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The Health Papers

Chronic Healthcare Spending Disease:

Background and Methodology

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The Study in Brief

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This working paper examines from a macroeconomic perspective the trajectory of total (public and private) healthcare spending in Canada over the next two decades. Our purpose is to estimate the extent to which healthcare spending is going to absorb a greater fraction of income than we have experienced to date, under two scenarios: a "baseline" one calculated from parameters estimated from historical experience and an "optimistic" one calculated from parameters which assume an unprecedented improvement in the efficiency and effectiveness of the healthcare system and large improvement in real potential output growth.

In the base case, where total healthcare spending rises from nearly 12 percent to 18 ¾ percent of GDP over the two-decade period, governments would have to find revenue increases or expenditure reductions, or both, equivalent to about 4 ¾ percentage points of GDP if they continue to finance about 70 percent of total healthcare spending. Even in the optimistic case, they will have to find revenue increases or expenditure reductions of about 2 ½ percentage points of GDP. Even if we in Canada are collectively incredibly successful in taking the difficult actions to improve the productivity, efficiency and effectiveness of the healthcare system (our optimistic case), we face difficult but necessary choices as to how both governments and individuals finance the rising costs of healthcare.

1. INTRODUCTION

Over the past half century in North America and Europe, both national income and public and private spending on healthcare have risen markedly. The relatively fast expansion in the scope and quality of healthcare services, coupled with apparent[1] low rates of productivity growth in the healthcare sector, has meant that the share of national income devoted to healthcare has increased substantially over the last decades. In the United States this share has doubled since 1975, in the United Kingdom it has increased by almost 65 percent, and in Canada it has risen by over 70 percent, from 7 percent to 12 percent. In other words over the last 35 years or so in Canada, we have collectively on average devoted roughly an additional 0.15 percent of GDP each and every year to the consumption of healthcare services.

The growth of real per capita expenditures on healthcare has far exceeded that of personal income per capita (Figure 1).[2] Expressed differently, we have chosen to spend on average from 1976 to 2009 13 percent of the increase in our per capita national income on healthcare services. Note that this collective decision has still left plenty of additional income each year to be devoted to consumption of other goods and services, to investment, and to other public services.

Our demonstrated public and private decisions to allocate a considerable fraction of rising per capita national income to healthcare services over the last 35 years broadly reflects the choice of Canadians given: (a) the rate of growth of national income, b) the demographic structure of Canada, c) the relative price of healthcare services,[3] and d) the net effect of the expansion of the possible scope and quality of healthcare services less the cost-reducing impact of new technologies. Were these four factors to continue over the next two decades in the same way as they have over the past few decades, then there is no reason to think that it would be "unsustainable" for the share of national income devoted to healthcare to continue to rise, on average, at about 0.15 percentage points per year.[4] Indeed, that is what we might expect given the demonstrated choices that Canadians (and Europeans and Americans) have made over the last few decades.[5]

Our goal in this paper is twofold: first, tracing the evolution over the next two decades of healthcare expenditures under a base case and an optimistic case, and second, drawing the consequences of the projected growth rates of healthcare expenditures for private and public financing, thereby illuminating the difficult choices that Canadians will have to make even in an optimistic scenario.

Our strategy for projecting healthcare expenditures consists in combining separate projections of nominal GDP and the ratio of healthcare spending to nominal GDP. We begin by constructing base-case and optimistic-case projections of nominal GDP growth. The base case reflects business-as-usual assumptions whereas the optimistic projection incorporates the assumed effects of new policy initiatives and structural developments. We then generate base-case projections for Canada of the growth rates in both real per capita healthcare expenditures and total healthcare spending-to-GDP ratio to 2031, using a "macro" model that specifies the response of the

We would like to thank those who reviewed a shorter version of this paper for their enormously helpful suggestions.

1 Labour productivity in the healthcare sector is subject to considerable mis-measurement because of the difficulty of adequately measuring quality changes, prices and quantities in this sector. For instance, any failure to differentiate between true price increases and improvement in efficacy and quality would lead to overestimation of the true price of healthcare. See, for instance, Sharpe, Bradley and Messinger (2007).

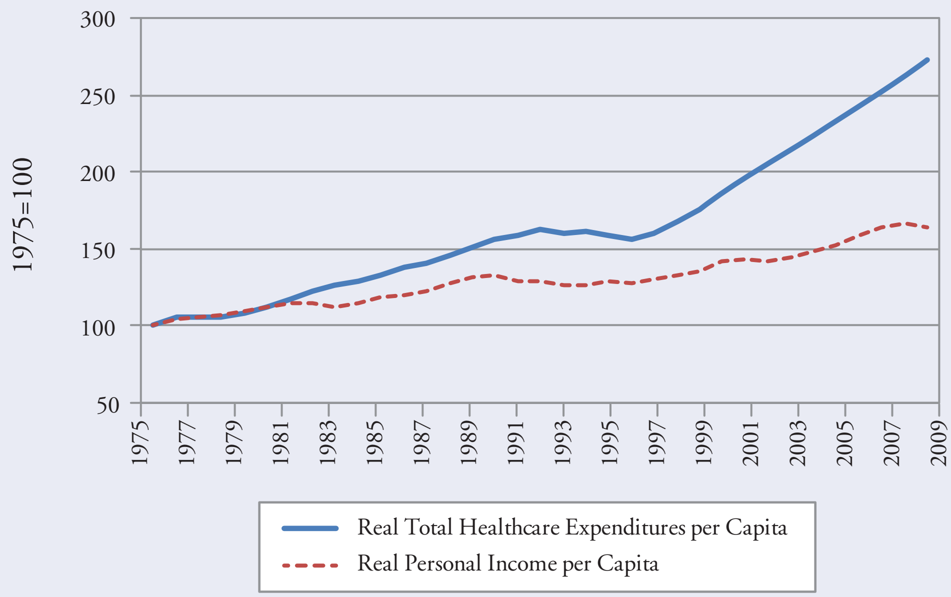
2 Both healthcare expenditures per capita and personal income per capita are deflated by the price of personal consumption expenditures.

3 This relative price is not purely the result of competitive forces. In part it reflects the desires and power of providers in a healthcare system in which political bargaining power and negotiations over administered prices prevail.

4 But "sustainable" does not necessarily imply "optimal" if the delivery system is increasingly inefficient or ineffective.

5 Hall and Jones (2007) shows that if the marginal utility of non-health consumption falls sufficiently rapidly and, as income increases, healthcare consumption becomes the most valuable channel for spending as it can buy additional years of good life. In this context, a rising share of income devoted to healthcare spending is a choice of Canadians and not necessarily "unsustainable."

Figure 1: Index of Total Healthcare Spending and Personal Income



Source: CIHI (2010) and authors' calculations.

expenditures and the ratio to the four drivers mentioned earlier.[6] We also construct "optimistic" projections of growth rates in real per capita healthcare expenditures and total healthcare spending-to-GDP ratio by judgmentally evaluating the plausible effects of new policies and structural developments as they impart:

- a smaller net contribution to expenditure growth of the expansion of the scope of services less technology-enabled cost reductions;
- a reduction in the relative price of healthcare services; and
- a smaller effect of population aging on healthcare spending

Combining the projected total healthcare spending-to-GDP ratio and nominal GDP, each under a base case and an optimistic case, then results in two projected paths for total healthcare spending (public and private) in Canada over the next two decades. Each represents one possible path, the base case being more or less the result of business-as-usual assumptions while the optimistic case assumes unprecedented policy initiatives and structural change.

2. INCOME GROWTH PROJECTIONS

While national income growth in the short term varies with the business cycle, over the longer term, national income grows at about the rate of potential output growth adjusted for general inflation and changes in the terms of trade. Rate of growth of potential is (in simplified terms) a function of the rates of growth of labour input and labour productivity. Labour input growth is largely a function of the rate of growth of labour-force aged population (traditionally those aged 15 to 65), the participation rate of this group in the labour force and the average hours worked per worker. Labour productivity growth is a much more complex (and less understood) function of technological change, change in capital per worker, improvement in labour skills, and change in management and industrial organization.

6 Our analysis is akin to a macro "decomposition-of-growth" type of analysis, not one built up from complex micro-foundations. It represents a generalization of empirical results on the determinants of aggregate healthcare spending over past decades in advanced countries.

Table 1: Labour Force, Income and Inflation in Canada

	Average Annual Growth (percent)	
	2001/1976	2009/2001
Population	1.13	1.06
Population 25-54	1.78	1.11
Participation Rate – Total	0.28	0.26
Participation Rate – 25-54	0.59	0.19
Participation Rate – 55+	-0.75	3.86
Labour Force	1.73	1.65
Hours Worked	1.53	1.00
Labour Pproductivity	1.34	0.73
Real GDP	2.90	1.74
Inflation – Final Dom. Demand	4.27	1.98
Inflation – Contribution of Terms of Trade*	-0.20	0.36

*Measured by the difference between the inflation rates of GDP and final domestic demand.

a) Historical Patterns

Over the last quarter of the 20th century the share of the population of prime labour force age (25 to 54) grew as the "baby boom generation" swelled the ranks of this age cohort (Table 1). In addition the participation rates of women in this age group continued to increase and hours worked remained fairly constant. On average, labour input increased by 1.5 percent per year.

Labour productivity increases were less over this period than in the previous quarter century (and sharply less than in many other OECD countries over this period), but nevertheless labour productivity increased by 1.3 percent per year between 1976 and 2001. With terms of trade relatively constant over the period as a whole, total national income grew at 2.9 percent in real terms, or 1.8 percent per capita.

In the period from 2001 to 2009, the rate of growth of the prime age cohort slowed as did the rate of increase in the participation rate of women so that the labour input growth slowed to 1.0 percent. Productivity performance was poor over this period, averaging only 0.7 percent per year and accounting for significantly less than half of the 1.7 percent growth rate of real GDP.

b) Base Case Projections

Under our base case scenario, nominal GDP growth decelerates from 4 ¾ percent over 2012-2016 to 3 ¾ percent in the 2020s largely as a result of a ¾ percentage point decline in real potential growth to 1 ¾ percent (Table 2).[7] Actual real GDP progressively returns to potential over 2012/2009 with the cyclical upturn boosting growth by 0.8 percent per year on average relative to an underlying potential growth of 2 percent. The latter temporarily picks up over 2016/2012 as the negative effects of the global economic crisis on trend productivity unwind and restructuring pays off, but subsequently decelerates to 1 ¾ percent in the 2020s. This slowdown reflects a steady

7 In this paper, our projections of income and total healthcare spending are broken up in 2016 to allow for a transition between the short term and the long term in view of the fact that both adjustment to policy changes and the unwinding of short-term shocks take time.

Table 2: Canada's Annual Potential Growth – 2009 to 2031

	2009-2012	2012-2016	2016-2021	2021-2031
	Growth in Percent			
Cyclical Component of GDP	0.8	0.0	0.0	0.0
Population 15+	1.19	1.06	0.95	0.99
Trend Total Hours	1.0	1.1	0.8	0.5
Optimistic Case	*1.0*	*1.1*	*0.9*	*0.7*
Trend Labour Productivity	1.0	1.5	1.25	1.25
Optimistic Case	*1.0*	*1.5*	*1.75*	*1.75*
Real Potential Growth	2.0	2.5	2.0	1.75
Optimistic Case	*2.0*	*2.6*	*2.7*	*2.5*
Domestic Inflation	2.0	2.0	2.0	2.0
Contribution of Terms of Trade	0.5	0.25	0.0	0.0
Nominal GDP Growth	5.25	4.75	4.0	3.75
Optimistic Case	*5 25*	*4.9*	*4.7*	*4.5*

Source: Authors' calculations.

contraction in the growth rate of total hours worked from a little over 1 percent per annum in 2016/2012 to about 1/2 percent in the 2020s, which in turn stems from a declining aggregate trend participation rate in the labour force. A slowdown in the growth rate of the population 15+ also contributes to lower growth in trend total hours, but to a much lesser extent than the decline in trend labour force participation from the mid-2010s onwards as Table 2 shows.

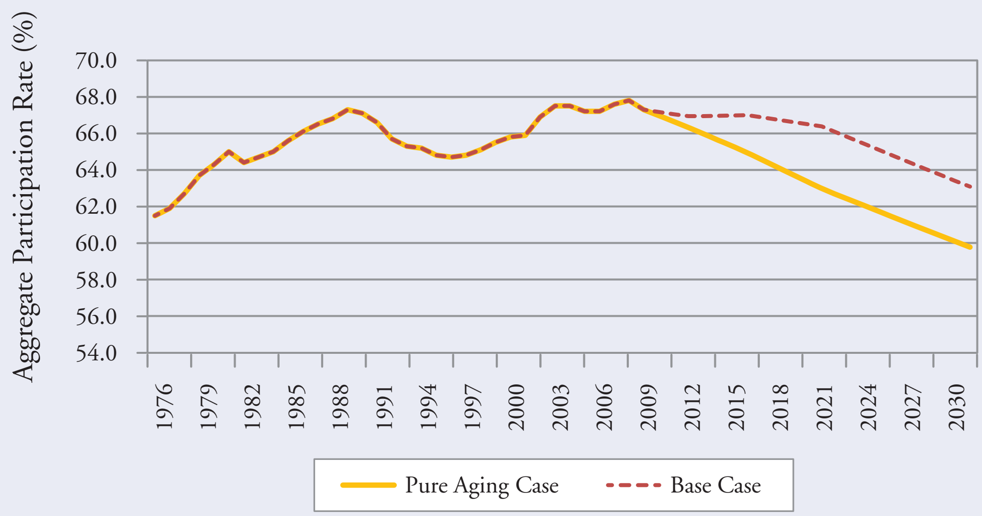
The decline in the aggregate trend participation rate arises from two factors: (1) an "aging effect" that cuts the labour force by over 0.5 percent per year as the proportion of older workers with a relatively low participation rate in the labour force increases over time (Figure 2)[8]; (2) a slowing "cohort effect" as the trend participation rates of successive cohorts of workers of different ages increase over time as a result of socio-economic factors but at a diminishing rate until they rise no more over 2021-2031.

This positive but diminishing cohort effect largely rests on further increases in the participation rates of the 55 and over age groups, but at a slower rate than in the last decade, and on further convergence of female on male participation rates, including in the important 25-54 age group. The cohort effect more or less offsets the aging effect up until the middle of this decade, but subsequently falls short of it and, as a result, the aggregate participation rate (of the population 15 years and over) in our base case systematically declines from then on.

In our base case, from 2017 onwards trend labour productivity grows at 1 ¼ percent per year, barely faster than the historical average of

8 This aging effect results in the "Pure Aging Case" in Chart 2 below. In the pure aging case, projected changes in the aggregate participation rate only reflect projected changes in the working-age-population weights of age groups (15-24, 25-54, 55-59, and 65 and over) applied to the 2009 participation rates for these groups.

Figure 2 : Aging and the Aggregate Participation rate



Source: Authors' calculations.

1.2 percent per year over the 30 years to the late 2000s. A key factor is that with lower effective marginal tax rates on investment, a strong Canadian dollar and more wage pressures as labour supply growth slows, business investment and capital per worker would increase more rapidly than in the past. One factor prompting us to hold back on future productivity growth in spite of the large potential for a catch-up of Canadian productivity level on the much higher U.S. productivity level is the surprisingly tepid productivity performance in Canada in light of all the favourable macro-structural policies that have been put in place since the late 1980s: FTA and NAFTA, the introduction of the GST, reductions in personal and corporate income taxes, reform of employment insurance, generous tax incentives for R&D, a scaling-down of industrial subsidies, and fiscal consolidation. We do not quite understand what has held down Canadian productivity growth particularly over the decade to 2008. For this reason we have assumed a productivity growth rate close to the historical average in our base case.

Consistent with Bank of Canada current policy objectives, a general inflation rate of 2 percent is assumed over the next two decades. At the same time Canada's terms of trade may well show a transitory upward trend as a result of generally tightening markets for commodities before supply fully adjusts. Combined with real GDP growth these expected price developments would result in nominal GDP growth in the order of 5 ¼ percent per year in the short term, slowing steadily to 3 ¾ percent in the 2020s. A slight deceleration of GDP price inflation via slower terms of trade gains made a slight contribution to the slowing of nominal GDP growth only up to 2016.

c) Optimistic Case Projections

Under the optimistic case, potential output growth barely slows between 2012-2016 and 2021-2031, both because of an assumed larger increase in the participation rate of the 55 and over age group as a result of policy initiatives and favourable structural change, and because of stronger trend productivity growth as a result of renewed attempts by the private sector at catching up with a much higher level of productivity in the United States. As a result, nominal GDP growth decelerates much less than in the base case, from about 5 percent over 2012-2016 to 4 ½ percent in the 2020s.

As mentioned earlier, a projected decline in the aggregate trend participation rate reflects an aging effect and a cohort effect. While there is nothing one can do about the aging effect, the cohort effect could be boosted through policy initiatives in order to moderate the decline in the aggregate participation rate. Initiatives which would boost the participation rate of the 15-24 cohort include more efficient use of students' time in school – particularly those in post-secondary education. A switch in emphasis from adding more years of schooling to making more effective use of time in school would help. Participation rates of women 25 to 54 might be modestly enhanced further through improved access to child care and elder care. Very importantly, participation rates of the 55-64 cohort (both sexes) could continue to be enhanced by ending early retirement provisions in public and private pension plans and the introduction of more flexible and "age-friendly" work practices by employers. Participation rates for the 65-69 age cohort could also be increased by raising the normal retirement age in both public and private pension plans fairly quickly to 67 or 68.[9] There may be some very modest scope to raise participation of the 70-74 cohort by allowing RRSP contributions to be made up to 75 years of age.

It is very difficult to judge how much all these policies might add to participation rates and most importantly to total hours worked. The "optimistic" cohort effect in Table 3 reflects our judgment of what an aggressive policy change might induce. This cohort effect boosts labour force growth by 0.15 percent per annum over 2016-2021 and by 0.25 percent per annum over 2021-2031, through more increase than in the base case in the trend participation rates of the 15-24, 55-59, 60-64, and 65 and over age groups. We assume no change at all over 2009-2031 in either the trend unemployment rate or trend average hours per worker.

Figure 3 plots past and projected aggregate participation rates for the base case and the optimistic case. By 2031, the aggregate participation rate would fall 7.5 percentage points below its 2009 level to 59.8 percent due to aging alone, but an expected normal cohort effect would raise it back 3.3 points to 63.1 percent and, with luck, policy initiatives could prop it up a further 2.1 points to 65.2 percent.

The substantial shortfall of the Canadian productivity level relative to the U.S. suggests that there is considerable scope to get closer to the U.S. performance, and in so doing raise productivity growth, notwithstanding structural impediments related to geography, local market size, and other factors. The post-war decades witnessed a similar process of Canadian productivity catch-up to the US, which a priori could be re-initiated in the future. This consideration underpins our alternative, "optimistic" scenario of trend productivity growth: 1 ¾ percent per annum over 2016-2031 compared to 1 ¼ percent in the base case. At first glance the ½ percent per annum incremental growth may appear excessive in light of the recent Canadian experience, but it must be kept in mind that it would cumulate to a fraction at most of the actual level gap prevailing in 2031 (barring an unlikely drop in the meantime in U.S. trend productivity growth to sharply below our base case for Canadian trend productivity growth).

3. PROJECTIONS OF TOTAL HEALTHCARE SPENDING

Total healthcare spending, combining public and private expenditures, has tended to rise as a proportion of GDP since at least the late 1970s.[10] It more or less stabilized from 1983 to 1988 and

9 The average annual growth rate of the population aged 65-69 increased from 1.9percent in 2009/2001 to 5.4 percent in 2012/2009, 4.5 percent in 2016/2012, 2.6 percent in 2021/2016 and 1.6 percent in 2031/2021. Thus, to capture as much as possible the surge of population aged 65-69 associated with the "baby boom" wave, it is best to raise the normal retirement age as soon as possible.

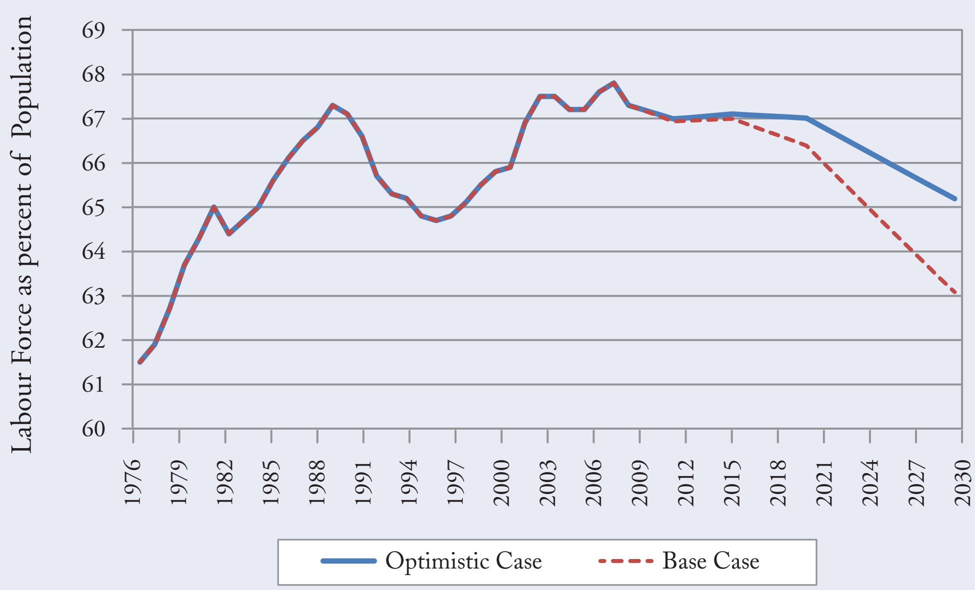
10 Healthcare expenditures data are from the Canadian Institute for Health Information (2010). These expenditures cover spending related to hospitals, other institutions, physicians, dental services, vision care services, other professional (health) services, drugs, capital, public health, administration, health research and other miscellaneous expenditures.

Table 3: Projected Annual Growth in Trend Hours and Their Elements (percent)

	2009-2012	2012-2016	2016-2021	2021-2031
Population 15 and Over	1.19	1.06	0.95	0.99
Trend Participation Rate				
Aging Effect	-0.49	-0.53	-0.61	-0.52
Cohort Effect				
Base Case	0.31	0.55	0.43	0.01
Optimistic Case	0.33	0.57	0.58	0.25
Total				
Base Case	-0.18	0.02	-0.18	-0.51
Optimistic Case	-0.15	0.04	-0.03	-0.27
Trend Total Hours				
Base Case	1.02	1.09	0.77	0.48
Optimistic Case	1.04	1.11	0.92	0.71

Source: Authors' calculations.

Figure 3 : Aggregate Labour Force Participation Rate



Source: Authors' calculations.

declined from 1993 to 1997 as a result of fiscal retrenchment, but then sprung back to reach a new high for the whole period in 2009 (Figure 4). Since 1975, nominal healthcare expenditures on average have grown faster than GDP by 1.7 percentage points per year (8.3 percent vs 6.6 percent).

Our projections of the growth of total healthcare spending ultimately derive from a macro model of real per capita (total) healthcare expenditures. This model allows us to derive a formulation for projecting the total healthcare spending-to-GDP ratio and, in conjunction with our projections of nominal GDP growth, the total healthcare expenditures over the next two decades.

a) A Model of Total Healthcare Spending

Extensive research on the macro determinants of growth in real per capita healthcare expenditures suggests four key factors at play for a country like Canada: real per capita personal income growth, changes in the age-gender structure of the population, changes in the price of healthcare relative to total consumption, and "technology", which refers to technology-related changes in the quality and scope of medical services.[11] In percentage terms over time, this relationship can be approximated by Equation (1):

$$\left(\frac{\dot{H}}{pop \cdot P_c}\right) \approx \left(\frac{P\dot{I}}{pop \cdot P_c}\right) + \left(DE\dot{M}O\right) + \left(\frac{\dot{P}_H}{P_c}\right) + \left(\dot{T}\right), \quad (1)$$

where $\left(\frac{\dot{H}}{pop \cdot P_c}\right)$ refers to the growth rate of real healthcare expenditures per capita, $\left(\frac{P\dot{I}}{pop \cdot P_c}\right)$ to the growth rate of real personal income per capita, $(DE\dot{M}O)$ to the effect of changes in the age-gender structure of the population, $\left(\frac{\dot{P}_H}{P_c}\right)$ to the growth rate of the price of health consumption relative to total consumption, and $(\dot{T})$ to the effect of "technology". Note that Equation (1) imposes unit elasticities to real income and relative prices. This will be discussed further below.

One can relate the growth rate of real per capita healthcare spending $(\dot{H}/(pop \cdot P_c))$ to the growth rate of the healthcare spending-to-GDP ratio $(\dot{H}/Y_N)$ as follows:

$$\left(\frac{\dot{H}}{Y_N}\right) \approx \left(\frac{\dot{H}}{pop \cdot P_c}\right) - \left(\frac{\dot{Y}}{pop}\right) - \left(\frac{\dot{P}_Y}{P_c}\right),$$

where $(\dot{Y}/pop)$ refers to real per capita GDP growth and $(\dot{P}_Y/P_c)$ to growth in the relative price of GDP to total consumption.

Replacing $\left(\frac{\dot{H}}{pop \cdot P_c}\right)$ by the right-hand side of Equation (1) and manipulating yields the following relationship:

$$\left(\frac{\dot{H}}{Y_N}\right) \approx \left(DE\dot{M}O\right) + \left(\frac{\dot{P}_H}{P_Y}\right) + \left(\dot{T}\right) + \left(\frac{P\dot{I}/P_c}{Y}\right), \quad (2)$$

Equation 2 specifies that the following four factors fundamentally drive changes in the healthcare/GDP ratio over time: changes in the age-gender structure of the population, changes in the price of healthcare relative to GDP, technology-related changes in the quality and scope of medical services, and the evolution of real personal income relative to real GDP.

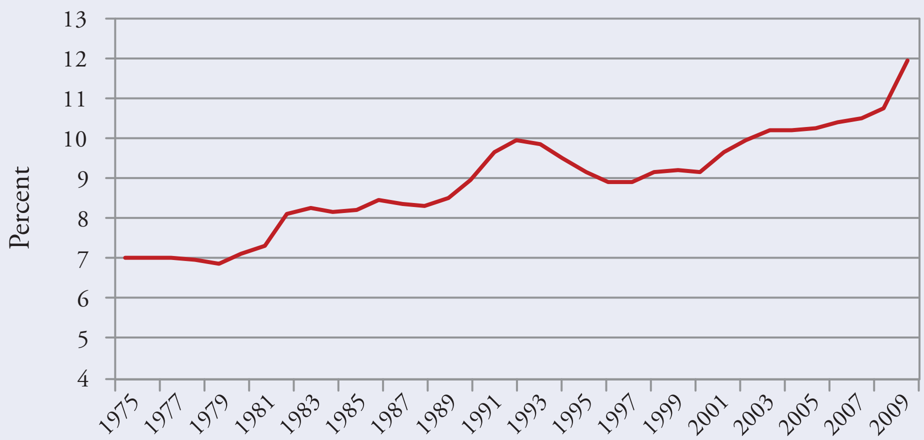
b) Income Effects

The income effects captured by $\left(\frac{P\dot{I}}{pop \cdot P_c}\right)$ in Equation (1) mean that healthcare expenditures tend to move in tandem with aggregate personal income over time, once one takes into account other factors affecting healthcare spending.[12] The implied unit income elasticity of real healthcare spending is much higher than typically found in micro studies based on individuals but is in the

11 See for instance Smith, Newhouse and Freeland (2009) and Ginsburg (2008). Insurance coverage is another potential factor but unlikely of importance in Canada in view of the preponderant share of public financing in healthcare spending.

12 In fact, the unadjusted elasticity of real spending per capita to real GDP per capita tends to significantly exceed 1 because it incorporates not only income effects per se but also the influence of factors that are correlated with GDP per capita and wealth over time such as medical technology development and diffusion (Smith, Newhouse and Freeland 2009). While isolating the pure income effects raises empirical issues, it seems generally accepted that the macro-level income elasticity should not be very far on either side of unity.

Figure 4: Healthcare Expenditures as Percent of GDP – 1975 to 2009



Source: Authors' calculations.

range of empirical estimates based on aggregate data. Increases in aggregate income and wealth generate demand for more and better-quality care and at the same time raise the fiscal capacity to respond to this demand.[13]

One implication of the unit income elasticity is that the expected reduction in potential GDP growth over the next two decades will tend to slow the pace of real healthcare spending, other things equal. It is important to note, however, that under the unit elasticity assumption changes in the rate of potential output growth have no impact on the evolution of the healthcare spending-to-GDP ratio except through its possible effects on the growth of the relative price of healthcare to GDP, changes in the quality and scope of medical services, or the growth of real personal income to GDP. Our projections ignore such possible indirect effects for lack of empirical evidence on these relationships. What an increase (decrease) in the rate of potential output growth would do, however, is to make more (less) resources available for the production and consumption of all public and private goods and services in the economy. For a given path of healthcare spending-to-GDP over time, faster potential output growth allows faster growth in public and private spending on non-healthcare goods and services without increasing private or public debt relative to GDP.

In both our base and optimistic projections, real personal income growth slows at the same pace as real potential GDP growth over the next two decades. This ignores the possibility that shifts in the labour share of income or movements in the terms of trade steer real personal income growth away from real GDP growth.

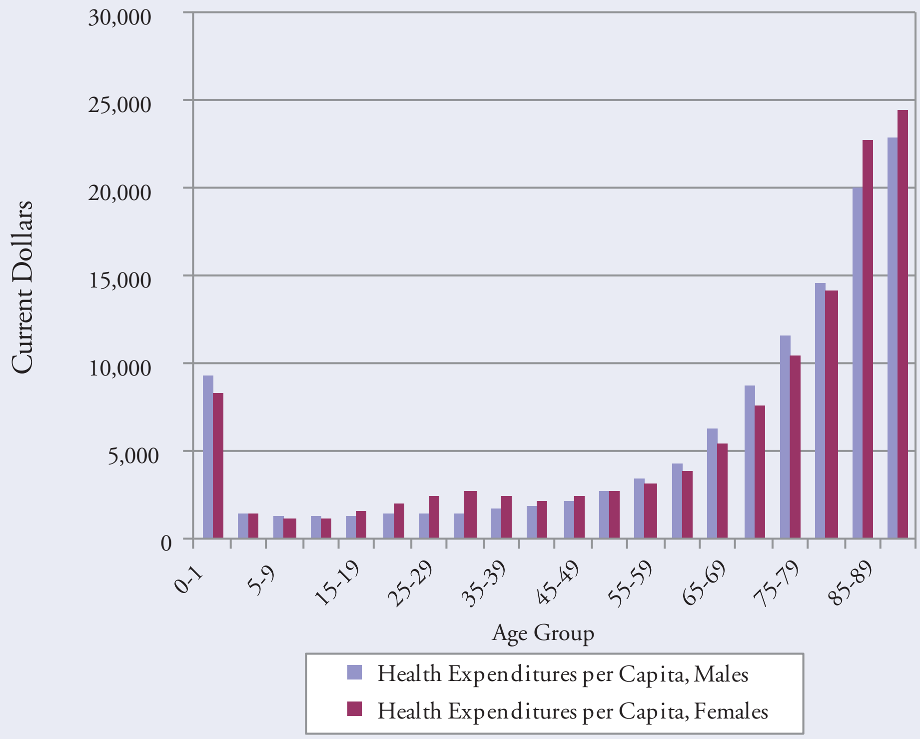
c) Demographics

Changes in the age-gender structure of the population affect aggregate real healthcare expenditures per capita because average healthcare spending per capita increases rapidly with the age of the persons beyond a mid-40s age threshold, as illustrated in Figure 5.[14]

13 Hall and Jones (2004) see the growth of health spending as a rational response to changing economic conditions. In their model "health spending is valued because it allows people to live longer and better lives…the rise in the health share [of GDP] occurs because of an income effect. As consumption increases with income, the marginal utility of consumption falls rapidly while the value of extending life rises. As agents in our model get richer and richer, consumption rises but they devote an increasing share of resources to healthcare" (p. 2).

14 The projections of population by age and gender groups are from Scenario M1 (medium-growth) of Statistics Canada. See Statistics Canada (2010).

Figure 5 : Healthcare Spending per Capita, by Age Group – 2008



Source: Authors' calculations.

Moreover it does so more slowly for women than for men up to old age. For example, healthcare spending per capita associated with the 65-74 age group is larger than that associated with the 0-44 age group by a factor of 4.6 for males and 3.2 for females (Table 4). To some degree at least, the faster increase for men represents a catch-up on the higher absolute level of spending on women that prevails between the age of 15 and that of 49 (Figure 5). It is worth noting that a considerable share of lifetime healthcare expenditures is incurred not long before a person dies, so an exponentially rising mortality rate as age increases beyond a mid-life threshold is a very significant driver of the age-spending gradient.

In our base case, the 2008 profile of spending by age group is assumed to hold throughout the next two decades. In our optimistic case, the health cost indexes for the 65-74 and 75-84 age groups relative to the benchmark 0-44 age group are smaller on average by 8percent over 2016-2021 and 15percent over 2021-2031.[15] This is consistent with the assumption that the current 44-65 cohort is in better health than was the 44-65 cohort twenty years ago, leading to less healthcare spending per person than now when this cohort reaches 65-84 years of age over the next twenty years.[16] Note that this works through a lower incidence or severity of disease (lower morbidity rate) rather than a lower mortality rate since the demographic projection is a given.

15 This is the outcome of lowering the (2008) health cost indexes by 15 percent in 2021 until 2031 relative to 2016. As a result, the contribution of changes in the age-gender structure of population to growth in the healthcare spending-to-GDP ratio is reduced in the optimistic case relative to the base case over 2016-2021 but remains unchanged from the base case over 2021-2031, as Table 2 shows.

16 Work by Sanderson and Scherbov (2010) suggests that when forecasting the impact of aging, policymakers need to adjust for increases in longevity and health, which they estimate have the effect of cutting the effective speed of aging considerably. Note that the lower morbidity rates for older groups implied by the optimistic case can be seen as contributing to the higher participation rates of older workers in our optimistic case for income growth relative to our base case.

Table 4: **Total Healthcare Expenditures per Capita by Age Group – 2008**

	Current Dollars		Index, Age 0-44 = 1.00	
Age Group	Males	Females	Males	Females
0-44	1,590	2,030	1.00	1.00
45-64	2,990	2,890	1.88	1.42
65-74	7,330	6,400	4.61	3.15
75-84	12,690	12,080	7.98	5.95
85+	20,730	23,360	13.04	11.51

Source: CIHI (2010) and authors' calculations.

d) Relative Price of Healthcare

A change in the relative price of healthcare can affect total real healthcare spending through demand and supply channels. In this exercise, an increase (decrease) has no negative (positive) effect on demand because the latter is assumed to respond little to changes in relative prices, consistent with empirical evidence (Smith, Newhouse and Freeland 2009). Relative health price movements are expected instead to be positively reflected in real healthcare spending per capita and the healthcare spending-to-GDP ratio with unit elasticities.[17] Growth in the former, for instance, can be decomposed as follows: $\left(\frac{\dot{H}}{pop \cdot P_c}\right) \approx \left(\frac{H \dot{/} P_H}{pop}\right) + \left(\frac{\dot{P}_H}{P_c}\right)$. While growth in the true price of healthcare services no doubt differs somewhat from that in P_H (the deflator used in this study), the inclusion of $(\dot{P}_H / P_c)$ among the determinants of growth in real healthcare spending tentatively controls for the role played by relative price movements in the measure of real spending growth.

The price of healthcare services is proxied by the National Accounts price of health service consumption.[18] This is a value-added deflator that is essentially driven by the evolution of wages and salaries in the healthcare sector and drug prices. Growth in the measured productivity of healthcare workers is by assumption close, if not equal, to zero. Relative to the price of total consumption, the price of healthcare consumption has risen over time for at least two reasons: wage and salaries have tended to increase faster in the healthcare sector than in the rest of the economy on average, and "measured" productivity growth has most likely been slower in the healthcare sector. Between 2001 and 2009, average weekly earnings have annually increased 1.2 percentage points faster in this sector than in the total economy (Table 5). To some degree this represents a catch-up of the ground lost in the previous decade as a result of fiscal austerity. The relatively rapid wage increase in the health sector was likely facilitated by a tighter demand-supply situation for healthcare workers, more increase in overtime work in this sector than in the rest of the economy, and more wage bargaining power than average in the health sector, in part because of a relatively high unionization rate.

17 It is worth noting that real spending is driven by the price of healthcare consumption relative to the price of total consumption, whereas the healthcare spending-to-GDP ratio is driven by the price of healthcare consumption relative to the price of GDP. See Equations 1 and Equation 2 above.

18 An alternative measure of price change in the healthcare sector would reflect a weighted average of the growth rates of the various input prices net of the growth of total factor productivity in the healthcare sector. Data constraints prevent the estimation of such a measure.

Table 5: Wage Growth by Industry – Average Weekly Earnings

	Average Annual Growth 2001-2009
All Industries	2.87
Ambulatory Healthcare	5.23
Hospitals	3.87
Nursing and Care	3.44
Total Employment-Weighted Health Sector	4.07

Source: Authors' calculations.

Relative to the price of GDP, the price of healthcare consumption rose by 0.69 percent per year over 1991-2001 but has edged down on average between 2001 and 2009 because gains in the terms of trade boosted the price of GDP.

In our base case, fiscal austerity and terms-of-trade gains are projected to further reduce the relative price of healthcare to GDP by 0.9 percent per year over the 2010-2012 period. Growth in the relative price returns to 0 percent per year from 2013 to 2016 and to its 1991-2009 average of 0.2 percent per year thereafter. By implication, the relative price of healthcare to total consumption rises by 0.5 percent per year over 2012-2016 and 0.7 percent per year over 2016-2031. This is broadly consistent with average rates of 0.45 percent between 1996 and 2001 and 0.77 percent between 2001 and 2009. Indeed over the last 30 years the inflation differential between P_H and P_C has been systematically positive except for a brief period in the mid-1990s (Figure 6).

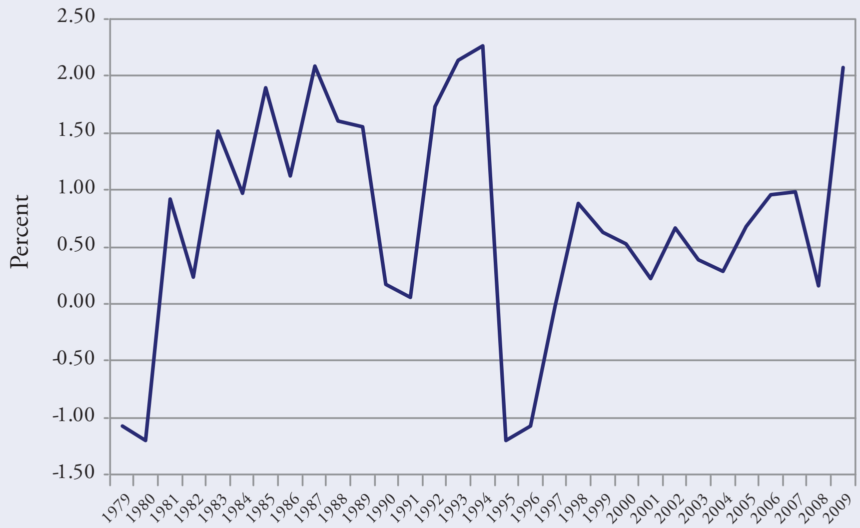
In our optimistic case, the price of healthcare consumption relative to GDP declines by 0.5 percent per year over 2013-2016 and 0.3 percent per year over 2016-2031 as a result of efficiency gains and possibly slower wage growth in the healthcare sector relative to the rest of the economy due to fiscal pressures. By implication, the price of healthcare relative to total consumption remains flat over 2012-2016 and rises by 0.2 percent per year over 2016-2031.

e) Technology

Changes in medical technology and practices are expected to have a material impact on healthcare spending. For instance, introducing a more effective but more expensive diagnostic or treatment of a particular disease would generate increased demand for healthcare services and boost healthcare costs. This technology factor is next to impossible to measure directly at the aggregate level, so its contribution to the growth rates of both real per capita healthcare spending and the healthcare spending-to-GDP ratio is estimated residually instead: once accounting for growth in real per capita personal income, changes in the age-gender structure of population, and changes in the relative price of healthcare consumption to total consumption, the actual growth rate of real per capita healthcare spending over 1996-2009 leaves a residual of 1.1 percent per year, which is ascribed to "technology".[19] This factor thus accounts for fully one quarter of the growth in real per capita healthcare spending over 1996-2009. By comparison, technology is estimated to account for as much as 27-48 percent of the growth in real per capita healthcare

19 It is worth noting that the importance of the "technology" factor and the nature of its drivers may differ significantly between the public and private sectors of the healthcare system. This interesting issue is beyond the scope of this paper.

Figure 6 : Inflation Differential: Healthcare Services – Total Consumption



Source: Authors' calculations.

spending in the United States over 1960-2007 (Smith, Newhouse and Freeland 2009).[20]

Being a residual, "technology" could reflect the net impact of a variety of factors such as changes in the scope and quality of healthcare services, technological improvements in services delivery, changes in the wellness of the population, changes in the physician specialty mix, and the potentially stimulating effect of increased supply of healthcare resources on the use of healthcare services. However, we concur with the widespread view that changes in the scope and quality of the health-care services, which are importantly influenced by changes in medical technology, are the most fundamental factor underlying the residual.

In our base projection the contribution of technology is assumed to be the same as over 1996-2009 (or each of 1996-2001 and 2001-2009 for that matter), accounting for about 1.1 percentage points of the annual growth rates of both real per capita health expenditures and the healthcare spending-to-GDP ratio.

In our optimistic case, however, the contribution of technology is smaller by 25 percent over 2016-2021 and 50 percent over 2021-2031. These reductions, which are substantial in view of the stable contribution of technology over the 1996-2009 period, reflect our judgment that better price incentives and bottom-up accountability measures leading to more cost-effective treatments and practices, or a slower rate of increase in "new" procedures and drugs, or faster creation and diffusion of cost-reducing technology could result in a major reduction in the rate of growth of costs, provided that very significant efforts are deployed.

f) Effects of Non-unitary Income Elasticity

Equation 1 and Equation 2 above suggest that, under the assumption of a unitary income elasticity, a fall in potential real GDP growth would depress the rate of growth of real per capita healthcare spending but have no effect on the rate of growth of the healthcare spending-to-GDP ratio. It is useful to have in mind what would be the effect of the expected slowdown in real potential GDP growth under the assumption of a non-unitary income elasticity. In this case,

20 Note, however, that the model used by Smith, Newhouse and Freeland to extract a "technology" residual is not identical to the one used in this study.

Equation 1 and Equation 2 would incorporate the following additional term:
$-(1-\varepsilon_Y)\cdot\left(\frac{\dot{P}I}{pop\cdot P_c}\right)$, where $\varepsilon_Y \neq 1$ refers to a non-unitary income elasticity and $\left(\frac{\dot{P}I}{pop\cdot P_c}\right)$ to the growth rate of real personal income per capita. With $\varepsilon_Y < 1$, a decline in $\left(\frac{\dot{P}I}{pop\cdot P_c}\right)$ associated with the fall in real potential GDP growth gives rise to a faster growth in real per capita healthcare spending and a larger rise in the healthcare spending-to-GDP ratio, ceteris paribus. The assumption that $\varepsilon_Y < 1$, implies that the contribution of "technology" over history, which is residually estimated, is larger than with a unitary income elasticity. If this larger contribution is maintained intact over the projection period, then the paths of real per capita healthcare spending and healthcare spending-to-GDP ratio would both be higher over the next 20 years than under the assumption of a unitary income elasticity. Conversely, and under the same conditions, the assumption that the income elasticity is greater than one, $\varepsilon_Y < 1$, would result in lower paths of real per capita healthcare spending and healthcare spending-to-GDP ratio than under the assumption of a unitary income elasticity. All our projection results below are based on the assumption of a unitary income elasticity ($\varepsilon_Y \neq 1$).

g) Projection Results

In the base case, growth in real per capita (total) health spending slows from 4.2 percent per annum over 2001-2009 to around 3.7 percent per annum from 2013 onwards (Table 6). This is essentially due to the fall in the growth rate of real per capita personal income that accompanies the projected slowdown in potential real GDP growth. This is only partly offset by a growing positive effect of demographics associated with population aging.

In the optimistic case, real per capita healthcare spending grows more slowly than in the base case, but only slightly because faster income expansion associated with stronger potential growth provides support for stronger demand and capacity to pay for healthcare services. This should not mask the fact that cost-reducing developments with respect to demographics, relative prices and technology have a significant dampening effect on the growth rate of real per capita healthcare spending.

These cost-reducing developments are not likely to be independent of each other in the decades ahead. For instance, faster improvement in cost-reducing technology for existing procedures, as reflected in the optimistic-case technology factor, could be also at the origin of the flatter health cost index as a function of age and slower relative price growth that are implemented in the optimistic case. Thus, by adding the three stand-alone reductions in the optimistic case, one might exaggerate the total effect of improvement in cost-reducing technology. To mitigate this risk, we introduce a separate "interaction effect", which is arbitrarily set to be equivalent to offsetting 20 % of the stand-alone reductions associated with the technology and relative price factors.

In the base case, aging and technology each account for about half of the annual growth in the total healthcare spending-to-GDP ratio from 2013 onwards (Table 7). An increase in real personal income relative to GDP makes an appreciable contribution over 2009 to 2001 but its subsequent flat profile has no effect on the ratio over the projection horizon.[21] Changes in the relative price of healthcare consumption boosts the ratio by 0.2 percent per year from 2017 onwards. The healthcare spending-to-GDP ratio rises from close to 12 percent in 2009 to 18.7 percent in 2031 (Figure 7).

In the optimistic case, the rise in the healthcare spending-to-GDP ratio is more limited than in the base case but quite significant nonetheless since it brings the ratio to 15.4 percent by 2031.

21 Except for temporary declines in 2010 and 2011, which show up in Figure 5.

Table 6: Projected Annual Growth in Real Per Capita Healthcare Spending

	History			Projections			
	Growth in Percent						
	1996-2009	1996-2001	2001-2009	2009-2012	2012-2016	2016-2021	2021-2031
Real Per Capita Health Expenditures	4.39	4.69	4.20	3.1	3.8	3.6	3.7
Optimistic Case				*3.1*	*3.5*	*2.6*	*3.6*
Contributions From:							
Real Per Capita Personal Income	1.93	2.28	1.71	1.6	1.4	1.0	0.8
Optimistic Case				*1.7*	*1.5*	*1.7*	*1.6*
Age-Gender Structure of Population	0.78	0.86	0.67	0.9	0.8	0.9	1.1
Optimistic Case				*0.9*	*0.8*	*-0.3*	*1.1*
Relative Price of Healthcare	0.65	0.45	0.77	-0.5	0.5	0.7	0.7
Optimistic Case				*-0.5*	*0.0*	*0.2*	*0.2*
Technology	1.03	1.10	1.05	1.1	1.1	1.1	1.1
Optimistic Case				*1.1*	*1.1*	*0.8*	*0.5*
Interaction Effect (Optimistic Case)				0	0.1	0.2	0.2

Source: Authors' calculations.

Demographics, relative prices and technology, all contribute to the lower escalation of the ratio than in the base case.

From a policy perspective, one important outcome of these projections is the very important role played by technology in driving the total healthcare spending-to-GDP ratio. This makes it a key area for health policy initiatives aiming at improving the efficiency of the delivery system and the incentives for more cost-effective healthcare intervention, in contrast with aging which is equally important but over which healthy-living and healthcare policies have little influence over the next 20 years.

4) IMPLICATIONS FOR NON-HEALTHCARE SPENDING

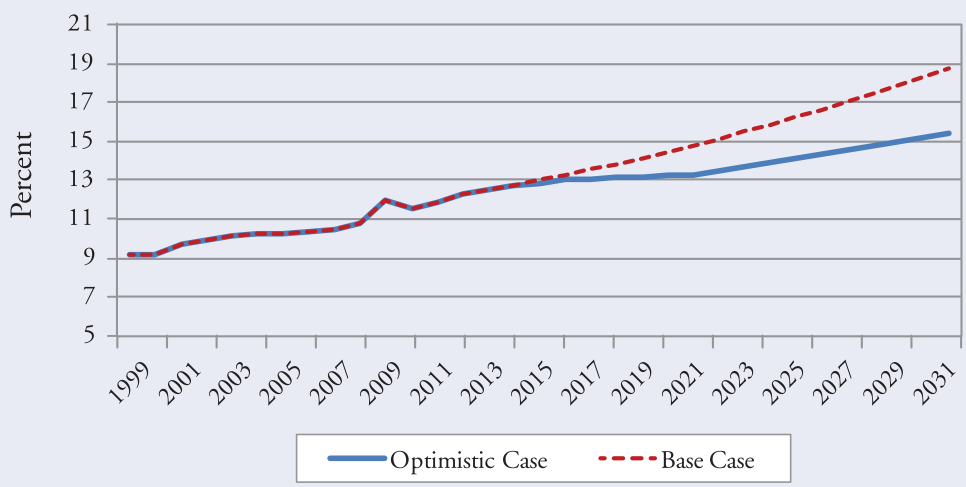
Our projections of nominal GDP and the healthcare spending-to-GDP ratio allow us to extract the trajectory of healthcare expenditures over the next two decades. In our base case the annual increase in healthcare spending per capita in dollars is set to rise from about $250 in the last decade to $675 in the 2020s. This would bring total annual spending per capita after inflation to about $7,400 in 2021 and $10,700 in 2031, up from nearly $4,900 in 2009. Even in our optimistic case it is set to rise to about $600. Over the same period the annual increase in GDP per capita in our base case climbs from $1193 to

Table 7: Annual Growth In the Healthcare Spending-to-GDP Ratio

	2001-2009	2009-2012	2012-2016	2016-2021	2021-2031
	Growth in Percent				
Healthcare Spending/GDP Ratio (Base Case)	2.7	1.1	1.9	2.2	2.4
Optimistic Case	*2.7*	*1.1*	*1.5*	*0.4*	*1.5*
Contributions From:					
Age-Gender Structure of Population	0.7	0.9	0.8	0.9	1.1
Optimistic Case	*0.7*	*0.9*	*0.8*	*-0.3*	*1.1*
Technology	1.1	1.1	1.1	1.1	1.1
Optimistic Case	*1.1*	*1.1*	*1.1*	*0.8*	*0.5*
Relative Price of Health Care	-0.1	-0.9	0.0	0.2	0.2
Optimistic Case	*-0.1*	*-0.9*	*-0.5*	*-0.3*	*-0.3*
Real Personal Income/Real GDP	1.0	0.0	0.0	0.0	0.0
Optimistic Case	*1.0*	*0.0*	*0.0*	*0.0*	*0.0*
Interaction Effect (Optimistic Case)	0	0.0	0.1	0.2	0.2

Source: Authors' calculations.

Figure 7 : Projected Healthcare Spending-to-GDP Ratio



Source: Authors' calculations.

$2161 and in our optimistic policy-induced case to about $2900. The implication of our base case is that in the 2020s, Canadians will be spending 31 cents of every dollar of increase in their nominal incomes on healthcare, thus bringing the average share of healthcare spending in GDP up to nearly 17 percent. Even in our optimistic case, 20 cents of every additional dollar will be directed to healthcare. These figures contrast with an average of about 11 cents between 1976 and 2001 but do not wildly differ from the roughly 20 cents in the first decade of this century.

In our base case the amount of real additional per capita income, expressed in constant 2009 dollars, that would be left over each year to be spent on all other goods and services would fall over the next two decades from roughly $1,550 in 2010-2012 to $1,030 in 2021-2031, while in our optimistic case it would rise to $1,590 (Figure 8).

Even though rising healthcare costs will not eat up the preponderance of national income increases over the next two decades, there will nonetheless be very difficult choices ahead – especially for Canadian governments which will be held responsible for providing most of these services, and for any offloading of costs onto individuals or employers.

5. IMPLICATIONS FOR HEALTHCARE FINANCE [22]

Over 2012-2031, the annual growth of healthcare expenditures averages 6.4 percent in the base case and 5.8 percent in the optimistic case. This compares with 4.0 percent and 4.6 percent respectively for nominal GDP growth. Public and private spending as shares of additional income are thus expected to rise substantially in the base case and quite significantly in the optimistic case.

As Table 8 below shows, of the 6.4 percent growth rate projected in the base case over 2012-31, 2 percent comes from growth in real personal income, 2.1 percent from general inflation, about 1 percent each from population aging and technology-related, more expensive new medical treatments and practices, and 0.2 percent from a rise in the relative price of healthcare services. The optimistic case implies less growth from the last three factors but more growth associated with real personal income. For this reason, our optimistic case is not one that brings minimal growth in nominal healthcare spending. Indeed an hybrid case combining the base-case assumptions for income growth with the optimistic-case assumptions for the healthcare sector would result in a 5.2 percent growth in total healthcare spending over 2012-31. Rather, our optimistic case is one that makes it easiest to finance healthcare spending and that maximizes real income available for spending on other goods and services.

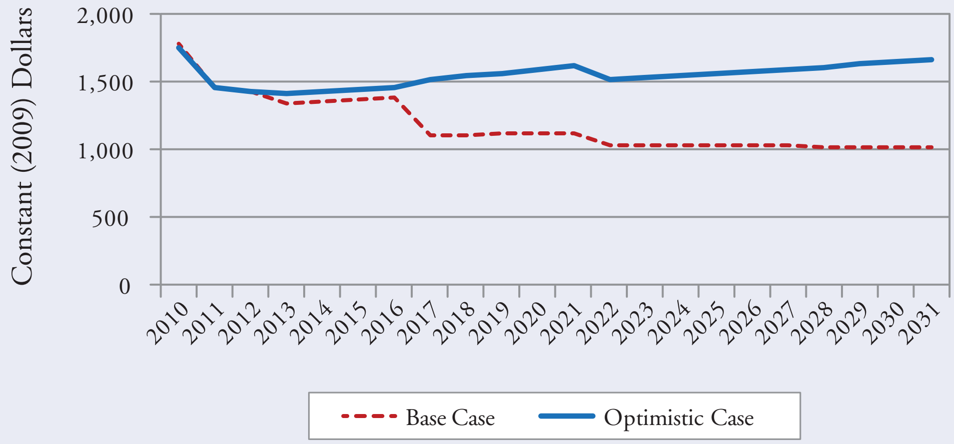
Even under an optimistic scenario when healthcare spending rises by 3 ½ percentage points of GDP over the next two decades, private citizens will have to devote an increasing share of additional income to private healthcare insurance, direct out-of- pocket expenses on healthcare services, and long-term care, assuming no change in the private sector share of total healthcare financing.

In the base case, to prevent the rise in the total healthcare spending-to-GDP ratio from pushing up the public debt/GDP ratio over the next two decades, governments will have to increase their revenues or reduce their non-healthcare expenditures, or both, by the equivalent of about 4 ¾ percentage points of GDP if they continue to finance about 70 percent of total healthcare spending.[23] Even in the optimistic case they will

22 See also Ragan (2010).

23 Government revenues would increase only slightly faster than nominal GDP on the assumption that the elasticity of revenues to GDP continues to modestly exceed one. This implies that, other things equal, tax rates would have to increase to prevent a rise in the debt/GDP ratio in the face of an escalation in the healthcare spending-to-GDP ratio. On the expenditure side, spending on other programs would have to increase less rapidly than GDP through cuts in services, increase in labour productivity in the public sector, or compression of public-sector wages relative to private-sector wages.

Figure 8 : Annual Increase in Real GDP per Capita Available for Non-Health Expenditures



Note: Author's calculations (see explanations in text).

Table 8: Sources of Annual Growth in Total Healthcare Spending

	Growth in Percent					
	2001-2009	2009-2012	2002-2016	2016-2021	2021-2031	2012-2031
Healthcare Spending (Base Case)	6.9	6.4	6.7	6.3	6.3	6.4
Optimistic Case	*6.9*	*6.4*	*6.4*	*5.0*	*6.0*	*5.8*
Contributions From:						
Real Personal Income Growth	2.8	2.8	2.5	2	1.8	2.0
Optimistic Case	*2.8*	*2.8*	*2.6*	*2.7*	*2.5*	*2.6*
General Inflation	2.3	2.5	2.3	2	2	2.1
Optimistic Case	*2.3*	*2.5*	*2.3*	*2*	*2*	*2.1*
Age Gender Structure of Population	0.7	0.9	0.8	0.9	1.1	1.0
Optimistic Case	*0.7*	*0.9*	*0.8*	*-0.3*	*1.1*	*0.7*
Technology	1.1	1.1	1.1	1.1	1.1	1.1
Optimistic Case	*1.1*	*1.1*	*1.1*	*0.8*	*0.5*	*0.7*
Relative Price of Healthcare (Ph/Py)	-0.1	-0.9	0	0.2	0.2	0.2
Optimistic Case	*-0.1*	*-0.9*	*-0.5*	*-0.3*	*-0.3*	*-0.3*
Interaction Effect (Optimistic Case)	0	0	0.1	0.2	0.2	0.2

Source: Authors' calculations.

have to find revenue enhancements or expenditure constraints equivalent to about 2 ½ percentage points of GDP. At the same time, in this optimistic case they will have to carry out both a major overhaul of the healthcare delivery system and pursue structural policies to increase productivity and labour force participation, neither of which will be politically popular.[24]

If, after 2014, health-related federal transfers to the provinces increase at the same rate as Canadian nominal GDP, then the overall budgetary position of provincial governments could deteriorate significantly over the next decades, ceteris paribus. For example, the Ontario government would see its healthcare spending rise from about $43.5 billion in 2009 to $154 billion in 2031 if this spending was to grow at the same rate as total Canadian healthcare expenditures in the optimistic case, or 5.9 percent per annum. If at the same time health-related federal transfers to Ontario were to increase at the same pace as Canadian GDP in the optimistic case, or 4.7 percent per annum, then the Ontario government would need to generate additional own-sources revenues or compress non-healthcare program spending by a substantial amount each year over 2010 to 2031 in order to prevent the rise in the healthcare spending-to-GDP ratio from pushing up its debt-to-GPP ratio. Alternatively (or in addition) Ontario would have to reduce very significantly the scope of insured services.

6. CONCLUSION

Even if we in Canada are collectively incredibly successful in improving the productivity, efficiency and effectiveness of the healthcare system (our optimistic case), we face difficult but necessary choices as to how we finance the rising costs of healthcare and manage the rising share of additional income (20 percent) devoted to healthcare.

In addition to increased spending by individuals (and employers) for services currently uninsured by provinces, some combination of the following actions will be necessary to manage the "spending disease":

1) sharp reduction in public services (other than healthcare) provided by governments, especially provincial governments;
2) increased taxes to finance the public share of healthcare spending;
3) increased spending by individuals on healthcare services which are currently insured (paid for) by provinces, through some form of co-payment or through delisting of services which are currently publicly financed;
4) major degradation of publicly insured healthcare standards (longer queues, services of poorer quality), and the development of a privately funded system to provide better quality care for those willing to pay for it (as in the U.K. and many European countries). This "two-tier" option would not have much effect on the rate of growth of total spending but, like option 3 above, would alter the public/private split and have significant distributional implications.

None of these options is appealing; there is no easy way to manage the chronic healthcare spending rise. In this paper we have attempted to provide a macro diagnostic of the "spending disease" and a prognosis of its evolution. The prognosis is not good, even if we are incredibly successful in improving the efficiency and effectiveness of healthcare delivery. But the spending disease must be managed. It is now up to Canadians to have an adult discussion about how to manage it.

24 To compound the problem, global population aging may well put upward pressure on long term interest rates and hence intensify debt service costs over the next forty years (Takats 2010). The rationale is "that house prices are determined jointly with financial asset prices. Hence, if house prices face headwinds, so should financial asset prices." (Takats 2010, p.3) With aging, the proportion of the population that dissaves or saves relatively little and thereby sells assets (housing and financial) to finance retirement increases.

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