proportion of female smokers is statistically insignificant regardless of the valid instruments employed. For female age-standardized mortality rate, its coefficient is statistically significant, yet has an unexpected sign, implying that as the proportion of female smokers increases, female age-standardized mortality rate decreases.

The coefficient of the alcohol consumption variable is statistically significant and has an expected sign when HCPI and RCFEDHTR are instruments. A 100 more liters of per capita alcohol consumption is correlated with increases in male and female infant mortality rates by 3 and 2 extra deaths per 1,000 live births, respectively. It is also correlated with decreases in male and female life expectancies at birth by about 5 and 3 years, respectively.

The relationship between health and lifestyle variables such as smoking rates and alcohol consumption is not contemporaneous, which makes the interpretation of the effects of those lifestyle variables on population health difficult. In our initial model specifications, nutritional variables such as per capita weekly household spending on meat and fat are found statistically insignificant for 1978-1992. They are omitted in the final version of the model specification since the relationship between nutrition variables and health outcomes is difficult to anticipate and the overall effect would largely depend on the individuals' health status at the time of the consumption of the nutrition (Cremieux *et al.* 1999)

5.5. Provincial Differences and Unobserved Factors

The EPF dummy variable accounting for the existence of Established Programs Financing during 1975 – 1996 is statistically insignificant, except in a specification with female age-standardized mortality rates as a health variable and POP65 and RCFEDHTR as instruments. It has a positive sign in a specification with infant and age-standardized mortality rates and a negative sign for life expectancies at birth. The 1996 dummy variable accounting for the change in calculation method for public health care spending is statistically significant and has a negative sign for both infant and age-standardized mortality rates, while it has a positive sign for life expectancies at birth, when HCPI and RCFEDHTR are the instruments. A provincial dummy is employed to account for provincial differences. Compared to Alberta, other provinces whose coefficients are statistically significant have higher infant and age-standardized mortality rates and lower life expectancies at birth for both sexes. Manitoba, Saskatchewan and British Columbia have about two more male and female infant deaths per 1,000 live births. Male and female age standardized mortality rates in Manitoba are higher by about three more deaths per 1,000 people than the ones in Alberta when POP65 and RCFEDHTR are instruments. The differences in male age standardized mortality rates between Alberta and the other provinces are greater when HCPI and RCFEDHTR are employed as instruments. Male mortality rates in Manitoba and Quebec are higher by about four and five more deaths per 1,000 people, respectively, with HCPI and RCFEDHTR as instruments. The differences in female age standardized mortality rates between Alberta and the other provinces are also greater when HCPI and RCFEDHTR are employed as instruments. According to the sign of coefficient of the provincial dummy, Ontario has a higher male life expectancy than Alberta. Yet, the coefficient is not statistically significant. It is not clear what creates better health outcomes in Alberta than the other provinces since the differences in real per capita public health care spending across provinces are relatively small and income effect on population health is found insignificant and negative.

5.6. Conclusion

Two sets of valid instruments are found to correct for the simultaneity between public health care spending and population health whose severity is confirmed through a Hausman test. The two sets of valid instruments are: (1) HCPI and RCFEDHTR, and (2) POP65 and RCFEDHTR. However, HCPI and RCFEDHTR were only valid in a specification taking gender specific infant mortality rates as a health variable. POP65 and RCFEDHTR were valid together for female age-standardized mortality rates as well as male and female infant mortality rates. No valid instruments were found for specifications taking life expectancies at birth and male age-standardized mortality rates as a health variable. Estimation results employing POP65 and RCFEDHTR as instruments were also interpreted since they were very close to being a valid set of instruments. The estimation results were similar for both RCPUHEX and RCPGVHEX as public health care spending variables. Estimation results for specifications with RCPUHEX as a public health care spending variable is interpreted unless it is specified. When HCPI and RCFEDHTR are employed as instruments, more than 70% of the variation in population health is explained by the explanatory variables in the final model specification. For instance, 76% of the variations in male infant mortality rate is explained by the explanatory variables with HCPI and RCFEDHTR as instruments, while only 47 % is explained with POP65 and RCFEDHTR as instruments. According to adjusted R-squares, the variations in male age standardized mortality rates and female infant mortality rates are the most and the least explained by the explanatory variables in our final model specification, respectively.

A decrease in the level of public health care spending has a statistically significant negative impact on population health. The impact in terms of public health care spending elasticity of health outcome is greater on male and female infant mortality rates than male and female age-standardized mortality rates and life expectancies at birth. The public health care spending elasticity of gender specific infant mortality rates found by IV estimation is more than two times greater than the one found by OLS or FGLS estimations. When HCPI and RCFEDHTR are instruments, a 1% decrease in public health care spending is correlated with about 2.22% and 2.14% increases in male and female infant mortality rates, respectively. The impact of changes in the level of public health care spending on each of the health outcome indicators is greater when POP65 and RCFEDHTR are employed as instruments. Its impact on gender specific life expectancies at birth is found to be similar, regardless of estimation chosen. When POP65 and RCFEDHTR are instruments a 1% decrease in public health care spending is correlated with a 0.29% and a 0.18% decrease in male and female life expectancies at birth, respectively. Its impact on gender specific age-standardized mortality rates is moderate compared to its impact on infant mortality rates, yet greater than the one on life expectancies at birth. When POP65 and RCFEDHTR are instruments, a 1% decrease in public health care spending is correlated with a 1.19% and a 1.09% increase in male and female age-standardized mortality rates.

It is apparent that a decrease in public health care spending is negatively correlated with population health. This result is consistent regardless whether an endogenous relationship between public health care spending and population health is accounted for. However, accounting for the endogeneity gives us the results that public health care spending has a greater impact on population health, comparing to its impact found by holding public health care spending exogenous in health equation. The difference in results indicates the importance of accounting for a simultaneous relationship between public health care spending and population health.

CHAPTER SIX: DISCUSSION AND CONCLUSION

Based on the health production function as a loose theoretical underpinning to explain the link between population health and public health care spending, this thesis empirically tested for endogeneity between them and estimated the effects of public health care spending on population health in Canada, controlling for the effects of Canada's economic, socio-demographic and lifestyle factors on population health to limit specification bias using provincial data eliminating heterogeneity. Population health is represented by the most commonly used aggregate health outcome indicators: gender specific infant, age-standardized mortality rates and life expectancies at birth. Both real per capita public health expenditures and real per capita provincial government health expenditures were separately considered as a public health care spending variable for robustness of the estimation. The estimation results from controlling for the simultaneous relationship between public health care spending and population health are somewhat different from ones found in previous work that do not control for the endogeneity. Public health care spending has a statistically significant and negative impact on infant and age-standardized mortality rates and a positive impact on life expectancies at birth for both male and female. The positive impact of public health care spending on population health could reflect that more public health resources allow more and better delivery of health goods and services to the population, thus result in better population health.

The greatest elasticity of public health care spending is found for gender specific infant mortality rates. This implies that the impact of changes in the level of public health care spending is greater on infant mortality rates among health outcomes including age-standardized mortality rates and life expectancies at birth. One interpretation could be that infant mortality rates are more directly affected by the availability and quality of health care, while other health outcomes such as age-standardized mortality rates and life expectancies are greatly affected by more complex factors and broader decisions affecting health through out one's lifetime (Cremieux *et al.* 1999).

The positive impact of public health care spending on population health is an important finding in this thesis. It is suspected that studies finding insignificant and/or negative impact of public health care spending on population health mainly suffer from failing to control for the endogeneity and possibly other problems such as specification biases and data heterogeneity.

Another important finding in this thesis is that accounting for a simultaneous relationship between public health care spending and population health yields greater public health care spending elasticity of health, compared to the elasticity found in previous studies ignoring the simultaneity. According to OLS and FGLS estimates, 10% reduction in public health care spending is correlated with about 10% and 2% increases in infant and age-standardized morality rates, respectively and less than 1% decrease in life expectancies at birth. On the other hand, the 10% reduction is correlated with more than 20% and 10% increases in both infant and age-standardized mortality rates and about 2% decrease in life expectancies at birth, according to the IV estimates that accounts for the simultaneity. The elasticity found by IV estimation is more than twice OLS or FGLS estimates for infant mortality rates and life expectancies at birth, and about five times greater for age-standardized mortality rates. This implies that ignoring the simultaneity results in a downward bias in the estimation of the impact of public health care sending on population health.

This thesis has provided evidence that reducing public health care spending negatively impacts Canadian's health, and that the magnitude of the impact is greater than the one found in previous studies.

Table 3.1: Summary Statistics

VARIABLE	Obs	MEAN	STD. DEV.	MINIMUM	MAXIMUM
year	220	1985.5	6.358757	1975	1996
mortm	220	9.976818	1.025145	7.9	12.6
mortf	220	5.818182	0.5543818	4.7	7.6
infantm	220	10.06	3.450305	1.9	22
infantf	220	7.997273	2.815384	0	23.7
lifexm	220	73.00618	1.677748	68.54	76.2
lifexf	220	79.87836	1.189403	76.54	82.08
rcpvhex	220	533.2616	113.0979	289.82	827.59
rcpuhex	220	1580.395	201.8947	1030.19	1988.22
rctohex	220	2113.658	269.9181	1330.75	2615.97
rcpgvhex	220	1468.113	181.3694	976.85	1864.04
rcfedhtr	220	587.9228	62.92595	442.17	843.92
rcpgdp	220	21356.27	5488.167	11350.64	38470.94
bam1k	220	1.740264	0.4169303	0.937	2.823
baf1k	220	1.952568	0.5872709	0.848	3.839
bamf1k	220	3.655491	0.9230131	1.893	6.662
doc1k	220	1.551395	0.2734417	1.002	2.096
povertyr	220	14.03182	2.999343	6.9	25
unemr	220	10.38091	3.797151	2.9	20.8
hcpi	220	70.89091	25.5796	30.8	105.9
smkfr	220	28.23073	3.190811	19.8	37.73
smkmr	220	35.15814	5.286881	24	51.02
calc	220	113.71	15.47061	80.2	146.5
meat	177	0.1639534	0.0406263	0.10739	0.30818
fat	177	0.0116708	0.0030533	0.0076808	0.020492
density	220	7.716841	6.839648	1.497	24.061
pop65	220	10.82351	1.877398	6.374	14.498
pop	220	2615901	2988079	117723	1.11E+07
nf	220	0.1	0.3006842	0	1
pe	220	0.1	0.3006842	0	1
ns	220	0.1	0.3006842	0	1
nb	220	0.1	0.3006842	0	1
qe	220	0.1	0.3006842	0	1
on	220	0.1	0.3006842	0	1
mn	220	0.1	0.3006842	0	1
sk	220	0.1	0.3006842	0	1
bc	220	0.1	0.3006842	0	1
epf	220	0.8636364	0.3439569	0	1
d96	220	0.0454545	0.2087739	0	1

See Appendix I for listings of variables.

Table 4.1: Results from Hausman test

IVs: HCPI, RCFEDHTR

Public Health Care Spending Variable	Health Variable	COEFFICIENT	STD. ERROR	T	P >ITI
Real per capita public health expenditures	mortm	-0.0040224	0.0003145	-12.789	0.000
	mortf	-0.002097	0.0001731	-12.118	0.000
	infantm	-0.0126046	0.001153	-10.932	0.000
	infantf	-0.0107798	0.0009999	-10.78	0.000
	lifexm	0.0074454	0.0003934	18.928	0.000
	lifexf	0.004978	0.0003382	14.72	0.000
Real per capita provincial government health expenditures	mortm	-0.004255	0.000339	-12.552	0.000
	mortf	-0.0022012	0.0001849	-11.904	0.000
	infantm	-0.0136278	0.0012247	-11.127	0.000
	infantf	-0.0117778	0.0010566	-11.147	0.000
	lifexm	0.0079175	0.0004317	18.342	0.000
	lifexf	0.0052386	0.0003643	14.378	0.000

IVs: POP65, RCFEDHTR

Public Health Care Spending Variable	Health Variable	COEFFICIENT	STD. ERROR	T	P >ITI
Real per capita public health expenditures	mortm	-0.0064804	0.000651	-9.955	0.000
	mortf	-0.0036699	0.0003401	-10.79	0.000
	infantm	-0.0171666	0.0024517	-7.002	0.000
	infantf	-0.0174907	0.0020105	-8.7	0.000
	lifexm	0.0113629	0.0009363	12.137	0.000
	lifexf	0.0081071	0.0007149	11.34	0.000
Real per capita provincial government health expenditures	mortm	-0.0067779	0.0007988	-8.486	0.000
	mortf	-0.003944	0.0004111	-9.595	0.000
	infantm	-0.0194053	0.0028939	-6.706	0.000
	infantf	-0.0200241	0.0023748	-8.432	0.000
	lifexm	0.0121106	0.0011737	10.318	0.000
	lifexf	0.008669	0.0008743	9.915	0.000

Table 5.1: Male Age Standardized Mortality Rate Equation Estimates

OLS Regression: Public Health Care Spending Held Exogeneous
Public Health Care Spending Varible: Real per capita public health expenditures

Source	SS	df	MS
Model	267.018763	19	14.536191
Residual	9.14250426	200	0.045712521
Total	276.161268	219	1.26101035

Number of obs = 220
F(19, 200) = 307.43
Prob > F = 0
R-squared = 0.9669
Adj R-squared = 0.9637
Root MSE = 0.2138

mortm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	-0.0009396	0.0001418	-6.625	0	-0.0012193	-0.0006599
rcpgdp	0.0000152	0.0000111	1.371	0.172	-6.66E-06	0.0000371
bamf1k	0.1509922	0.0504349	2.994	0.003	0.0515398	0.2504446
povertyr	-0.0073517	0.0113072	-0.65	0.516	-0.0296484	0.014945
pop652se	-0.6152245	0.0383167	-16.056	0	-0.6907811	-0.539668
smkmr	0.0042253	0.0073989	0.571	0.569	-0.0103645	0.0188151
smkfr	-0.0101729	0.0091012	-1.118	0.265	-0.0281195	0.0077738
calc	0.0110722	0.0029157	3.797	0	0.0053227	0.0168216
nf	1.035962	0.1936229	5.35	0	0.654158	1.417766
pe	3.573179	0.3304081	10.814	0	2.921649	4.22471
ns	3.157512	0.2138874	14.762	0	2.735748	3.579275
nb	2.62311	0.1942509	13.504	0	2.240067	3.006152
qe	2.261485	0.1489866	15.179	0	1.967699	2.555271
on	1.650649	0.1374611	12.008	0	1.37959	1.921708
mn	2.966369	0.1945974	15.244	0	2.582643	3.350095
sk	2.803155	0.190541	14.712	0	2.427428	3.178883
bc	1.850801	0.1859844	9.951	0	1.484059	2.217543
epf	-0.1405511	0.0687928	-2.043	0.042	-0.2762033	-0.0048988
d96	-0.1533771	0.1087528	-1.41	0.16	-0.3678263	0.0610721
_cons	14.16173	0.9431618	15.015	0	12.30191	16.02154

Weighted with respect to provincial population

Table 5.2: Male Age Standardized Mortality Rate Equation Estimates

Cross-sectional time-series FGLS Regression: Public Health Care Spending Held Exogeneous
Coefficeints: generalized least squares
Panels: hetroscedastic
Correlation: no autocorrelation
Public Health Care Spending Varible: Real per capita public health expenditures

Estimated covariances	= 10	Number of obs	= 220
Estimated autocorrlations	= 0	Number of groups	= 10
Estmated coefficients	= 20	No. of time periods	**= 22**
Log likelihood	= -4.034649	Wald chi2(19)	= 11630.36
		Pr > chi2	**= 0**

mortm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	-0.0011415	0.0001066	-10.707	0	-0.0013505	-0.0009326
rcpgdp	0.0000224	9.28E-06	2.414	0.016	4.21E-06	0.0000406
bamf1k	0.1618978	0.0377302	4.291	0	0.087948	0.2358475
povertyr	0.0032738	0.0094328	0.347	0.729	-0.0152142	0.0217617
pop652se	-0.6503534	0.0307356	-21.16	0	-0.7105941	-0.5901128
smkmr	0.0015306	0.0062888	0.243	0.808	-0.0107954	0.0138565
smkfr	-0.0067398	0.0078426	-0.859	0.39	-0.022111	0.0086314
calc	0.0102529	0.002194	4.673	0	0.0059528	0.014553
nf	1.072708	0.3085099	3.477	0.001	0.4680398	1.677376
pe	3.816772	0.4725484	8.077	0	2.890594	4.74295
ns	3.28402	0.197778	16.605	0	2.896382	3.671658
nb	2.734678	0.1734567	15.766	0	2.394709	3.074646
qe	2.339947	0.1237733	18.905	0	2.097356	2.582539
on	1.761304	0.1168326	15.075	0	1.532316	1.990291
mn	3.146136	0.1877288	16.759	0	2.778194	3.514078
sk	2.977174	0.2056409	14.478	0	2.574125	3.380222
bc	2.025397	0.1545186	13.108	0	1.722546	2.328248
epf	-0.1421443	0.0499915	-2.843	0.004	-0.2401258	-0.0441629
d96	-0.1447002	0.0815143	-1.775	0.076	-0.3044653	0.015065
_cons	14.48903	0.718306	20.171	0	13.08117	15.89688

Weighted with respect to provincial population

Table 5.3: Male Age Standardized Mortality Rate Equation Estimates

Instrumental Variables (2SLS) Regression
Instrumented: RCPUHEX
Instruments: HCPI, RCFEDHTR and all other predetermined explanatory variables

Source	SS	df	MS
Model	241.463343	18	13.4146302
Residual	34.6979243	201	0.172626489
Total	276.161268	219	1.26101035

Number of obs	= 220
F(18, 201)	= 85.16
Prob > F	= 0
R-squared	= 0.8744
Adj R-squared	= 0.8631
Root MSE	= 0.41548

mortm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	-0.0038773	0.0004198	-9.237	0	-0.004705	-0.0030496
rcpgdp	0.000074	0.0000233	3.175	0.002	0.000028	0.0001199
bamf1k	0.137386	0.0981073	1.4	0.163	-0.0560656	0.3308376
povertyr	0.0214004	0.0219414	0.975	0.331	-0.0218645	0.0646653
smkmr	0.0424608	0.0130865	3.245	0.001	0.0166564	0.0682652
smkfr	-0.0296203	0.0178247	-1.662	0.098	-0.0647677	0.0055271
calc	0.0344364	0.004189	8.221	0	0.0261763	0.0426965
nf	0.5272069	0.3611452	1.46	0.146	-0.1849123	1.239326
pe	1.350286	0.5617818	2.404	0.017	0.2425438	2.458028
ns	1.470402	0.3648462	4.03	0	0.7509855	2.189819
nb	1.348138	0.3381084	3.987	0	0.6814438	2.014833
qe	1.301751	0.2354436	5.529	0	0.8374951	1.766008
on	0.2122161	0.2102496	1.009	0.314	-0.2023618	0.626794
mn	1.185784	0.2793317	4.245	0	0.6349876	1.736581
sk	0.7143834	0.2632753	2.713	0.007	0.1952476	1.233519
bc	0.0580816	0.2472078	0.235	0.814	-0.4293718	0.545535
epf	0.0097493	0.1378494	0.071	0.944	-0.2620672	0.2815658
d96	-0.5247017	0.2057175	-2.551	0.011	-0.930343	-0.1190605
_cons	8.351078	1.532264	5.45	0	5.329704	11.37245

Weighted with respect to provincial population

Table 5.4: Male Age Standardized Mortality Rate Equation Estimates

Instrumental Variables (2SLS) Regression
Instrumented: RCPUHEX
Instruments: POP65, RCFEDHTR and all other predetermined explanatory variables

Source	SS	df	MS
Model	168.330126	18	9.35167368
Residual	107.831141	201	0.53647334
Total	276.161268	219	1.2611035

Number of obs = 220
F(18, 201) = 26.91
Prob > F = 0
R-squared = 0.6095
Adj R-squared = 0.5746
Root MSE = 0.73244

mortm	**Coef.**	**Std. Err.**	**t**	**P>|t|**	**[95% Conf.**	**Interval]**
rcpuhex	-0.0074899	0.0017347	-4.318	0	-0.0109104	-0.0040694
rcpgdp	0.0001738	0.0000597	2.91	0.004	0.000056	0.0002915
bamf1k	0.3615479	0.1984681	1.822	0.07	-0.0297987	0.7528945
povertyr	0.0396704	0.0394854	1.005	0.316	-0.0381883	0.1175292
smkmr	0.0226259	0.0246256	0.919	0.359	-0.0259318	0.0711835
smkfr	-0.054685	0.0332547	-1.644	0.102	-0.1202579	0.0108879
calc	0.0191073	0.0099426	1.922	0.056	-0.0004979	0.0387125
nf	1.397596	0.740417	1.888	0.061	-0.0623856	2.857577
pe	1.926587	1.021486	1.886	0.061	-0.0876169	3.940791
ns	1.407986	0.6437474	2.187	0.03	0.1386217	2.677351
nb	1.526984	0.6010809	2.54	0.012	0.3417508	2.712217
qe	2.168059	0.5602021	3.87	0	1.063432	3.272685
on	0.0996699	0.3738519	0.267	0.79	-0.637505	0.8368447
mn	1.737318	0.547593	3.173	0.002	0.657554	2.817082
sk	0.8106494	0.4659994	1.74	0.083	-0.1082251	1.729524
bc	0.7246971	0.5231962	1.385	0.168	-0.3069602	1.756354
epf	0.4190481	0.3010851	1.392	0.166	-0.1746425	1.012739
d96	-0.4791833	0.3631917	-1.319	0.189	-1.195338	0.2369713
_cons	13.29204	3.449796	3.853	0	6.489602	20.09447

Weighted with respect to provincial population

Table 5.5: Female Age Standardized Mortality Rate Equation Estimates

OLS Regression: Public Health Care Spending Held Exogeneous
Public Health Care Spending Varible: Real per capita public health expenditures

Source	SS	df	MS
Model	66.3332186	19	3.49122203
Residual	3.02579263	200	0.15128963
Total	69.3590112	219	0.31677814

Number of obs = 220
F(19, 200) = 230.76
Prob > F = 0
R-squared = 0.9564
Adj R-squared = 0.9522
Root MSE = 0.123

mortf	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	-0.0003262	0.0000816	-3.999	0	-0.0004871	-0.0001654
rcpgdp	-6.92E-06	6.38E-06	-1.085	0.279	-0.0000195	5.65E-06
bamf1k	-0.0192148	0.0290147	-0.662	0.509	-0.0764288	0.0379992
povertyr	-0.0207368	0.0065049	-3.188	0.002	-0.0335638	-0.0079097
pop652se	-0.3113495	0.0220432	-14.125	0	-0.3548164	-0.2678826
smkmr	0.0143163	0.0042565	3.363	0.001	0.005923	0.0227097
smkfr	-0.0119673	0.0052358	-2.286	0.023	-0.0222918	-0.0016428
calc	-0.0008492	0.0016774	-0.506	0.613	-0.0041568	0.0024584
nf	0.6835763	0.1113893	6.137	0	0.4639281	0.9032245
pe	0.9281513	0.1900806	4.883	0	0.5533322	1.30297
ns	1.410609	0.1230473	11.464	0	1.167972	1.653245
nb	0.9036211	0.1117507	8.086	0	0.6832604	1.123982
qe	0.8601995	0.0857105	10.036	0	0.6911873	1.029212
on	0.9504774	0.07908	12.019	0	0.7945398	1.106415
mn	1.406001	0.11195	12.559	0	1.185248	1.626755
sk	1.096551	0.1096164	10.004	0	0.8803987	1.312703
bc	0.8434692	0.106995	7.883	0	0.6324861	1.054452
epf	-0.2390392	0.0395758	-6.04	0	-0.3170786	-0.1609998
d96	-0.2239201	0.0625644	-3.579	0	-0.3472906	-0.1005496
_cons	9.451679	0.5425918	17.42	0	8.381744	10.52161

Weighted with respect to provincial population

Table 5.6: Female Age Standardized Mortality Rate Equation Estimates

Cross-sectional time-series FGLS Regression: Public Health Care Spending Held Exogeneous
Coefficeints: generalized least squares
Panels: hetroscedastic
Correlation: no autocorrelation
Public Health Care Spending Varible: Real per capita public health expenditures

Estimated covariances	= 10	Number of obs	= 220
Estimated autocorrlations	= 0	Number of groups	= 10
Estmated coefficients	= 20	No. of time periods	= 22
Log likelihood	= 116.0369	Wald chi2(19)	= 6365.14
		Pr > chi2	**= 0**

mortf	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	-0.0003659	0.0000702	-5.21	0	-0.0005036	-0.0002283
rcpgdp	-6.97E-06	5.98E-06	-1.167	0.243	-0.0000187	4.74E-06
bamf1k	-0.0055613	0.0237738	-0.234	0.815	-0.052157	0.0410344
povertyr	-0.0220078	0.0061478	-3.58	0	-0.0340574	-0.0099583
pop652se	-0.3281193	0.0200407	-16.373	0	-0.3673984	-0.2888402
smkmr	0.016689	0.0041227	4.048	0	0.0086087	0.0247693
smkfr	-0.0158856	0.0050276	-3.16	0.002	-0.0257394	-0.0060317
calc	-0.0030524	0.0013689	-2.23	0.026	-0.0057355	-0.0003694
nf	0.7011384	0.1508257	4.649	0	0.4055254	0.9967514
pe	0.9376136	0.2694514	3.48	0.001	0.4094986	1.465729
ns	1.399855	0.1215626	11.516	0	1.161597	1.638113
nb	0.8940257	0.1093821	8.173	0	0.6796407	1.108411
qe	0.8992969	0.0795387	11.306	0	0.7434038	1.05519
on	0.9774573	0.0753233	12.977	0	0.8298263	1.125088
mn	1.446436	0.114327	12.652	0	1.222359	1.670512
sk	1.122592	0.1139491	9.852	0	0.899256	1.345928
bc	0.9239567	0.0988955	9.343	0	0.730125	1.117788
epf	-0.1814035	0.0321177	-5.648	0	-0.2443531	-0.1184539
d96	-0.2013538	0.0525267	-3.833	0	-0.3043041	-0.0984034
_cons	9.869745	0.4642224	21.261	0	8.959886	10.7796

Weighted with respect to provincial population

Table 5.7: Female Age Standardized Mortality Rate Equation Estimates

Instrumental Variables (2SLS) Regression
Instrumented: RCPUHEX
Instruments: HCPI, RCFEDHTR and all other predetermined explanatory variables

Number of obs = 220
F(18, 201) = 75.06
Prob > F = 0
R-squared = 0.8589
Adj R-squared = 0.8463
Root MSE = 0.22066

Source	SS	df	MS
Model	59.5724475	18	3.3958041
Residual	9.7865638	201	0.048689372
Total	69.3590112	219	0.316707814

mortf	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	-0.0018494	0.0002229	-8.296	0	-0.002289	-0.0014098
rcpgdp	0.0000238	0.0000124	1.926	0.055	-5.64E-07	0.0000482
bamf1k	-0.0238401	0.0521033	-0.458	0.648	-0.1265792	0.078899
povertyr	-0.0060018	0.0116528	-0.515	0.607	-0.0289792	0.0169755
smkmr	0.0334663	0.00695	4.815	0	0.019762	0.0471706
smkfr	-0.0220619	0.0094664	-2.331	0.021	-0.0407281	-0.0033957
calc	0.0108203	0.0022247	4.864	0	0.0064335	0.0152071
nf	0.4348853	0.1917985	2.267	0.024	0.0566901	0.8130805
pe	-0.1909871	0.2983534	-0.64	0.523	-0.7792913	0.3973171
ns	0.5561763	0.193764	2.87	0.005	0.1741053	0.9382472
nb	0.260194	0.179564	1.449	0.149	-0.0938768	0.6142649
qe	0.3832388	0.1250404	3.065	0.002	0.1366796	0.6297979
on	0.221388	0.1116603	1.983	0.049	0.0012123	0.4415638
mn	0.5104544	0.1483487	3.441	0.001	0.2179351	0.8029737
sk	0.0404471	0.1398213	0.289	0.773	-0.2352576	0.3161519
bc	-0.0570582	0.1312882	-0.435	0.664	-0.315937	0.2018206
epf	-0.1588486	0.0732096	-2.17	0.031	-0.303206	-0.0144911
d96	-0.4113791	0.1092533	-3.765	0	-0.6268087	-0.1959494
_cons	6.560883	0.8137612	8.062	0	4.956279	8.165487

Weighted with respect to provincial population

Table 5.8: Female Age Standardized Mortality Rate Equation Estimates

Instrumental Variables (2SLS) Regression
Instrumented: RCPUHEX
Instruments: POP65, RCFEDHTR and all other predetermined explanatory variables

Source	SS	df	MS
Model	35.444731	18	1.96915172
Residual	33.9142803	201	0.168727763
Total	69.3590112	219	0.316707814

Number of obs = 220
F(18, 201) = 21.5
Prob > F = 0
R-squared = 0.511
Adj R-squared = 0.4672
Root MSE = 0.41076

mortf	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	-0.0040027	0.0009728	-4.114	0	-0.0059209	-0.0020844
rcpgdp	0.0000833	0.0000335	2.488	0.014	0.0000173	0.0001493
bamf1k	0.1097724	0.1113038	0.986	0.325	-0.1097004	0.3292452
povertyr	0.0048881	0.022144	0.221	0.826	-0.0387762	0.0485524
smkmr	0.0216436	0.0138104	1.567	0.119	-0.0055882	0.0488755
smkfr	-0.0370018	0.0186497	-1.984	0.049	-0.0737761	-0.0002276
calc	0.0016833	0.005576	0.302	0.763	-0.0093116	0.0126782
nf	0.9536836	0.4152365	2.297	0.023	0.1349051	1.772462
pe	0.1525193	0.5728642	0.266	0.79	-0.9770753	1.282114
ns	0.5189729	0.3610229	1.438	0.152	-0.1929051	1.230851
nb	0.3667957	0.3370948	1.088	0.278	-0.2979002	1.031492
qe	0.8996044	0.3141694	2.863	0.005	0.2801136	1.519095
on	0.1543044	0.2096616	0.736	0.463	-0.2591139	0.5677227
mn	0.8391982	0.3070981	2.733	0.007	0.233651	1.444745
sk	0.0978269	0.2613392	0.374	0.709	-0.4174913	0.613145
bc	0.3402804	0.293416	1.16	0.248	-0.238288	0.9188487
epf	0.0851155	0.1688529	0.504	0.615	-0.2478348	0.4180658
d96	-0.3842476	0.2036831	-1.886	0.061	-0.7858775	0.0173822
_cons	9.505958	1.934696	4.913	0	5.691055	13.32086

Weighted with respect to provincial population

Table 5.9: Male Infant Mortality Rate Equation Estimates

OLS Regression: Public Health Care Spending Held Exogeneous
Public Health Care Spending Varible: Real per capita public health expenditures

Number of obs = 220
F(19, 200) = 87.77
Prob > F = 0
R-squared = 0.8929
Adj R-squared = 0.8827
Root MSE = 0.97244

Source	SS	df	MS
Model	1577.03295	19	83.17341
Residual	189.127605	200	0.945638023
Total	1766.16055	219	8.06466006

infantm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	-0.0053248	0.0006451	-8.255	0	-0.0065968	-0.0040528
rcpgdp	0.0000594	0.0000504	1.178	0.24	-0.00004	0.0001588
bamf1k	0.0975731	0.2293908	0.425	0.671	-0.3547617	0.549908
povertyr	-0.047322	0.0514282	-0.92	0.359	-0.1487332	0.0540891
pop652se	-1.365141	0.1742741	-7.833	0	-1.708791	-1.02149
smkmr	0.0466619	0.0336519	1.387	0.167	-0.0196962	0.1130201
smkfr	0.0840544	0.0413946	2.031	0.044	0.0024285	0.1656803
calc	-0.0122994	0.0132614	-0.927	0.355	-0.0384495	0.0138506
nf	0.9648612	0.8806463	1.096	0.275	-0.7716819	2.701404
pe	4.275778	1.502781	2.845	0.005	1.312451	7.239105
ns	3.333937	0.9728144	3.427	0.001	1.415648	5.252226
nb	2.848227	0.883503	3.224	0.001	1.10605	4.590403
qe	0.5452898	0.677629	0.805	0.422	-0.7909242	1.881504
on	1.924074	0.6252083	3.077	0.002	0.6912283	3.15692
mn	7.137398	0.8850789	8.064	0	5.392114	8.882681
sk	7.59406	0.8666294	8.763	0	5.885156	9.302963
bc	5.485104	0.8459047	6.484	0	3.817068	7.153141
epf	-0.860248	0.3128872	-2.749	0.007	-1.477229	-0.243267
d96	-1.234608	0.4946354	-2.496	0.013	-2.209978	-0.2592384
_cons	27.03389	4.289741	6.302	0	18.57497	35.49281

Weighted with respect to provincial population

Table 5.10: Male Infant Mortality Rate Equation Estimates

Cross-sectional time-series FGLS Regression: Public Health Care Spending Held Exogeneous
Coefficeints: generalized least squares
Panels: hetroscedastic
Correlation: no autocorrelation
Public Health Care Spending Varible: Real per capita public health expenditures

Estimated covariances	= 10	Number of obs	= 220
Estimated autocorrlations	= 0	Number of groups	= 10
Estmated coefficients	= 20	No. of time periods	= 22
Log likelihood	= -3490.4462	Wald chi2(19)	= 2881.61
		Pr > chi2	**= 0**

infantm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	-0.0048714	0.0004952	-9.837	0	-0.005842	-0.0039008
rcpgdp	0.0000253	0.0000458	0.552	0.581	-0.0000645	0.000115
bamf1k	0.1368397	0.1769739	0.773	0.439	-0.2100227	0.4837021
povertyr	-0.1285103	0.0439829	-2.922	0.003	-0.2147153	-0.0423053
pop652se	-1.538256	0.1441209	-10.673	0	-1.820728	-1.255784
smkmr	0.0571888	0.0282676	2.023	0.043	0.0017854	0.1125922
smkfr	0.0900098	0.0361836	2.488	0.013	0.0190913	0.1609283
calc	-0.0425244	0.0105048	-4.048	0	-0.0631134	-0.0219355
nf	1.292926	0.9823039	1.316	0.188	-0.6323541	3.218207
pe	3.93372	4.004718	0.982	0.326	-3.915382	11.78282
ns	3.145686	1.049878	2.996	0.003	1.087963	5.203409
nb	2.565398	0.977134	2.625	0.009	0.6502507	4.480546
qe	0.8016104	0.6262275	1.28	0.201	-0.4257729	2.028994
on	2.174087	0.5893031	3.689	0	1.019074	3.3291
mn	7.453633	0.9254808	8.054	0	5.639724	9.267542
sk	7.625784	0.8729549	8.736	0	5.914824	9.336744
bc	6.154335	0.7711089	7.981	0	4.642989	7.665681
epf	-0.3925787	0.2285177	-1.718	0.086	-0.8404652	0.0553078
d96	-0.5162877	0.372464	-1.386	0.166	-1.246304	0.2137284
_cons	32.26329	3.354457	9.618	0	25.68868	38.83791

Weighted with respect to provincial population

Table 5.11: Male Infant Mortality Rate Equation Estimates

Instrumental Variables (2SLS) Regression
Instrumented: RCPUHEX
Instruments: HCPI, RCFEDHTR and all other predetermined explanatory variables

Source	SS	df	MS
Model	1383.7904	18	760.8772443
Residual	382.370155	201	1.90233908
Total	1766.16055	219	8.6466006

Number of obs = 220
F(18, 201) = 46.98
Prob > F = 0
R-squared = 0.7835
Adj R-squared = 0.7641
Root MSE = 1.3793

infantm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	-0.0140286	0.0013934	-10.068	0	-0.0167762	-0.0112809
rcpgdp	0.0002502	0.0000774	3.234	0.001	0.0000976	0.0004027
bamf1k	0.2029718	0.3256805	0.623	0.534	-0.4392168	0.8451604
povertyr	0.0275279	0.0728376	0.378	0.706	-0.1160959	0.1711516
smkmr	0.1195062	0.0434423	2.751	0.006	0.0338451	0.2051674
smkfr	0.0257409	0.0591715	0.435	0.664	-0.0909355	0.1424174
calc	0.030272	0.013906	2.177	0.031	0.0028516	0.0576924
nf	0.3624446	1.19887	0.302	0.763	-2.001531	2.72642
pe	-0.3080786	1.86491	-0.165	0.869	-3.985377	3.369219
ns	-0.4473952	1.211156	-0.369	0.712	-2.835596	1.940806
nb	0.1273328	1.122396	0.113	0.91	-2.085849	2.340515
qe	-1.060285	0.7815866	-1.357	0.176	-2.601446	0.4808761
on	-1.335786	0.6979519	-1.914	0.057	-2.712033	0.0404612
mn	3.520012	0.9272792	3.796	0	1.691569	5.348455
sk	3.017448	0.8739776	3.453	0.001	1.294107	4.740789
bc	1.910403	0.8206396	2.328	0.021	0.2922362	3.52857
epf	-0.2791673	0.4576096	-0.61	0.543	-1.181499	0.623164
d96	-2.031019	0.6829069	-2.974	0.003	-3.3776	-0.6844381
cons	17.12913	5.086557	3.368	0.001	7.099268	27.15898

Weighted with respect to provincial population

Table 5.12: Male Infant Mortality Rate Equation Estimates

Instrumental Variables (2SLS) Regression
Instrumented: RCPUHEX
Instruments: POP65, RCFEDHTR and all other predetermined explanatory variables

Source	SS	df	MS
Model	909.197151	18	500.5109529
Residual	856.963401	201	4.26349951
Total	1766.16055	219	8.6466006

Number of obs = 220
F(18, 201) = 19.62
Prob > F = 0
R-squared = 0.5148
Adj R-squared = 0.4713
Root MSE = 2.0648

infantm	**Coef.**	**Std. Err.**	**t**	**P>|t|**	**[95% Conf.**	**Interval]**
rcpuhex	-0.0224404	0.0048902	-4.589	0	-0.0320831	-0.0127977
rcpgdp	0.0004825	0.0001683	2.867	0.005	0.0001506	0.0008144
bamf1k	0.7249327	0.5594995	1.296	0.197	-0.3783088	1.828174
povertyr	0.0700697	0.1113128	0.629	0.53	-0.149421	0.2895605
smkmr	0.0733206	0.0694218	1.056	0.292	-0.0635679	0.2102091
smkfr	-0.0326223	0.0937481	-0.348	0.728	-0.2174783	0.1522337
calc	-0.0054218	0.0280291	-0.193	0.847	-0.0606906	0.049847
nf	2.389144	2.087302	1.145	0.254	-1.726675	6.504964
pe	1.033838	2.879662	0.359	0.72	-4.644384	6.712061
ns	-0.5927311	1.814782	-0.327	0.744	-4.171185	2.985723
nb	0.5437749	1.694501	0.321	0.749	-2.797505	3.885055
qe	0.9569115	1.57926	0.606	0.545	-2.157132	4.070955
on	-1.59785	1.053922	-1.516	0.131	-3.676013	0.4803129
mn	4.804259	1.543714	3.112	0.002	1.760306	7.848211
sk	3.241603	1.313694	2.468	0.014	0.6512128	5.831994
bc	3.462617	1.474937	2.348	0.02	0.5542818	6.370953
epf	0.673885	0.8487862	0.794	0.428	-0.9997827	2.347553
d96	-1.925029	1.02387	-1.88	0.062	-3.943934	0.0938757
_cons	28.63414	9.725289	2.944	0.004	9.457466	47.81082

Weighted with respect to provincial population

Table 5.13: Female Infant Mortality Rate Equation Estimates

OLS Regression: Public Health Care Spending Held Exogeneous
Public Health Care Spending Varible: Real per capita public health expenditures

Number of obs = 220
F(18, 200) = 76.2
Prob > F = 0
R-squared = 0.8786
Adj R-squared = 0.8671
Root MSE = 0.81594

Source	SS	df	MS
Model	963.905893	19	500.7318891
Residual	133.151406	200	0.665757028
Total	1097.0573	219	5.939406

infantf	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	-0.0033112	0.0005412	-6.118	0	-0.0043785	-0.0022439
rcpgdp	0.0000685	0.0000423	1.621	0.107	-0.0000149	0.000152
bamf1k	0.2152115	0.1924737	1.118	0.265	-0.1643267	0.5947496
povertyr	-0.0425708	0.0431516	-0.987	0.325	-0.1276613	0.0425197
pop652se	-1.277745	0.1462272	-8.738	0	-1.56609	-0.9894002
smkmr	0.0540623	0.0282361	1.915	0.057	-0.0016165	0.109741
smkfr	0.0665007	0.0347328	1.915	0.057	-0.0019887	0.1349902
calc	-0.0221006	0.0111272	-1.986	0.048	-0.0440422	-0.000159
nf	1.346399	0.7389192	1.822	0.07	-0.1106724	2.803471
pe	4.804926	1.26093	3.811	0	2.318503	7.291349
ns	2.817461	0.8162541	3.452	0.001	1.207893	4.42703
nb	2.735829	0.7413161	3.691	0	1.274031	4.197628
qe	0.7774947	0.5685745	1.367	0.173	-0.3436753	1.898665
on	2.011932	0.5245902	3.835	0	0.977495	3.04637
mn	6.397562	0.7426384	8.615	0	4.933156	7.861967
sk	6.889967	0.7271581	9.475	0	5.456087	8.323848
bc	4.987563	0.7097687	7.027	0	3.587973	6.387153
epf	-0.6516981	0.2625326	-2.482	0.014	-1.169385	-0.1340111
d96	-0.6622712	0.4150311	-1.596	0.112	-1.480669	0.1561271
cons	21.4393	3.59937	5.956	0	14.34171	28.53688

Weighted with respect to provincial population

Table 5.14: Female Infant Mortality Rate Equation Estimates

Cross-sectional time-series FGLS Regression: Public Health Care Spending Held Exogeneous
Coefficeints: generalized least squares
Panels: hetroscedastic
Correlation: no autocorrelation
Public Health Care Spending Varible: Real per capita public health expenditures

Estimated covariances	= 10	Number of obs	= 220
Estimated autocorrlations	= 0	Number of groups	= 10
Estmated coefficients	= 20	No. of time periods	= 22
Log likelihood	= -307.8903	Wald chi2(19)	= 2913.55
		Pr > chi2	**= 0**

infantf	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	-0.0025661	0.000386	-6.649	0	-0.0033226	-0.0018096
rcpgdp	0.0000476	0.000035	1.357	0.175	-0.0000211	0.0001162
bamf1k	0.2290333	0.1329296	1.723	0.085	-0.0315039	0.4895704
povertyr	-0.1063292	0.0348039	-3.055	0.002	-0.1745436	-0.0381147
pop652se	-1.460014	0.1152852	-12.664	0	-1.685968	-1.234059
smkmr	0.078861	0.0234859	3.358	0.001	0.0328294	0.1248926
smkfr	0.0438602	0.0294733	1.488	0.137	-0.0139063	0.1016268
calc	-0.050556	0.0079432	-6.365	0	-0.0661243	-0.0349876
nf	1.814169	0.9606317	1.889	0.059	-0.0686343	3.696973
pe	4.722145	3.8453	1.228	0.219	-2.814505	12.2588
ns	2.96344	0.7434531	3.986	0	1.506299	4.420581
nb	2.718176	0.7439219	3.654	0	1.260116	4.176236
qe	1.214177	0.4745623	2.559	0.011	0.2840518	2.144302
on	2.436111	0.4526755	5.382	0	1.548883	3.323339
mn	6.871793	0.7300994	9.412	0	5.440824	8.302762
sk	7.138502	0.7751327	9.209	0	5.619269	8.657734
bc	5.738731	0.5927996	9.681	0	4.576865	6.900597
epf	-0.3233857	0.1766142	-1.831	0.067	-0.6695432	0.0227717
d96	-0.2590175	0.293809	-0.882	0.378	-0.8348724	0.3168375
_cons	25.9341	2.593112	10.001	0	20.8517	31.01651

Weighted with respect to provincial population

Table 5.15: Female Infant Mortality Rate Equation Estimates

Instrumental Variables (2SLS) Regression
Instrumented: RCPUHEX
Instruments: HCPI, RCFEDHTR and all other predetermined explanatory variables

Source	SS	df	MS
Model	814.172165	18	450.2317869
Residual	282.885134	201	1.40738872
Total	1097.0573	219	5.939406

Number of obs = 220
F(18, 201) = 38.71
Prob > F = 0
R-squared = 0.7421
Adj R-squared = 0.7191
Root MSE = 1.1863

infantf	**Coef.**	**Std. Err.**	**t**	**P>|t|**	**[95% Conf.**	**Interval]**
rcpuhex	-0.0108532	0.0011985	-9.055	0	-0.0132166	-0.0084899
rcpgdp	0.0002304	0.0000665	3.463	0.001	0.0000992	0.0003616
bamf1k	0.2763514	0.2801269	0.987	0.325	-0.276013	0.8287157
povertyr	0.0244299	0.0626496	0.39	0.697	-0.0991049	0.1479647
smkmr	0.1255623	0.037366	3.36	0.001	0.0518828	0.1992419
smkfr	0.0161148	0.050895	0.317	0.752	-0.0842419	0.1164714
calc	0.0203106	0.011961	1.698	0.091	-0.0032744	0.0438957
nf	0.6368983	1.031181	0.618	0.538	-1.396423	2.67022
pe	0.418087	1.604061	0.261	0.795	-2.74486	3.581034
ns	-0.7113481	1.041749	-0.683	0.495	-2.765507	1.342811
nb	0.1591976	0.9654044	0.165	0.869	-1.744422	2.062817
qe	-0.8702599	0.6722645	-1.295	0.197	-2.195856	0.4553357
on	-1.0204	0.600328	-1.7	0.091	-2.204149	0.1633486
mn	2.919465	0.7975788	3.66	0	1.34677	4.49216
sk	2.590238	0.7517325	3.446	0.001	1.107945	4.072532
bc	1.53016	0.705855	2.168	0.031	0.1383296	2.921991
epf	-0.17631	0.3936028	-0.448	0.655	-0.9524304	0.5998105
d96	-1.415313	0.5873873	-2.41	0.017	-2.573545	-0.2570814
_cons	11.34181	4.37509	2.592	0.01	2.71485	19.96877

Weighted with respect to provincial population

Table 5.16: Female Infant Mortality Rate Equation Estimates

Instrumental Variables (2SLS) Regression
Instrumented: RCPUHEX
Instruments: POP65, RCFEDHTR and all other predetermined explanatory variables

Source	SS	df	MS
Model	280.015505	18	150.5564169
Residual	817.041794	201	4.6488455
Total	1097.0573	219	5.939406

Number of obs = 220
F(18, 201) = 12.86
Prob > F = 0
R-squared = 0.2552
Adj R-squared = 0.1885
Root MSE = 2.0162

infantf	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	-0.020649	0.004775	-4.324	0	-0.0300645	-0.0112336
rcpgdp	0.000501	0.0001644	3.048	0.003	0.0001769	0.0008251
bamf1k	0.884189	0.546312	1.618	0.107	-0.1930488	1.961427
povertyr	0.0739711	0.1086892	0.681	0.497	-0.1403462	0.2882884
smkmr	0.0717779	0.0677855	1.059	0.291	-0.0618841	0.2054398
smkfr	-0.0518508	0.0915385	-0.566	0.572	-0.2323497	0.128648
calc	-0.0212558	0.0273684	-0.777	0.438	-0.0752219	0.0327103
nf	2.997045	2.038104	1.471	0.143	-1.021763	7.015854
pe	1.980786	2.811788	0.704	0.482	-3.5636	7.525172
ns	-0.8805958	1.772007	-0.497	0.62	-4.374705	2.613513
nb	0.6441557	1.654562	0.389	0.697	-2.618369	3.906681
qe	1.47882	1.542037	0.959	0.339	-1.561824	4.519464
on	-1.325581	1.029081	-1.288	0.199	-3.35476	0.7035993
mn	4.415005	1.507329	2.929	0.004	1.4428	7.387211
sk	2.851274	1.28273	2.223	0.027	0.3219391	5.380608
bc	3.337756	1.440173	2.318	0.021	0.4979706	6.177541
epf	0.9335454	0.8287801	1.126	0.261	-0.7006735	2.567764
d96	-1.291885	0.9997374	-1.292	0.198	-3.263204	0.6794334
_cons	24.73972	9.496061	2.605	0.01	6.015039	43.4644

Weighted with respect to provincial population

Table 5.17: Male life Expectancy at Birth Equation Estimates

OLS Regression: Public Health Care Spending Held Exogeneous
Public Health Care Spending Varible: Real per capita public health expenditures

Source	SS	df	MS
Model	666.625322	19	35.855432
Residual	16.8731446	200	0.084365723
Total	683.498466	219	3.12099756

Number of obs = 220
F(19, 200) = 415.87
Prob > F = 0
R-squared = 0.9753
Adj R-squared = 0.973
Root MSE = 0.29046

lifexm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	0.0020123	0.0001927	10.444	0	0.0016323	0.0023922
rcpgdp	-0.0000386	0.0000151	-2.566	0.011	-0.0000683	-8.95E-06
bamf1k	-0.2115523	0.0685167	-3.088	0.002	-0.3466602	-0.0764445
povertyr	0.022921	0.0153611	1.492	0.137	-0.0073694	0.0532115
pop652se	1.035578	0.0520539	19.894	0	0.9329327	1.138223
smkmr	-0.0127248	0.0100515	-1.266	0.207	-0.0325453	0.0070957
smkfr	-0.0105392	0.0123642	-0.852	0.395	-0.03492	0.0138416
calc	-0.0097296	0.003961	-2.456	0.015	-0.0175403	-0.0019188
nf	-1.363138	0.2630402	-5.182	0	-1.881826	-0.8444505
pe	-5.68053	0.4488654	-12.655	0	-6.565646	-4.795414
ns	-4.609505	0.2905698	-15.864	0	-5.182478	-4.036531
nb	-4.100313	0.2638934	-15.538	0	-4.620683	-3.579942
qe	-3.167461	0.2024009	-15.649	0	-3.566574	-2.768347
on	-2.306459	0.1867434	-12.351	0	-2.674697	-1.93822
mn	-5.101447	0.2643641	-19.297	0	-5.622745	-4.580148
sk	-5.070242	0.2588535	-19.587	0	-5.580674	-4.55981
bc	-3.538804	0.2526632	-14.006	0	-4.03703	-3.040578
epf	0.0704359	0.0934562	0.754	0.452	-0.1138501	0.2547219
d96	0.2430501	0.1477426	1.645	0.102	-0.0482829	0.5343832
_cons	65.17469	1.281302	50.866	0	62.64809	67.70129

Weighted with respect to provincial population

Table 5.18: Male life Expectancy at Birth Equation Estimates

Cross-sectional time-series FGLS Regression: Public Health Care Spending Held Exogeneous
Coefficeints: generalized least squares
Panels: hetroscedastic
Correlation: no autocorrelation
Public Health Care Spending Varible: Real per capita public health expenditures

Estimated covariances	= 10	Number of obs	= 220
Estimated autocorrlations	= 0	Number of groups	= 10
Estmated coefficients	= 20	No. of time periods	= 22
Log likelihood	= -79.31869	Wald chi2(19)	= 21803.6
		Pr > chi2	**= 0**

lifexm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	0.0021481	0.0001305	16.456	0	0.0018923	0.002404
rcpgdp	-0.0000354	0.0000127	-2.786	0.005	-0.0000603	-0.0000105
bamf1k	-0.280917	0.0462255	-6.077	0	-0.3715174	-0.1903166
povertyr	0.0271157	0.0113987	2.379	0.017	0.0047746	0.0494567
pop652se	1.121132	0.0402414	27.86	0	1.04226	1.200004
smkmr	-0.0143003	0.0074883	-1.91	0.056	-0.028977	0.0003764
smkfr	-0.0025445	0.0098946	-0.257	0.797	-0.0219375	0.0168485
calc	-0.001062	0.0028814	-0.369	0.712	-0.0067096	0.0045855
nf	-1.413254	0.387277	-3.649	0	-2.172303	-0.6542049
pe	-5.812071	0.9289923	-6.256	0	-7.632862	-3.991279
ns	-4.568744	0.302252	-15.116	0	-5.161147	-3.976341
nb	-4.081243	0.2546601	-16.026	0	-4.580368	-3.582118
qe	-3.322424	0.1849324	-17.966	0	-3.684885	-2.959963
on	-2.416965	0.1767384	-13.675	0	-2.763366	-2.070564
mn	-5.287786	0.2662764	-19.858	0	-5.809679	-4.765894
sk	-5.221523	0.281567	-18.545	0	-5.773384	-4.669662
bc	-3.895206	0.2278225	-17.098	0	-4.34173	-3.448682
epf	-0.0160068	0.0586296	-0.273	0.785	-0.1309187	0.0989051
d96	0.1132413	0.0984079	1.151	0.25	-0.0796347	0.3061172
_cons	63.19227	0.8686872	72.745	0	61.48967	64.89486

Weighted with respect to provincial population

Table 5.19: Male life Expectancy at Birth Equation Estimates

Instrumental Variables (2SLS) Regression
Instrumented: RCPUHEX
Instruments: HCPI, RCFEDHTR and all other predetermined explanatory variables

Source	SS	df	MS
Model	586.055804	18	32.5586558
Residual	97.4426626	201	0.484789366
Total	683.498466	219	3.12099756

Number of obs = 220
F(18, 201) = 76.26
Prob > F = 0
R-squared = 0.8574
Adj R-squared = 0.8447
Root MSE = 0.69627

lifexm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	0.0073579	0.0007034	10.46	0	0.0059709	0.008745
rcpgdp	-0.0001487	0.000039	-3.807	0	-0.0002257	-0.0000717
bamf1k	-0.2135122	0.1644085	-1.299	0.196	-0.5376989	0.1106744
povertyr	-0.0275023	0.0367695	-0.748	0.455	-0.1000058	0.0450012
smkmr	-0.0748848	0.0219304	-3.415	0.001	-0.1181279	-0.0316417
smkfr	0.0249757	0.0298707	0.836	0.404	-0.0339244	0.0838758
calc	-0.0473572	0.00702	-6.746	0	-0.0611995	-0.033515
nf	-0.6033128	0.6052079	-0.997	0.32	-1.796684	0.5900583
pe	-2.00276	0.9414354	-2.127	0.035	-3.859117	-0.1464038
ns	-1.762753	0.6114101	-2.883	0.004	-2.968353	-0.5571519
nb	-1.974051	0.5666029	-3.484	0.001	-3.0913	-0.8568032
qe	-1.648073	0.3945569	-4.177	0	-2.426075	-0.8700712
on	0.1272693	0.3523369	0.361	0.718	-0.5674814	0.82202
mn	-2.165447	0.4681048	-4.626	0	-3.088473	-1.242421
sk	-1.56499	0.4411973	-3.547	0	-2.434959	-0.6950212
bc	-0.5951428	0.4142715	-1.437	0.152	-1.412018	0.2217327
epf	-0.2279541	0.2310084	-0.987	0.325	-0.6834648	0.2275567
d96	0.8630343	0.3447419	2.503	0.013	0.1832597	1.542809
_cons	74.40745	2.567772	28.977	0	69.34423	79.47068

Weighted with respect to provincial population

Table 5.20: Male life Expectancy at Birth Equation Estimates

Instrumental Variables (2SLS) Regression
Instrumented: RCPUHEX
Instruments: POP65, RCFEDHTR and all other predetermined explanatory variables

Number of obs = 220
F(18, 201) = 22.68
Prob > F = 0
R-squared = 0.5356
Adj R-squared = 0.494
Root MSE = 1.2567

Source	SS	df	MS
Model	366.054482	18	20.3363601
Residual	317.443984	201	1.5793233
Total	683.498466	219	3.12099756

lifexm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	0.0134591	0.0029763	4.522	0	0.0075903	0.0193279
rcpgdp	-0.0003172	0.0001024	-3.096	0.002	-0.0005192	-0.0001152
bamf1k	-0.592097	0.3405274	-1.739	0.084	-1.263561	0.0793675
povertyr	-0.0583584	0.0677482	-0.861	0.39	-0.1919468	0.0752299
smkmr	-0.0413858	0.0422521	-0.979	0.329	-0.1247	0.0419285
smkfr	0.0673073	0.0570578	1.18	0.24	-0.0452014	0.179816
calc	-0.0214681	0.0170593	-1.258	0.21	-0.0551062	0.0121701
nf	-2.073303	1.270392	-1.632	0.104	-4.578309	0.4317021
pe	-2.97607	1.752645	-1.698	0.091	-6.431999	0.4798596
ns	-1.657339	1.104529	-1.5	0.135	-3.835288	0.5206111
nb	-2.276102	1.031322	-2.207	0.028	-4.309701	-0.2425035
qe	-3.11117	0.9611832	-3.237	0.001	-5.006466	-1.215875
on	0.3173476	0.6414474	0.495	0.621	-0.9474819	1.582177
mn	-3.096927	0.9395489	-3.296	0.001	-4.949564	-1.24429
sk	-1.727573	0.7995521	-2.161	0.032	-3.304159	-0.1509869
bc	-1.720983	0.8976892	-1.917	0.057	-3.49108	0.0491133
epf	-0.9192148	0.5165956	-1.779	0.077	-1.937857	0.0994273
d96	0.7861586	0.6231568	1.262	0.209	-0.4426047	2.014922
_cons	66.06272	5.91909	11.161	0	54.39124	77.7342

Weighted with respect to provincial population

Table 5.21: Female life Expectancy at Birth Equation Estimates

OLS Regression: Public Health Care Spending Held Exogeneous
Public Health Care Spending Varible: Real per capita public health expenditures

Source	SS	df	MS
Model	309.4355	19	16.2860792
Residual	12.022038	200	0.06110193
Total	321.45754	219	1.46784267

Number of obs = 220
F(19, 200) = 270.94
Prob > F = 0
R-squared = 0.9626
Adj R-squared = 0.959
Root MSE = 0.24517

lifexf	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	0.0010325	0.0001626	6.348	0	0.0007118	0.0013532
rcpgdp	-5.92E-06	0.0000127	-0.466	0.642	-0.000031	0.0000191
bamf1k	0.0163924	0.0578346	0.283	0.777	-0.0976514	0.1304362
povertyr	0.0392718	0.0129662	3.029	0.003	0.0137037	0.0648398
pop652se	0.7102766	0.0439384	16.165	0	0.6236346	0.7969186
smkmr	-0.0306155	0.0084844	-3.608	0	-0.0473459	-0.0138852
smkfr	0.0160739	0.0104365	1.54	0.125	-0.0045058	0.0366536
calc	0.001201	0.0033435	0.359	0.72	-0.005392	0.007794
nf	-1.278755	0.2220307	-5.759	0	-1.716576	-0.8409333
pe	-2.33402	0.3788848	-6.16	0	-3.081142	-1.586899
ns	-3.066609	0.2452684	-12.503	0	-3.550252	-2.582965
nb	-2.097904	0.222751	-9.418	0	-2.537145	-1.658662
qe	-1.721891	0.1708455	-10.079	0	-2.05878	-1.385001
on	-1.902112	0.1576291	-12.067	0	-2.212941	-1.591284
mn	-3.425741	0.2231483	-15.352	0	-3.865767	-2.985716
sk	-2.858747	0.2184968	-13.084	0	-3.2896	-2.427894
bc	-2.146788	0.2132716	-10.066	0	-2.567338	-1.726239
epf	0.3716821	0.0788859	4.712	0	0.2161273	0.5272369
d96	0.3585683	0.1247087	2.875	0.004	0.1126557	0.604481
_cons	72.31018	1.08154	66.859	0	70.17749	74.44286

Weighted with respect to provincial population

Table 5.22: Female life Expectancy at Birth Equation Estimates

Cross-sectional time-series FGLS Regression: Public Health Care Spending Held Exogeneous
Coefficeints: generalized least squares
Panels: hetroscedastic
Correlation: no autocorrelation
Public Health Care Spending Varible: Real per capita public health expenditures

Estimated covariances	= 10	Number of obs	= 220
Estimated autocorrlations	= 0	Number of groups	= 10
Estmated coefficients	= 20	No. of time periods	= 22
Log likelihood	= -38.16326	Wald chi2(19)	= 9665.89
		Pr > chi2	= 0

lifexf	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	0.0010033	0.0001307	7.678	0	0.0007472	0.0012594
rcpgdp	1.21E-06	0.0000119	0.102	0.919	-0.0000221	0.0000245
bamf1k	0.0175761	0.0429308	0.409	0.682	-0.0665668	0.101719
povertyr	0.0455587	0.0115432	3.947	0	0.0229343	0.068183
pop652se	0.7554178	0.0394327	19.157	0	0.6781312	0.8327045
smkmr	-0.036739	0.0077897	-4.716	0	-0.0520065	-0.0214714
smkfr	0.0224473	0.0096917	2.316	0.021	0.0034519	0.0414427
calc	0.0075591	0.0025771	2.933	0.003	0.0025081	0.0126101
nf	-1.263396	0.3183302	-3.969	0	-1.887311	-0.63948
pe	-2.264252	0.6524474	-3.47	0.001	-3.543025	-0.9854782
ns	-3.047405	0.2502812	-12.176	0	-3.537947	-2.556863
nb	-2.020366	0.2243984	-9.003	0	-2.460179	-1.580554
qe	-1.772922	0.1644717	-10.78	0	-2.095281	-1.450564
on	-2.003645	0.158686	-12.626	0	-2.314664	-1.692626
mn	-3.511406	0.2413799	-14.547	0	-3.984502	-3.03831
sk	-2.892332	0.2390651	-12.099	0	-3.360891	-2.423773
bc	-2.308029	0.2047343	-11.273	0	-2.709301	-1.906758
epf	0.230818	0.0577014	4	0	0.1177253	0.3439107
d96	0.3020538	0.0966163	3.126	0.002	0.1126894	0.4914182
_cons	71.08547	0.8498028	83.649	0	69.41989	72.75106

Weighted with respect to provincial population

Table 5.23: Female life Expectancy at Birth Equation Estimates

Instrumental Variables (2SLS) Regression
Instrumented: RCPUHEX
Instruments: HCPI, RCFEDHTR and all other predetermined explanatory variables

Source	SS	df	MS
Model	272.637347	18	15.1465193
Residual	48.8201965	201	0.24288655
Total	321.457544	219	1.46784267

Number of obs = 220
F(18, 201) = 70.44
Prob > F = 0
R-squared = 0.8481
Adj R-squared = 0.8345
Root MSE = 0.49284

lifexf	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	0.0046225	0.0004979	9.284	0	0.0036407	0.0056043
rcpgdp	-0.0000793	0.0000276	-2.868	0.005	-0.0001338	-0.0000248
bamf1k	0.0197873	0.1163723	0.17	0.865	-0.2096798	0.2492544
povertyr	0.0050739	0.0260263	0.195	0.846	-0.0462458	0.0563936
smkmr	-0.0736689	0.0155228	-4.746	0	-0.1042773	-0.0430604
smkfr	0.0399028	0.0211432	1.887	0.061	-0.0017881	0.0815937
calc	-0.0249309	0.0049689	-5.017	0	-0.0347288	-0.0151331
nf	-0.7392084	0.4283806	-1.726	0.086	-1.583905	0.1054881
pe	0.2006528	0.6663704	0.301	0.764	-1.113321	1.514626
ns	-1.115413	0.4327706	-2.577	0.011	-1.968766	-0.2620598
nb	-0.6357737	0.401055	-1.585	0.114	-1.426589	0.1550412
qe	-0.6614658	0.2792768	-2.368	0.019	-1.212154	-0.1107777
on	-0.2352592	0.2493924	-0.943	0.347	-0.7270203	0.2565019
mn	-1.400353	0.3313357	-4.226	0	-2.053693	-0.7470132
sk	-0.4525484	0.31229	-1.449	0.149	-1.068333	0.1632364
bc	-0.113712	0.2932312	-0.388	0.699	-0.6919161	0.464492
epf	0.1756771	0.1635132	1.074	0.284	-0.1467442	0.4980985
d96	0.7847622	0.2440165	3.216	0.002	0.3036015	1.265923
_cons	78.74716	1.81753	43.326	0	75.16329	82.33103

Weighted with respect to provincial population

Table 5.24: Female life Expectancy at Birth Equation Estimates

Instrumental Variables (2SLS) Regression
Instrumented: RCPUHEX
Instruments: POP65, RCFEDHTR and all other predetermined explanatory variables

Source	SS	df	MS
Model	157.720189	18	8.76223272
Residual	163.737355	201	0.814613705
Total	321.457544	219	1.46784267

Number of obs = 220
F(18, 201) = 20.6
Prob > F = 0
R-squared = 0.4906
Adj R-squared = 0.445
Root MSE = 0.90256

lifexf	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rcpuhex	0.009174	0.0021376	4.292	0	0.0049591	0.013389
rcpgdp	-0.000205	0.0000736	-2.786	0.006	-0.0003501	-0.0000599
bamf1k	-0.2626364	0.244564	-1.074	0.284	-0.7448766	0.2196037
povertyr	-0.0179447	0.0486562	-0.369	0.713	-0.1138867	0.0779973
smkmr	-0.0486786	0.0303451	-1.604	0.11	-0.1085142	0.011157
smkfr	0.0714821	0.0409784	1.744	0.083	-0.0093207	0.1522849
calc	-0.0056176	0.0122518	-0.459	0.647	-0.0297763	0.018541
nf	-1.83582	0.912385	-2.012	0.046	-3.634894	-0.0367456
pe	-0.5254346	1.258735	-0.417	0.677	-3.007454	1.956585
ns	-1.036774	0.7932632	-1.307	0.193	-2.600959	0.5274112
nb	-0.8611031	0.7406869	-1.163	0.246	-2.321617	0.5994104
qe	-1.752935	0.6903137	-2.539	0.012	-3.11412	-0.3917491
on	-0.093461	0.4606822	-0.203	0.839	-1.001851	0.8149289
mn	-2.095236	0.6747761	-3.105	0.002	-3.425784	-0.7646878
sk	-0.5738349	0.5742316	-0.999	0.319	-1.706126	0.558456
bc	-0.9535875	0.6447129	-1.479	0.141	-2.224856	0.3176809
epf	-0.3400025	0.3710147	-0.916	0.361	-1.071583	0.3915777
d96	0.727413	0.447546	1.625	0.106	-0.1550745	1.609901
_cons	72.522	4.251041	17.06	0	64.13964	80.90435

Weighted with respect to provincial population

Table 5.25: Results of IV estimation - **Real per capita public health expenditure as health care spending variable**

Dependent variable	Male infant mortality rate		Female infant mortality rate		Male age standardised mortality rate for all age groups		Female age standardized mortality rate for all age groups		Male life expectancy at birth		Female life expectancy at birth	
Instrumental variables	HCPI and RCFEDHTR											
	Coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic
Provincial Variables:												
Newfoundland	0.3624	0.302	0.6369	0.618	0.5272	1.46	0.4349	2.267 *	-0.6033	-0.997	-0.7392	-1.726
Price Edward Island	-0.3081	-0.165	0.4181	0.261	1.3503	2.404 *	-0.1910	-0.64	-2.0028	-2.127 *	0.2007	0.301
Nova Scotia	-0.4474	-0.369	-0.7113	-0.683	1.4704	4.03 *	0.5562	2.87 *	-1.7628	-2.883 *	-1.1154	-2.577 *
New Brunswick	0.1273	0.113	0.1592	0.165	1.3481	3.987 *	0.2602	1.449	-1.9741	-3.484 *	-0.6358	-1.585
Quebec	-1.0603	-1.357	-0.8703	-1.295	1.3018	5.529 *	0.3832	3.065 *	-1.6481	-4.177 *	-0.6615	-2.368 *
Ontario	-1.3358	-1.914	-1.0204	-1.7	0.2122	1.009	0.2214	1.983 *	0.1273	0.361	-0.2353	-0.943
Manitoba	3.5200	3.796 *	2.9195	3.66 *	1.1858	4.245 *	0.5105	3.441 *	-2.1654	-4.626 *	-1.4004	-4.226 *
Saskatchewan	3.0174	3.453 *	2.5902	3.446 *	0.7144	2.713 *	0.0404	0.289	-1.5650	-3.547 *	-0.4525	-1.449
British Columbia	1.9104	2.328 *	1.5302	2.168 *	0.0581	0.235	-0.0571	-0.435	-0.5951	-1.437	-0.1137	-0.388
Health care and economic variables:												
Public health spending per capita	-0.0140	-10.068 *	-0.0109	-9.055 *	-0.0039	-9.237 *	-0.0018	-8.296 *	0.0074	10.46 *	0.0046	9.284 *
GDP per capita	0.2502	3.234 *	0.2304	3.463 *	0.0740	3.175 *	0.0238	1.926	-0.1487	-3.807 *	-0.0793	-2.868 *
Socio-demographic variables:												
Number of graduates per capita	0.2030	0.623	0.2764	0.987	0.1374	1.4	-0.0238	-0.458	-0.2135	-1.299	0.0198	0.17
Poverty rate	0.0275	0.378	0.0244	0.39	0.0214	0.975	-0.0060	-0.515	-0.0275	-0.748	0.0051	0.195
Lifestyle:												
Percentage of male smokers	0.1195	2.751 *	0.1256	3.36 *	0.0425	3.245 *	0.0335	4.815 *	-0.0749	-3.415 *	-0.0737	-4.746 *
Percentage of female smokers	0.0257	0.435	0.0161	0.317	-0.0296	-1.662	-0.0221	-2.331 *	0.0250	0.836	0.0399	1.887
Alcohol consumption per capita	0.0303	2.177 *	0.0203	1.698	0.0344	8.221 *	0.0108	4.864 *	-0.0474	-6.746 *	-0.0249	-5.017 *
EPF dummy variable	-0.2792	-0.61	-0.1763	-0.448	0.0097	0.071	-0.1588	-2.17 *	-0.2280	-0.987	0.1757	1.074
1996 dummy variable	-2.0310	-2.974 *	-1.4153	-2.41	-0.5247	-2.551 *	-0.4114	-3.765 *	0.8630	2.503 *	0.7848	3.216 *
Constant	17.1291	3.368 *	11.3418	2.592 *	8.3511	5.45 *	6.5609	8.062 *	74.4075	28.977 *	78.7472	43.326 *
Adjusted R-square	0.7641		0.7191		0.8631		0.8463		0.8447		0.8345	
Strength of IV - HCPI, RCFEDHTR	F statistic	68.37										
	Prob > F	0										

Weighted with respect to provincial population (summary table 3)

* significant at 0.05% level

Table 5.26: Results of IV estimation - Real per capita provincial government health expenditure as health care spending variable

Dependent variable	Male infant mortality rate		Female infant mortality rate		Male age standardised mortality rate for all age groups		Female age standardized mortality rate for all age groups		Male life expectancy at birth		Female life expectancy at birth	
Instrumental variables	HCPI and RCFEDHTR											
	Coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic
Provincial Variables:												
Newfoundland	0.7540	0.599	0.9496	0.873	0.6227	1.652	0.4832	2.434 *	-0.7917	-1.241	-0.8587	-1.926
Price Edward Island	0.5143	0.263	1.0622	0.63	1.5672	2.683 *	-0.0853	-0.277	-2.4203	-2.448 *	-0.0626	-0.091
Nova Scotia	-1.0780	-0.854	-1.2014	-1.101	1.2991	3.437 *	0.4738	2.381 *	-1.4360	-2.245 *	-0.9098	-2.036 *
New Brunswick	0.6093	0.52	0.5351	0.529	1.4774	4.213 *	0.3227	1.747	-2.2215	-3.743 *	-0.7916	-1.909
Quebec	-0.6122	-0.733	-0.5138	-0.712	1.4127	5.653 *	0.4389	3.335 *	-1.8659	-4.412 *	-0.7995	-2.705 *
Ontario	-1.1266	-1.554	-0.8592	-1.372	0.2708	1.248	0.2492	2.181 *	0.0165	0.045	-0.3048	-1.188
Manitoba	2.6308	2.776 *	2.2347	2.73 *	0.9358	3.299 *	0.3921	2.625 *	-1.6934	-3.527 *	-1.1042	-3.292 *
Saskatchewan	2.8717	3.16 *	2.4781	3.158 *	0.6733	2.476 *	0.0210	0.147	-1.4875	-3.232 *	-0.4040	-1.256
British Columbia	2.0970	2.437 *	1.6817	2.263 *	0.1003	0.389	-0.0349	-0.258	-0.6805	-1.561	-0.1682	-0.552
Health care and economic variables:												
Public health spending per capita	-0.0150	-9.622 *	-0.0117	-8.648 *	-0.0041	-8.777 *	-0.0020	-7.994 *	0.0078	9.878 *	0.0049	8.89 *
GDP per capita	0.2532	3.135 *	0.2337	3.352 *	0.0735	3.041 *	0.0239	1.877	-0.1485	-3.63 *	-0.0793	-2.774 *
Socio-demographic variables:												
Number of graduates per capita	0.2269	0.668	0.2972	1.013	0.1410	1.387	-0.0215	-0.401	-0.2220	-1.291	0.0142	0.118
Poverty rate	0.0611	0.802	0.0507	0.77	0.0303	1.33	-0.0017	-0.139	-0.0447	-1.157	-0.0057	-0.213
Lifestyle:												
Percentage of male smokers	0.1180	2.61 *	0.1242	3.18 *	0.0423	3.127 *	0.0333	4.678 *	-0.0745	-3.251 *	-0.0734	-4.584 *
Percentage of female smokers	0.0385	0.627	0.0258	0.486	-0.0258	-1.406	-0.0203	-2.1	0.0179	0.576	0.0355	1.634
Alcohol consumption per capita	0.0417	2.979 *	0.0291	2.402 *	0.0378	9.007 *	0.0124	5.604 *	-0.0536	-7.551 *	-0.0288	-5.814 *
EPF dummy variable	-0.2033	-0.424	-0.1133	-0.274	0.0251	0.175	-0.1503	-1.991	-0.2602	-1.072	0.1549	0.913
1996 dummy variable	-1.9676	-2.769 *	-1.3657	-2.225 *	-0.5080	-2.389 *	-0.4032	-3.601 *	0.8309	2.309 *	0.7645	3.04 *
Constant	14.6359	2.813 *	9.4559	2.104 *	7.6054	4.884 *	6.2173	7.581 *	75.7905	28.756 *	79.6107	43.227 *
Adjusted R-square	0.7447		0.6935		0.8538		0.8386		0.8308		0.8243	
Strength of IV - HCPI, RCFEDHTR	F statistic	61.03										
	Prob > F	0										

Weighted with respect to provincial population (summary table 3)

* significant at 0.05% level

Table 5.27: Results of IV estimation - Real per capita public health expenditure as health care spending variable

Dependent variable	Male infant mortality rate		Female infant mortality rate		Male age standardised mortality rate for all age groups		Female age standardized mortality rate for all age groups		Male life expectancy at birth		Female life expectancy at birth	
Instrumental variables	POP65 and RCFEDHTR											
	Coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic
Provincial Variables:												
Newfoundland	2.3891	1.145	2.9970	1.471	1.3976	1.888	0.9537	2.297 *	-2.0733	-1.632	-1.8358	-2.012 *
Price Edward Island	1.0338	0.359	1.9808	0.704	1.9266	1.886	0.1525	0.266	-2.9761	-1.698	-0.5254	-0.417
Nova Scotia	-0.5927	-0.327	-0.8806	-0.497	1.4080	2.187 *	0.5190	1.438	-1.6573	-1.5	-1.0368	-1.307
New Brunswick	0.5438	0.321	0.6442	0.389	1.5270	2.54 *	0.3668	1.088	-2.2761	-2.207 *	-0.8611	-1.163
Quebec	0.9569	0.606	1.4788	0.959	2.1681	3.87 *	0.8996	2.863 *	-3.1112	-3.237 *	-1.7529	-2.539 *
Ontario	-1.5979	-1.516	-1.3256	-1.288	0.0997	0.267	0.1543	0.736	0.3173	0.495	-0.0935	-0.203
Manitoba	4.8043	3.112 *	4.4150	2.929 *	1.7373	3.173 *	0.8392	2.733 *	-3.0969	-3.296 *	-2.0952	-3.105 *
Saskatchewan	3.2416	2.468 *	2.8513	2.223 *	0.8106	1.74	0.0978	0.374	-1.7276	-2.161 *	-0.5738	-0.999
British Columbia	3.4626	2.348 *	3.3378	2.318 *	0.7247	1.385	0.3403	1.16	-1.7210	-1.917	-0.9536	-1.479
Health care and economic variables:												
Public health spending per capita	-0.0224	-4.589 *	-0.0206	-4.324 *	-0.0075	-4.318 *	-0.0040	-4.114 *	0.0135	4.522 *	0.0092	4.292 *
GDP per capita	0.4825	2.867 *	0.5010	3.048 *	0.1738	2.91 *	0.0833	2.488 *	-0.3172	-3.096 *	-0.2050	-2.786 *
Socio-demographic variables:												
Number of graduates per capita	0.7249	1.296	0.8842	1.618	0.3615	1.822	0.1098	0.986	-0.5921	-1.739	-0.2626	-1.074
Poverty rate	0.0701	0.629	0.0740	0.681	0.0397	1.005	0.0049	0.221	-0.0584	-0.861	-0.0179	-0.369
Lifestyle:												
Percentage of male smokers	0.0733	1.056	0.0718	1.059	0.0226	0.919	0.0216	1.567	-0.0414	-0.979	-0.0487	-1.604
Percentage of female smokers	-0.0326	-0.348	-0.0519	-0.566	-0.0547	-1.644	-0.0370	-1.984 *	0.0673	1.18	0.0715	1.744
Alcohol consumption per capita	-0.0054	-0.193	-0.0213	-0.777	0.0191	1.922	0.0017	0.302	-0.0215	-1.258	-0.0056	-0.459
EPF dummy variable	0.6739	0.794	0.9335	1.126	0.4190	1.392	0.0851	0.504	-0.9192	-1.779	-0.3400	-0.916
1996 dummy variable	-1.9250	-1.88	-1.2919	-1.292	-0.4792	-1.319	-0.3842	-1.886	0.7862	1.262	0.7274	1.625
Constant	28.6341	2.944 *	24.7397	2.605 *	13.2920	3.853 *	9.5060	4.913 *	66.0627	11.161 *	72.5220	17.06 *
Adjusted R-square	0.4713		0.1885		0.5746		0.4672		0.4940		0.4450	
Strength of IV - POP65, RCFEDHTR	F statistic	7.98										
	Prob > F	0.0005										

Weighted with respect to provincial population (summary table 3)

* significant at 0.05% level

Table 5.28: Results of IV estimation - Real per capita provincial government health expenditure as health care spending variable

Dependent variable	Male infant mortality rate		Female infant mortality rate		Male age standardised mortality rate for all age groups		Female age standardized mortality rate for all age groups		Male life expectancy at birth		Female life expectancy at birth	
Instrumental variables	POP65 and RCFEDHTR											
	Coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic
Provincial Variables:												
Newfoundland	3.2111	1.331	3.8409	1.606	1.5595	1.928	1.0711	2.312 *	-2.4166	-1.712	-2.0887	-2.059 *
Price Edward Island	2.5080	0.774	3.4083	1.061	2.3274	2.143 *	0.3918	0.63	-3.7388	-1.972	-1.0607	-0.778
Nova Scotia	-1.6467	-0.829	-1.8707	-0.95	1.0822	1.625	0.3377	0.885	-1.0599	-0.912	-0.6251	-0.748
New Brunswick	1.3758	0.735	1.4371	0.775	1.7696	2.821 *	0.5061	1.408	-2.7284	-2.492 *	-1.1753	-1.493
Quebec	1.8714	0.97	2.4088	1.26	2.3597	3.649 *	1.0332	2.789 *	-3.5083	-3.108 *	-2.0428	-2.518 *
Ontario	-1.2751	-1.13	-1.0338	-0.924	0.2142	0.566	0.2136	0.986	0.1147	0.174	-0.2304	-0.486
Manitoba	3.4468	2.233 *	3.1950	2.087 *	1.2469	2.409 *	0.5874	1.981 *	-2.2330	-2.472 *	-1.5127	-2.329 *
Saskatchewan	3.0203	2.138 *	2.6529	1.894	0.7300	1.541	0.0566	0.209	-1.5858	-1.918	-0.4783	-0.805
British Columbia	3.9050	2.308 *	3.8093	2.27 *	0.7897	1.392	0.3977	1.224	-1.8762	-1.894	-1.0733	-1.508
Health care and economic variables:												
Public health spending per capita	-0.0248	-4.049 *	-0.0232	-3.815 *	-0.0078	-3.812 *	-0.0043	-3.661 *	0.0143	3.983 *	0.0098	3.806 *
GDP per capita	0.5075	2.635 *	0.5331	2.791 *	0.1705	2.64 *	0.0848	2.291 *	-0.3167	-2.809 *	-0.2066	-2.55
Socio-demographic variables:												
Number of graduates per capita	0.8096	1.296	0.9828	1.587	0.3631	1.734	0.1180	0.983	-0.6074	-1.662	-0.2775	-1.056
Poverty rate	0.1293	1.038	0.1309	1.06	0.0563	1.348	0.0146	0.612	-0.0897	-1.231	-0.0398	-0.76
Lifestyle:												
Percentage of male smokers	0.0669	0.879	0.0640	0.849	0.0228	0.894	0.0211	1.444	-0.0406	-0.913	-0.0478	-1.493
Percentage of female smokers	-0.0166	-0.166	-0.0391	-0.393	-0.0468	-1.392	-0.0335	-1.738	0.0543	0.925	0.0631	1.494
Alcohol consumption per capita	0.0104	0.37	-0.0078	-0.278	0.0258	2.729 *	0.0049	0.901	-0.0329	-1.991	-0.0132	-1.108
EPF dummy variable	0.8816	0.908	1.1633	1.209	0.4387	1.348	0.1093	0.586	-0.9777	-1.721	-0.3882	-0.951
1996 dummy variable	-1.8112	-1.637	-1.1816	-1.077	-0.4483	-1.209	-0.3658	-1.721	0.7274	1.124	0.6862	1.474
Constant	25.5116	2.498 *	22.2540	2.198 *	11.7524	3.432 *	8.8199	4.496 *	68.5980	11.476 *	74.1664	17.262 *
Adjusted R-square	0.3855		0.0274		0.5581		0.4226		0.4561		0.4025	
Strength of IV - POP65, RCFEDHTR	F statistic	6.3										
	Prob > F	0.0022										

Weighted with respect to provincial population (summary table 3)

* significant at 0.05% level

Table 5.29: Public Health Care Spending Elasticity of Population Health

Public Health Care Spending Variable	Estimation Method	Male infant mortality rate	Female infant mortality rate	Male age standardized morality rate for all age groups	Female age standardized morality rate for all age groups	Male life expectancy at birth	Female life expectancy at birth
Real per capita public health expenditures	OLS	-1.0278	-0.8796	-0.2358	-0.164	0.0636	0.033
	FGLS, p(h)	-0.9943	-0.7652	-0.2786	-0.1819	0.0651	0.0338
	IVs: HCPI, RCFEDHTR	-2.2038	-2.1448	-	-	-	-
	IVs: POP65, RCFEDHTR	-3.5253	-4.0806	-1.1865	-1.0873	0.2914	0.1815
Real per capita provincial government health expenditures	OLS	-0.9587	-0.7993	-0.215	-0.1518	0.0583	0.0305
	FGLS, p(h)	-0.9377	-0.6919	-0.2566	-0.167	0.0601	0.0312
	IVs: HCPI, RCFEDHTR	-2.1937	-2.142	-	-	-	-
	IVs: POP65, RCFEDHTR	-3.6229	-4.2576	-1.1534	-1.088	0.2874	0.1804

FGLS, p(h) denotes feasible generalized least squares method correcting for autocorrelation.
No elasticity is reported when intruments are invalid in the model specification and denoted -.
Explanatory variables in the final model: rcproGDP Bamf1K povertyr smkmr smkfr alcohol efp d96 NF PEI NS NB QB ON MN SK BC
(See Appendix II for listing of variables)

Appendix I: Listing of the variables

year	indicates the period of 1975-1996
mortm	indicates age standardized male mortality rate for all age groups as deaths per 1,000 population
mortf	indicates age standardized female mortality rate for all age groupsas deaths per 1,000 population
infantm	indicates female infant mortality rates as deaths per 1,000 live born
infantf	indicates male infant mortality rates as deaths per 1,000 live born
lifexm	indicates male life expectancy at birth in years
lifexf	indicates female life expectancy at birth in years
rcpvhex	indicates province specified real per capita private health expenditures
rcpuhex	indicates province specified real per capita public health expenditures
rctohex	indicates province specified real per capita total health expenditures
rcpgovhe	indicates real per capita provincial government health expenditures
rcfhtr	indicates real per capita federal health transfers
rcpgdp	indicates real per capita provincial Gross Domestic Products
bam1k	indicates number of male BA and first professional degree gradutes per 1,000 population
baf1k	indicates number of female BA and first professional degree gradutes per 1,000 population
bamf1k	indicates number of male and female BA and first professional degree gradutes per 1,000 population
doc1k	indicates number of civilian physicians per 1,000 population
povertyr	indicates incidence of low income families
unemr	indicates unemployment rates
hcpi	indicates consumer price index for health goods and services
smkmr	indicates proportion of male smokers
smkfr	indicates proportion of female smokers
calc	indicates per capita alcohol consumption in liters
meat	indicates per household weekly spending on meat
fat	indicates per household weekly spending on fat
density	indicates province specified population density
pop652se	indicates proportion of population aged 65 and older
pop	indicates provincial population
nf	indicates Newfoundland
pe	indicates Prince Edward Island
ns	indicates Nova Scotia
nb	indicates New Brunswick
qe	indicates Quebec
on	indicates Ontario
mn	indicates Manatoba
sk	indicates Saskatchewn
bc	indicates British Columbia
epf	indicates a dummy variable for Established Programs Fiancing
d96	indicates a dummy variable for 1996

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