

**Health care expenditures in Canada and the United States: The 1990s Federal
funding reforms and pooled estimates of health spending determinants**

Rapport de recherche

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1. Introduction

Health care expenditures have been a subject of interest for many years in regards to public policy. Most empirical work has been done to determine if health care is a luxury good or a necessary good. The answer to that question has no doubt important implications in terms of policy. Our interest in this paper are health care expenditures determinants and health care financing by federal and sub national governments in Canada and the United States and the effects of the reforms of federal financing programs. The financing of health care expenditures by the United States and Canada differ in both means and methods. According to the OECD, in 2004 the United States spent 15.3% in terms of GDP on health care and only 44.7% of these expenditures were public expenditures. In contrast, Canada spent about 9.9% in terms of GDP on health care in 2004 and 69.8% of these were financed by public monies (OECD, 2006).

Very little empirical work has been done to estimate the impacts of federal funding reforms in the health care expenditures literature. Federal funding reforms in health care financing happened in several occasions in both Canada and the United States. The impacts of such reforms can enlighten us on how different levels of governments react to changes in budgetary environments. This is particularly interesting as health care expenditures are expected to rise faster than sub national government revenues. Also, little has been done to estimate health care expenditures determinants for Canada and the United States using methods to correct for non-stationarity and cointegrating relationship with multiple regressors. Better inference provided by recent econometric tools helped in addressing these issues.

This paper is divided in three parts. The first part contains an extensive review of the literature on determinants of health care expenditures and a presentation of the model we used in this study. The second part includes a survey of the American and Canadian health systems and the data used for the paper. The third part is dedicated to the results of the non-stationarity and cointegration tests on the data and the regression results of each country's models.

Part 1

2. Overview of health care expenditure determinants

In 1977, Professor Newhouse asked: “*What determines the quantity of resources a country devotes to medical care?*”(Newhouse, 1977, p.115), since then, many economists have tried to answer that question. Most of them inspired by Newhouse have tried explaining health care expenditures by using a “determinants” approach in which the per capita health care expenditures are regressed on variables that are believed to have an impact on those expenditures. Most of these studies used either international or national level data. Over the years, methods of estimation have differed considerably and have been changing along with the advancements in econometric theory. One could say that these studies have gone through four phases. The first phase would be regressions using cross-sections analysis from the simple bivariate regression to the slightly more complex multivariate regression. The second phase would be the use of pooled time series techniques for the added benefits of more observations to estimate health care expenditure determinants. The third phase would be studies that have explored issues regarding stationarity and cointegration of data in the pooled time series context and corrections that have been made to surpass such issues. A stationary time series is a series whose mean and variance do not change with time. If variables in a regression are non-stationary and not cointegrated, the implication is that the regression is spurious (Di Matteo, 2003. p.22). The fourth phase is a more recent development in studies of health care expenditure determinants and researchers have been looking into new functional forms using non-parametric techniques or even growing interest in new variables. Studies chosen for the literature review were selected to reflect the several phases of the health care determinant literature and also to their links to Canadian and American estimations and problems of non-stationarity and cointegration which were useful in our analysis. A synthesis of these studies will be presented in a table at the end of this section.

The study by Newhouse (1977) looked at the relationship between per capita medical care expenditure and per capita gross domestic product. He uses a bivariate regression to regress per capita health care expenditure on per capita GDP using a cross-section composed of 13 developed countries. Using the results of the regression using a linear functional form, he calculates implied elasticities of health care with respect to GDP and finds that the elasticities exceed one. To him, this means that health care must be a “luxury” good and that GDP per capita is the main factor in explaining variance in per capita health care expenditures since his R^2 is over 90 percent.

David Parkin (1987) published a paper criticizing the use of macroeconomic data such as aggregates like per capita GDP and giving a microeconomic analysis of results. The main issue according to him is the use of aggregates to determine the behavior of individuals in the context of estimating an Engel curve. A correct approach to determine if health care is a luxury good or not, would be to use household budgets on a national level and not use GDP on an international level. To interpret Newhouse’s results we would need to “*regard the national data as a very highly aggregated econometric model of individual consumer (or household) behavior*” (Parkin, 1987, p.116). Parkin also uses a bivariate regression to estimate the relationship between health care expenditures and GDP. He finds that the elasticity is situated around 1 depending on the use of either per capita data transformed in US dollars or PPP and also depending on the functional form used for the regression.

Gerdtham *et al.* (1992) used a single cross-section of 19 OECD countries in 1987 and used a multivariate regression model. They found that per capita GDP, urbanization, share of public financing to total expenditure, share of inpatient care expenditure to total expenditure and a dummy for countries with fee-for-services as the dominant form of payment in outpatient care are all significant variables to explain health care expenditures. Again, following the previous literature, they find that the income elasticity is greater than one, and they report an income elasticity of 1.33 according to their estimation.

To remedy the problem of small cross-sections, Hitiris and Posnett (1992) re-examined the results of previous studies with a pooled time-series and cross-section observations for 20 OECD countries for the 28 year period of 1960-1987. With these 560 observations, they come to the conclusion that the “*new evidence is consistent with an income elasticity of health spending at or around unity*” (Hitiris and Posnett, 1992, p.180). They also confirm the importance of non-income variables, but like their predecessors they find the effects to be comparatively small.

Blomqvist and Carter (1997) in their paper look at the time series structure of the income and expenditure variables used in their model. The data comes from the health data of 24 OECD countries and have time series for each country for the period of 1960 to 1992. They find non-stationarity in the time series and use cointegrated models to estimate the relationship between per capita income and health care expenditures. Using both standard time-series and pooled time series, they conclude that their “*results (...) are interesting from a substantive point of view, and cast serious doubt on the widely held view that ‘health care is a luxury good’*” and that country-specific effects might be caused by institutional factors.

Di Matteo and Di Matteo (1998) looked at the health spending of Canadian provincial governments during the period of 1960-1991 and use pooled time-series cross-section regression analysis. In addition to real per capita GDP, their model uses the proportion of the provincial population over age 65 and real provincial per capita federal transfer revenues. They also include provincial dummies and provincial-interactive dummy of the Established Programs Financing (EPF) reform, which we discuss in section 4. Di Matteo and Di Matteo find that both per capita federal transfers and the proportion of the provincial population over age 65 are positively and significantly related to health care expenditures. The EPF reform “*had a negative and significant effect on the level of real per capita provincial government health expenditures only in Newfoundland and Quebec*” (Di Matteo and Di Matteo, 1998, p.227). Like Blomqvist and Carter (1997), they find contrary evidence of health care expenditure being a luxury good and estimate

that the income elasticity is 0.77. They therefore conclude that provincial government health expenditures are a necessity rather than a luxury.

Another study that uses Canadian provincial data is the one by Ariste and Carr (2003). They use data for the time period of 1966 to 1998 and use pooled time-series cross-section analysis. This study differentiates itself from the previous one by acknowledging problems related to stationarity and cointegration with the series of health care expenditures and of per capita GDP. The model uses variables that are coherent with past studies, but adds the ratio of deficit or surplus to gross domestic product. They conclude that for per capital health expenditure and per capita GDP, each variable forms a non-stationary group and finds this results in using, then recent, econometric methods to test the stationarity of panel data. For cointegration, Ariste and Carr do not find convincing evidence of such a relationship partly due to the weakness of the tests used. Knowing the results of the non-stationarity of the series, they decide to ignore these results and use all information without correcting the time-series issues due to the small sample size. They do incorporate a trend in the regression to acknowledge the behavior of the GDP and health care expenditures series. Ariste and Carr find an income elasticity of 0.88 confirming results found by Di Matteo and Di Matteo (1998) that health care in Canada seem not to be a “luxury good”. They find that, contrary to Di Matteo and Di Matteo, the proportion of the population of age 65 and over seem not to be significant; this result might be explained by the inclusion of a linear trend in the model. The variable ratio of deficit or surplus to GDP is positive and significant and behaves as we would have expected.

Gerdtham and Löthgren (2002) concentrate on the existence of cointegration between health expenditure and GDP using data from 25 OECD countries for the period 1960-1997. They first use panel unit root test to determine that GDP and health care expenditures are both difference stationary I(1) series. They then continue to examine the cointegration relationship using a heterogeneous bivariate vector error correction panel model that allows for trending data as well as intercepts and trends in the cointegrating relations. They conclude that by using a new panel rank test developed by Larsson *et al.*

(2001) they find “that health expenditure and GDP are cointegrated around a linear trend” (Gerdtham and Löthgren, 2002, p.1679).

A study by Freeman (2003) estimates the income elasticity of health care and uses US states data for the years 1966-1998. Instead of using per capita GDP as a measure of income, Freeman uses disposable personal income taken from the Bureau of Economic Analysis. He uses panel unit root tests to determine if both health care expenditure and disposable income series are non-stationary and concludes like previous studies that they are in fact non-stationary. Using an error correction model, Freeman, finds that both series are cointegrated. From there, a Dynamic OLS (DOLS) with fixed time effects is used to estimate the income elasticity and he finds estimates in the range of 0.817 to .844 and still significantly less than 1 and therefore conclude that “*measured at the state-level, health is a necessity*” (Freeman, 2003, p.501).

Di Matteo (2005) studies health care expenditure determinants with US state-level and Canadian province-level data. He examines the impact of the population aged over 65 and the impact of technological changes in a conventional pooled time-series cross-section analysis using American data for the years 1980-1998 and the years 1975-2000 for the Canadian data. He does a regression of per capita health expenditure on real per capita GDP, province/region-specific dummy variables and the proportion of the population age 65 and over. Federal cash transfers are used for the Canadian model. Taking into account the rapid rise in expenditures in the last few years, Di Matteo suggests that “*simple linear modeling of age distribution as simply the proportion of population over age 65 may not be appropriate*” (Di Matteo, 2005, p.32). To capture non-linear effects, the study uses the proportion of the population aged 0-17, 18-44, 45-64, 75 and over for Canada. For the United States, the age groups used are 0-24, 25-44, 45-64, 65-84, 85 and over. To try to capture non-linear effects of technological change, individual year indicator variables are used (year dummies) even if the author knows that these will also capture other effects other than technological changes. He estimates two models, one with the proportion of 65 and over and no year dummies and the other with the different age groups and year dummies. He finds that for the US that income elasticity

at the mean is 0.73 for the first model and 0.5 for the second one, for Canada income elasticity at the mean is small at 0.15 and 0.01. For both countries, simple models find that growth in the proportion of population aged 65 and over are responsible for much of the increase spending. In the more complex model, time seems to be the major factor explaining health expenditures. Ageing distribution, once time is controlled for, seem to explain very little of the expenditures, although the impact of age is of more concern at the last stages of life.

Table.1 - Literature Review

Study	Design/Model	Data level	Year(s)	Sample (N)	Endogenous variable	Exogenous variable(s)	Results
Newhouse(1977) <i>Medical-Care Expenditure: A Cross-National Survey</i>	Cross-section/bivariate OLS	International (13 countries)	Circa 1970	N=13	Per Capita Medical-Care Expenditure (\$US)	Per Capita GDP (\$US)	Income elasticity for health care spending is greater than 1 and ranging from 1.15 to 1.13. "Over 90 percent of the variance in per capita medical expenditure in these countries can be explained by per capita GDP" (Newhouse 1977). Therefore, medical health care is a luxury good.
Parkin (1987) <i>Aggregate Health Care Expenditure and National Income: Is Health Care a Luxury Good?</i>	Cross-section/bivariate OLS	International (25 countries)	1980	N=23 (\$US) N=18 (PPP)	Total health care expenditures per person (\$US or PPP)	GDP per person (\$US or PPP)	Income elasticity for health care ranges from 0.80 to 1.19 when \$US is used. Income elasticity for health care ranges from 0.90 to 1.12 when PPP is used. The use of "luxury good" is according, to him, inappropriate for use with macroeconomic aggregates.
Gerdtham et al. (1992) <i>An Econometric Analysis of Health Care Expenditure: A Cross-section Study of OECD Countries</i>	Cross-section/multivariate OLS	International (19 OECD countries)	1987	N=19	Health Care Expenditures Per Capita converted by PPP	GDP per capita (PPP), Ratio of health care on GDP (PPP), Practicing physicians per capita*1000, total health care expenditure on inpatient health care, Share of total health expenditure on public expenditure, Dummy for dominant fee-for-service, Female participation ratio, Age 65 and over, Share of population living in urban areas.	"The significant regressors are: per capita income (GDP), urbanization, share of public financing to total expenditure, share of inpatient care expenditure to total expenditure and a dummy variable for countries with fee-for-service as the dominant remuneration in outpatient care" (Gerdtham et al., 1992, p.78). Income elasticity is above one and estimated to be 1.33. Also, countries with large shares of public financing seem to have lower health care expenditures.
Hitiris and Posnett (1992) <i>The Determinants and Effects of Health Expenditure in Developed Countries</i>	Pooled time-series cross-section/multivariate regression	International (20 OECD countries)	1960-1987	N=560	Health Care Expenditure Per Capita (\$US or PPP)	GDP Per Capita, Proportion of population age 65 and over, Public finance share of total health spending, Set of shift dummies for country-specific effects.	The study finds that income elasticity of health care expenditures is at or around unity. The proportion of the population age 65 and over is positive and significant. The shift dummies are also significant, this maybe explained by either difference in prices or efficiency.

Table.1 (continued) - Literature Review

Study	Design/Model	Data level	Year(s)	Sample (N)	Endogenous variable	Exogenous variable(s)	Results
Blomqvist and Carter (1997) <i>Is Health Care Really a Luxury Good?</i>	Time series, Pooled time-series cross-section/Univariate ADF, multivariate regression	International (18 OECD countries)	1960-1991	N=576	Real Per Capita Health Care Expenditure (\$US)	Real Per Capita GDP, Proportion of population age 65 and over, Time trend.	They find non-stationarity in the time series health care expenditure and per capita GDP. Their results cast doubts on the view that health care is a "luxury good" with an estimate of income elasticity below 1. Health care expenditures tend to rise by 2% per year even if income remains constant. This points toward better, but more costly medical technologies.
Di Matteo and Di Matteo (1998) <i>Evidence on the Determinants of Canadian Provincial Government Health Expenditure: 1965-1991</i>	Pooled time-series cross-section/multivariate regression	National (10 Canadian provinces)	1965-1991	N=270	Real Per Capita Provincial Government Health care Expenditures	Real Per Capita GDP, Proportion of population age 65 and over, Real Per Capita Federal Transfers, Provincial Dummies, Provincial-Interactive Dummies of the EPF reform.	The study finds that income elasticity of health care expenditure is 0.77 and therefore, suggesting that health care is a necessity not a luxury. They also find that the age 65+ elasticity is 0.81 and significant, as well as the federal transfer elasticity of 0.48. The EPF reform was significant only for the Province of Quebec and Newfoundland, and the reform had a negative impact on their expenditures.
Ariste and Carr (2003) <i>New Considerations on the Empirical Analysis of Health Expenditures in Canada: 1966-1998</i>	Pooled time-series cross-section/Panel unit root tests, Panel cointegration tests, multivariate regression	National (10 Canadian provinces)	1966-1998	N=330	Real Per Capita Provincial Government Health Expenditures	Real Per Capita GDP, Proportion of population age 65 and over, Ratio of the Provincial Government's budget deficit or surplus to Provincial GDP, Time trend.	Evidence of non-stationarity of the health care expenditure and GDP series. No conclusive evidence of cointegration. They regress without any correction for the non-stationarity, except using a time trend. The study finds an income elasticity of 0.88. Budget deficit or surplus is significant and has the expected sign. Proportion of age 65 and over isn't significant, this might be due to the time trend. With income fixed, health care spending should grow 2% per year.
Gerdtham and Løthgren (2002) <i>New Panel Results on Cointegration of International Health Expenditure and GDP</i>	Pooled time-series cross-section/ Panel unit root test, Panel Cointegration test (bivariate vector error correction model)	International (25 OECD countries)	1960-1997	N=950	Per Capita Health Expenditure	Per Capita GDP	The study concludes that both series are non-stationary (I(1) series) and are cointegrated around a linear trend. They finish the study with the following remark: "it cannot be ruled out that the results are sensitive to inclusion of additional variables in the health expenditure system" (Gerdtham and Løthgren, 2002, p. 1685).

Table.1 (continued) - Literature Review

Study	Design/Model	Data level	Year(s)	Sample (N)	Endogenous variable	Exogenous variable(s)	Results
Freeman (2003) <i>Is Health Care a Necessity or a Luxury? Pooled Estimates of Income Elasticity from US State-Level Data</i>	Pooled time-series cross-section/Panel unit root test, Panel Cointegration test, Dynamic OLS	National (50 US States)	1966-1998	N=1650	Health Care Expenditure	Disposable Personal Income, Time trend, State fixed-effects.	The paper concludes that US state-level spending on health care and in state-level disposable income are both non-stationary, or I(1). Using panel cointegration tests, the study concludes that both "series comprise a cointegrated panel" (Freeman, 2003, p.501). DOOLS panels with fixed time effects find an estimate of income elasticity of 0.817 to 0.844. So, at the state-level, health care is then a necessity, confirming previous studies.
Di Matteo (2005) <i>The Macro Determinants of Health Expenditure in the United States and Canada: Assessing the Impact of Income, Age Distribution and Time</i>	Pooled time-series cross-section/multivariate regression	National (10 Canadian provinces and 51 US States)	Canada: 1975-2000 US: 1980-1998	Canada: N=260 US: N=969	Canada: Real Per Capita Provincial Government health expenditures US: Real Per Capita Personal Health Expenditures	Real Per Capita GDP, Province/Region-specific Dummy Variables and the Proportion of the population age 65 and over, Federal Cash Transfers, Proportion of the population aged 0-17, 18-44, 45-64, 75 and over for Canada, 0-24, 25-44, 45-64, 65-84, 85 and over for the US.	Income elasticity at the mean in the US varies from 0.5 to 0.73. For Canada, income elasticity at the mean varies from 0.01 to 0.15. With simple modeling, proportion of population age 65 and over are responsible for much of the increasing in health spending. In the more complex specification time is the most important variable. In this case time can be a proxy for technological change and policy shifts. For Canada, federal cash transfers are positive and significant and more elastic than income. In the more complex model, federal cash transfers becomes more inelastic.

3. The Model

We chose for this study to adopt the demand approach used in all studies overviewed in the previous section. Regressing health care expenditures on variables we deem to have an impact on the demand for health care. Of course this methodology supposes that supply is perfectly elastic. Our choices in variables were mainly influenced by the studies of Di Matteo and Di Matteo (1998), Ariste and Carr (2003) and Freeman (2003). Our model of per capita health care expenditure (HCE) in provincial/state i can be written in the following way:

$$HCE_{it} = f \left(\begin{array}{cccccc} GDP_{it} / DPI_{it} & PROPAGE65_{it} & FEDTRANS_{it} & RHPRICE_{it} & COUNTVAR_{it} & dREF_{it} \\ + & + & + & - & +/- & +/- \end{array} \right), i = 1, \dots, N; t = 1, \dots, T_i$$

The variable GDP/DPI is per capita nominal gross national product or per capita nominal disposable personal income depending on the country we are modeling. $PROPAGE65$ is the proportion of the population age 65 and over, $FEDTRANS$ is nominal per capita federal transfers to province/state, $RHPRICE$ is the relative price of health care. $COUNTVAR$ is a country specific variable used only in one particular model. The choice to assign each country a specific variable was made due to availability of data or characteristics of each country's health care system. We give a more thorough explanation in section 5.6. The variables in question are: UNEMP which is the unemployment rate will be the American country specific variable and RATIONETLEND is the ratio of deficit or surplus to gross national product which is the Canadian specific variable. The $dREF$ is a dummy variable to observe the effects of the federal funding reforms we wish to study. The + and – signs under the function represents the expected signs of the partial derivative. Our model will also use provincial/state fixed effects, a linear time trend and year dummies to account for changes in technology, business cycles and other more mundane changes in legislation. All variables will be in their natural logarithmic form for estimation. The log-log functional form is the most commonly used functional form in the health care expenditures literature. Gerdtham *et al.* (1992) investigated functional forms with the Box-Cox methodology and found evidence in favor of the log-log functional form.

We also looked at the non-stationarity of *HCE* and *GDP/DPI* and the possible cointegrating relationship between the two series with the panel cointegration test. Since, non-stationarity and cointegration cannot be rejected, we proceeded with a dynamic ordinary least square (DOLS) model to correct these issues.

The reforms we wish to investigate are the *Balance Budget Act* of 1997 (BBA) for the American model and the *Canadian Health and Social Transfer* of 1996 (CHST) for the Canadian model. The BBA was in part enacted to control Medicare expenditures that were growing fast:

To control spending on services already paid prospectively, such as the services provided by hospital inpatient departments, the Act reduced payment updates in relation to what they would have been. To control spending on services that had been reimbursed largely on the basis of costs or charges, such as those provided by hospital outpatient departments, skilled nursing facilities, and home health agencies, the Act established new prospective payment systems. To control spending and to expand beneficiaries' choices of private health plans, the law also created the Medicare+Choice program, which allows new types of plans to participate, and established new payment rules that raised payments to plans in some areas, lowered them in others, and capped the growth in payments at less than the growth in fee-for-service spending. (MEDPAC, 2002)

On the other hand the BBA of 1997 created the *State Children's Health Insurance Program* (SCHIP) and expanded existing State insurance coverage, which we discuss further in section 4.1.3. With the BBA, the *Enhanced Federal Medicaid Assistance Percentage* (EFMAP) was created and augmented the federal transfers to States to permit an expansion of Medicaid eligibility for a greater number of children. We would then expect a positive sign for the reform dummy for the BBA.

The CHST of 1996 reform regrouped the *Established Programs Financing* (EPF) and *Canada Assistance Plan* (CAP) into one block fund from the Federal government. This reform was made with budget tightening in mind and the total amount of the CHST was smaller than the sum of the projected EPF and CAP transfers. In fact, the "*reform was an occasion for the federal government to reduce its transfers to provinces by 20%*" (Brosseau, Rault, Vaillancourt, 2006, p.12).

Therefore, we expect a negative sign associated with the reform dummy for the CHST.

Part 2

4. A brief survey of health care systems

4.1 The American health care system

4.1.1 Health care in the United States

As we mentioned above, the American health care system is different from the Canadian system. It does not have a universal public insurance program and it relies mostly on the private sector to provide insurance coverage. It is estimated that nearly three-quarters of the US population are covered by private insurance which are mostly purchased by employers (OECD, 2003 p.8) and that 14 per cent of the population has no insurance coverage whatsoever (OECD, 2003, p.1). For the uninsured, charities and subsidised programs help to provide access to health care services.

Although the private sector has somewhat of a dominant role, the public sector also plays a critical role in the American health care system. Each level of government plays a different part in financing, organising and providing health care. The federal government is a “*purchaser of health insurance and a third-party payer for health care*” for individuals that qualify for programs such as Medicare or Medicaid and also federal government employees and military personnel (OECD, 2003, p.7). It also runs a health care delivery system for military veterans and is a collector of health data.

The state governments also finance health insurance and health care to poor families and this, mostly through Medicaid, which is a co-financed program with the federal government. Much like the federal government, the state governments offer insurance to their employees and their dependants. The “*responsibility for regulating health care providers and insurance companies is the prerogative of the individual states*” (OECD, 2003, p.7), this can explain why we observe variation in terms of regulations across states.

The local governments are more involved in financing “*safety net providers*” and in maintaining emergency response services (OECD, 2003, p.7)

Table.2 **U.S. Personal health care spending by source of funds**

	(percent)				
	1980	1990	1995	2000	2004
<i>Private Funds</i>	59.7	61.0	55.4	56.7	55.3*
Out-of-pockets payments	27.1	22.5	16.9	17.2	N/A
Private Insurance	28.3	33.4	33.4	34.6	N/A
Other	4.3	5.0	5.1	5.0	N/A
<i>Public Funds</i>	40.3	39.0	44.6	43.3	44.7*
Federal funds	29.3	28.6	34.1	32.8	N/A
Medicare	16.9	17.6	20.6	19.2	N/A
Medicaid	6.4	6.6	9.5	9.8	N/A
Other	6.0	4.4	4.0	3.8	N/A
State and local funds	11.1	10.5	10.5	10.5	N/A
Medicaid	5.1	4.8	6.2	6.9	N/A
Other	5.9	5.6	4.3	3.6	N/A

Source: *Centers for Medicare and Medicaid Services (OECD, 2003, p.8)*

*OCDE in Figures 2006-2007, 2006, p.8

4.1.2 Medicare and Medicaid

In 1965 the American Congress passed legislation expanding the Social Security Act and established Medicare and Medicaid programs as Title XVIII and Title XIX (CMS, 2006, p.3). The administration of both programs was the responsibility of the Department of Health, Education and Welfare, which is now the Department of Health and Human Services. Medicare was titled “Health Insurance for the Aged and Disabled” and established a program of health insurance for aged citizens to complement the retirement and disability insurance benefits already included in the Social Security Act (CMS, 2006, p.6). This program is the biggest federal expenditure (table 1.) in terms of health care and is solely financed by the federal government. Medicaid was a response to a “*widely perceived inadequacy of welfare medical care*” of public aid (CMS, 2006, p.3). It is a program that is financed both by the Federal and State governments and has for mission to pay for medical assistance for certain low income individuals and families. Medicaid is

now the “*largest source of funding for medical and health related services for America’s poorest people*” (CMS, 2006, p.13).

4.1.2 Medicare

Medicare is a program consisting of four parts. There were two parts that were originally offered and two others that were subsequently added to the program.

The first part, also known as part A, is the Hospital Insurance (HI) which is generally provided automatically to persons age 65 and over who are eligible for Social Security and Railroad Retirement benefits (CMS, 2006, p.6). People who have been eligible for Social Security disability coverage for at least 24 months are also eligible for Part A. Medicare is also available to ineligible aged and disabled individuals if they pay monthly premiums based on yearly income to get coverage. Part A specifically covers inpatient hospital care, skilled nursing facility care, home health agency care and hospice care for all people that are under its coverage. In 2005, part A covered about 14% of the United States population and the benefit payments totalled 180 billion USD (CMS, 2006, p.7).

The second part, also known as part B, is the Supplementary Medical Insurance (SMI) which “*all citizens age 65 and over, and all disabled persons entitled to coverage under part A, are eligible to enrol in part B on a voluntary basis by payment of a monthly premium*”(CMS, 2006, p.7). Part B covers a multitude of medical services and supplies that aren’t provided with Part A. These services include physicians and surgeons’ services, including some covered services provided by chiropractors, podiatrists, dentists and optometrists (CMS, 2006, p.8). Laboratory tests, preventive care services are also part of the Supplementary Medical Insurance. There is a very wide range of services in part B, some are subject to special payment rules, including deductibles and sometimes even higher cost-sharing requirements. Therefore it is hard to define a general rule to the types of services and supplies covered by part B. Most individuals “*entitled to Part A choose to enrol in Part B*” (CMS, 2006, p.8). In 2005, Part B protected about 13.5% of the population and the amount of benefits paid totalled 150.3 billion USD.

Medicare Advantage program, also known as Part C, was established by the Balanced Budget Act (BBA) of 1997 as Medicare+Choice program and was renamed and modified by the Medicare Prescription Drug, Improvement, and Modernization Act (MMA) of 2003 (CMS, 2006, p.6). This program is a way to “*expand*” beneficiaries’ choices in terms of participation in private-sector health plans. Individuals enrolled in Part A and B can choose to adhere to a Medical Advantage plan instead. Private sector organizations can offer plans as Medical Advantage plans to individuals and must provide at least the current Medicare benefit package (CMS, 2006, p.9). They also can provide additional services to the individuals covered and must do so “*if plan costs are lower than the Medicare payments received by the plan*” (CMS, 2006, p.9). It is estimated that in 2006, 6 million individuals took part in a Medicare Advantage plan.

Part D was established with the MMA in 2003, and it is a new prescription drug benefit program. Since its creation, it is no longer correct to treat Part B and SMI as synonyms (CMS, 2006, p.6), because both Part B and D are now SMIs. The program “*provides subsidized access to prescription drugs insurance coverage on a voluntary basis, upon payment of a premium*” (CMS, 2006, p.9) for individuals on Medicare and with premium and cost-sharing subsidies for low-income individuals.

Funding for the four parts of Medicare are handled by two trust funds which are special accounts in the US Treasury. The first fund is used exclusively for Hospital Insurance (Part A) and the other is for Supplementary Medical Insurance (Parts B and D). The SMI account was divided in two, one for Part B and the other for Part D, to ensure that funds for one part wouldn’t finance the other (CMS, 2006, p.6). Funding for Part C, or Medicare Advantage plans, is taken directly from both the Part A trust fund and the Part B of SMI trust fund. Payments are financed in “*proportion to the relative weights of Part A and Part B benefits to the total benefits paid by the Medicare program.*” (CMS, 2006, p.12)

The Part A trust fund is financed by six categories of revenue sources, the main source is a mandatory payroll tax of 1.45% of earnings paid by employees and a matching amount

by the employers and a 2.9% tax for self-employed individuals. The fund also receives revenues from a portion of the income taxes levied on Social Security benefits paid to high income beneficiaries, premiums from certain individuals who choose to enrol voluntarily, reimbursement from the general fund of the US treasury for the cost of providing Part A to certain aged persons who retired when Part A began, interest earnings on invested assets and other miscellaneous income sources (CMS, 2006, p.10).

The SMI trust fund is financed differently from the HI trust fund in regards to revenue sources. As we have mentioned above, the SMI trust fund is divided in two separate accounts but both of them are similarly financed, they are financed by contributions from the general fund of the US Treasury and beneficiary premiums. Both Parts B and D accounts primarily receive funding from the general fund of the US Treasury. For Part B beneficiary premiums, paid monthly, are usually at a level that covers a fourth of the average expenditures for aged beneficiaries, although there are other criteria that can alter the premium paid by the enrollees (CMS, 2006, p.10).

Like Part B, Part D receives funding from beneficiary premiums that represent on average 25.5% of the cost of standard coverage. Premiums for Part D vary greatly depending on the plan chosen by the individual and are seldom equal to the base beneficiary premium. What sets Part D apart from Part B in terms of funding is that it also receives funding from the States. The reason for State financing comes from the *“availability of prescription drug coverage and low income subsidies under Part D, Medicaid is no longer the primary payer for prescription drugs for Medicaid beneficiaries who also have Medicare, and States are required to defray a portion of Part D expenditures for those beneficiaries”* (CMS, 2006, p.11).

States involvement in the expenditures of Part D is closely linked to the “dual eligibles” of prescription drug coverage from Medicare and Medicaid. In fact, *“States are required to continue to finance much of the cost of providing the new Medicare Part D benefit to dual eligibles on an ongoing basis through monthly maintenance-of-effort or “clawback” payments to the federal government. The payments are designed to return to the federal government a significant share of the amount states would have spent on dual eligibles’ prescription drug coverage under Medicaid if the new Medicare law had not been*

enacted. The share of such expenditures, described as the “takeback” share, is set at 90 percent in 2006 and tapered down to 75 percent for 2015 and later years. The size of the clawback payments for any given state in any given month will be determined by a complex formula, primarily based on the state’s per capita expenditures on Medicaid prescription drugs for dual eligibles in 2003 trended forward by per capita growth in prescription drug spending nationwide since 2003iv; the number of dual eligibles in the state who are enrolled in the new Part D program in the month in question; and the “takeback” share for the month in question.” (Kaiser Commission, 2007, p.2)

4.1.3 Medicaid

Medicaid essentially covers “*poor families with children, low-income elderly and the disabled*” (OECD, 2003, p.11) and, as we have mentioned earlier, is a jointly financed program by the Federal and State governments. States have a large discretion in establishing the groups and criteria for Medicaid programs and eligibility. To receive federal funding, States are required to provide Medicaid coverage for certain individuals that correspond to pre-established criteria by the federal government. Also, States usually have “State-only” programs that deliver medical assistance to the poor which aren’t included in the Medicaid program and are not funded by federal monies. To receive federal matching funds, the States must cover these mandatory Medicaid “categorically needy” eligibility groups:

- Individuals meeting the requirements for the Aid to Families with Dependent Children (AFDC) program that were in effect in their State on July 16, 1996.
- Children under age 6 whose family income is at or below 133 percent of the Federal Poverty Level (FPL).
- Pregnant women whose family income is below 133 percent of the FPL.
- Supplemental Security Income (SSI) recipients in most States.
- Recipients of adoption or foster care assistance under Title IV of the Social Security Act.
- Special protected groups (typically individuals who lose their cash assistance due to earnings from work or from increased Social Security benefits, but who may keep Medicaid for a period of time).
- All children under age 19, in families with incomes at or below the FPL.
- Certain Medicare beneficiaries (low-income Medicare beneficiaries).

CMS, 2006, p.17

It is also possible for States to provide Medicaid coverage to “*categorically related*” groups (CMS, 2006, p.17) that share characteristics of the previous “*categorically needy*” eligibility groups. These related groups have eligibility criteria more loosely defined than the “*categorically needy*” groups. The broadest of these optional groups that qualify for federal matching funds are:

- Infants up to age 1 and pregnant women not covered under mandatory rules whose family income is no more than 185 percent of the FPL (Percentage is set by the State).
- Children under age 21 who meet criteria more liberal than the AFDC income and resources requirements.
- Institutionalized individuals eligible under a “special income level”.
- Individuals who would be eligible if institutionalized, but who are receiving care under home and community-based services (HCBS) waivers.
- Certain aged, blind, or disabled adults who have incomes above those requiring mandatory coverage, but below the FPL.
- Recipients of State supplementary income payments.
- Certain working-and-disabled persons with family income less than 250 percent of the FPL who would qualify for SSI if they did not work.
- TB-infected persons who would be financially eligible for Medicaid at the SSI income level if they were within a Medicaid-covered category.
- Certain uninsured or low-income women who are screened for breasts or cervical cancer through a program administered by the Centers for Disease Control.
- “Optional targeted low-income children” included in the State Children’s Health Insurance Program (SCHIP) established by the BBA of 1997.
- “Medically needy” persons (an option that allows States to extend Medicaid eligibility to certain individuals).

CMS, 2006, p.18

If a State decided to have a Medically Needy (MN) program, there are certain requirements concerning groups eligible and services for the program to receive Federal backing; these include “*children under age 19 and pregnant women who are medically needy must be covered, and prenatal and delivery care for pregnant women, as well as ambulatory care for children*” (CMS, 2006, p.18). In 2003, thirty-six States and the District of Columbia had decided to have a MN program to provide services to the needy.

Moreover, to receive federal matching funds, States must provide medical assistance for certain basic services to most categorically needy individuals. Those basic services generally include:

- Inpatient hospital services.
- Outpatient hospital services.
- Prenatal care.
- Vaccines for children.
- Physician services.
- Nursing facility services for persons aged 21 or older.
- Family planning services and supplies.
- Rural health clinic services.
- Home health care for persons eligible for skilled-nursing services.
- Laboratory and X-ray services.
- Pediatric and family nurse practitioner services.
- Nurse-midwife services
- Federally qualified health-center services, and ambulatory services
- Early and periodic screening, diagnostic, and treatment services for children under age 21.

CMS, 2006, p.20

In 1996, the United States underwent welfare reforms that modified eligibility for SSI coverage and impacted the Medicaid program. These reforms had an impact on eligibility for several groups of individuals and restricted or removed their Medicaid coverage. One of the reforms concerned the program known as Aid to Families with Dependent Children (AFDC) which was an open-ended Federal entitlement program. It was replaced by the Temporary Assistance for Needy Families (TANF) which is a time-limited cash assistance to families to a maximum of 5 years in a lifetime for general cases. This particular reform had limited impact on Medicaid since people that would have been eligible for Medicaid under AFDC as it was determined on July 16, 1996 are still eligible now for Medicaid (CMS, 2006, p.19).

One significant change that was brought to Medicaid in the 90s was the Title XXI of the Social Security Act who was initiated by the BBA of 1997. This program is known as the State Children's Health Insurance Program (SCHIP), it allows "*States to craft or expand an existing State insurance program*" and "*provides more Federal funds for States to*

expand Medicaid eligibility to include a greater number of children who are currently uninsured” (CMS, 2006, p.19). These children are low-income children who would not qualify for Medicaid based on the criteria in effect on April 15, 1997. States can also use the funds from SCHIP to “*provide medical assistance to children during a presumptive eligibility period for Medicaid*” (CMS, 2006, p.19). In 2005, 28 million children were covered by Medicaid and another 6 million were covered through the SCHIP program (Schwartz, 2007).

Two more reforms were brought to Medicaid in subsequent years, in 1999 the Ticket to Work and Work Incentives Improvement Act “*provides continuous Medicaid coverage to certain disabled beneficiaries who work despite their disability*” (CMS, 2006, p.19).

More recently, in 2005, the Deficit Reduction Act modified eligibility standards for Medicaid beneficiaries and adopted tougher requirements for citizenship and immigration documentation, changed rules for long-term care eligibility by increasing the look-back period for determining community spouse income and assets and limiting eligibility to individuals whose home is valued under \$500,000 (CMS, 2006, p.19).

Federal funding given to States for medical assistance expenditures under the Medicaid program is called the Federal Medical Assistance Percentage (FMAP). The FMAP is determined by a formula written in the Social Security Act:

"Federal medical assistance percentage" for any State shall be 100 per centum less the State percentage; and the State percentage shall be that percentage which bears the same ratio to 45 per centum as the square of the per capita income of such State bears to the square of the per capita income of the continental United States (including Alaska) and Hawaii; except that (1) the Federal medical assistance percentage shall in no case be less than 50 per centum or more than 83 per centum, (2) the Federal medical assistance percentage for Puerto Rico, the Virgin Islands, Guam, the Northern Mariana Islands, and American Samoa shall be 50 per centum. (DHHS, 2006)

This text can be easily translated in a simple formula:

$$FMAP = \left[1.00 - 0.45 \left(\frac{\text{State Per Capita Income}}{\text{US Per Capita Income}} \right)^2 \right] \left[0.50 \leq FMAP \leq 0.83 \right]$$

In the fiscal year 2007, a rich State like Massachusetts had an FMAP of 50% and a poor State like Mississippi had the highest FMAP at 75.89% (DHHS, 2006), the average of FMAP being 57.58%. The BBA raised permanently the FMAP of the District of Columbia to 70%. The State of Alaska following several periods of adjustment had its FMAP raised in the years 2000 to 2007 (CMS, 2006, p.22) but should now be calculated with the standard formula for the fiscal year 2008. It is also worth noting that the Jobs and Growth Tax Relief Reconciliation Act of 2003 made modifications to the FMAP calculation and “for the last two quarters of 2003 and first three quarters of 2004, the newly calculated FMAP increased by 2.95 percentage points.” (CMS, 2006, p.22). To be eligible to the 2.95% increase of the standard FMAP calculation, states must respect certain conditions:

“Eligibility under its Medicaid State plan (including any waiver under title XIX of the Social Security Act or under section 1115 of the Act) can be no more restrictive than the eligibility under such plan or waiver as in effect on September 2, 2003. If any State has restricted eligibility under its Medicaid State plan (including any waiver under title XIX of the Social Security Act or under section 1115 of the Act) after September 2, 2003, it will become eligible for the 2.95 percentage point increase in its FMAP in the first calendar quarter (and subsequent calendar quarters) in which the State has reinstated eligibility that is no more restrictive than the eligibility in effect on September 2, 2003.” (DHHS, 2, 2003)

As for the children covered under SCHIP, Federal funding pays a share that is derived from a formula that was introduced with the BBA of 1997, it was called the Enhanced Federal Medicaid Assistance Percentage:

The “enhanced FMAP”, for a State for a fiscal year, is equal to the Federal medical assistance percentage (...) for the State increased by a number of percentage points equal to 30 percent of the number of percentage points by which (1) such Federal medical assistance percentage for the State, is less than (2) 100 percent; but in no case shall the enhanced FMAP for a State exceed 85 percent. (DHHS, 2006)

Again, this translates to a simple formula:

$$EFMAP = \left[FMAP + 0.30(1-FMAP) \mid EFMAP \leq 0.85 \right]$$

In the fiscal year 2007, again the lowest EFMAP belongs to rich States like Massachusetts with an FMAP of 65% and the highest to the poor State of Mississippi with an EFMAP of 83.12%, the average of EFMAP being 70.31%.

4.2 The Canadian health care system

4.2.1 Health care in Canada

In contrast to the American health care system, publicly funded health care is the dominant form of health care in Canada. The public health care expenditures represent about 70% of health care expenditures in the country, although this is a national percentage and the public expenditures do change from province to province.

The Canadian public health care system can be characterized as “*an interlocking set of ten provincial and three territorial health insurance plans*” (HC, 1, 2005, p.1). This public system provides all Canadians coverage for medically necessary hospital and physician services. The private portion of the Canadian health care system focuses more on additional services such as prescription drugs, dental care, vision care, medical equipment and appliances (prostheses, wheelchair, etc.), services of health care professional such as podiatrists and chiropractors (HC, 1, 2005, p.4). The basic principles of the present Canadian health care system are provided by the Canada Health Act (CHA). In general, the CHA “*sets out the primary objective of Canadian health care policy, which is “to protect, promote and restore the physical and mental well-being of residents of Canada and to facilitate reasonable access to health services without financial or other barriers”*” (HC, 2, 2006, p.3).

Each level of government has its own role to play in Canada’s health care system. These roles are largely determined by the Canadian Constitution which gives most of the responsibility to provinces in terms of the delivery of health and social services. This fact

does not diminish the importance of the federal government has in the organization of the public health system. The federal government's role includes:

- Setting and administering national principles for the system under the CHA.
- Financial support to the provinces and territories.
- Direct delivery of primary and supplementary services of certain groups of people (e.g., First Nations people living in reserves; Inuit; serving members of the Canadian Forces and the Royal Canadian Police; eligible veterans; inmates in federal penitentiaries; and refugee protection claimants).
- Public health programs to prevent disease, promote health and educate the public on health implications of the choices they make.
- Health protection (food safety and nutrition, and regulation of pharmaceuticals, medical devices, consumer products and pest management products).
- Funding for health research and health information activities.

HC, 1, 2005, p.6

The financial support for the provinces and territories is not unconditional. The CHA established criteria and principles that each province's health insurance plan must meet in order to receive federal funds. There are five program criteria that apply to insured health services:

- **Public administration:** The provincial and territorial health care insurance plans must be administered and operated on a non-profit basis by a public authority, which is accountable to the provincial or territorial government for decision-making on benefit levels and services, and whose records and accounts are publicly audited.
- **Comprehensiveness:** Health care insurance plan of a province or territory must cover all insured health services provided by hospitals, physicians or dentists (i.e., surgical-dental services that require a hospital setting).
- **Universality:** All insured residents of a province or territory must be entitled to the insured health services provided by the provincial or territorial health care insurance plan on uniform terms and conditions.
- **Portability:** Residents moving from one province or territory to another must continue to be covered for insured health services by the "home" jurisdiction during any waiting period imposed by the new province or territory of residence. Residents who are temporarily absent from their home province or territory or from Canada, must continue to be covered for insured health services during their absence.
- **Accessibility:** Insured persons in a province or territory must have reasonable access to insured hospital, medical and surgical-dental services on uniform terms and conditions, unprecluded or unimpeded, either directly or indirectly, by charges (user charges or extra-billing) or other means (e.g., discrimination on the basis of age, health status or financial circumstances).

HC, 2, 2006, p.4

The CHA provides mechanisms to deal with noncompliance on the part of the provinces. These consist of discretionary penalties such as deductions on the federal cash transfer to the province. When it comes to user charges or extra-billing for covered services, provinces would be subject to mandatory dollar-for-dollar deductions from the federal transfer payment. To date, most disputes between the federal government and provinces have been settled without resorting to deductions (HC, 3, 2007).

As it was mentioned earlier, the provincial and territorial governments administer and deliver most of Canada's health care services. Provinces fund these services from taxes levied on their territory but also from assistance from federal cash transfers. Each province or territory has a health insurance plan and it must meet the principles contained in the CHA that were enumerated above to obtain the federal assistance. These insurance plans must cover medically necessary hospital and doctor services and are provided "free of charge". The provincial and territorial role includes:

- Administering the provincial health insurance plan.
- Planning, paying for and evaluating hospital care, physician care, allied health care, prescription drug care in hospitals and public health.
- Negotiating fee schedules for health professionals.

HC, 1, 2005. p.7

Also, most provinces and territories have programs to offer and fund supplementary benefits for certain groups such as drugs prescribed outside hospitals, ambulance cost, hearing, vision and dental care that aren't covered by the CHA.

The private sector in the Canadian health system provides coverage for supplementary health services. The private sector clients are mostly individuals that aren't qualified for the publicly funded coverage of those supplementary services, like dental care and prescription drug benefits. These individuals either pay these services "out-of-pocket" or can be covered by private insurance plans provided by an employer or bought by the individual. There are limits to the coverage of private insurance, in fact private insurers are usually "*restricted from offering coverage that duplicates that of the publicly funded plans, but they can compete in the supplementary coverage market*" (HC, 1, 2005. p.7).

This last part was recently taken to court and in June 9, 2005 the Supreme Court ruled in the *Chaoulli Decision* that it violates the *Quebec Charter of Human Rights and Freedom* and also three judges found that it violates section seven of the *Canadian Charter of Rights and Freedom* (Sack-Goldblatt-Mitchell, 2007). This decision is controversial in many circles due to fears of the erosion of the Canadian public health care system. The argument used to discredit the *Chaoulli Decision* is that under limited resources, a private parallel system must necessarily attract better physicians and have better equipment to have any value (Flood and Sullivan, 2005, p.1). Thus the quality of the public funded health care would be significantly reduced.

4.2.2 The evolution of federal health care transfers

The early federal involvement in health care was fairly limited due to the binding restraints of the Canadian Constitution. The federal government was given jurisdiction over marine hospitals and quarantine by the Constitution Act of 1867, and it could spend as much money as it wanted as long as it did not infringe on the provinces' powers. In 1948, the Federal government created the *National Health Grants* program which provided the provinces and territories with grants to support health-related initiatives, including hospital construction, professional training, public health research (HC 3, 2007).

In the mid-1950s the federal government put forth plans to offer financial assistance to provinces to establish health insurance programs. In 1957, the Hospital Insurance and Diagnostic Services Act (HIDS) was adopted. The HIDS “*offered to cost-share one half of provincial and territorial costs for specified hospital and diagnostics services*” (HC, 1, 2005, p.10). To qualify for the federal cost sharing provincial plans had to:

- Provide coverage to all residents of the province on uniform terms and conditions.
- Include specified diagnostic services.
- Limit co-insurance or “deterrent” charges so as to ensure that an excessive financial burden was not placed on patients.

CFHCC, 2002, p.3

Once the program was established, it took four years for all provinces and territories to agree to provide publicly funded inpatient hospital and diagnostic services.

In 1966, the Medical Care Act was passed by the federal government. This act offered to cost-share half of provincial costs for medical services provided by a doctor outside hospitals, more accurately “50 percent of the average national per capita costs of the insured services, multiplied by the number of insured persons in each province and territory” (HC, 3, 2007). Once again, to receive federal funds the provinces’ health plan had to meet certain conditions:

- Administration and operation on a non-profit basis by a public authority.
- Coverage of “all services rendered by medical practitioners that are medically required”.
- Universal coverage of all provincial residents (at least 95 percent of the eligible population) on equal terms and conditions.
- Portability of benefits.

CFHCC, 2002, p.3

The following six years after the Medical Care Act, each provinces and territories developed their own universal physician insurance plan (HC 1, 2005, p.11).

The commitment to cover half the provincial costs to health care made it more difficult for the federal government to control its budget. The open-ended nature of the transfer made the situation difficult since the provinces had little incentives to control expenditures since half of them were covered by the federal government. The provincial governments weren’t entirely happy with the situation either, since eligibility issues were subject to extensive negotiations year after year.

Established Programs Financing

In 1977, the Federal-Provincial Fiscal Arrangements and Established Programs Financing Act (EPF) was adopted after negotiations between the federal and provincial governments to resolve the problems mentioned earlier. The new act modified the way funds would reach the provinces for health care and post-secondary education. The Department of Finance Canada characterizes these modifications in this manner:

Established Programs Financing (EPF) was introduced, with federal funding to be provided in equal parts through a tax transfer and a cash transfer. EPF replaced cost-sharing programs for health and post-secondary education. Provinces received 13.5 percentage points of personal income tax (PIT) and 1 percentage

point of corporate income tax (CIT), including some points carried over from the previous post-secondary education program. The value of the transferred tax points was equalized. The value of the tax points was to grow as economies expanded, and the cash transfer was escalated by the growth rate of per capita GNP. EPF was to be distributed equal per capita over time. (DFC, 1, 2007)

The federal government ceded some of its “tax room” to the provincial governments, with the former lowering his rate for the later to raise its rate by an equivalent amount. This way the transfer would be done without having any net impact on the taxpayer. The value of the tax point transferred being subject to equalization meant that the cash transfer was also subject to the equalization formula due to the unequal nature of the value of both transfers under the EPF. The EPF also included a new transfer that was destined for nursing home intermediate care, adult residential care, ambulatory health care and health aspect of home care (HC, 3, 2007). This was block funded and subject to virtually no conditions and was not subject to specified program delivery criteria.

The federal government with the EPF had very little means to compel the province to fully comply with the criteria of the then hospital and medical care legislation. The only mechanism was to withhold the whole monthly transfer until the province or territory would meet the conditions (HC, 3, 2007).

In 1984, the Canada Health Act (CHA) was passed and the act included the principles provided in the federal hospital and medical insurance acts (HC, 1, 2005, p.11). The CHA also introduced special deduction provisions allowing dollar-for-dollar deductions for extra-billing and user-charges and discretionary deductions when provincial plans failed to comply with other provisions included in the CHA (HC, 3, 2007).

Canada Health and Social Transfer

In 1995, the federal government restructured the EPF Act and renamed it the *Federal-Provincial Fiscal Arrangement Act*, with special provisions for a Canada Health and Social Transfer (CHST) (HC 3, 2007). This change was prompted by the federal government to face budgetary difficulties. The CHST combined the health and post-

secondary education funding of the EPF with the Canada Assistance Plan (CAP) funding. The CAP was a federal transfer to provinces and territories destined to social and welfare programs. The CHST was also composed of a tax transfer and a cash transfer similar to that of the EPF, although when the CHST was introduced for the first time the combined value of CAP and EPF was greater than the CHST transfer. Indeed, for the year 1995-96 the “*EPF growth was set at GNP-3, and CAP was frozen at 1994-95 levels for all provinces. CHST was set at \$26.9 billion for 1996-97 and \$25.1 billion for 1997-98. CHST for 1996-97 was allocated among provinces in the same proportion as combined EPF and CAP entitlements for 1995-96*” (DFC, 1, 2007). This new arrangement between the provinces and the federal government was still subject to the conditions and criteria set in the Canadian Health Act including the provisions relating to extra-billing and user charges. Conditions relating to welfare programs were relaxed and only the “no minimum residency requirement for social assistance benefits” was maintained (Rault, 2003. p.10). The legislation also modified the authority of Health Canada and transferred responsibility of the cash transfer to the Department of Finance. Health Canada continues to determine amounts of deductions on transfer payments if necessary and the Department of Finance proceeds to the actual deductions (HC, 3, 2007).

It is worth noting that Quebec had a different arrangement than the other provinces in the CHST transfer, and in fact received more tax point transfers and less cash transfers than the other provinces. This “special” arrangement is called Alternative Payments for Standing Programs and it was a proposal of opting-out arrangements made by the federal government in the 1960s (DFC, 2, 2007). The province of Quebec was the only province to choose this special arrangement.

In the early 2000s the federal government announced increased spending in health care renewal and early childhood development. Also, between 2001-2002 and 2005-2006 the government announced an additional \$21.1 billion dollars for increases to the CHST cash contributions (HC, 3, 2007). In 2003, the federal government with the *Accord on Health Care Renewal* created a five-year \$16-billion Health Reform Transfer (HRT) to “*help provinces and territories accelerate reform in priority areas identified by First Ministers: primary care, home care and catastrophic drug coverage*”(HC, 3, 2007). The provinces

agreed to publish annual reports to the citizens on the reforms and the progress of the province's objectives made under the HRT.

Canada Health Transfer

In the 2003 Federal budget, the federal transfers to health care were again restructured and the CHST was divided in two new transfers, the Canada Health Transfer (CHT) and the Canada Social Transfer (CST). This reform, effective April 1, 2004, has existing CHST-legislated amounts “*apportioned between the new transfers, with the percentage of cash and tax points allocated to each transfer reflecting provincial and territorial spending patterns among the areas supported by the transfers: 62 percent for the CHT and 38 percent for the CST*” (HC, 3, 2007). Again, the province of Quebec has a distinct arrangement than the rest of the other provinces and is still under the *Quebec Abatement*. To be eligible for the CHT, provinces and territories must still meet the national criteria and conditions of the Canadian Health Act. In the federal budget of 2003, the federal government set out a long term predictable, sustainable and growing funding framework for the CHT and CST transfers with legislated cash levels up to 2007-2008 (HC 3, 2007).

Following provincial-federal Accords, the federal government will fund the provinces with \$2.5 billion to enhance the availability of publicly funded diagnostic care and treatment services. Much like the HRT, provincial governments must report the progress and how the invested the funds to the citizens of the province.

5. The Data

This study uses pooled time-series cross-section of sub national level data for Canada and the United States. For Canada, the province level data is for a period of 23 years from 1981 to 2003. The American state-level data is for a period of 25 years from 1980 to 2004. All variables that are in monetary form are in current dollars. This choice was made since there aren't any state specific deflators for the gross state product (GSP) or state specific Consumer Price Index (CPI) or health care CPI for the American data. The

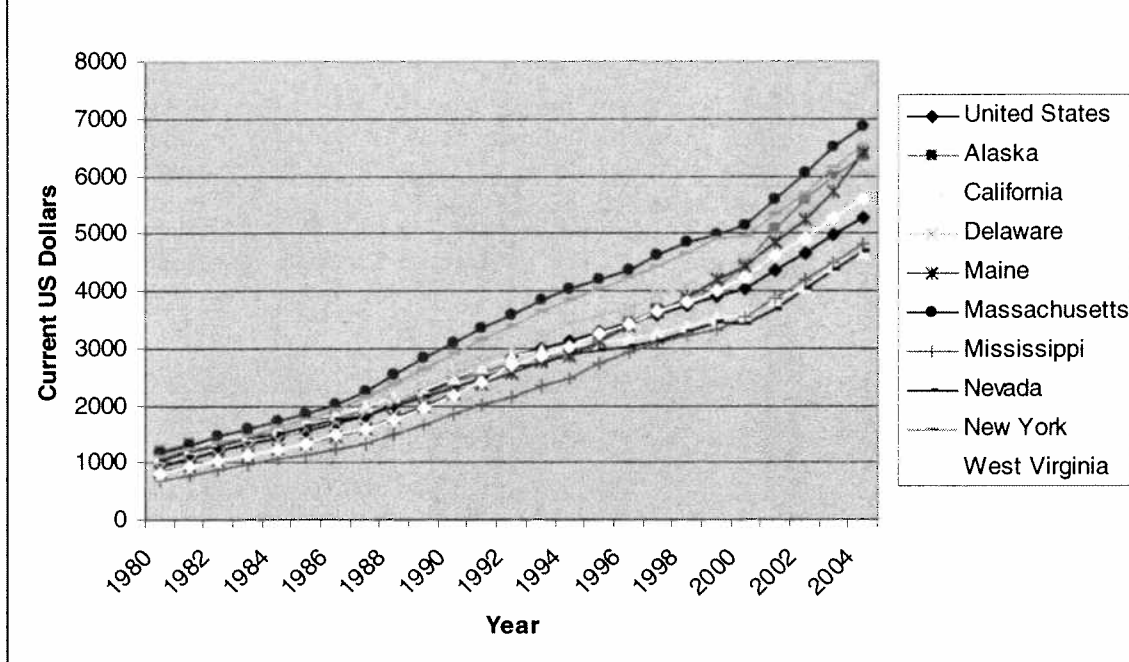
Canadian data is faced with a different problem, “*because outcome measurements are not used in the Canadian health care system, deflators for health care products tend to be of poor quality*”(Ariste and Carr, 2003, p.4). Therefore, we chose to use current dollars for the Canadian series as well.

5.1 Health care expenditures

United States

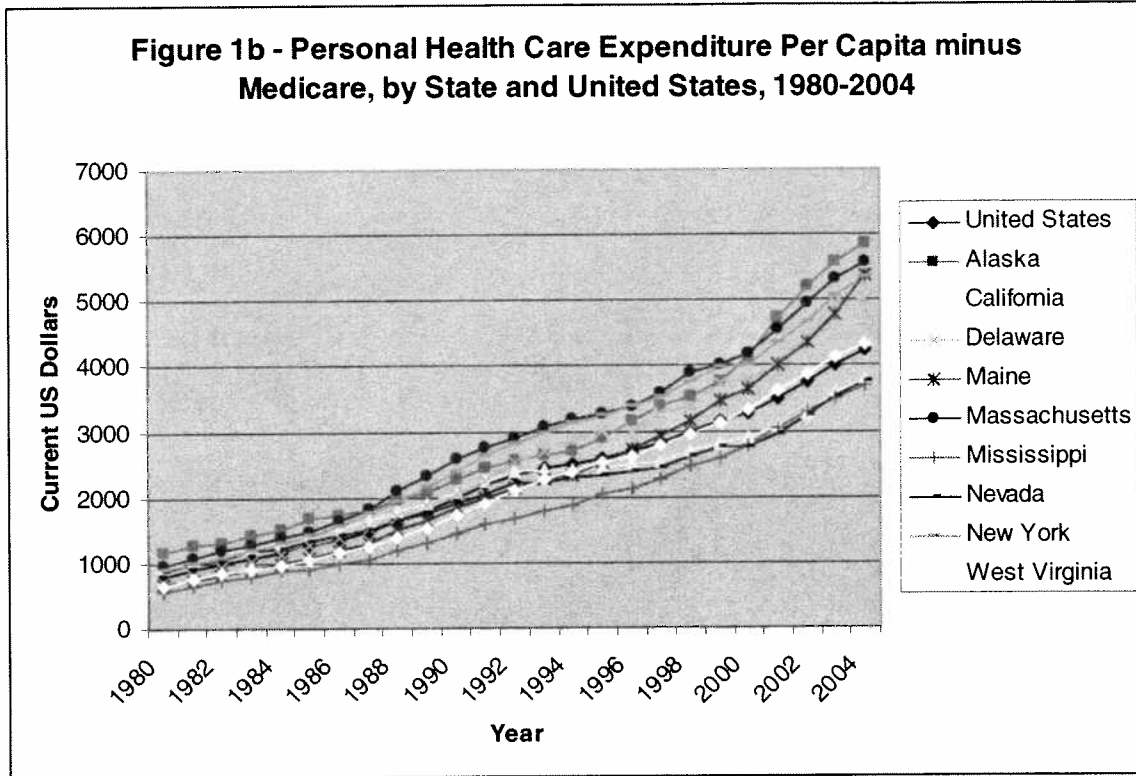
The health care expenditures state-level data for the United States were obtained from the CMS website. The series used is the personal health care expenditure by State-of-provider, which reflects spending for services delivered in that state to residents and non-residents. This can overstate or understate health care expenditure by State-of-residence which would be a much better series to use. Unfortunately, estimates for State-of-residence health care expenditures are available only for the time period of 1991-1998 which would severely reduce our ability to evaluate the impacts of the BBA of 1997 reforms. Therefore it must be noted that the per capita health care expenditures by State-of-provider is not a perfect substitute for per capita health care expenditures by State-of-residence. The use of this series in per capita form isn't a first in the health care expenditures determinants literature and was used by Di Matteo (2005).

Figure 1a - Personal Health Care Expenditure Per Capita, by State and United States, 1980-2004



Personal health care expenditures have risen consistently over the years. For the United States, the annual growth rate has been of 7.4% with the highest growth rate going to the State of Maine with an annual growth rate of 8.8% and the slowest rate of growth going to the State of California with 6.13%. Looking at Figure 1a, one can see that the slopes of the state's personal health care expenditures seem to have three distinct values. The first value is for the period of 1980-1985, then the slope increases for the period of 1985-1999 and increases even more drastically for the remaining period of 1999-2004.

To evaluate the impacts of the federal funding reforms of the BBA of 1997 on Medicaid, we needed to remove the federal expenditures provided for Medicare from the series, since the BBA of 1997 modified the Medicare program. The Medicare expenditures by State-of-provider for personal health care was also obtained via the CMS website, we then proceeded to subtract the series from the previous series of personal health care expenditures by State-of-provider.



In this modified series the annual growth rate was slightly smaller for the United States with 7.26%. The fastest growth rate remains in Maine with 9.05% annually and the smallest in California with 5.95%. Once Medicare is removed, we can see that the State of Massachusetts has a similar health care expenditure per capita which is now comparable to States like New York and Maine.

Canada

The data for health care expenditures by province were obtained from the Canadian Institute for Health Information (CIHI) from their National Health Expenditure Database. This series contains both public and private health care expenditures; this series was chosen over the public-only health expenditures since we wanted to know the total health care expenditures determinants of the Canadian system and not only what determines public health expenditures.

Figure 1c - Health Care Expenditures Per Capita, by province and Canada, 1981-2003

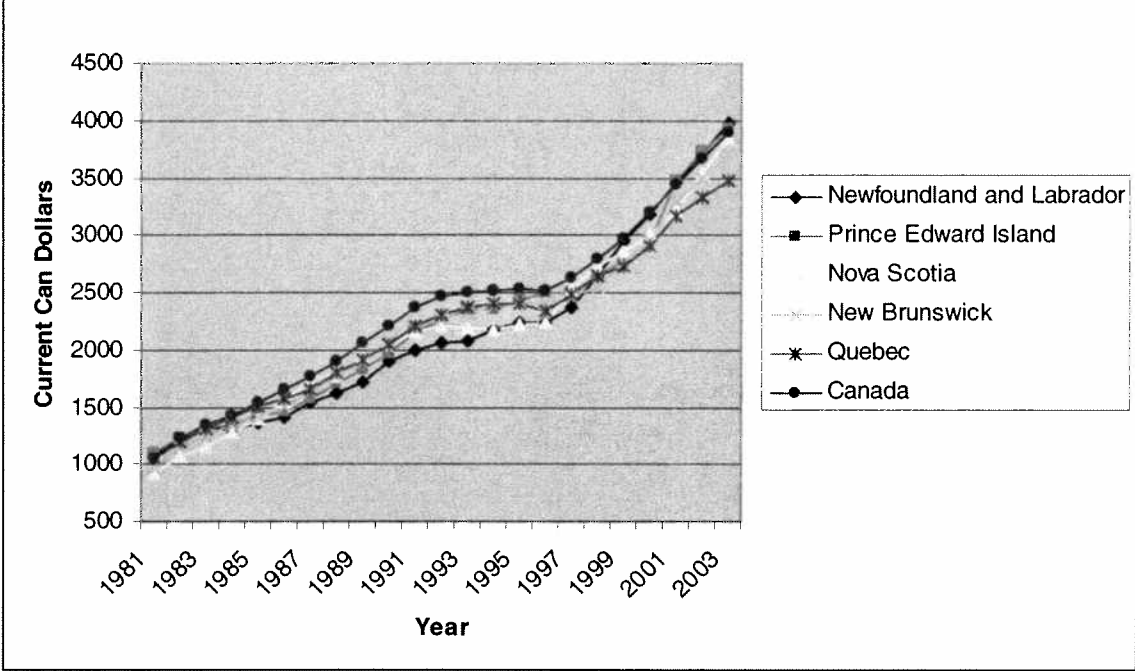
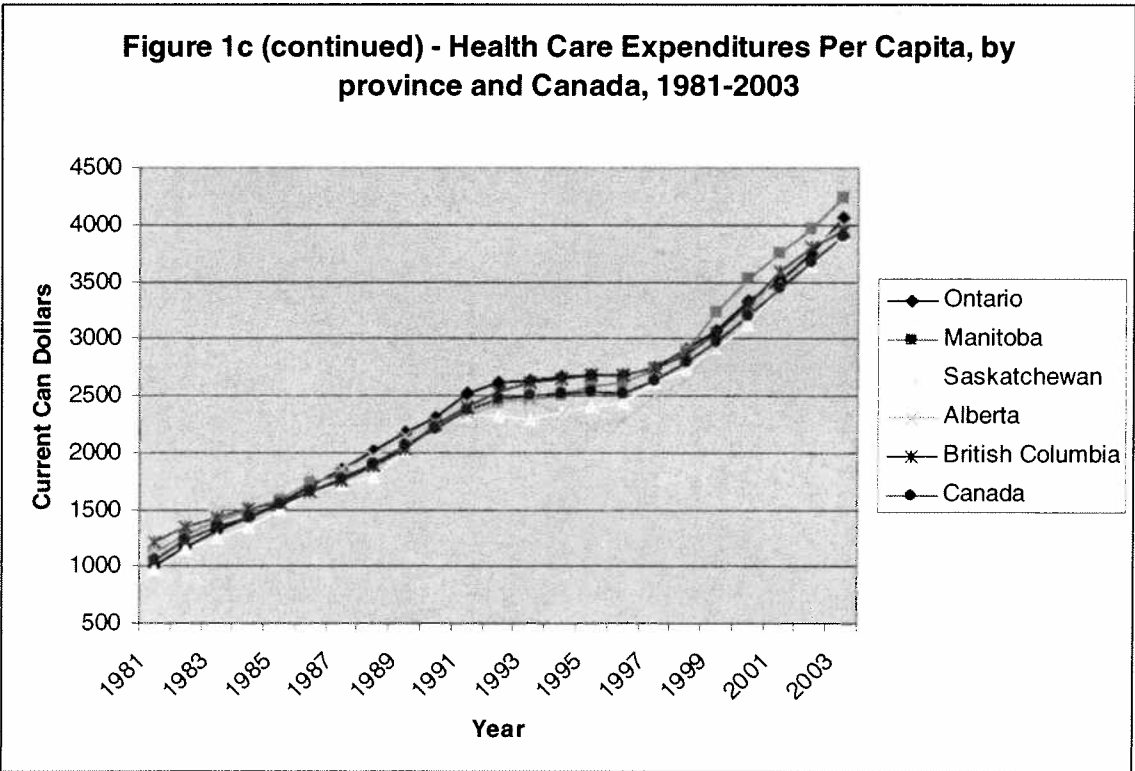


Figure 1c (continued) - Health Care Expenditures Per Capita, by province and Canada, 1981-2003



For Canada, health care expenditures have risen annually by 6.1% during the 23 year period. The largest increase was in Nova Scotia with an annual increase of 6.7% and the

slowest increase in health care expenditures was in British Columbia with an annual increase of 5.5%. Figure 1c shows clearly that for the period of 1991-1997 health care expenditures in Canada maintained themselves at a somewhat constant level with a very limited increase in current dollars, which with inflation can arguably be said that health care expenditures during that period were reasonably stable. After that period, Canada's health care expenditures annual growth rose to 6.75% for the remainder of the series.

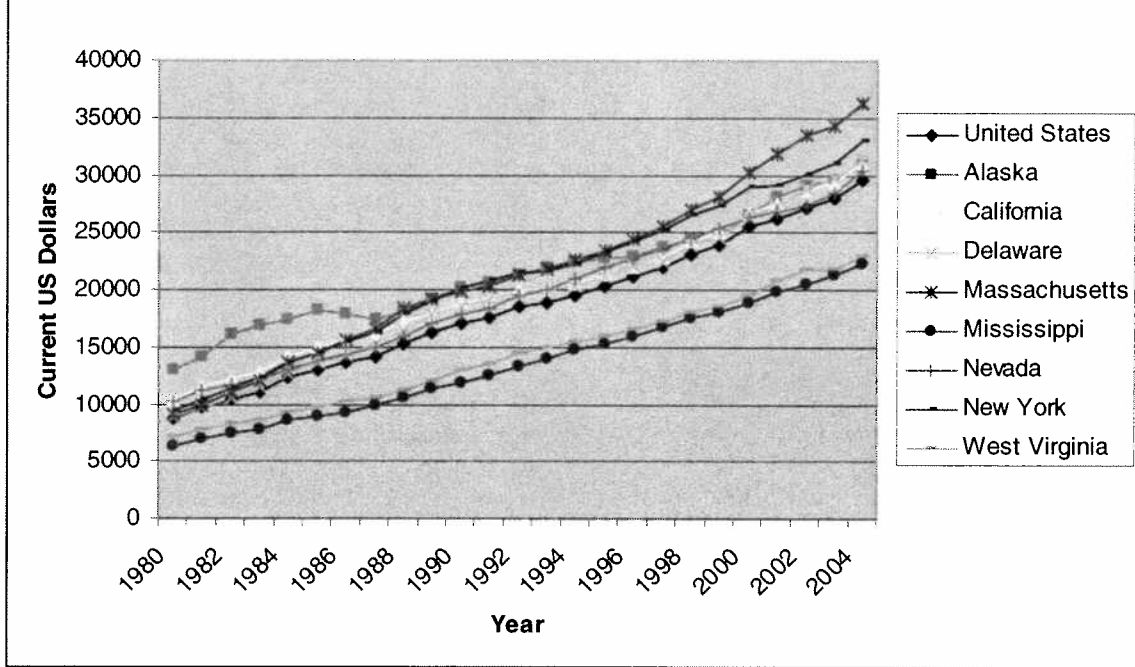
5.2 Gross national product and disposable personal income

This study uses both gross national product and disposable personal income for its analysis. In keeping with the health care determinants literature in regards to the United States, disposable personal income will be used as a determinant for the United States model. This choice reflects the nature of the American health care system where the private system has a dominant role. For the Canadian model, disposable personal income will be replaced by gross national product which is the most frequent determinant used in studying Canadian health care expenditures.

United States

The per capita disposable personal income (DPI) for each state was obtained from the Bureau of Economic Analysis (BEA) from the Regional Economic Accounts web page. During the 25 year period the annual growth rate of the disposable personal income in current US dollars for the United States was 5.17%. Excluding the special case of the District of Columbia, Massachusetts had the strongest growth during that period with a 5.94% annual increase in disposable income. As Figure 2a shows, the slowest growth in all the states was Alaska with an annual growth rate of 3.69%. Alaska had the highest DPI per capita in the United States in 1980 and the state of Mississippi the lowest. Again, if we remove the special case of the District of Columbia, Connecticut had the highest DPI in 2004 and Mississippi keeps its position as the state with the lowest DPI.

Figure 2a - Disposable Personal Income Per Capita, by state and United States, 1980-2004



Canada

The expenditure-based gross domestic product data for each province was obtained from the provincial economic accounts from CANSIM. During the 23 year period of 1981 to 2003, Canada's per capita nominal GDP grew by 4.52% annually. Newfoundland who had one of the lowest GDP per capita in 1981 grew the fastest during that period with an annual growth rate of 6.38%. The slowest growth in per capita nominal GDP was for the province of British Columbia with an annual growth rate of 3.67% which comes into contrast with its nominal GDP growth of 6.18% annually. The province of Alberta has had the highest per capita nominal GDP in almost the whole 23 year period, but with an annual growth rate of 3.92%, the per capita growth rate was below the Canadian one. That being said, the annual per capita GDP growth rate of the years 1999 and onward was a strong 8.12% which is unmatched by almost all Canadian provinces except for Newfoundland with an annual growth rate of 11.24%. We must mention that GDP might be an incorrect measure of income for the province of Newfoundland for the last few

years of the study. Much of the recent growth in GDP of the province of Newfoundland is due to increase oil production. This inflated the GDP but had little impact in terms of income to the provincial government since early exploitation yield little gains due to the royalty rates. Figure 2b shows the steady climb of the per capita nominal GDP of the Canadian provinces and the economic slowdown of the early 1990s and the continued growth that followed these slower years.

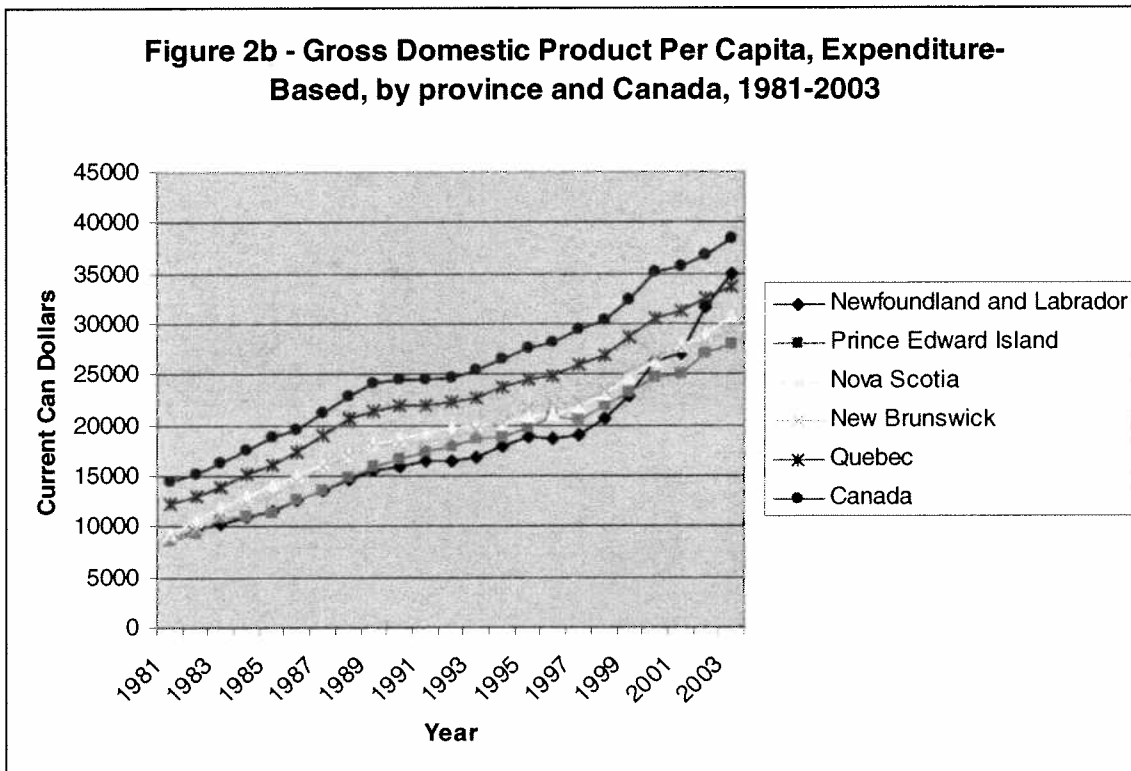
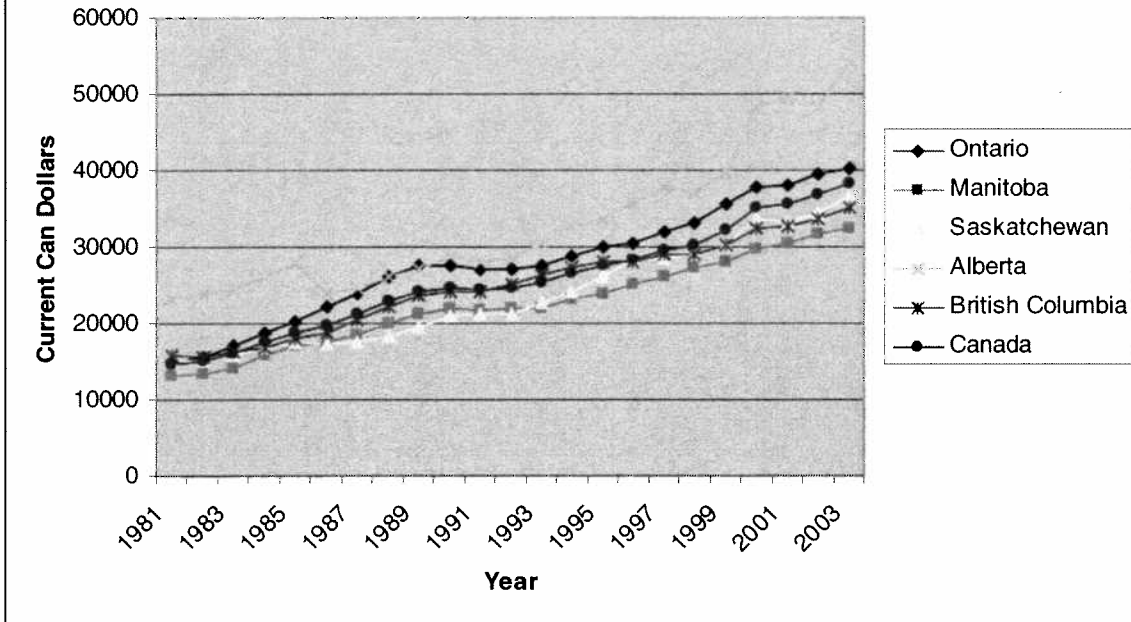


Figure 2b(continued) - Gross Domestic Product Per Capita, Expenditure-Based, by province and Canada, 1981-2003



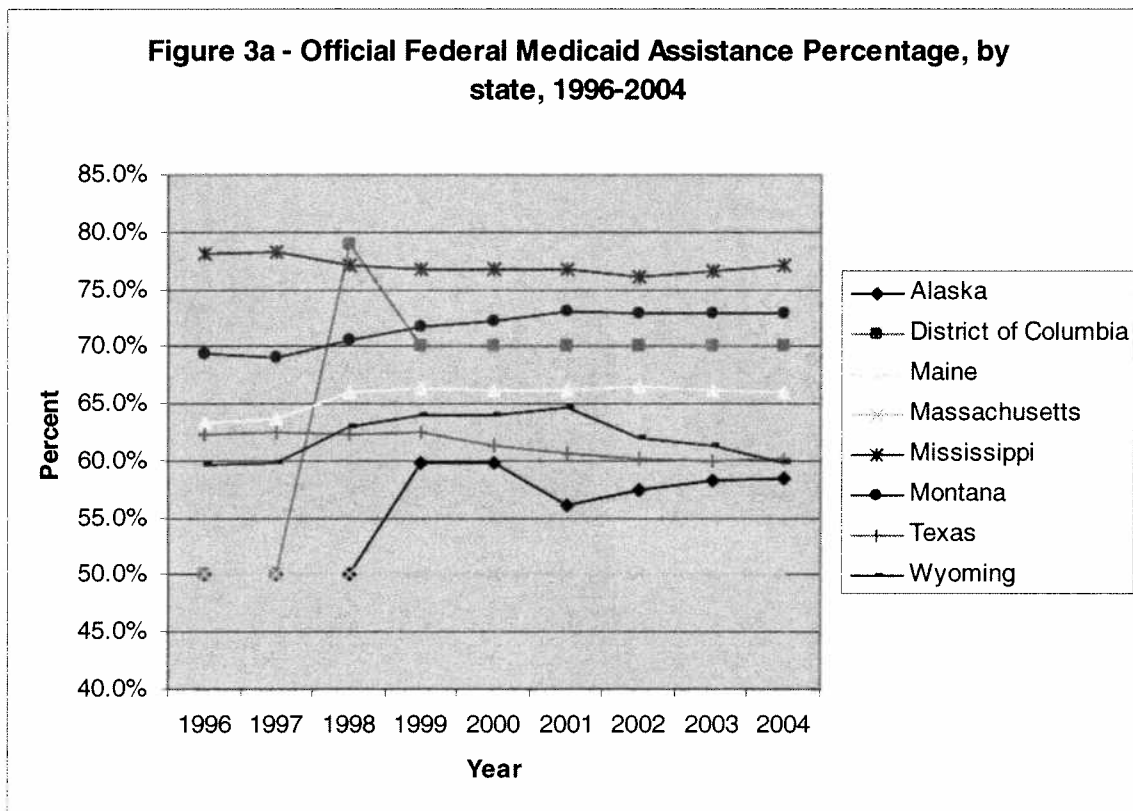
5.3 Federal transfers for health care

Federal transfers to provinces or states play an important role in both health care systems. In the context of the American system, transfers to health by the federal government are determined by the number of individuals that qualify for the Medicaid and SCHIP programs and the services offered. As it was mentioned before, the federal government funds a fixed share of the medical expenditures under the Medicaid and SCHIP programs determined by a formula called the Federal Medicaid Assistance Percentage (FMAP) and the Enhanced FMAP.

The Canadian system is also characterized by federal transfers to health care, and since these transfers are non-negligible sources of income for provincial governments it is included in the analysis as a determinant of health care expenditure.

United States

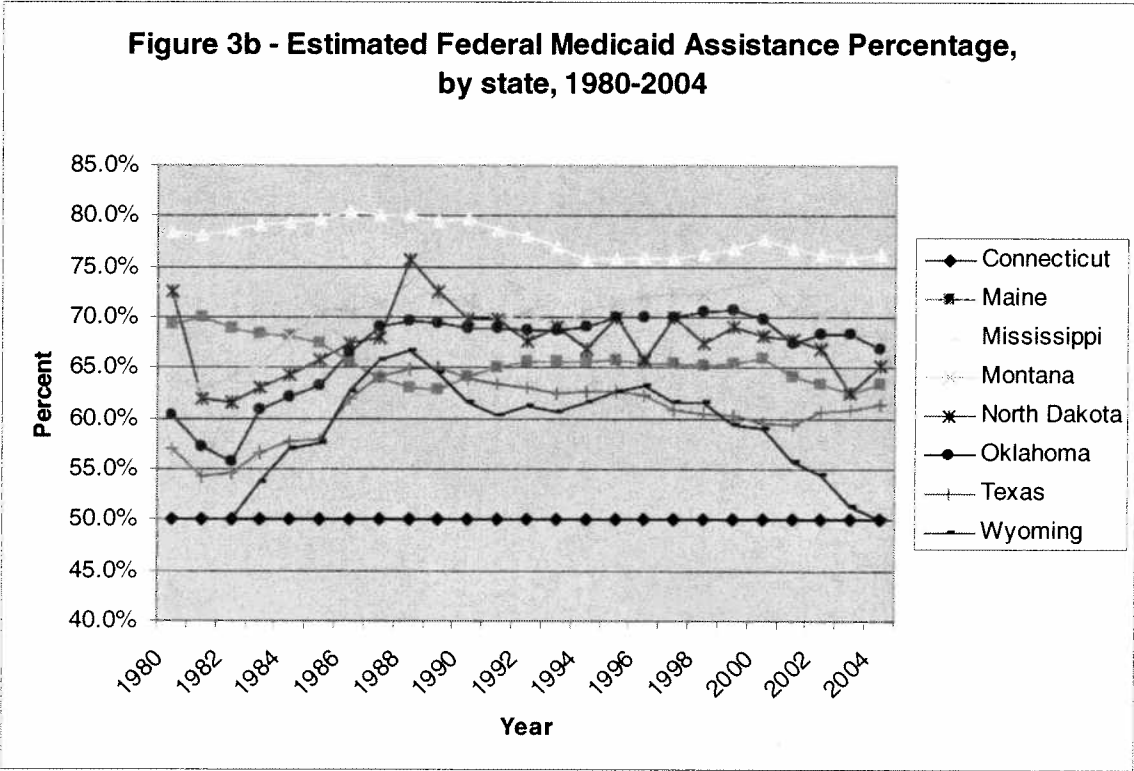
Due to the unavailability of data on federal transfers to states for the Medicaid and SCHIP programs, we decided to include the FMAP as a proxy variable for the federal transfers dedicated to these programs. This choice also came with its problems since the official FMAPs were only available from the Department of Health and Human Services for the fiscal years of 1996 and over (Figure 3a). As we would expect, a wealthy state like Massachusetts has a FMAP of 50% and a relatively poor state like Mississippi has the highest FMAP of all the states with a percentage well above 75%. For most states, their respective FMAP hasn't moved much in the less than 10 year period of 1996-2004.



To address the problem of the limited availability of data for the FMAP, we decided to estimate the FMAP values for the whole period of 1981 to 2004. The mathematical formula to derive the official FMAPs is known and thus we could construct our own FMAP. As it was mentioned in section 4 of the paper, the FMAP is constructed with the use of the personal income per capita of each state and the national per capita personal

income. We obtained the data for per capita personal income from the BEA's Regional Economics Accounts web page.

The limited variation of each state's FMAP over the period of 1996-2004 could be a reason to omit this proxy variable and assume that a state dummy variable or a state fixed effect would capture the difference in FMAP from state to state. Although, for a period of 25 years this assumption is much too strong, since states economies can grow faster or falter relative to other states over this longer period of time. Again, if we take a relatively rich state like Connecticut, its estimated FMAP doesn't change over the whole 25 year period, and a poorer state like Mississippi sees a very limited variation of its FMAP. A state like Wyoming, however, offers a very different picture. In using the personal income per capita data we can estimate that Wyoming's starting FMAP was of 50% which then went up to 66.7% to go back down to 50% at the end of the series. Figure 3b gives a relative idea of what several state FMAPs can look like over a period of 25 years.



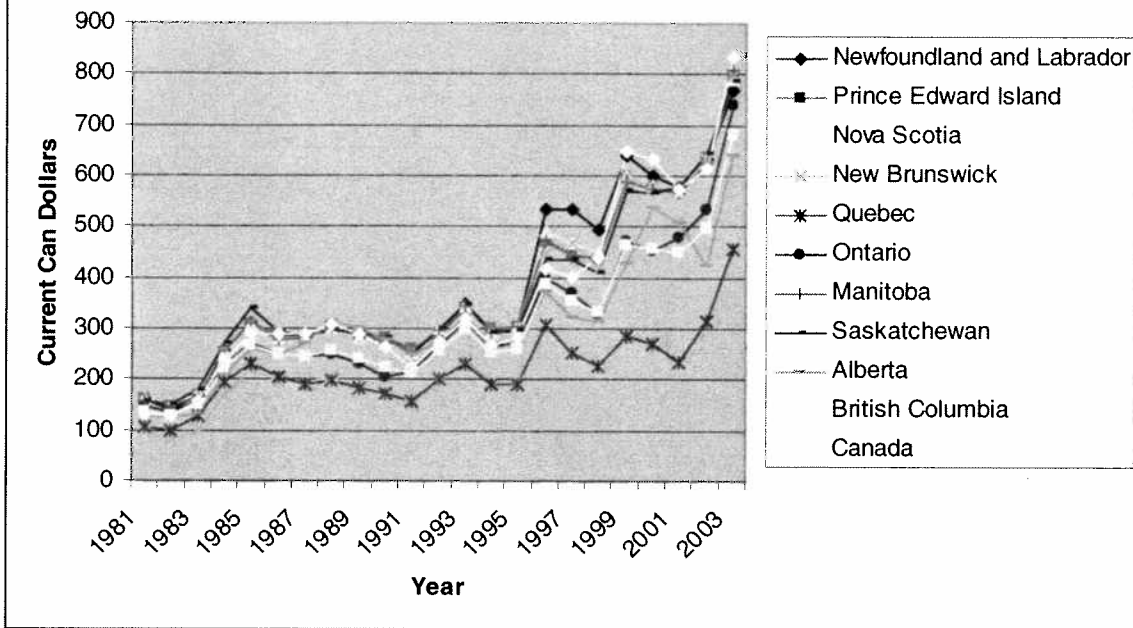
Canada

In this study we chose to use the total federal transfers to provincial government sub-sector obtained from CANSIM. These transfers include money for social programs, postsecondary education, health care, taxation agreements, official languages, regional economic expansion payments and other miscellaneous transfers. The decision to use a larger transfer comes from the fact that even though transfers for health care are designated, nothing prevents the provincial governments from taking other transfers and redirect them towards health spending, thus limiting our analysis to designated health care transfers would bias our estimates.

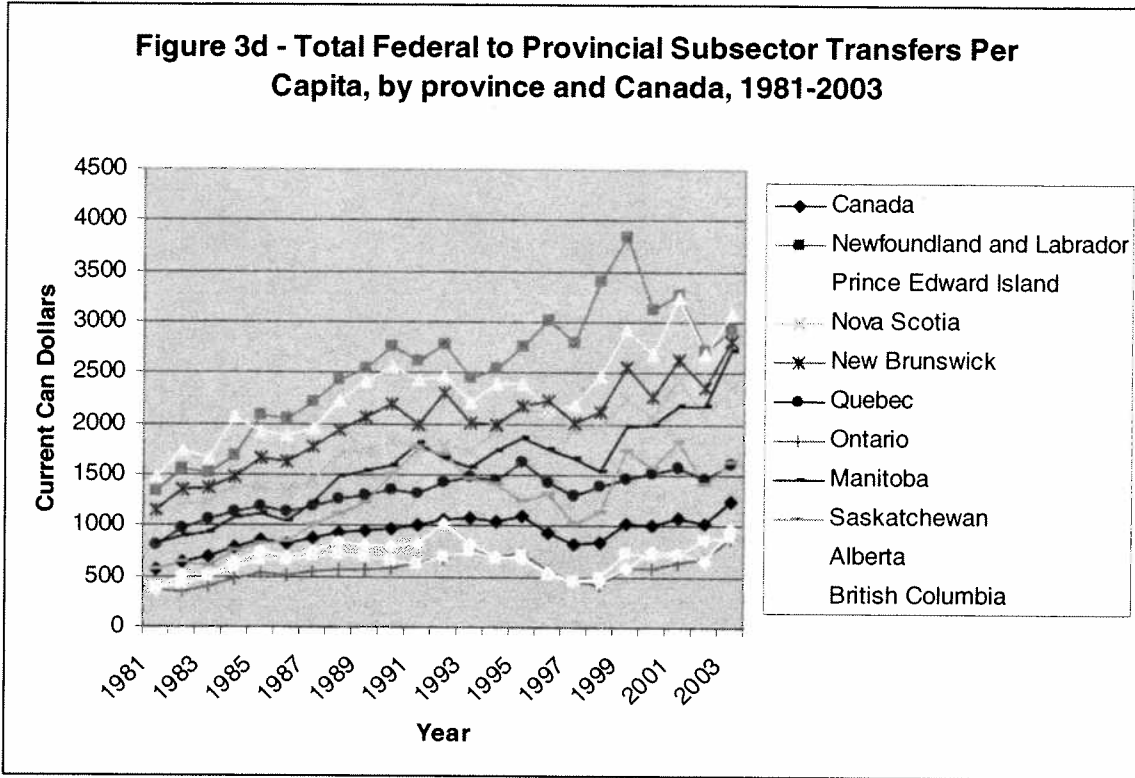
One of the purposes of our study is to determine the impacts of federal funding reforms. Therefore our analysis wouldn't be complete without taking a look at the health specific federal transfers. Data for health transfers were obtained from CANSIM; these include transfers from the Hospital Insurance Act and the Health Resources Fund for years up to 1998 and also transfers for the Canadian Health and Social Transfer (CHST) for the year 1996 and over.

Figure 3c shows that health specific transfers were somewhat stable during the late 1980s to early 1990s. In 1996, we can see a dramatic increase in the health federal transfers. This is due to the new CHST that combines health and social program transfers into one transfer. As we have mentioned before, this reform was intended to reduce spending on the federal side. Thus our image is incomplete without looking at a much bigger aggregation of federal transfers. It is important to note that even if this reform was intended to reduce spending; health federal transfers in Canada had a growth rate of 8.34% annually for the period of 1996 to 2004. Also, in Figure 3c Quebec has the lowest transfers per capita. This situation can be explained by the Quebec Abatement which puts a greater emphasis on tax point transfers than cash transfers, thus lowering the amount of the federal cash transfer for health.

Figure 3c - Health Federal Transfers Per Capita, by province and Canada, 1981-2003



In the case of the total federal transfers, for the entirety of Canada, they grew during that 23 year period at a pace of 3.63% annually. For that period, Maritime Provinces get the biggest transfers while the western provinces like Alberta and British Columbia get the smallest. Looking at Figure 3d, we can see that for most provinces, transfers hit a peak in 1995 and then slowed down for two to three years to increase once more. This more closely reflects the perceived notion of the federal government lowering its spending. For this series we corrected for the Quebec Abatement using data on direct taxes on individuals in the province of Quebec going to the federal government from CANSIM.



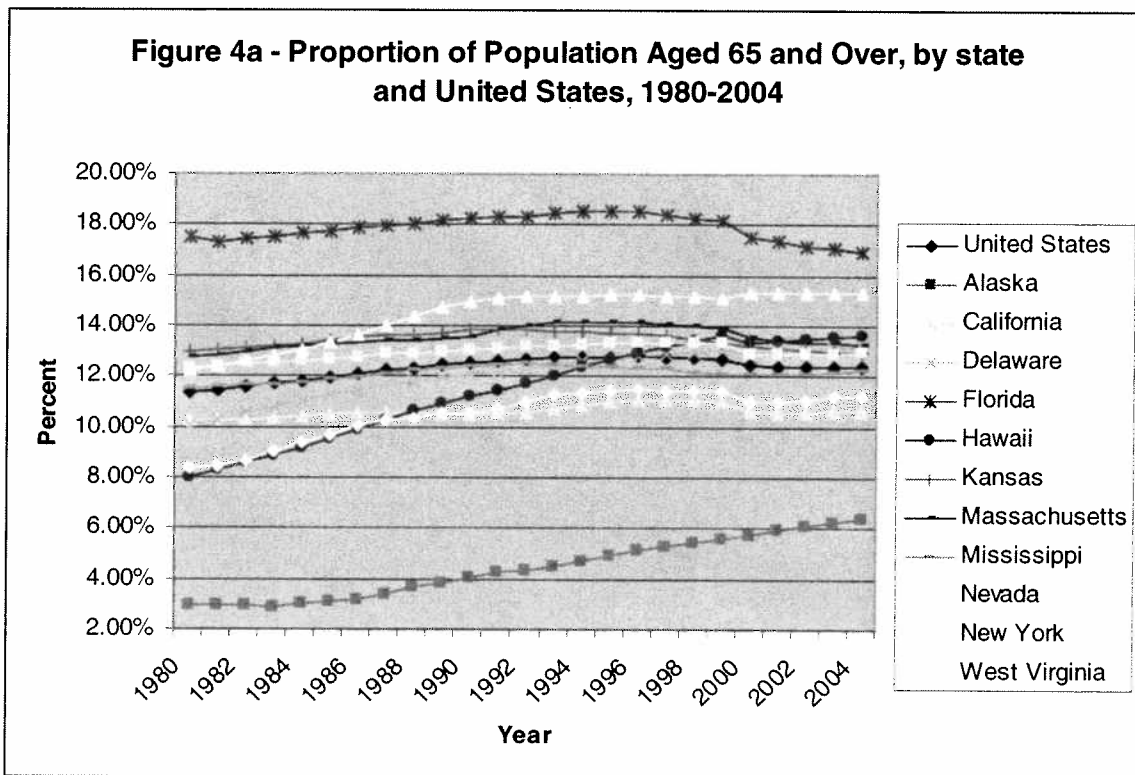
5.4 Proportion of the population aged 65 and over

The ageing of the population is a growing concern in the media and in public policy discussion. A lot of attention has been brought on the fact that an ageing population would drastically increase expenditures on health care. Studies by Denton and Spencer (1975) and Pollock (2000) have postulated that ageing would contribute to an increase in spending. Although these assumptions have been criticized and studies have suggested that closeness to death would be an important cost-driver (Seshamani and Gray, 2004). Nonetheless, even if this source of increasing health care expenditures have been overstated in the public debate, an increase in the general age of the population remains a relevant determinant of health care spending (Seshamani and Gray, 2, 2004).

United States

Data for the proportion of population aged 65 and over was obtained from the US Census Bureau's website. This variable is calculated from the Census Bureau's estimates of the United States population by State and the estimates of the population divided by age groups. The proportion of the population of age 65 and over has grown over the 25 years by 8.97%, going from 11.35% in 1980 to 12.37% in 2004. The two extreme scenarios were the ones from Florida and Alaska. Florida has the highest proportion of individuals over 65 and this proportion has actually declined over the 25 year period which is unique in the whole United States. Alaska, who has the smallest proportion of individuals aged 65 and over, saw the biggest increase in this proportion with a growth of 3.3% annually.

Most states are situated in the band between the states of West Virginia and California and have seen very limited increases in their respective ageing population.



Canada

The data of the proportion of the Canadian population aged over 65 comes from estimates obtained from CANSIM. The proportion of individuals age 65 and up in Canada has grown by 34.06% in the 23 year period. The province with the smallest proportion is the

province of Alberta with 10.3% of its population over 65 in 2003. The biggest proportion goes to the province of Saskatchewan with 14.85% in 2003. The fastest increase in the proportion happened in the province of Newfoundland with an annual growth rate of 2.29%. The slowest growth rate happened in Prince Edward Island with a total increase of the proportion of 14.54% for the period of 1981-2003.

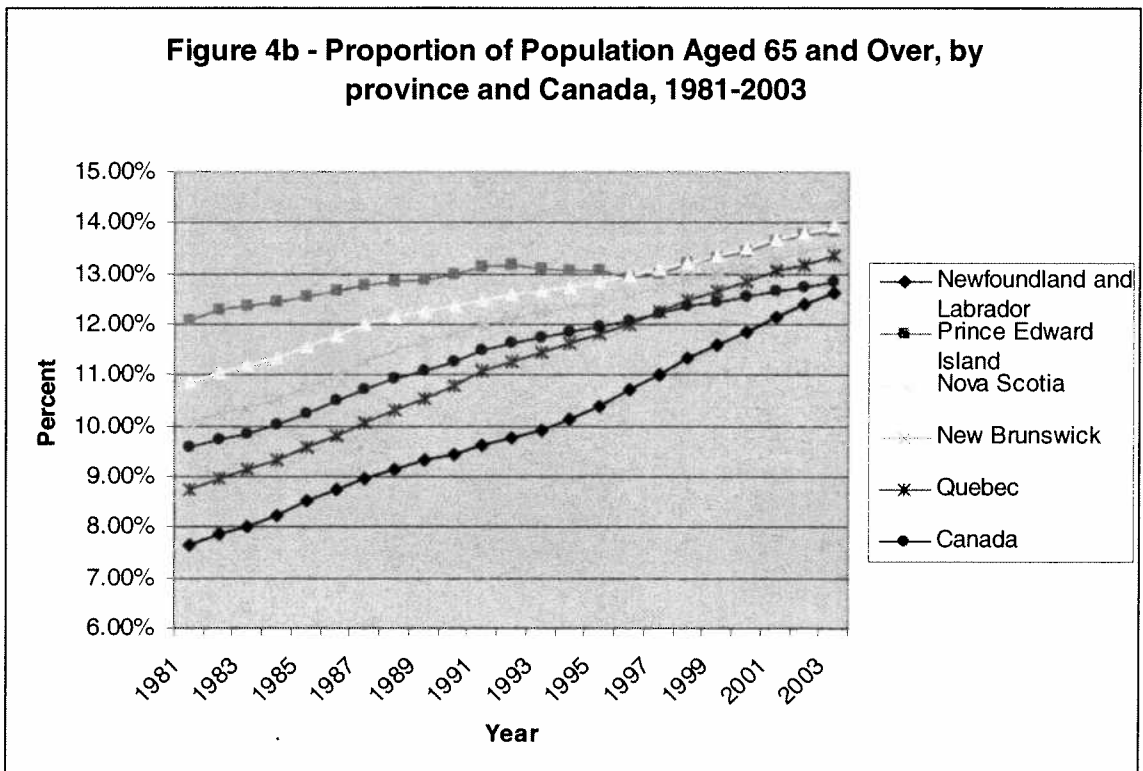
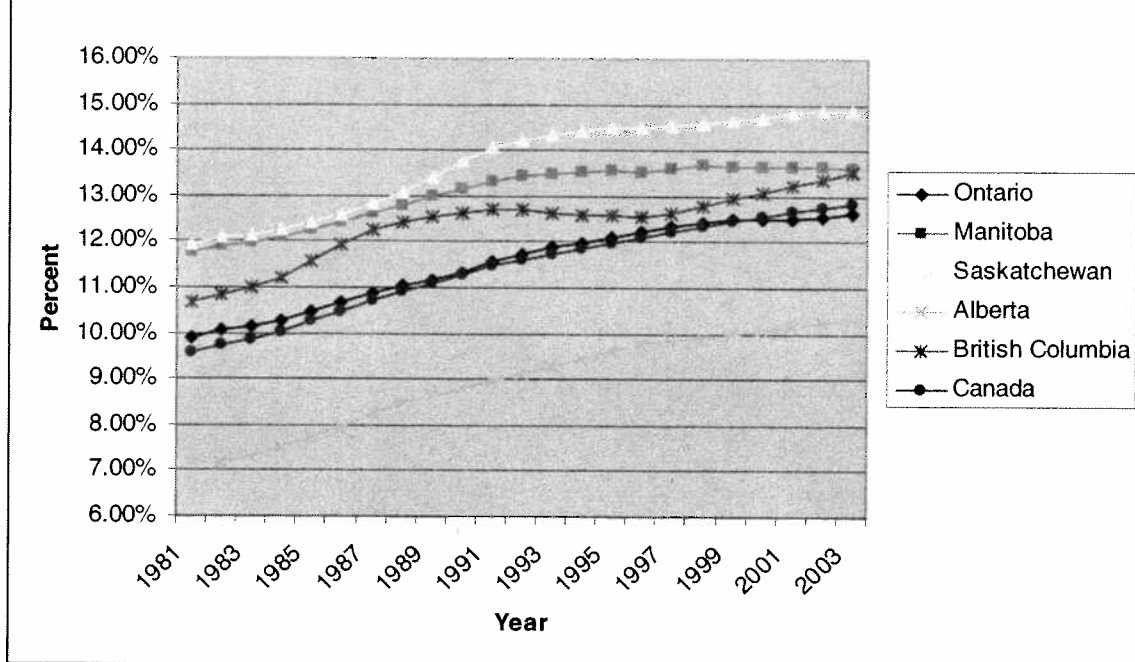


Figure 4b (continued) - Proportion of Population Aged 65 and Over, by province and Canada, 1981-2003



5.5 Relative price of health care

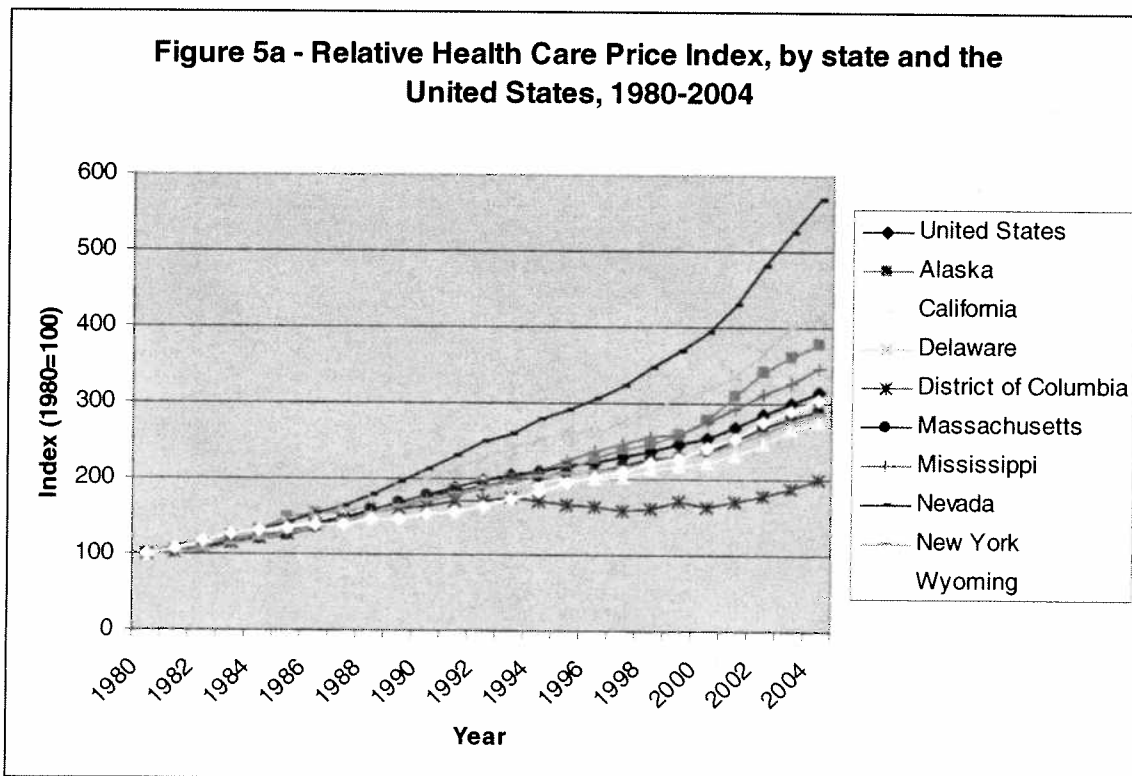
This study includes a relative price variable to remove the substitution effect from the income elasticity coefficient. Economic theory tells us that both income and substitution effects will determine the quantity of a good or service purchased. In the case of health care, the concept of the Baumol effect will most likely apply. This concept stipulates that as an economy develops and income rises, labour-intensive services become more expensive relative to manufactured goods that benefit from increase productivity. Thus health care services, which are relatively labour-intensive and do not benefit from increasing productivity, will most likely have an increasing relative price compared to other goods. This effect is closely linked to income, therefore controlling for this is important if we do not wish to get a biased estimate of the income elasticity.

To include the relative price of health care in our study we will mimic the methodology used by L'Horty *et al.* (1997) who build an index by dividing a health spending price index by the consumer price index. The constructed health spending price index used in

both countries to create the relative price index was not used to deflate our dependant variable. We did not have enough confidence in the constructed price index to deflate our dependant variable and thus altering our results significantly. The use of the relative price index in our study as an independent variable is motivated by reasons mentioned above, but we realize that this constructed variable may bias our results and therefore leads us to estimate our models with and without this variable.

United States

The data used to construct the relative price index comes from the health expenditure by state-of-provider data obtained from the CMS and the consumer price index (CPI) from the Bureau of Labor Statistics (BLS) website. We were able to build a health spending price index for each state, but we divided these indexes by a common CPI for all states since state specific CPI do not exist for the United States. The relative health care price has grown annually for the United States at a rate of 4.87%. As Figure 5a shows, the state of Nevada had the highest increase during the 25 year period with an annual growth rate of 7.51%. The slowest increase in the relative price in the United States was in the District of Columbia with an annual growth rate of 2.91% annually.



Canada

For this study, we have built two distinct relative health care price indexes.

The first relative health care price index (RHPRICE) for Canada has been built using health care expenditure data by province obtained from the CIHI and with the province specific CPI obtained from CANSIM. Canada's relative health price index had for the period of 1981-2003 an annual growth rate of 3.13% percent. The province of Ontario has seen its relative price index increase the most during the same period, with an annual growth rate of 4.47%. In the case of Newfoundland, it has seen the slowest increase in relative health price with annual increase of 2.47%. The relative health care prices in the western provinces and Ontario seem to increase the fastest and have a relatively higher ratio than the eastern provinces.

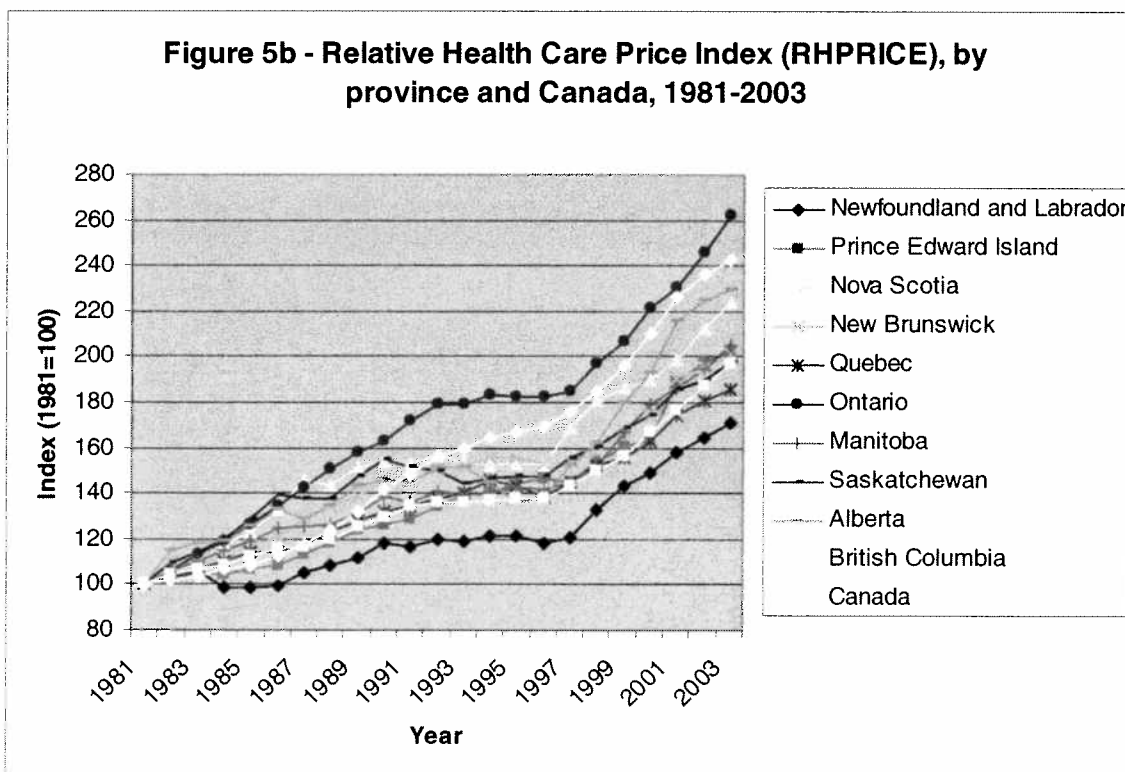
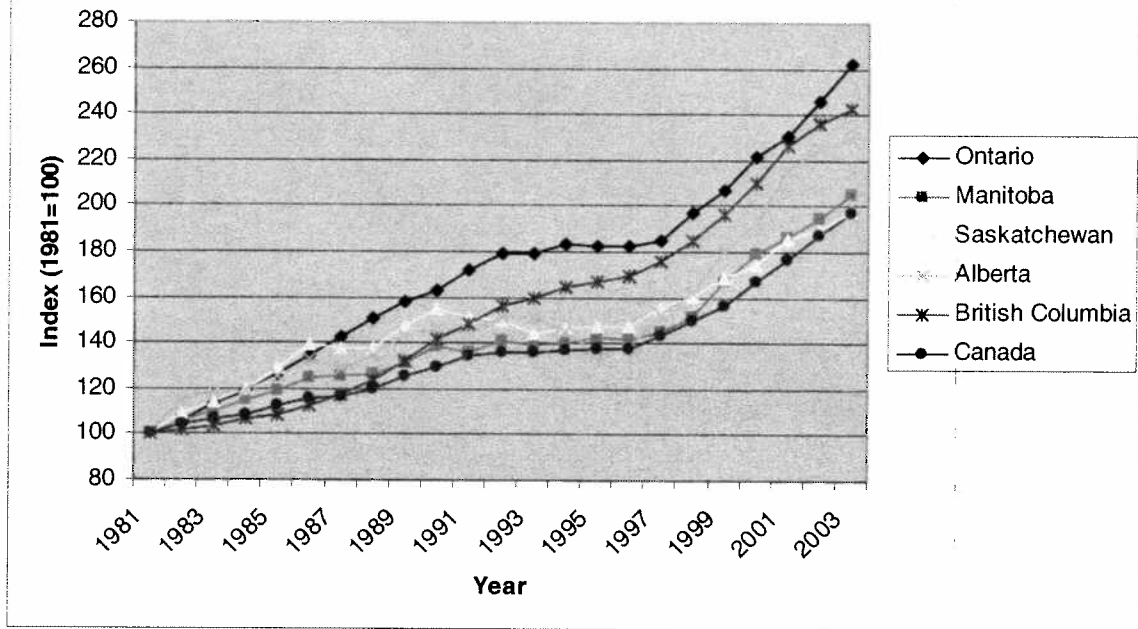


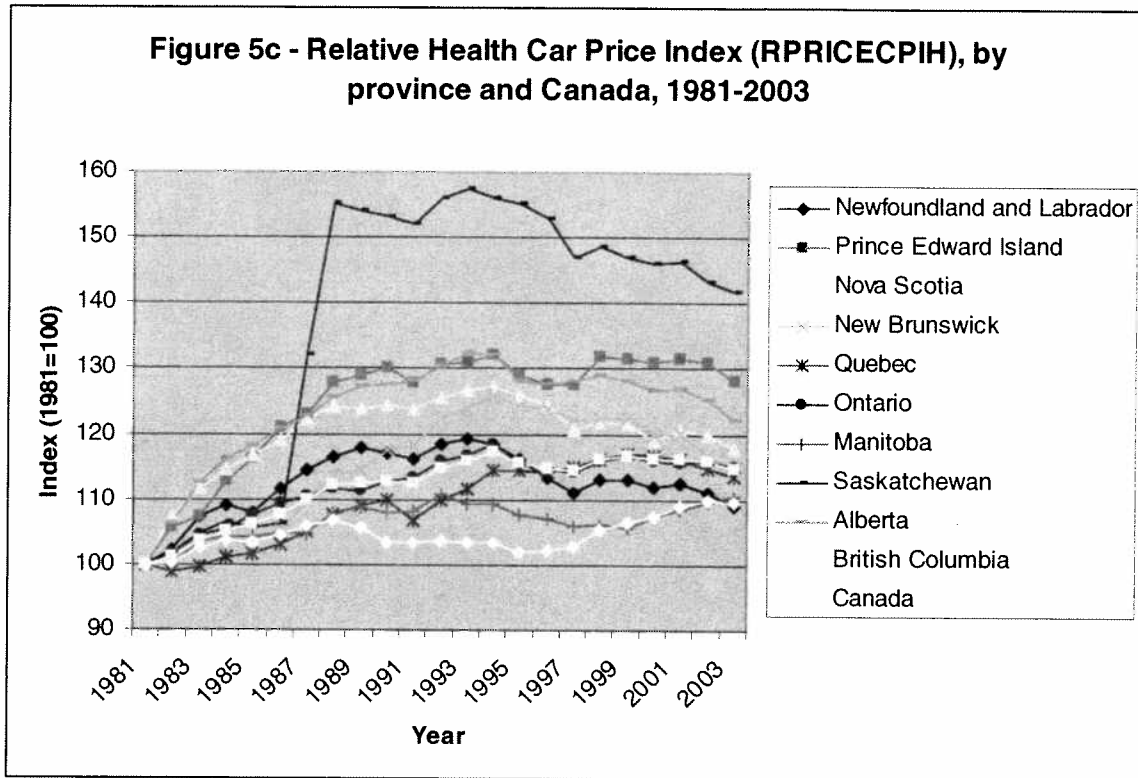
Figure 5b (continued) - Relative Health Care Price Index (RHPRICE), by province and Canada, 1981-2003



The second relative health care price index was built using a province specific CPI index for health care obtained from CANSIM which we divided by the province specific CPI for general goods also used in the first relative health care price index. We chose to create this other index because we had an available index to measure health care prices, but also to use something other than our earlier construction which we do not have full confidence in.

This second index gives us a whole other picture than the first index. It does not seem to be ever increasing and even slowing down towards the end of the series. For Canada, this index increased by 14.72% during the whole 23 year period. The highest growth in the relative health care price would go to Saskatchewan with an increase of 41.92%, who saw a huge increase in the late 1980s to decrease slowly ever since. The slowest growth in relative price would be for the province of British Columbia with a total increase of 9.67% in the 23 year period.

Figure 5c - Relative Health Car Price Index (RPRICECPIH), by province and Canada, 1981-2003



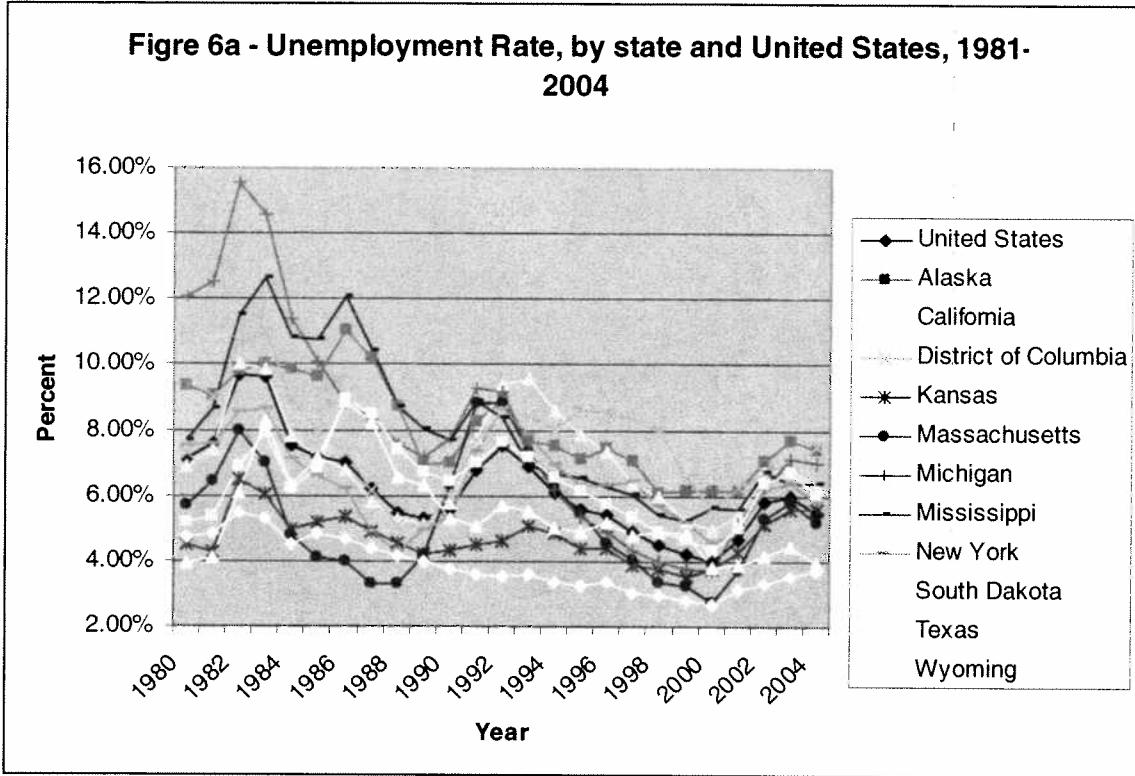
5.6 Country-specific variables

For this study we use one variable unique to each model for a specific country. The choice of these variables has been made according to intrinsic characteristics of each country's health care system and of availability of data. The country specific variable in the United States model is the unemployment rate. One of the characteristic of the American health system is that health insurance is closely linked to employment since most employers offer health coverage to their employees. Thus, in all logic if the unemployment rate rises, more individuals would then participate in the Medicaid plan who offers protection to the uninsured and poorer individuals. This does not apply to the Canadian health system, since all citizens are covered whether they are employed or not. Therefore the unemployment rate is not expected to be a cost-driver in the Canadian system.

The Canadian specific variable is the ratio of deficit or surplus to gross domestic product. Like Ariste and Carr (2003) this study includes a measure of the budgetary surplus or deficit of the provincial governments as a health care determinant. In a pure public finance context, one would imagine that if a provincial government faced a budgetary deficit, he would then lower his expenditures including health care. We would have liked to add state budgetary surplus or deficit in the American model, but restriction in the availability of the data was the major cause of this study having forgone the use of this variable. Also, in most cases state governments have balance budget requirements that are constitutional, statutory or even judicial decisions. Since state intervention in health care is more limited in the American context than in the Canadian, we do not think it would drastically alter the estimates of the American model.

United States

The data for state specific unemployment rate was obtained from the BLS's website. From Figure 6a, we can see that the unemployment rate has a downward trend during the 25 year period covered by this study. Although, not all states have seen their unemployment rate lowered, and states like Kansas, Texas and a few others have a higher unemployment rate then 25 years ago. The District of Columbia is the state with the highest unemployment rate for the year of 2004 with an unemployment rate of 7.5%. The lowest unemployment rate in the mainland of the United States in 2004 is in the state of South Dakota with an unemployment rate of 3.69%.



Canada

The data used for the budgetary surplus and deficit comes from the *government sector revenue and expenditure* from the provincial economic accounts obtained from CANSIM. We use the net lending series for the measure of the budgetary surplus or deficit, since the net lending represents in CANSIM the difference between government revenues and expenditures. The data for the GDP to complete the ratio is the same we obtained earlier from the provincial economic accounts from CANSIM. Figure 6b shows that province's deficit seem to be smaller in proportion to GDP than in the decade of the 1980s, although this is not an absolute. It is also interesting to note that many provinces had seen a peak in their budget surpluses around the year 1995-1996 and then have a sharp drop towards deficit in the following years.

Figure 6b - Ratio of Net Lending to Gross Domestic Product, by province, 1981-2003

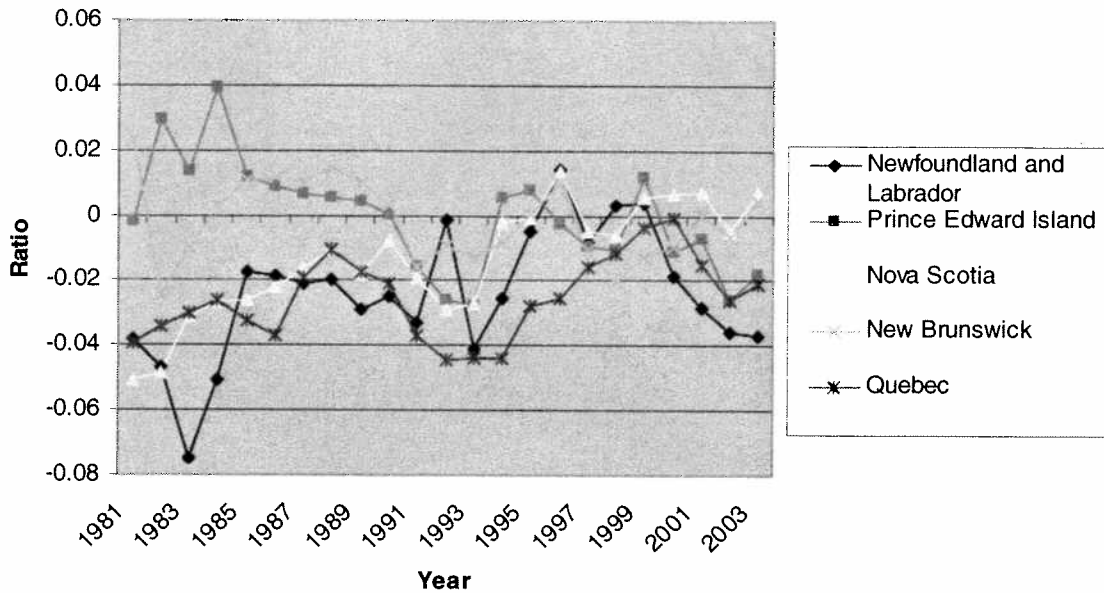
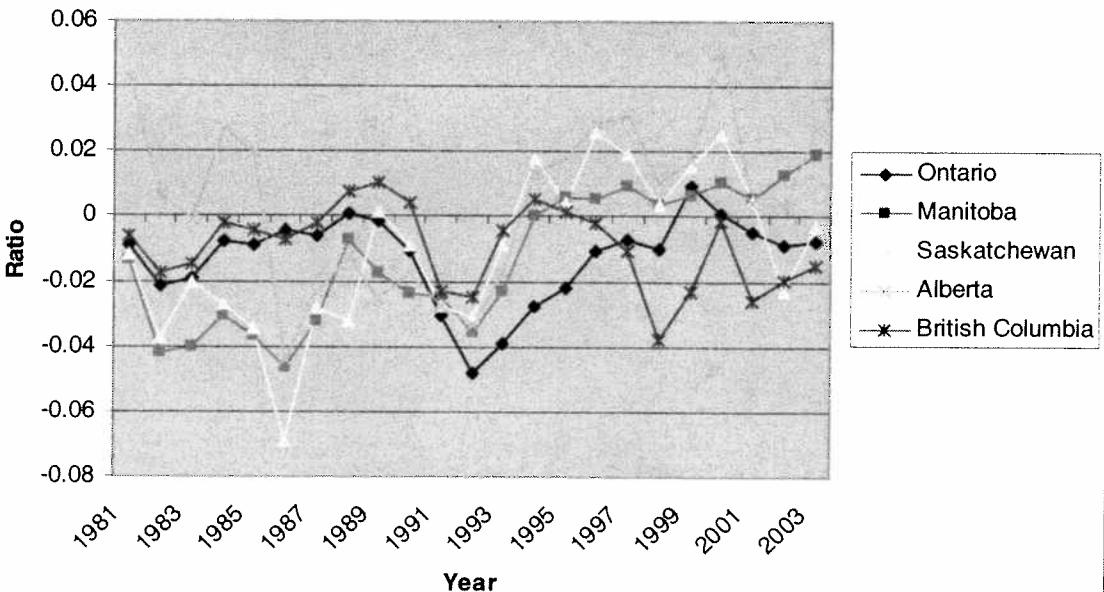


Figure 6b (continued) - Ratio of Net Lending to Gross Domestic Product, by province, 1981-2003



Part 3

6. Unit root and cointegration

The use of pooled time-series cross-section in the analysis of health care expenditures creates statistical and methodological issues relevant to time series econometrics. These issues mainly are related to the stationarity, or the absence of stationarity in the time series used in health care expenditures studies. As we have mentioned above, regressions involving non-stationary variables will most likely lead to spurious regressions which will seem to have significant relationships (Phillips, 1986). An economic relationship between non-stationary variables is nonetheless possible. In certain cases “*a linear combination of non-stationary variables exists which is itself stationary*” (Gerdtham and Löthgren, 2002, p.1679). In that case we say that these non-stationary series are cointegrated. Questions of non-stationarity and cointegration have been the center of several papers (Hansen and King, 1996; Gerdtham and Löthgren, 2000, 2002; Freeman, 2003) in the health care expenditures literature.

This study also looked for evidence of non-stationarity and cointegration in the variables used in its analysis. To test for unit roots in panel data we used methods developed by Levin, Lin and Chu (2002) and Im *et al.* (2003). To test for cointegration we used new methods developed by Pedroni (1999, 2004) which have not been used before in the health care expenditure literature. All tests have been made using the RATS (Regression Analysis of Time Series) software version 6.2.

The different methodologies in testing for unit root come with their strengths and limitations. Simulations of the Levin and Lin tests (LL) indicate that these tests perform well in relatively small samples and offer “*dramatic improvements in power compared to performing a separate unit root test for each individual series*” (Levin, Lin and Chu, 2002, p.18). The LL tests also have limitations; contemporaneous correlations between individuals, in our case provinces or states, pose a problem to these tests and the independence assumption across individuals is necessary. Also the LL tests have the

alternative hypothesis that all individual series are stationary with identical first order autoregressive coefficient, this however does not have a significant impact since the tests are consistent asymptotically (Moon and Perron, 2004). The methodology proposed by Im, Pesaran and Shin (IPS), or the IPS test, differs from the LL tests in certain ways. The first thing that is different from the LL tests is that the alternatives do not require all individual first order autoregressive coefficients to be identical. The IPS test also performs well in small samples according to Monte Carlo simulations, but this is only true when there is no serial correlation. When disturbances in the dynamic panel are serially correlated a greater number of individuals and time observations are required to have sufficient power.

The Pedroni tests for cointegration in heterogeneous panels “*allow for considerable heterogeneity among individual members of the panel, including heterogeneity in both the long run cointegrating vectors as well as heterogeneity in the dynamics associated with short run deviations from these cointegrating vectors*” (Pedroni, 1999, p.1). Pedroni also has produced critical values for cointegration tests with multiple regressors. Therefore the Pedroni tests offer characteristics that are crucial to our analysis. The methodology from Pedroni offers seven different tests with four based on pooling along the “within-dimension” and three along the “between-dimension”. The within-dimension tests are similar to the LL tests which the alternative requires that the autoregressive coefficient to be identical for all individuals. The between-dimension tests are similar to the IPS test in respect to the fact that individual autoregressive coefficients can differ. Each of these tests has a comparative advantage in terms of small size and power properties depending on the data generating process.

6.1 Unit root test results

Three test statistics are used to determine the stationarity of the variables used in this study. The LL tests statistics used are the t-rho statistic and an augmented Dickey-Fuller (ADF) based test. The main difference between the t-rho statistic and the ADF statistic is the way in which they correct for autocorrelation. The IPS test statistic is an ADF based

statistic for which we have to determine before hand the lag or lags to use. All three of these tests have unit root for the null hypothesis. Thus a rejection of the null gives us evidence of stationarity in the variable in question.

Each test has been made with state or province specific trends when deemed necessary and also with time dummies to remove all common time effect from the series. Some variables have been tested with both absence and presence of trend. This choice was made due to the difficulty of evaluating if there was a trending behavior in the variables in question or not.

Table.3 Unit root test results		United States		
Variables Logarithmic form	Trend	Levin and Lin		IPS
		t-rho	ADF	ADF
State HCE	Yes	Does not reject H0	Does not reject H0	Does not reject H0
DPI	Yes	Does not reject H0	Rejects H0 at 5%	Does not reject H0
FMAP	No	Rejects H0 at 5%	Rejects H0 at 5%	Rejects H0 at 5%
PROPAGE65	Yes/No	Does not reject H0/ Does not reject H0	Does not reject H0/ Does not reject H0	Rejects at 5%/ Does not reject H0
RHPRICE	Yes	Does not reject H0	Does not reject H0	Does not reject H0
UNEMP	Yes/No	Does not reject/ Rejects at 5%	Rejects H0 at 5%/ Rejects at 5%	Rejects H0 at 5%/ Rejects at 5%
H0: unit root N=51, T=25				

Each variable was tested in their logarithmic form since it is the functional form used to estimate our model. The exception to this is the Canadian model variable of the ratio of net lending to GDP which is sometimes negative and thus can't be transformed with the natural logarithm. The results reported in Table 3 and Table 4 do not include the test statistics results and also the lags used in the IPS ADF based tests; these are available in the appendix.

Table.4 Unit root results		Canada		
Variables Logarithmic form	Trend	Levin and Lin		IPS
		t-rho	ADF	ADF
HCE	Yes	Does not reject H0	Does not reject H0	Does not reject H0
GDP	Yes	Does not reject H0	Does not reject H0	Does not reject H0
FEDTRANSFERS	Yes	Rejects H0 at 10%	Rejects H0 at 5%	Rejects H0 at 5%
PROPAGE65	Yes	Does not reject H0	Does not reject H0	Does not reject H0
RHPRICE	Yes	Does not reject H0	Does not reject H0	Does not reject H0
RHPRICECPIH	Yes	Does not reject H0	Does not reject H0	Does not reject H0
RATIONETLEND (level form)	No	Rejects H0 at 5%	Rejects H0 at 10%	Rejects H0 at 5%
H0: Unit root N=10, T=23				

Both test methods require independence between individuals to have meaningful results. Therefore, to know if these tests would be useful to us we had to test for cross-section dependence. We used the method developed by Pesaran (2004) to determine if there is evidence of cross-section dependence (CD) in the American and Canadian data. The results of the Pesaran's CD tests lead us to conclude that there is in fact cross-section dependence in our data. Therefore, we must be careful in the use of our results since there is a probability of them being wrong due to cross-section dependence. Nonetheless, cross-sectional dependence in these tests causes over-rejection of the null; therefore the non rejections of the null results are thus much stronger. That being said, the inclusion of time dummies drastically reduces the presence of cross-sectional correlation in the error terms and sometimes even eliminates it completely.

For the American data, we can't reject the presence of unit root for the State HCE, DPI and RHPRICE. We have evidence to assume stationarity for the estimated FMAP and UNEMP variables. The variable PROPAGE65 is more ambiguous. If we use a state specific trend, it rejects the null at 5%, therefore PROPAGE65 would be stationary. If we exclude the trend, we can't reject the null thus it could very well be a unit root process. Looking at a graphic of the natural logarithmic transformation of PROPAGE65 it is difficult to notice a trend in the data. Although, most states have seen a rise in their proportion of population over the age of 65 which not only indicates a trend, but confirms

conventional wisdom in the fact that most western nations have seen their population aged. The inclusion of time dummies in the LL tests removes cross-sectional correlation which makes the LL tests valid for our analysis. Therefore we have evidence for a unit root process whether we include a trend or not. We then conclude that PROPAGE65 is likely to be non-stationary.

The Canadian data has similar results. We do not find evidence to reject the null of the presence of a unit root process for the variables of HCE, GDP, PROPAGE65 and RHPRICE. For the variables FEDTRANSFERS and RATIONETLEND we find evidence against a unit root and establish these variables to be stationary.

6.2 Cointegration test results

The within-dimension based statistics are referred to as the panel statistics and the between-dimension based statistics are referred to as the group statistics. The first panel statistic is a nonparametric variance ratio statistic. The second is a panel version of a nonparametric statistic that is analogous to the Phillips and Perron “rho” statistic. The third one is a nonparametric statistic analogous to the Phillips and Perron t-statistic and the fourth statistic is a panel cointegration statistic analogous to the ADF t-statistic. For the group mean statistics, the first one is analogous to the Phillips and Perron “rho” statistic, the second one is analogous to the Phillips and Perron t-statistic and the last one is analogous to the ADF t-statistic. These statistics, like the common ADF cointegration test, has no cointegration as the null hypothesis.

Monte Carlo simulations from Pedroni (2004) give us an insight on the statistics more likely to be useful to us. In small panels of around 20 individuals, if the group-rho statistics rejects the null then we are confident that there is cointegration between the variables since this particular statistic is “*empirically the most conservative*” (Pedroni, 2004, p.615). Looking at the Figures presented in the same paper, we can say that the group t statistic has more empirical power when the T dimension is smaller and also it has an oversized empirical size. A close competitor is the panel t statistic who also has

good empirical power when T is small and is slightly oversized as well. Unfortunately, the version we have of Pedroni's paper does not include Monte Carlo simulations for the ADF based statistics.

Our methodology is to take the non-stationary variables and see if there is a relationship that is stationary. If a relationship can not be established with all the non-stationary variables, we then remove one and test again for a cointegrating relationship. We do this until we find a relationship or run out of variables. All of the variables tested are in their natural logarithmic form as it was done for the unit root tests.

For both Canada and the United States we included trends in the tests to determine the relationship. Time dummies to remove as much cross-sectional correlation were also used in the tests. We should mention that it is possible that cross-sectional correlation was not entirely removed and thus affecting the validity of our tests as was proven by Monte Carlo simulations by Banerjee *et al.* (2004).

Table.5 Cointegration test Results	United States	
Cointegration relationship	Rejects H0	Does not reject H0
State HCE, DPI, PROPAGE65, RHPRICE	Panel V-stat Panel adf-stat Group adf-stat	Panel rho-stat Panel pp-stat Group rho-stat Group pp-stat
State HCE, DPI, PROPAGE65	Panel pp-stat Panel adf-stat Group pp-stat Group adf-stat (Rejects at 10%)	Panel V-stat Panel rho-stat Group rho-stat
H0: no cointegration N=51, T=25		

Table.5 Cointegration test Results	Canada	
Cointegration relationship	Rejects H0	Does not reject H0
HCE, GDP, PROPAGE65, RHPRICE	Panel V-stat Panel pp-stat Group pp-stat Group adf-stat	Panel rho-stat Panel adf-stat Group rho-stat
HCE, GDP, PROPAGE65, RHPRICECPIH	Panel adf-stat Group adf-stat	Panel V-stat Panel rho-stat Panel pp-stat Group rho-stat Group pp-stat
HCE, GDP, PROPAGE65	Panel adf-stat Group adf-stat	Panel V-stat Panel rho-stat Panel pp-stat Group rho-stat Group pp-stat
H0: no cointegration N=10, T=23		

The American results for the cointegration tests indicate to us that there is a good probability that there exists a linear combination of State HCE, DPI, and PROPAGE65 that is stationary. We do have evidence for a cointegrating relationship with the above variables including RHPRICE, but the rejection of both the pp-stats make us more confident about the second test results and thus, exclude the RHPRICE variable from the relationship.

The Canadian results seem to indicate a cointegration relationship between HCE, GDP, PROPAGE and RHPRICE. We replaced the price variable with the RHPRICECPIH and we get a much less clear cut result. Only the ADF based tests reject the null of no cointegration. The empirical power of the ADF based tests isn't well known to us, but we do now have evidence of a cointegration relationship that we won't ignore.

7. Regression results

Estimates of the American and Canadian models were made using Intercooled STATA 9.1. All variables are in natural logarithmic form except the Canadian variable RATIONETLEND. In light of our results on cointegration in the previous section, all estimates will be made using the dynamic ordinary least square (DOLS) method.

7.1 United States

Two models were estimated for the United States. The first model contains the variable RHPRICE, and the other doesn't. In the American models we were also able to add an interaction variable between the FMAP and the BBA of 1997 dummy.

We used fixed-effects estimation for both models because economically we can't say that there aren't any correlations between the individual state effects and the explanatory variables. We also did a Breush-Pagan LM test that warns us against using random-effects. We then proceeded to test for serial correlation using the method proposed by Wooldridge (2002). In both cases the test gives us clear evidence of first-order autocorrelation. We also tested for cross-sectional correlation using the Pesaran (2004) method and found evidence for cross-sectional correlation. It is to be noted that for both cases adding time dummies drastically reduced this correlation.

The fact that there is good probability of first-order autocorrelation made us use the *XTREGAR* command to estimate both models. This permitted us to use fixed-effects estimation and also do it with an AR(1) disturbance correction. We would have liked to use *XTGLS* who does a feasible GLS to correct for both cross-sectional correlation and serial correlation to estimate our models. The last method was unavailable to us since the method had to estimate the correlation matrix which would have required more estimates than we have observations. We would like to add that *XTREGAR* does not give standard errors robust to heteroskedasticity or cross-sectional correlation.

Table 6. Regression results for the United States models						
Variables	With RHPRICE			Without RHPRICE		
	Coef.	Std. Err.	t	Coef.	Std. Err.	t
State HCE						
Trend	.0394	.003589	10.97	.0425	.004556	9.33
DPI	.4486	.083516	5.37	.48846	.105465	4.63
FMAP	-.1804	.034638	-5.21	-.2011	.0451	-4.46
PROPAGE65	.2499	.067440	3.71	.26368	.07922	3.33
UNEMP	.00168	.006468	0.26	-.0052	.00848	-0.61
Difference of RHPRICE	.60097	.024657	24.37			
FMAP*dBBA97	.05648	.014998	3.77	.0719	.019449	3.70
dBBA97	.01745	.008237	2.12	.0267	.010713	2.49
	Obs:	969		Obs:	969	
	F(34,884)	= 423.32		F(33,885)	=343.05	
	R-sq:	Within=	0.9421	R-sq:	Within=	0.9275
		Between=	0.4116		Between=	0.4308
		Overall=	0.8805		Overall=	0.8840

To properly estimate the DOLS model with two lags and to correct for the autocorrelation, we had to lose the observations for the years 1980-1982 and the years 2002-2004. Therefore we were left with 969 observations which are for 50 states and the District of Columbia during the time period of 1983-2001. We also included time dummies for all years used and left out the base year of 1983. The choice of two lags was made using the method similarly employed to choose the number of lags in an ADF test which consists of using a maximum of lags and testing the coefficient assigned to each lag against the null of zero.

Results of Table 6 give us the estimated coefficients of the United States models. We can see that DPI per capita is positive and significant in both models. And the income elasticity of state health care expenditures is between 0.45 and 0.49. This is close to what Di Matteo (2005) found for the United States, although slightly lower. We must note that his study used Gross State Product (GSP) per capita as the income variable.

The FMAP coefficient is negative and significant in both models. This is not the sign that we expected. The FMAP variable proxies for federal transfers for Medicaid, we would then expect that the more transfers you receive the more the state health expenditures increase. This is either not true because transfers are made for services offered under certain criteria or states can't actually increase their spending with that type of transfer. Or this negative estimate is a result of econometric problems such that the variable is correlated closely to per capita income and that the higher the FMAP the poorer the state. Thus having a high FMAP is synonymous to a poorer state which would then have lower health care expenditures.

The proportion of individuals aged 65 and over has a significant and positive coefficient. This result confirms that health care expenditures in the United States do go up when the population ages. The coefficient is not very elastic at around 0.25, but it is an interesting result considering the impact that adding a linear trend had in the previous studies in the health care expenditures determinants literature. If the inelastic coefficient is correct this would also confirm, in part, that fears of an ageing population on health care expenditures might have been overstated.

The coefficients in both models for the unemployment rate are not significant and are small. This is somewhat unexpected due to the importance that employment has in health insurance in the United States. We would expect a negative value for the coefficient associated with unemployment, with a higher unemployment resulting with lowered access to expensive care or even medical care at all. The small and insignificant coefficient might be due to the effectiveness of the Medicaid plan and other government intervention, but we remain unconvinced of this explanation when faced with the fact 45.8 million individuals are medically uninsured in the United States (DHHS,3, 2005, p1.).

The effect of the relative health price in the model estimated is hard to interpret. We added the RHPRICE in difference since we knew of its non-stationarity from the

previous section's tests. The sign of the coefficient is positive which would run contrary to economic theory, since we expect that the more expensive a good or service becomes relative to other goods the less we purchase. This result can be explained in two ways. The first explanation comes from the very nature and creation of this variable. It was constructed from a more aggregated health care expenditures data series which would include the dependent variable. Therefore a positive correlation between our dependent variable and this one is more than likely. The second explanation might come from the nature of the demand for health care services. The demand might be price inelastic and that expenditures in value would rise with the increase in relative health prices. This would make sense since the CPI for medical care, taken from the BLS, has grown by 314% during the 25 year period of 1980-2004.

The reforms variables associated with the Balanced Budget Act of 1997 are both positive and significant in both models. The dummy variable dBBA97 tells us that health care expenditures in states excluding Medicare were higher due to the reform that extended coverage to many poor children. The interaction variable is also positive, which means that the higher FMAP was also correlated in more state health care expenditures. This might be due to reform and the EFMAP formula which takes into account the FMAP. The higher FMAPs go to the poorer states and thus poorer states would of have more poor families whose children would be covered by the new SCHIP program. These results confirm that the BBA of 1997 Medicaid funding reforms did in fact raise health care expenditures.

The coefficients associated with the linear trend in both models are positive and significant. This linear trend can be interpreted partially has technological change in the medical field. Thus if all things remain constant, nominal state health care expenditures should rise by 3.9% to 4.25% annually. These estimates are higher than the 2% found by both Blomqvist and Carter (1997) and Ariste and Carr (2003). This is no doubt due to the fact that our dependent variable hasn't been deflated like the previous studies.

7.2 Canada

Three models were estimated for Canada. One model is estimated using the variable *RHPRICE*, the second with the variable *RHPRICECPIH* and the last one is estimated without any price variable. This choice was made since we do not have full confidence on the *RHPRICE* variable being a valid measure of relative health prices. Unlike the United States models, we could not add an interaction variable between federal transfers and the reform dummy *dCHST* due to problems of collinearity with the time dummies used in several regressions.

Like for the case of the United States we can't economically make the hypothesis of non correlation between the individual effects and our independent variables. We did a Breush-Pagan LM test to confirm our assumption. The test did warn us again using random-effects for our estimates for both models. We also tested for the presence of serial correlation in our data by using the same test suggested by Wooldridge (2002). Once again, for both models the test gives evidence of first order correlation in the errors. We then proceeded to test for the presence of cross-sectional correlation with the Pesaran test. Both tests reject the null of no cross-sectional correlation even if time dummies were present.

The method we chose to estimate both models is the *XTGLS* command. This does a Feasible GLS and that method permits us to correct for problems of serial correlation, cross-sectional correlation and heteroskedasticity which we are able to do for the Canadian models since the number of provinces is smaller than the number of states in the United States. To include province fixed-effects we added province dummies for all provinces except Ontario. We estimated each model twice, once with time dummies and the other without. Since the *XTGLS* address the problem of cross-sectional correlation, the necessity of adding time dummies is now much less of a problem. This comes with the benefit of reducing the problem of collinearity between the reform dummy and the time dummies.

To estimate the DOLS model with two lags we had to lose observations for the years 1981-1983 and for the years 2002-2003. This leaves us with 180 observations which are

for 10 provinces for the time period of 1984-2001. The choice of using two lags was determined in the same fashion than for the American models.

Table 7a presents the regression results made with the time dummies and Table 7b presents the regression results made without them. The major differences that we can see at a first glance between the estimations with and without time dummies is that coefficients are slightly bigger when time dummies are absent. Also the estimates for the impact of the aging population completely changes sign and significance depending on the model used.

Variables	With RHPRICE			With RPRICECPIH			Without a relative price variable		
	Coef.	Std. Err.	z	Coef.	Std. Err.	z	Coef.	Std. Err.	z
HCE									
Trend	.02683	.00156	17.20	.04228	.00260	16.27	.04504	.00256	17.59
GDP	.32368	.02444	13.25	.39013	.05482	7.12	.29250	.05473	5.34
FEDTRANSFERS	.03942	.00655	6.02	.05022	.01461	3.44	.03637	.01291	2.82
PROPAGE65	-.00468	.03326	-0.14	-.28049	.07013	-4.00	-.24162	.07405	-3.26
RATIONETLEND (lagged 1 period)	.10802	.03653	2.96	.10077	.10440	0.97	-.03567	.10316	-0.35
RHPRICE /RPRICECPIH	.43348	.02920	14.85	-.00146	.05381	-0.03	-	-	-
dCHST	-.05062	.00567	-8.93	-.05243	.01204	-4.36	-.04320	.00953	-4.53
	Obs:	180		Obs:	180		Obs:	180	
	Wald Chi2(46)=	2656338		Wald Chi2(46)=	2606603		Wald Chi2(40)=	784032.11	
	Log likelihood=	705.063		Log likelihood=	555.27		Log likelihood=	541.02	

Variables	With RHPRICE			With RPRICECPIH			Without a relative price variable		
	Coef.	Std. Err.	z	Coef.	Std. Err.	z	Coef.	Std. Err.	z
HCE									
Trend	.01289	.00173	7.45	.03189	.00309	10.31	.03350	.00302	11.09
GDP	.39669	.02714	14.61	.51015	.05610	9.09	.45171	.04786	9.44
FEDTRANSFERS	.06836	.00812	8.42	.09483	.01602	5.92	.07494	.01514	4.95
PROPAGE65	.18092	.03756	4.82	-.06487	.08389	-0.77	-.07486	.08850	-0.85
RATIONETLEND (lagged 1 period)	.16750	.04662	3.59	.04534	.11169	0.41	-.03242	.10471	-0.31
RHPRICE /RPRICECPIH	.56955	.03232	17.62	.02161	.06510	0.33	-	-	-
dCHST	-.02091	.00566	-3.69	-.07005	.01215	-5.76	-.06662	.01203	-5.54
	Obs:	180		Obs:	180		Obs:	180	
	Wald Chi2(31)=	18047.8		Wald Chi2(31)=	8335.5		Wald Chi2(25)=	6839.25	
	Log likelihood=	599.146		Log likelihood=	459.21		Log likelihood=	461.27	

The coefficients related to GDP per capita are all positive and significant. The lowest income elasticity is 0.293 and the highest is 0.51. The coefficients taken from the regressions including RPRICECPIH were always bigger than the ones taken from the other models. The same is also true from coefficients taken from regressions without time dummies and those with time dummies. Our findings of income elasticities that are less than unity go along with the economic literature that finds inelastic income elasticities.

The per capita federal transfers are positive and significant in all six regressions. These coefficients are fairly small compared to earlier estimates by Di Matteo and Di Matteo (1998) and Di Matteo (2005). This tells us that federal cash transfers per capita are much less elastic than income. The biggest estimate is from the no time dummies-RPRICECPIH regression with an estimate of 0.095. This would mean that an increase of 10% in the nominal per capita federal cash transfers would only raise per capita health care expenditures by less than 1%. This result might be explained by the fact that we used a larger aggregation of federal transfers that are earmarked for other provincial expenditures. Thus not all the money would go to finance health care expenditures.

Nonetheless we find this to be very unlikely considering the proportion of health care expenditures in the provincial budgets. This result might indicate a downward bias in this coefficient.

The proportion of people aged 65 and over is significant for only three regressions and these are of opposite sign. The coefficients are negative for five of the six regressions which is an odd result. As we have mentioned above, the inclusion of time dummies has an effect on the sign of the coefficient. The regression including RPRICECPIH and time dummies has a negative coefficient that is significant. The coefficient associated with PROPAGE65 is significant and positive when we remove the time dummies from the regression that includes RHPPRICE. The coefficients in the regressions without a relative price index are both negatives but only the one including time dummies has a significant coefficient. The fact that removing time dummies has a positive effect on the PROPAGE65 variable is in concordance with the empirical literature that found that controlling for time, like adding a linear trend, usually diminished significantly the coefficient and the significance of variables related to age groups. Thus we put more emphasis on results are estimated without time dummies present. This leads us to conclude that even if the positive and significant coefficient was really the correct estimate; the impact of aging in the Canadian system would be very limited. Thus it is fair to say that in the Canadian models, the proportion of individuals aged 65 and over do not seem to have a very significant impact on health care expenditures. Past studies have accredited the lack of variation in the values of their observations of the aging population for the small and not significant estimates. It is also possible that the aging of the population did not affect significantly the public health care expenditures because governments may have controlled costs associated to services to the elderly and reduced the quality of care to maintain somewhat of a balanced budget.

The coefficients associated with the lagged variable of the ratio of net lending on GDP are positive and significant in two of the four regressions that include a relative price index. These are of the expected sign, thus a surplus the year before should raise health care expenditures in the current year and a budget deficit the year before should

technically reduce spending. Regressions made without a relative price index produce negative and non-significant coefficients. The non-significance in four of the regressions might be due to the fact that we did not include enough lags of this variable. This would make sense since budgetary decisions might take into account past deficits and thus would give a much clearer picture of the fiscal health of the provincial governments.

The relative health price variables used in the models offer very distinct results depending which variable was chosen. The coefficients related to the RHPRIE variable are both positive and significant. This result is not surprising due to the construction of the variable. Nonetheless, these estimates indicate that if the relative price rises by 1% the nominal per capita health care expenditures should rise by about 0.5%. This is the opposite of what we would expect in an economic perspective. The results take from the regressions made with the RPRICECPIH variable are both non-significant. Both coefficients are small and one is of the expected sign. We are more confident of the health price index used in the creation of the RPRICECPIH variable so we would put greater emphasis on the results provided with this variable. Nonetheless the fact that the relative health price is not significant seems odd. There might be a problem of endogeneity related to a price variable since price does not only affect demand but also supply.

The reform variable dCHST estimated in all regressions are negative and significant. This is what was expected from the reform that joined two transfers to create the *Canadian Health and Social Transfer*. Holding all things equal and using a semi-elasticity calculation we find that the percentage difference in the nominal per capita health care expenditures due to the federal funding reform was -2% to -6.76%.

The coefficients associated with the linear trend in all six regressions were positive and significant. The coefficients range from 0.013 to 0.045, which tells us that if all things are equal nominal health care expenditures should rise from 1.3% to 4.5%. We must remember that dependent variable was not deflated so an estimate of 1.3% would suggest very little increase if not at all from technological change. But five coefficients are well

above 2%, so this gives us an indication that technological change might have a part to play in the increase in health care expenditures.

7.3 Comparison of the American and Canadian estimates

Comparing both systems is necessarily hard since both systems are fundamentally very different. Also the estimation techniques were not exactly the same since we could not correct for cross-sectional correlation the same way we did for the Canadian models.

Without surprise, income is one of the major determinants and is highly significant in all models estimated. The income elasticities for both countries are fairly similar. Although the United States models have been estimated with the disposable personal income to reflect the private aspect of the American system, both systems seem to have an income elasticity of about 0.4. It is difficult to say if one country is more elastic to income than the other since we do not use the same variable to define income.

The federal transfers are difficult to compare since we do not have comparable estimates. The American proxy variable for federal transfers was found to be unreliable and much too correlated to the presence of poverty to give an estimate of the elasticity of health care expenditures in respect to federal transfers. Although we would assume that federal transfers would be more elastic in the Canadian context since there are no strict criteria to the category of individuals that can receive care with the money from the federal government like the Medicaid program.

The effect of the proportion of individuals over age 65 is one of the major differences between the two countries. The American estimates are clearly and significantly positive while the Canadian estimates are somewhat ambiguous. Even if we took the positive and significant coefficient from one of the Canadian regressions, it is still less elastic than the smallest estimate from the American models. The impact of the proportion of individuals aged over 65 in the United States could be related to medical practices that might be

different in a country where its health care system is dominated by private medicine. Individuals in such a system benefit from greater consumer choices when it comes to treatment or methods than in the Canadian system where individuals are more patients than consumers. It is difficult to say if that explanation can encompass the whole difference in both countries. The difference could be very well related to more expensive treatment offered to elders than the treatments offered in the publicly run Canadian system.

The effects of RHPPRICE in both countries' estimates are similar in terms of significance. It is hard to compare estimates since we had to include the difference of the variable to compensate for the non-stationarity of the series in the American model. The coefficients from both countries are positive which suggest that nominal per capita health care expenditures would rise with the increase in the relative price of health care services. As we have mentioned above, this might be due to the method used to create the variable. Nonetheless, it is possible that for both countries that an increase in the price would raise the expenditures nominally.

The American and Canadian reforms are not necessarily comparable since the nature of both types of federal transfers is by definition quite different. But it is interesting to note that the semi-elasticities estimates from the American reform dummy are smaller than the semi-elasticities of the Canadian reform dummy. It is possible that this reflects the conditional nature of the SCHIP program which clearly states who is illegible for assistance or not. The Canadian reform did not impose any restriction on coverage, but merged two transfers into one.

8. Conclusions

This study used Canadian province-level and American state-level data to estimate the determinants of nominal per capita health care expenditures and the impact of federal funding reforms of the 1990s in both countries. The study also looked for evidence of

non-stationarity and cointegration in the data used in the determinants literature with recent developments in cointegration tests in heterogeneous panels with multiple regressors.

This study found that income elasticities in both countries are below unity. Although we are uneasy in using a microeconomic concept on macroeconomic data, but we can confirm that health care is a necessary good and not a “luxury” good.

In the American model, health care expenditures are positively related to income, an aging population, relative price of health care and technological change proxied by time. Interestingly, unemployment did not have any significant impact on health care expenditures in the United States.

The Canadian results confirm that health care expenditures are positively related to income, federal transfers, budget surpluses, relative price of health and technological changes. The curious finding in the Canadian estimates is that the aging population does not seem to have a clear impact on per capita health care expenditures.

Federal funding reforms in both countries had their expected effects and were significant. Thus the Balanced Budget Act of 1997 did raise the health care expenditures in states when it comes to expenditures others than those of Medicare. The reform that merged the EPF and CAP to form the Canadian Health and Social Transfer had a negative impact on provincial health care expenditures. Thus, this form of budgetary tightening can have an impact on provincial behavior.

Panel unit root tests could not reject the hypothesis of a unit root for several variables used in our models. For the United States, health care expenditures, disposable personal income, proportion of individuals aged 65 and over and the relative price of health care were all variables that we did not find evidence against their non-stationarity.

For the variables of the Canadian model like health care expenditures, gross domestic products, proportion of persons aged 65 and over and the relative price of health care, we did not find evidence either for their stationarity. These results for health expenditures and income are a confirmation of findings by Freeman (2003) on American data.

New panel cointegration tests suggested by Pedroni (1999, 2004) rejected the null of no cointegration for a combination of several variables in both countries. In the American data, we find that health care expenditures, disposable income, proportion of individuals aged 65 and over and the relative price of health care are cointegrated. In the Canadian data we find that health care expenditures, gross domestic product, proportion of persons aged 65 and over and the relative price of health care are cointegrated. Therefore, we now have evidence that for models using these variables in the literature have unreliable inference if no steps were taken to correct for the cointegration relationship.

Further work would be necessary on the estimation of similar models estimated in this study. We would have liked to add a measure of poverty in the American model to see if we could remove the correlation between the estimates associated with the Federal Medicaid Assistance Percentage and poverty which most likely biased our estimates. For the Canadian model, separating different federal transfers as an alternative to regrouping them all into the same variable could be a possible solution to properly estimate the impact of health care specific federal funding. Also, it might be a good idea to use a two stage least square method to deal with the possible endogeneity problem brought by the use of a variable of relative price of health care.

The use of macroeconomic data is usually plagued with problems of cross-sectional correlation. Available tests for unit root or cointegration all depend on the absence of such correlation. It would be interesting to use tests, once available, that are robust to cross-sectional correlation to re-verify our results of unit root and especially results obtained from cointegration tests.

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Annex 1- Unit root and Cointegration tests results for the United States data

<pre>@pancoint(trend,tdum,mlag=2) # lnstatehce RESULTS: ***** -raw panel unit root test results- Levin-Lin rho-stat = 0.23600 Levin-Lin t-rho-stat = -0.55479 Levin-Lin ADF-stat = -0.56756 IPS ADF-stat = -0.18464 (using large sample adjustment values) Nsecs = 51 , Tperiods = 25 , no. regressors = 0 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances *****</pre>	<pre>@pancoint(tdum,trend,mlag=2) # ldpicap RESULTS: ***** -raw panel unit root test results- Levin-Lin rho-stat = -1.08096 Levin-Lin t-rho-stat = -1.05008 Levin-Lin ADF-stat = -1.63394 IPS ADF-stat = -2.01705 (using large sample adjustment values) Nsecs = 51 , Tperiods = 25 , no. regressors = 0 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances *****</pre>
<pre>@pancoint(tdum) # lnfmapest RESULTS: ***** -raw panel unit root test results- Levin-Lin rho-stat = -5.18767 Levin-Lin t-rho-stat = -1.97424 Levin-Lin ADF-stat = -2.74816 IPS ADF-stat = -7.63555 (using large sample adjustment values) Nsecs = 51 , Tperiods = 25 , no. regressors = 0 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances *****</pre>	<pre>@pancoint(tdum,trend,mlag=2) # lpropage65 RESULTS: ***** -raw panel unit root test results- Levin-Lin rho-stat = 2.09543 Levin-Lin t-rho-stat = 0.03768 Levin-Lin ADF-stat = -0.33429 IPS ADF-stat = -2.94667 (using large sample adjustment values) Nsecs = 51 , Tperiods = 25 , no. regressors = 0 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances *****</pre>
<pre>@pancoint(tdum,mlag=2) # lpropage65 RESULTS: ***** -raw panel unit root test results- Levin-Lin rho-stat = 1.85074 Levin-Lin t-rho-stat = 2.51342 Levin-Lin ADF-stat = 2.36964 IPS ADF-stat = 0.80961 (using large sample adjustment values) Nsecs = 51 , Tperiods = 25 , no. regressors = 0 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances *****</pre>	<pre>@pancoint(tdum,trend) # lnhrprice RESULTS: ***** -raw panel unit root test results- Levin-Lin rho-stat = 2.85791 Levin-Lin t-rho-stat = 0.07079 Levin-Lin ADF-stat = -0.16550 IPS ADF-stat = -0.20450 (using large sample adjustment values) Nsecs = 51 , Tperiods = 25 , no. regressors = 0 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances *****</pre>

<pre> @pancoint(tdum,trend) # lunemp RESULTS: ***** -raw panel unit root test results- Levin-Lin rho-stat = -1.72798 Levin-Lin t-rho-stat = -0.69048 Levin-Lin ADF-stat = -2.28305 IPS ADF-stat = -4.85531 (using large sample adjustment values) Nsecs = 51 , Tperiods = 25 , no. regressors = 0 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances ***** </pre>	<pre> @pancoint(tdum) # lunemp RESULTS: ***** -raw panel unit root test results- Levin-Lin rho-stat = -6.80820 Levin-Lin t-rho-stat = -1.71591 Levin-Lin ADF-stat = -3.28181 IPS ADF-stat = -7.24497 (using large sample adjustment values) Nsecs = 51 , Tperiods = 25 , no. regressors = 0 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances ***** </pre>
<pre> @pancoint(tdum,trend,mlag=1) # lnstatehce ldpicap lpropage65 lnhrprice RESULTS: ***** panel v-stat = 9.68903 panel rho-stat = 3.01001 panel pp-stat = -1.18042 panel adf-stat = -2.38823 group rho-stat = 4.97802 group pp-stat = -1.27644 group adf-stat = -2.67343 Nsecs = 51 , Tperiods = 25 , no. regressors = 3 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances ***** </pre>	<pre> @pancoint(tdum,trend,mlag=2) # lnstatehce ldpicap lpropage65 RESULTS: ***** panel v-stat = 0.84958 panel rho-stat = 0.67579 panel pp-stat = -3.15738 panel adf-stat = -2.59364 group rho-stat = 3.15182 group pp-stat = -1.78308 group adf-stat = -1.52418 Nsecs = 51 , Tperiods = 25 , no. regressors = 2 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances ***** </pre>

Annex 2- Unit root and Cointegration tests results for the Canadian data

<pre>@pancoint(tdum,trend,mlag=1) # lhce RESULTS: ***** -raw panel unit root test results- Levin-Lin rho-stat = -0.19145 Levin-Lin t-rho-stat = -0.66969 Levin-Lin ADF-stat = -0.22681 IPS ADF-stat = 0.23825 (using large sample adjustment values) Nsecs = 10 , Tperiods = 23 , no. regressors = 0 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances *****</pre>	<pre>@pancoint(tdum,trend,mlag=1) # lgdp RESULTS: ***** -raw panel unit root test results- Levin-Lin rho-stat = -0.45050 Levin-Lin t-rho-stat = -0.53857 Levin-Lin ADF-stat = 0.17558 IPS ADF-stat = 0.83640 (using large sample adjustment values) Nsecs = 10 , Tperiods = 23 , no. regressors = 0 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances *****</pre>
<pre>@pancoint(trend,tdum) # lnfedtransprvgov RESULTS: ***** -raw panel unit root test results- Levin-Lin rho-stat = -4.33548 Levin-Lin t-rho-stat = -1.38367 Levin-Lin ADF-stat = -1.61632 IPS ADF-stat = -2.66081 (using large sample adjustment values) Nsecs = 10 , Tperiods = 23 , no. regressors = 0 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances *****</pre>	<pre>@pancoint(tdum,trend,mlag=1) # lpropage65 RESULTS: ***** -raw panel unit root test results- Levin-Lin rho-stat = 3.21673 Levin-Lin t-rho-stat = 1.31889 Levin-Lin ADF-stat = -0.44270 IPS ADF-stat = -1.38633 (using large sample adjustment values) Nsecs = 10 , Tperiods = 23 , no. regressors = 0 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances *****</pre>
<pre>@pancoint(tdum, trend, mlag=1) # lnhrprice RESULTS: ***** -raw panel unit root test results- Levin-Lin rho-stat = -1.07678 Levin-Lin t-rho-stat = -0.97383 Levin-Lin ADF-stat = -0.39292 IPS ADF-stat = 0.00686 (using large sample adjustment values) Nsecs = 10 , Tperiods = 23 , no. regressors = 0 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances *****</pre>	<pre>@pancoint(tdum,trend) # lnhrpricecpih RESULTS: ***** -raw panel unit root test results- Levin-Lin rho-stat = -0.40037 Levin-Lin t-rho-stat = -0.82131 Levin-Lin ADF-stat = -0.02635 IPS ADF-stat = -0.37157 (using large sample adjustment values) Nsecs = 10 , Tperiods = 23 , no. regressors = 0 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances *****</pre>

<pre> @pancoint(tdum) # rationetlend RESULTS: ***** -raw panel unit root test results- Levin-Lin rho-stat = -4.75204 Levin-Lin t-rho-stat = -1.96154 Levin-Lin ADF-stat = -1.46565 IPS ADF-stat = -2.33916 (using large sample adjustment values) Nsecs = 10 , Tperiods = 23 , no. regressors = 0 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances ***** </pre>	<pre> @pancoint(trend,tdum,mlag=2) # lhce lgdp lpropage65 lnhrprice RESULTS: ***** panel v-stat = 6.00761 panel rho-stat = 0.66521 panel pp-stat = -2.42095 panel adf-stat = -2.64455 group rho-stat = 1.79418 group pp-stat = -2.27625 group adf-stat = -2.72930 Nsecs = 10 , Tperiods = 23 , no. regressors = 3 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances ***** </pre>
<pre> @pancoint(tdum,trend,mlag=2) # lhce lgdp lpropage65 lnhrpricecipih RESULTS: ***** panel v-stat = -0.42315 panel rho-stat = 1.71272 panel pp-stat = -0.08120 panel adf-stat = -1.91556 group rho-stat = 2.92236 group pp-stat = 0.61205 group adf-stat = -2.28196 Nsecs = 10 , Tperiods = 23 , no. regressors = 3 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances ***** </pre>	<pre> @pancoint(tdum,trend,mlag=1) # lhce lgdp lpropage65 RESULTS: ***** panel v-stat = -0.59203 panel rho-stat = 1.02283 panel pp-stat = -0.65544 panel adf-stat = -1.64179 group rho-stat = 2.23186 group pp-stat = 0.00909 group adf-stat = -1.74029 Nsecs = 10 , Tperiods = 23 , no. regressors = 2 All reported values are distributed N(0,1) under null of unit root or no cointegration Panel stats are weighted by long run variances ***** </pre>