# Federal Patent Extension, Provincial Policies, and Drug Expenditures, 1975-2000

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**PRÉCIS**

Dans cet article, les auteurs examinent l'évolution du paiement des médicaments par les gouvernements provinciaux au Canada au cours de la période de 1975 à 2000 en utilisant des données spécifiques par province et par année provenant de l'Institut canadien d'information sur la santé. Les médicaments pharmaceutiques constituent un facteur important dans la santé des Canadiens : ils représentent environ 15 pour cent des dépenses totales pour les soins de santé et environ 7 pour cent des dépenses des gouvernements provinciaux pour les soins de santé. Les auteurs évaluent les facteurs socio-économiques et démographiques qui expliquent le niveau des dépenses réelles per capita des gouvernements provinciaux via une analyse de régression de séries chronologiques groupées en coupes transversales. Les auteurs constatent que le vieillissement de la population est un facteur déterminant important. Les dépenses les plus importantes se produisent à l'âge de 65 ans, quand de nombreuses personnes deviennent admissibles aux subventions pour les médicaments payées par les gouvernements provinciaux. Les dépenses diminuent après l'âge de 75 ans, dû possiblement à l'effet des « survivants en bonne santé ». Si l'introduction de régimes provinciaux de partage des frais de médicaments a en général servi à limiter les dépenses, l'introduction de régimes gouvernementaux universels de médicaments a toutefois eu des résultats variables. On constate qu'au fil des ans, les tendances lourdes que sont le développement technologique, les effets de la législation fédérale sur l'extension de la durée des brevets (en 1987 et 1993) et d'autres facteurs de temps variables non modélisés ont joué un rôle primordial dans la fluctuation des dépenses des provinces en médicaments. L'augmentation de la durée des brevets semble toutefois n'avoir eu que des effets négligeables sur les dépenses provinciales en médicaments avant 1996, quoiqu'elle semble être responsable des fortes

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augmentations qui se sont produites par la suite. Il se pourrait que divers plans gouvernementaux pour maîtriser le coût des médicaments, combinés avec la création du Conseil d'examen du prix des médicaments brevetés (CEPMB), compensent à court terme la prolongation de la durée des brevets. D'un autre côté, il est possible que le réel impact global de l'augmentation de la protection des brevets soit encore à venir.

**ABSTRACT**

This article examines the evolution of provincial government drug expenditures in Canada over the period 1975-2000 on the basis of province- and year-specific data from the Canadian Institute for Health Information. Pharmaceutical drugs are an important input into the health of Canadians: they account for approximately 15 percent of total health-care spending and about 7 percent of provincial government health-care spending. We estimate the socioeconomic and demographic determinants of real per capita provincial government drug expenditure on the basis of a pooled time-series cross-section regression analysis. We find that population aging is an important determinant; the largest expenditure increase occurs at age 65, when many individuals become eligible for provincial drug subsidies. Expenditures drop off after age 75, however, possibly as a result of a "healthy survivor" effect. The introduction of provincial drug co-payment plans has generally served to depress expenditures, whereas the introduction of universal government drug plans has had mixed results. We found that secular trends, representing technological extension, the effects of federal legislation to extend patent terms (in 1987 and 1993) and other, unmodelled time-varying factors, account for much of the variation in provincial drug expenditure over time. Patent-term extension, however, appears to have had negligible effects on provincial drug expenditures before 1996 but may be responsible for the large increases that have occurred since then. It may be that various provincial government schemes for controlling drug costs, in combination with the introduction of the Patented Medicines Prices Review Board (PMPRB), offset the potential price impact of lengthened patent terms in the short run. On the other hand, the full impact of increased patent protection may have yet to be realized.

**KEYWORDS:** DRUGS ■ SUBSIDIES ■ COST SHARING ■ HEALTH CARE EXPENDITURES ■ DEMOGRAPHY ■ SENIOR CITIZENS

## INTRODUCTION

Drugs are an important component of health care for Canadians. They accounted for approximately 15 percent of the $102 billion spent on health care in Canada in 2001.[1] Moreover, drug expenditures are growing in importance: over the period 1975-2000, total nominal health spending increased by approximately 686 percent, but total spending on drugs increased by 1,230 percent. Provincial government expenditures on drug programs have grown even faster: over the same period, provincial and territorial governments' total health-care spending increased by 625 percent, but their spending on drugs alone increased by 3,004 percent.[2] Even during the 1990s, an era of fiscal restraint, provincial drug spending increased by 87 percent, whereas spending on physicians increased by only 30 percent and spending on hospitals increased by only 16 percent.[3] Despite the growing importance of

provincial drug expenditures, however, there has been little research into the effects on these expenditures of factors such as federal and provincial policies, provincial income, demographics, and technological change. This article uses annual data on provincial government drug expenditures over the period 1975-2000 to explore the effects of these factors.

Technological extension—that is, the introduction of new drugs and treatments—is one of the most important factors behind the increases in drug expenditures. During the last quarter century, pharmaceuticals have been introduced to treat, palliate, and prevent an ever-broader range of health conditions. In some contexts, pharmaceuticals have actually replaced other health services. The introduction of anti-psychotic drugs, for example, has reduced dependence on institutionalization, and the development of anti-ulcer drugs has reduced ulcer patients' recourse to surgery. The introduction of new drugs has perhaps even reduced the amount of time that physicians spend with their patients.[4] To this factor one can add the usual list of socioeconomic variables associated with health spending, such as income and age. In the Canadian context, however, government policy, federal and provincial, is another factor in the increase in spending on drugs.

Neither the Medical Care Act (1968) nor the Canada Health Act (1984) included drugs in the set of "medically necessary" health services that required public subsidization. It was the provinces, starting in the early 1970s, that introduced drug subsidy plans for various beneficiary groups, including seniors and recipients of social assistance.[5] Since the economic slowdown of the early 1990s, however, the provinces have attempted to reduce their expenditures on drug programs by increasing beneficiary co-payments and limiting access to specific drugs through drug formulary restrictions.

Federal policies, too, have directly and indirectly affected provincial drug expenditures and drug subsidies. First, circa 1996-97, the federal government reduced its block grants to the provinces, thereby limiting the resources available to fund provincial drug plans. Second, legislative changes in 1987, 1993, and 2001 increased the period of patent protection afforded to brand-name drugs. The 1987 legislation also created the Patented Medicines Prices Review Board (PMPRB)—a quasi-judicial body whose mandate is to keep the prices of patented drugs in check.

The first section below briefly surveys the literature on the determinants of pharmaceutical drug expenditures. The second section provides an overview of the data used in the present study. The third section formulates and estimates an econometric model, and the fourth section discusses the empirical results and their implications for provincial government drug expenditures and policies. There is also a brief concluding section.

## ISSUES AND LITERATURE

The modernist or neoclassical approach to the role of government that currently dominates public finance is a pragmatic view associated with the economist Richard Musgrave. It defines three economic activities of government: allocation, distribution,

and stabilization.[6] The main reason for government intervention in the allocation of resources is market failure—that is, the failure of the price system to allocate resources efficiently owing to informational asymmetries, externalities in production and consumption, and non-competitive behaviour. If market forces produce a distribution of economic resources that is perceived as being inequitable, then there is a role for government to rectify the situation through the tax-transfer system or regulation. Finally, government's stabilization role concerns the actions that government takes to affect the business cycle. Provincial government involvement in the market for pharmaceutical products, and in the market for health care in general, is explicable largely in terms of government's allocative and distributive functions.

The features that characterize health-care markets in general also characterize the provision of pharmaceutical care.[7] There are asymmetries in information about the benefits of drugs between physicians and patients and between drug manufacturers and physicians. The usual adverse selection and moral hazard problems arise in connection with the provision of insurance for drugs. Externalities, too, may be important: consumers of medications to prevent or treat infectious disease ignore the value that others place on their consumption; in the absence of secure property rights over their innovations, developers of new pharmaceutical technologies may not have sufficient incentive to conduct research and development. Finally, there are concerns over distributive equity in terms of both access to drug treatments and the ability to pay for them.[8] For these reasons, government has intervened in the pharmaceutical market by directly subsidizing the drug use of certain groups; protecting the property rights of the developers of new drugs through patent legislation; and monitoring the safety, efficacy, and promotion of new drugs.

Direct public subsidy of prescription drugs is limited to groups whose members either lack access to private drug insurance or cannot afford it. About 75 percent of public spending on drugs is accounted for by provincial government coverage of seniors, social assistance recipients, residents of long-term-care facilities, individuals with specific diseases (such as cystic fibrosis or HIV/AIDS), and, outside the Atlantic region, any other individuals whose out-of-pocket drug costs are high relative to their income. What remains of public spending on drugs is accounted for primarily by provincial spending on drugs used in hospitals (as mandated by the Canada Health Act) and by federal government subsidization of the drug use of members of First Nations, active and retired military personnel, prison inmates, and the RCMP. The federal government and most provincial governments also indirectly subsidize employer-provided private drug insurance via the income tax system, since benefits are not counted as employee taxable income. Stabile estimates that the proportion of Canadians who have drug insurance is 13 percentage points higher than it would be in the absence of the tax subsidies; the result is greater use than there would otherwise be of both drugs and complementary publicly funded health services such as physician visits.[9]

The combination of direct public drug subsidies and the indirect subsidy of private insurance has increased drug expenditure in several ways. First, it has reduced

the direct costs of drug use, and this cost reduction has likely made physicians more willing to prescribe drugs and patients more willing to fill these prescriptions. Second, by increasing demand for drugs, public drug subsidies both at home and abroad have likely contributed to the tremendous rate of technological innovation in the pharmaceutical sector. Some recent studies provide evidence of the impact on expenditure of new drugs. Anderson et al. examine the increase in pharmaceutical expenditures over the period 1981 to 1988 under British Columbia's pharmacare program for seniors and find that one-third of expenditure growth was attributable to spending on new drug molecules.[10] Morgan finds that although the number of prescriptions per capita dispensed to British Columbia seniors has grown by only 16 percent over the period 1987 to 1999, the average expenditure per senior per drug increased by 150 percent—an outcome attributable primarily to the substitution of newer, typically more expensive drugs for older and generally less expensive drugs.[11] New drugs also vary in their therapeutic novelty. According to the PMPRB, only 41 (7 percent) of the 556 new drugs introduced in Canada during the period 1988-1995 were "breakthrough" drugs—that is, drugs that represented either a truly new means of treating a particular illness effectively or a substantial improvement on existing drugs.[12] Truly innovative drugs do, however, offer the potential to reduce overall health-care costs and improve health. Lichtenberg, for example, estimated that a one-dollar increase on the purchase of certain pharmaceuticals was associated with an average reduction of $3.65 in hospital expenditures.[13]

Public subsidies also reduce the price sensitivity of drug use, an outcome that according to standard economic theory will lead firms to charge higher prices for their patent-protected new drugs. The large profit margins on drugs, in turn, induce drug manufacturers to engage in activities intended to encourage sales. These activities include sales calls on physicians in order to explain the benefits of a new drug and the practice of giving gifts to prescribers in order both to engender product recognition and to instill a sense of obligation and brand loyalty on the part of the prescriber.[14] Recent evidence suggests that promotional activity of this kind may also reduce the prescriber's sensitivity to drug prices in deciding what to prescribe.[15]

Another factor that contributes to growth in drug expenditure is patent protection—the provision of a state-sanctioned period of market exclusivity (usually 20 years). Patent protection gives firms market power, allowing them to charge prices higher than they could otherwise charge and thereby to recoup sunk development costs. Drug patent policy in Canada has a long history. Legislation enacted in 1923 permitted "compulsory licensing" of pharmaceuticals. A compulsory licence granted a firm permission to make, use, or sell a patented drug before the patent expired in exchange for a fixed royalty to the patent holder, provided that the active ingredient was produced in Canada. This constraint proved to be binding: only 22 compulsory licences were granted between 1923 and 1969.[16] The generic drugs sector in Canada did not prosper until amendments to the Patent Act in 1969 removed the requirement that the active ingredient be produced in Canada. Bill C-22, passed in 1987,[17] weakened compulsory licensing but did not eliminate it. Compulsory licences

could be issued only after the patented drug had been on the market for 7 years (or 10 years if the active ingredients for the generic drug were imported). Bill C-22 created the PMPRB, an independent, quasi-judicial body. Among other roles, the PMPRB ensures that both the introductory prices of drugs and the rate of drug price inflation are below pre-set levels. Bill C-22 also changed patent terms from 17 years from the date of patent grant to 20 years from the date of patent filing; this provision became effective in 1989.[18]

Bill C-91, enacted in 1993, eliminated compulsory licensing and strengthened the powers of the PMPRB to mandate price rollbacks, demand reimbursement of excess revenues, and levy fines of up to twice the amount of the excess revenues.[19] Although compulsory licences were no longer granted, the new legislation allowed generic drug firms to develop and stockpile copies of a brand-name drug in advance of the expiry of the patent in order undertake marketing as soon as the patent expired.

Generic firms' ability to market generic copies is hampered, however, by the so-called NOC-link regulations associated with Bill C-91.[20] These regulations require the patent holder to submit to Health Canada a list of all of the patents relevant to the product and their expiry dates. Should a generic firm challenge the patentee's claims, it serves the patentee with a notice of allegation. The patentee then has 45 days to decide whether it will initiate a court injunction seeking to prevent the government from issuing marketing approval (known as a notice of compliance or NOC) until the expiry of the listed patents. Once court proceedings are initiated, the government cannot issue a NOC to the generic manufacturer until the parties reach agreement, the listed patents expire, the court renders a decision, or 30 months elapse. Although the court proceedings run in parallel with Health Canada's approval process, the generic companies, represented by the Canadian Drug Manufacturers' Association, claim that the courts often "evergreen" patents beyond the 20-year limit by adding patents on various aspects of the drug, including its colour and indications for its use.[21]

Little is known at present about the extent to which the strengthening of patent protection in Canada has increased drug costs, although some observers have predicted that drug expenditures will increase substantially over time. For example, analysts at the Queen's University Health Policy Unit have estimated that over the 20-year period 1997-2016 the undiscounted cost of providing an additional three years of patent protection for drugs that were available in 1997 will be between $6.0 billion and $9.4 billion.[22]

Growth in drug expenditures, coupled with fiscal constraints, have led provincial drug programs to reduce the number of prescriptions they reimburse and the price they pay for them. Most of the provinces now require the beneficiaries of the programs to share the costs of drugs,[23] insist upon the substitution of generic drugs when they are available, seek direct negotiation of pharmacy dispensing fees and the prices paid for drugs, and restrict the use of newer, typically high-cost drugs. For example, all of the provinces now require evidence that a new drug is either more effective or less costly than existing drugs before they will agree to cover it.

Even if a new drug is covered, some provinces will not pay for it unless the patient has failed to respond to a therapeutically similar, less expensive drug.

## DATA OVERVIEW

We obtained province-specific data on provincial government prescription drug expenditures for the period 1975-2000 from the health expenditure databases maintained by the Canadian Institute for Health Information (CIHI). Since these data do not include drugs dispensed in hospitals, they understate total provincial government drug expenditures.[24] The CIHI data also exclude municipal government drug expenditures and "social security funds"—government-administered drug programs that are funded by compulsory payments from their beneficiaries (examples include the programs conducted by workers' compensation boards and the mandatory public drug insurance program in Quebec). We used data from the federal Department of Finance and from Statistics Canada's Canadian Socio-Economic Information Management System (CANSIM) to construct socioeconomic and demographic variables. CANSIM does not have consistently defined data for provincial gross domestic product (GDP) over the entire sample period 1975 through 2000. The appendix to this article describes the methods we used to combine data for two shorter intervals to construct a series for the entire period.

Between 1975 and 2000, drug expenditures by provincial governments rose from $141.8 million to $4.402 billion. Total provincial government health spending grew at a much slower rate: it rose over the period from $7 billion to $59 billion. Figure 1 shows that real total drug expenditures by Canada's provincial governments, expressed in 1992 dollars, rose from $452 million in 1975 to $3.8 billion in 2000.[25] Figure 2 shows that the public share of total drug spending varies across the provinces but has generally risen over time—from an average of 16 percent in 1975 to an average of 32 percent in 2000. Figure 3 shows that the share of provincial government health expenditures devoted to drug expenditures rose from 1.9 percent in 1975 to 7.5 percent in 2000. Finally, figure 4 shows that average real per capita expenditure on drugs across provincial governments rose steadily over the period, from $19.58 in 1975 to $125.46 in 2000. These figures imply that average real per capita provincial government drug expenditures grew over the period by about 7.5 percent per year.

Figure 5 shows that the growth in per capita provincial government drug expenditure over the period 1975-2000 varied substantially from province to province. Initially, expenditures grew much faster in Saskatchewan than in the other provinces, but by the late 1980s the rate of growth in Saskatchewan was comparable to the rates elsewhere. By 2000, Ontario, Quebec, British Columbia, and Newfoundland were the biggest per capita spenders and Alberta, New Brunswick, Saskatchewan, and Manitoba were clustered at the bottom. The variation across provinces in the rate of growth in drug expenditures led to changes over time in relative expenditure shares. In particular, as figures 6 and 7 show, the share of provincial government drug expenditures accounted for by Ontario grew from 13 percent in 1975 to 43 percent in 2000.[26] All other provinces' shares have declined since 1975.

**FIGURE 1 Real Provincial Government Drug Expenditures in Canada, 1975-2000**

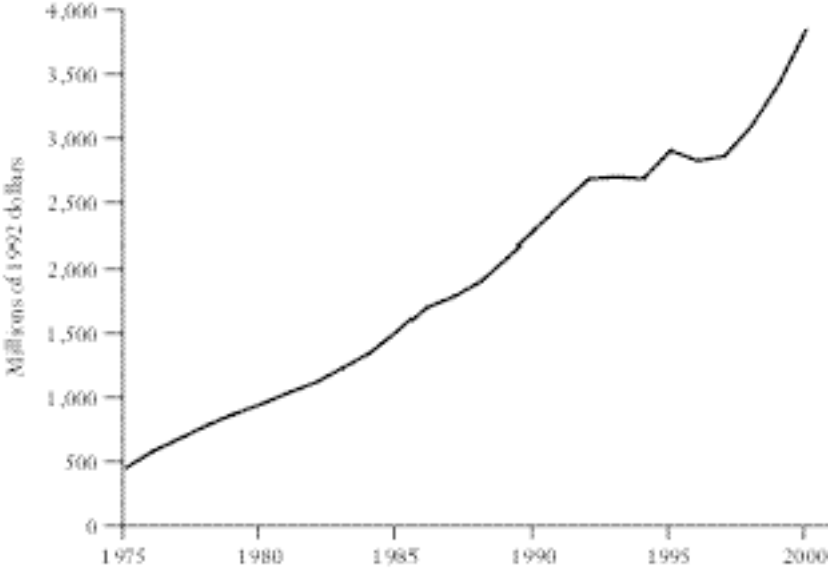



**FIGURE 2 Public Share of Total Drug Expenditures by Province, 1975-2000**

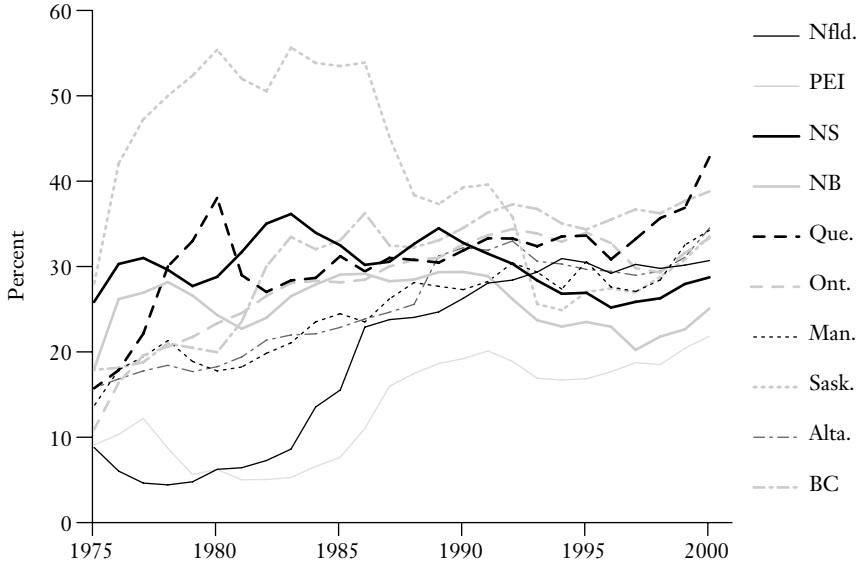


**FIGURE 3 Drugs as a Share of Provincial Government Health-Care Expenditures, 1975-2000**

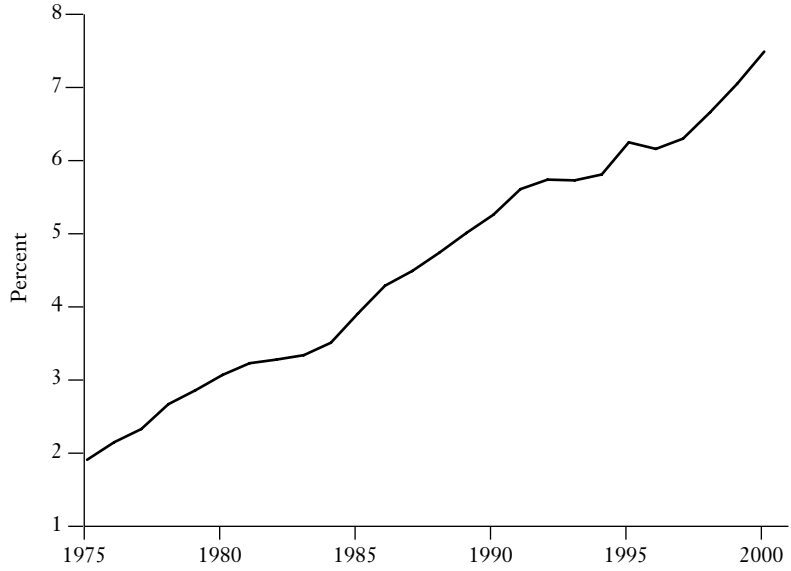



**FIGURE 4 Real per Capita Provincial Government Drug Expenditures, 1975-2000**

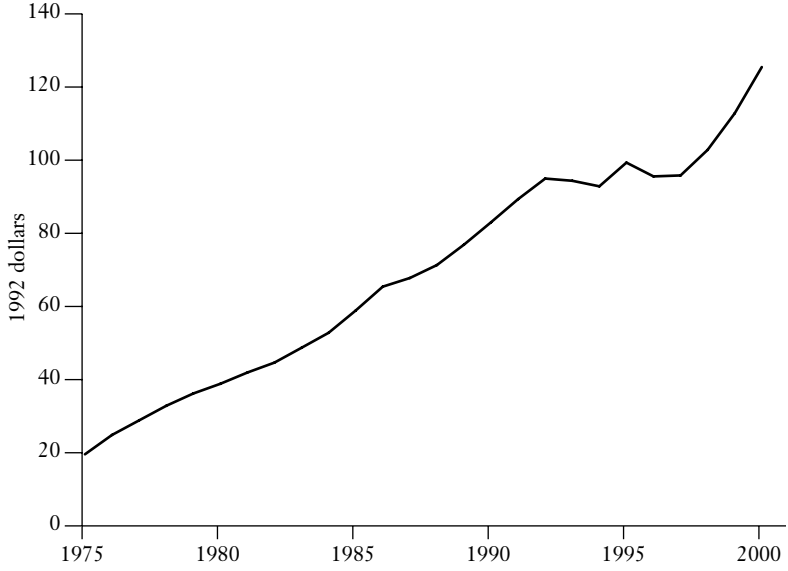


**FIGURE 5 Real per Capita Provincial Government Drug Expenditures by Province, 1975-2000**

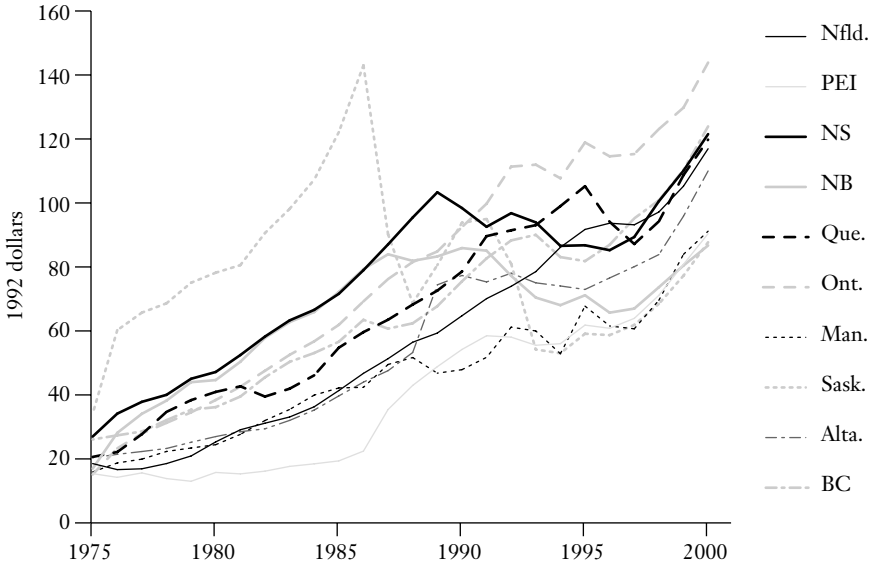



**FIGURE 6 The Distribution of Provincial Government Drug Expenditures, 1975**

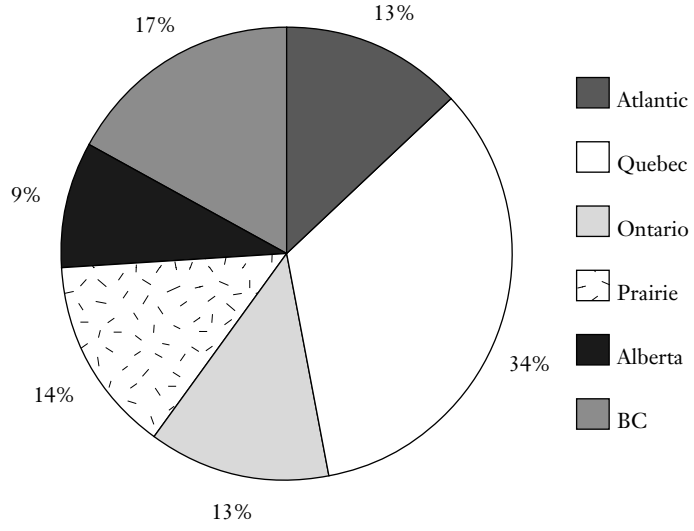
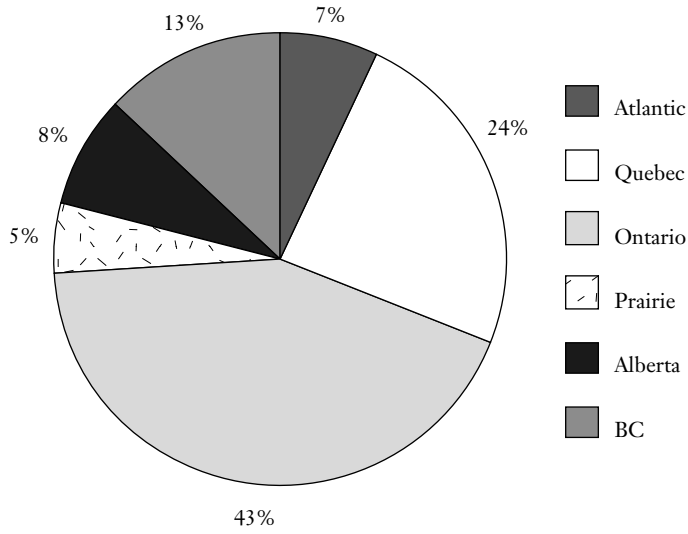


**FIGURE 7 The Distribution of Provincial Government Drug Expenditures, 2000**




## THE MODEL

Our basic model has the form $y = f(\boldsymbol{z})$ where $y$ is real per capita provincial government drug expenditures[27] and $\boldsymbol{z}$ represents a vector of exogenous social, demographic, economic, and policy variables that is thought to influence this spending. In order to make the model operational, one must select variables to represent the determinants of provincial government drug expenditures.

The last quarter-century has seen the emergence of a body of literature that seeks to explain the rise in health expenditures by identifying the determinants of these expenditures and to suggest which determinants it may be possible to influence in order to reduce costs. Historically, the important determinants of per capita health expenditures have been income, the proportion of population either over 65 or under age 15, the public finance share of health-care spending, urbanization, and the number of practising physicians per capita.[28] Much attention has been given to the role of income in explaining international variations in health-care expenditures, and this emphasis has created what Culyer refers to as one of the great "monocausal" myths—namely, that health care is a luxury good because its income elasticity of demand is greater than one.[29]

In the basic model that we estimate here, drug expenditure is a function of economic determinants (real per capita income, defined as real per capita provincial GDP in 1992 dollars, and real per capita federal cash transfers), the proportions of the population aged 18-44, 45-64, 65-74, and over age 75, and the per capita number of prescribing physicians. Most of these variables have been found to be significant determinants of Canadian health-care expenditures.[30] In addition, we use dummy variables to control for both the onset of a variety of changes in provincial government

drug subsidies and residual secular trends. The model specification is linear so that one can interpret the coefficients as real per capita dollar amounts. The estimation technique is ordinary least squares,[31] and the data are annual from the period 1975-2000. Table 1 summarizes the definitions of the variables. Some additional discussion of the variables is in order, however.

The inclusion of a per capita income variable is standard in studies of health-care expenditure, and higher income is usually associated with greater spending on health care.[32] In the case of spending on drugs by provincial governments, however, there is no a priori reason for the relationship to be positive, and ultimately the income coefficient will depend on provincial government spending priorities. Since there is little reason for all of the provinces to react to income in the same way, our model allows the effect of income to vary by province.

Federal transfers are an important source of revenue for provincial governments, although their importance varies across both provinces and years. Historically, the provinces obtained about 20 percent of their revenue from federal transfers, but by the 1996-97 fiscal year the federal government's deficit-fighting agenda had reduced provincial transfers to about 15 percent of total provincial revenues. Estimated federal transfers (in the form of both cash and tax points)[33] to the provinces and territories in fiscal 2000-1 amounted to about $43 billion, of which 30 percent consisted of general-purpose transfers (such as equalization payments)[34] and the remainder consisted of specific-purpose transfers, mainly under the rubric of the Canada Health and Social Transfer (CHST).[35]

The past 25 years have seen changes not only in the dollar amounts of federal transfers but also in the institutional arrangements that govern the transfers. Before 1977, federal cash transfers effectively funded 50 percent of all provincial insured health-care expenditures.[36] The rapid increases in provincial health-care expenditures in the 1970s alarmed the federal government, which in 1977 replaced this open-ended grant system with the so-called established programs financing (EPF) system. The new scheme linked the cash grant for health care and post-secondary education to provincial income and population growth, thus severing the direct link between provincial health expenditures and the federal cash contribution. In 1986, as part of its deficit-control strategy, Ottawa further restricted the growth of EPF transfers.[37] Finally, in 1996, insured health services, post-secondary education, and the Canada Assistance Plan (CAP) were all collapsed into the new CHST. The cash portion of the CHST was about one-third less than the previous combined EPF/CAP total and saw $6.2 billion in cash removed. In fiscal 1999-2000, there was a partial restoration of the CHST funding via one-time transfers. In September 2000, the federal government committed itself to spending $21.1 billion on the CHST over a five-year period.

Nevertheless, over the period 1975-2000, federal cash transfers for health care have fallen as a share of total provincial and territorial health-care costs from nearly 30 percent to less than 15 percent. Moreover, the arrival of the CHST has made it much more difficult to obtain specific data on federal health transfers, since they are now incorporated into a much more general transfer payment. Even

**TABLE 1 Regression Variable Definitions**

| Variable | Definition |
|---|---|
| RDRGPGC | Real per capita provincial government drug expenditures (1992 dollars).[a] |
| RGDPC | Real per capita provincial gross domestic product (1992 dollars). |
| RNFCSHC | Real per capita provincial revenue from federal cash transfers (1992 dollars). |
| PRP017 | Proportion of provincial population aged 0 to 17. |
| PRP1844 | Proportion of provincial population aged 18 to 44. |
| PRP4564 | Proportion of provincial population aged 45 to 64. |
| PRP6574 | Proportion of provincial population aged 65 to 74. |
| PRP75 | Proportion of provincial population aged 75 and over. |
| BC65CHRG87[b] | 1 after introduction of senior's co-payment in British Columbia (1987-4).[c] |
| BCREFPRC | 1 after introduction of reference pricing in British Columbia, 0 otherwise (1997-10) |
| AB65CHRG94 | 1 after increase in senior's co-payment in Alberta (1994-7). |
| SK65CHRG93 | 1 after increase in senior's and general population co-payment in Saskatchewan (1993-3). |
| MBGPINTR96 | 1 after introduction of a universal plan in Manitoba (1996-4) |
| ONGPINTR95 | 1 after introduction of a universal plan in Ontario (1995-4) |
| ON65CHRG96 | 1 after introduction of senior's co-payment in Ontario (1996-7) |
| PQGP65INTR | 1 after introduction of a universal plan in Quebec (1997-1) |
| NB65CHRG83 | 1 after introduction of senior's co-payment in New Brunswick (1983-11). |
| NB65CHRG96 | 1 after increase in senior's co-payment in New Brunswick (1996-4) |
| NS65CHRG90 | 1 after introduction of senior's co-payment in Nova Scotia, (1990-6) |
| NS65CHRG93 | 1 after increase in senior's co-payment in Nova Scotia (1993-1). |
| PE65INTR86 | 1 after introduction of senior's plan in Prince Edward Island (1986-1) |
| NF65INTR80 | 1 after introduction of (low-income) senior's plan in Newfoundland (1980-4). |
| HOSPHG | Hospital share of total health spending. |
| PHYC | Number of prescribing physicians per 1,000 population. |
| NFLD | 1 if Newfoundland, 0 otherwise. |
| PEI | 1 if Prince Edward Island, 0 otherwise. |
| NS | 1 if Nova Scotia, 0 otherwise. |
| NB | 1 if New Brunswick, 0 otherwise. |
| QUE | 1 if Quebec, 0 otherwise. |
| ONT | 1 if Ontario, 0 otherwise. |
| MAN | 1 if Manitoba, 0 otherwise. |
| SASK | 1 if Saskatchewan, 0 otherwise. |
| ALTA | 1 if Alberta, 0 otherwise. |
| BC | 1 if British Columbia, 0 otherwise. |

[a] Provincial government drug expenditures, federal transfers, and GDP were deflated on the basis of the Government Expenditure Implicit Price Index. All indexes: 1992 = 100. Source: CIHI.

[b] The dates in parenthesis refer to the year and the month in which the policy change took effect.

[c] Reference pricing was introduced in late 1995 and fully implemented by 1997.

before the arrival of the CHST, there was some discretion in the use of transfer income, particularly in the case of provinces that received equalization cash transfers.

We used data from the Department of Finance to construct real per capita federal cash transfers. The transfer components we used were equalization cash transfers, the cash component for EPF, the cash component of the CHST entitlement, and the value of health grants for the two years before the onset of EPF in 1977. These transfer variables attempt to include all cash resources transferred from the federal government to the provinces that might have been employed for health expenditure purposes. The appendix describes the transfer variable further.

Again, there is no a priori reason for all provincial drug expenditures to respond to an increase in real per capita federal cash transfers in the same way. Drugs are not an insured medical expenditure, as physicians and hospital services are, and given provincial differences in health-spending priorities[38] the allocation of transfer revenues to drug programs may well vary by province. In order to allow for potential differences among the provinces in their responses to transfer payments, we multiplied the payments by the values of the provincial dummies.

To capture the possibly non-linear effects of demography on drug spending, we included as covariates the proportions of the population aged 18-44, 45-64, 65-74, and over 75. One might expect, for example, an expenditure increase owing to use of contraceptives by women in the 18-44 age group. The largest increase in individuals' drug use, however, is expected to occur at age 65, when most Canadians become eligible for provincial drug subsidies. Individuals under age 65 are eligible for provincial subsidies only if they are indigent, require specific high-cost drugs (such as those for HIV/AIDS), or lack private insurance and incur large drug costs.[39] In addition to the effects of drug subsidies, of course, there is the increasing prevalence of chronic health problems as people grow older. Canadian studies have shown that the per capita cost of health care for a 60-year-old are nearly double the cost for a 40-year-old; for a 70-year-old, the cost is nearly triple the cost for a 40-year-old.[40] A study of the effects of demographic composition on physician expenditures in British Columbia estimated that the average per capita cost of health care for people aged 75 and over increased at an annual rate of 5.5 percent; the increase in the use of specialist care was even greater.[41] Studies for the United States show similar patterns and trends in the health-care expenditures associated with the aging of the population.[42] Given that the proportion of the Canadian population age 65 and over was 7.6 percent in 1961 and is expected to reach 18 percent by 2025,[43] the growing number of elderly will also be a factor in rising drug expenditures.[44]

Our model also specifies a set of drug policy variables for these regression estimates. During our period, as table 2 shows, a number of provinces both reduced their coverage for seniors and introduced coverage for non-senior beneficiaries. One would expect the adoption of universal drug plans to increase public spending on drugs and potentially crowd out private spending. On the other hand, the increase in the co-payments required under the plans for seniors should have the opposite effect.[45] As well, we employ a dummy variable to capture the introduction in 1995 of "reference pricing," a drug cost-control policy, in British Columbia.[46]

**TABLE 2 A Brief Summary of Prescription Drug Subsidy Programs for Seniors by Province**

| Province and date of introduction | Description |
|---|---|
| Newfoundland (April 1980) . . . . . | Only low-income seniors are covered. The co-payment is the dispensing fee (typical value, $7.61 in 1992) plus 10% of ingredient cost if it is more than $30. |
| Prince Edward Island (January 1986) . . . . . | The province provided full coverage until December 1986. Since then, there has been a fixed co-payment per prescription (e.g., $11.85 in 1992, $15.45 in 1999). |
| Nova Scotia (October 1974) . . . . . | Initially the plan provided full coverage for all seniors. In June 1990, the province introduced a fixed co-payment of $3 per prescription. Since July 1991, the co-payment has been 20% of the cost (minimum $3), with various maximums (e.g., $150 in 1992) that have sometimes been income-contingent. Since April 1995, the province has also collected income-contingent premiums to a maximum of $215/year; an opt-out provision was introduced in September 1996. |
| New Brunswick (January 1975) . . . . . | There was initially no co-payment. Since November 1983, there has been a fixed co-payment per prescription (e.g., $7.05 in 1992, $9.05 in 1999) to an annual maximum for all seniors—initially $30, raised to $45 in January 1985. In January 1988, the maximum was restricted to lowest-income seniors and raised to $120 ($250 in April 1996). Since July 1992, there has been a premium for high-income seniors (e.g., $48/month in 1992). |
| Quebec (August 1974) . . . . . | The program was initially limited to low-income seniors. In October 1977, all seniors became eligible. In May 1992, the province introduced a co-payment, although low-income seniors were exempt. Others paid $2 per prescription to an annual maximum of $100. In August 1996, all seniors paid 25% of the cost, subject to various income-contingent maximums. In January 1997, the program introduced a quarterly deductible of $25 and income-contingent premiums. |
| Ontario (September 1974) . . . . | The program was initially limited to low-income seniors. In August 1975, all seniors became eligible. Since July 1996, low-income seniors have paid $2 per prescription. Others pay $6.11 per prescription above an annual deductible of $100. |
| Manitoba (July 1973) . . . . . | Co-payment and deductible (e.g., 20% and $106.60 in 1992). In January 1993, the co-payment increased to 30%. Since April 1996, the province has reduced the co-payment to zero and introduced income-contingent deductibles (2-3% of household income). |

(Table 2 is concluded on the next page.)

**TABLE 2 Concluded**

| Province and date of introduction | Description |
|---|---|
| Saskatchewan (September 1975) .... | An initial fixed co-payment of $2 had increased gradually to $3.95 by January 1984. The co-payment became 20% in July 1987, 25% in March 1991, and 35% in May 1992. In July 1987, the province introduced annual deductibles of $75 per senior family and $50 per single senior. In May 1992, the deductibles became payable semi-annually. In March 1993, family-level deductibles were replaced by individual-level deductibles, and the deductible amounts increased to $100 for low-income seniors and $850 for high-income seniors. Also in March 1993, the program introduced semi-annual out-of-pocket expenditure limits of 1.7% of adjusted household income for seniors with adjusted incomes of less than $50,000. |
| Alberta (July 1970) ..... | Co-payments were initially 20%; in July 1994, they increased to $25, or 30% of the prescription cost, whichever was lower. The program initially had income-contingent premiums, but these were eliminated in January 1972. |
| British Columbia (July 1972) ..... | In its first year, the program provided coverage for low-income seniors only, with a co-payment of $2 plus 50% of the balance. In July 1973, the province extended the program to all seniors, without cost sharing. In April 1987, it introduced a co-payment of 75% of the dispensing fee to an annual maximum of $125. In April 1994, the co-payment became 100% of the dispensing fee to an annual maximum of $200. Beginning in January 2002, low-income seniors paid $10 per prescription to an annual maximum of $200. Higher-income seniors paid $25 per prescription to an annual maximum of $275. |

Source: Adapted from P. Grootendorst, "Beneficiary Cost Sharing Under Canadian Provincial Prescription Drug Benefit Programs: History and Assessment" (2002) vol. 9, no. 2 *Canadian Journal of Clinical Pharmacology* 79-99.

Pertinent federal policies include the limitation of compulsory licensing and the extension of the patent term in 1987 and the elimination of compulsory licensing in 1993. Since the 1987 extension coincided with the introduction of the PMPRB, which has the power to mandate prices, its effects on expenditures are difficult to determine. In any case, these effects are likely to be non-linear, since in any given year they depend on the number of drugs that would have come off patent in the year had their patents not been extended—a number that would not necessarily have been constant from year to year. The effects of patent extensions on drug expenditures also depend on the level of consumption for a given drug and its price: the greater are the revenues realized by the drug, the more likely it is that in the absence of the patent extension a generic competitor would have entered the market.

For these reasons, the effect of patent extensions on drug expenditures would probably not be captured by an indicator variable that assumes a constant effect over time. Instead, we have allowed for the non-linear effects of patents on expenditures by using year indicator variables. The drawback of year dummies is that they capture the effect of all influences on drug use that are not directly controlled for, such as technological change and decisions by provincial drug plans to reimburse or not reimburse users of particular drugs. Nevertheless, since the year dummies include both a period before and a period after the onset of changes to patent terms, it may be possible to discern their impact by comparing the estimates of the year effects for the two periods.

We included dummy variables for the provinces in order to capture any time-invariant regional effects that are not captured by other variables in the model. The Canadian federation is diverse, and variations in regional preferences, culture, tax systems,[47] and geography may all help to determine the level of provincial government drug expenditures. The model also includes the number of prescribing physicians per capita, a variable whose net effect on drug expenditures could be either positive or negative. On the one hand, an increase in physician density might increase the number of patients receiving care and thereby increase prescribing rates; on the other hand, it might also increase physician contact time per patient, which could be a substitute for pharmacotherapy. Finally, we specified a variable defined as the hospital share of total health-care spending. As we noted earlier, the CIHI data on drug expenditures exclude expenditures by hospitals; hence one would expect the trend to the provision of health care outside of hospitals to increase reported CIHI drug expenditures.

## RESULTS

Tables 3 and 4 present the results of our regressions. Table 3 presents ordinary least squares regression estimated with robust standard errors using STATA 7.0; for the purposes of comparison, table 4 presents estimates that use OLS standard errors. With a few noted exceptions, the coefficient estimates significances are reported at the 5 percent level. Overall, the regressions explain approximately 97 percent of the variation in real per capita drug expenditures by provincial governments.

As the tables show, per capita income is a positive and statistically significant determinant of real per capita provincial government drug expenditures in Nova Scotia; this result suggests that provincial government drug spending is a normal good in that province. For Prince Edward Island and New Brunswick, however, the coefficient on income is negative and significant.[48] The regression yielded no significant relationships between income and provincial government drug expenditures for the remaining provinces.[49] It may be that provincial government drug expenditures are somewhat more sensitive to income in the lower-income Atlantic provinces than they are elsewhere. In the provinces for which the income coefficient is significant, the economic impact of the income variable was fairly modest. In Prince Edward Island, growth in real per capita income over the period 1975-2000

**TABLE 3 Regression Results for Drug Expenditures (OLS with Robust Standard Errors)**

| Variable | Estimated coefficient | Standard error | T-ratio |
|---|---|---|---|
| NFLD | 30.13317 | 23.91283 | 1.26 |
| PEI | 49.81531 | 27.19824 | 1.83 |
| NS | –3.561982 | 19.03989 | –0.19 |
| NB | 22.95727 | 30.02165 | 0.76 |
| QUE | 9.734035 | 23.28591 | 0.42 |
| ONT | 7.193189 | 23.91423 | 0.30 |
| MAN | 43.57351 | 30.12563 | 1.45 |
| SASK | 74.14597 | 30.7454 | 2.41[a] |
| BC | 18.50716 | 20.89842 | 0.89 |
| PRP1844 | 110.2556 | 132.1082 | 0.83 |
| PRP4564 | 250.6677 | 148.3129 | 1.69[b] |
| PRP6574 | 1664.104 | 407.7845 | 4.08[a] |
| PRP75 | –1204.028 | 583.3344 | –2.06[a] |
| PHYC | –21.81005 | 16.2951 | –1.34 |
| HOSPHG | –36.74908 | 29.64024 | –1.24 |
| NFLD*RNFCSHC | 0.001584 | 0.0112604 | 0.14 |
| PEI*RNFCSHC | –0.0053917 | 0.0087362 | –0.62 |
| NS*RNFCSHC | –0.030108 | 0.0131174 | –2.30[a] |
| NB*RNFCSHC | 0.0557014 | 0.0211762 | 2.63[a] |
| QUE*RNFCSHC | –0.0046615 | 0.0138768 | –0.34 |
| ONT*RNFCSHC | –0.0497131 | 0.0202864 | –2.45[a] |
| MAN*RNFCSHC | –0.0398704 | 0.0134881 | –2.96[a] |
| SASK*RNFCSHC | –0.0242135 | 0.0090085 | –2.69[a] |
| BC*RNFCSHC | 0.0248109 | 0.0192988 | 1.29 |
| NFLD*RGDPC | –0.0021963 | 0.0013899 | –1.58 |
| PEI*RGDPC | –0.003922 | 0.0017811 | –2.20[a] |
| NS*RGDPC | 0.0032419 | 0.0008418 | 3.85[a] |
| NB*RGDPC | –0.0062494 | 0.0018065 | –3.46[a] |
| QUE*RGDPC | –0.000395 | 0.0009405 | –0.42 |
| ONT*RGDPC | 0.0004341 | 0.0007572 | 0.57 |
| MAN*RGDPC | –0.0008468 | 0.0013004 | –0.65 |
| SASK*RGDPC | –0.0017405 | 0.0010254 | –1.70[b] |
| BC*RGDPC | –0.0008188 | 0.0005309 | –1.54 |
| BC65CHRG87 | –7.87298 | 3.596174 | –2.19[a] |
| BCREFPRC | –4.986812 | 4.577905 | –1.09 |
| AB65CHRG94 | –20.68465 | 3.995774 | –5.18[a] |
| SK65CHRG93 | –39.94079 | 6.038359 | –6.61[a] |
| MBGPINTR96 | 12.61766 | 7.580456 | 1.66 |
| ONGPINTR95 | 8.765432 | 5.028513 | 1.74[b] |

(Table 3 is concluded on the next page.)

**TABLE 3 Concluded**

| Variable | Estimated coefficient | Standard error | T-ratio |
|---|---|---|---|
| ON65CHRG96 | –3.251536 | 5.33938 | –0.61 |
| PQGPINTR97 | –11.3566 | 5.324875 | –2.13[a] |
| NB65CHRG83 | 6.582539 | 7.277657 | 0.90 |
| NB65CHRG96 | –38.06962 | 9.405488 | –4.05[a] |
| NS65CHRG90 | –7.36209 | 4.790652 | –1.54 |
| NS65CHRG93 | –11.64049 | 5.146317 | –2.26[a] |
| PE65INTR86 | 4.899692 | 7.411874 | 0.66 |
| NF65INTR80 | –4.322733 | 3.101959 | –1.39 |
| yr1976 | 3.415065 | 3.048695 | 1.12 |
| yr1977 | 2.764039 | 3.502826 | 0.79 |
| yr1978 | 2.632239 | 4.350103 | 0.61 |
| yr1979 | 5.519671 | 5.607982 | 0.98 |
| yr1980 | 3.805177 | 6.558828 | 0.58 |
| yr1981 | 6.897883 | 7.441098 | 0.93 |
| yr1982 | 9.067033 | 8.751976 | 1.04 |
| yr1983 | 15.20597 | 9.630439 | 1.58 |
| yr1984 | 18.98992 | 10.03996 | 1.89[b] |
| yr1985 | 23.95497 | 10.61332 | 2.26[a] |
| yr1986 | 32.72504 | 11.38599 | 2.87[a] |
| yr1987 | 39.15708 | 12.55934 | 3.12[a] |
| yr1988 | 47.04345 | 13.35801 | 3.52[a] |
| yr1989 | 54.39872 | 13.80635 | 3.94[a] |
| yr1990 | 59.36237 | 13.80553 | 4.30[a] |
| yr1991 | 62.81844 | 13.87003 | 4.53[a] |
| yr1992 | 65.79055 | 13.58061 | 4.84[a] |
| yr1993 | 69.05754 | 14.05087 | 4.91[a] |
| yr1994 | 68.33875 | 12.99358 | 5.26[a] |
| yr1995 | 75.03113 | 13.43134 | 5.59[a] |
| yr1996 | 76.82944 | 13.42556 | 5.72[a] |
| yr1997 | 79.02451 | 13.47623 | 5.86[a] |
| yr1998 | 89.19156 | 13.90047 | 6.42[a] |
| yr1999 | 102.8663 | 14.23627 | 7.23[a] |
| yr2000 | 114.4798 | 14.6951 | 7.79[a] |
| Constant | –75.56335 | 81.05494 | –0.93 |

R-squared = 0.9763
F = 376.14

[a] Significant at the 5 percent level
[b] Significant at the 10 percent level.

**TABLE 4 Regression Results for Drug Expenditures (OLS)**

| Variable | Estimated coefficient | Standard error | T-ratio |
|---|---|---|---|
| NFLD | 30.13317 | 22.26804 | 1.35 |
| PEI | 49.81531 | 24.11017 | 2.07[a] |
| NS | –3.561982 | 17.99368 | –0.20 |
| NB | 22.95727 | 23.87323 | 0.96 |
| QUE | 9.734035 | 24.35545 | 0.40 |
| ONT | 7.193189 | 26.46455 | 0.27 |
| MAN | 43.57351 | 32.65262 | 1.33 |
| SASK | 74.14597 | 29.35636 | 2.53[a] |
| BC | 18.50716 | 27.88364 | 0.66 |
| PRP1844 | 110.2556 | 109.7652 | 1.00 |
| PRP4564 | 250.6677 | 148.7195 | 1.69[b] |
| PRP6574 | 1664.104 | 408.2377 | 4.08[a] |
| PRP75 | –1204.028 | 492.6543 | –2.44[a] |
| PHYC | –21.81005 | 14.95176 | –1.46 |
| HOSPHG | –36.74908 | 28.99526 | –1.27 |
| NFLD*RNFCSHC | 0.001584 | 0.0094628 | 0.17 |
| PEI*RNFCSHC | –0.0053917 | 0.0101745 | –0.53 |
| NS*RNFCSHC | –0.030108 | 0.0118314 | –2.54[a] |
| NB*RNFCSHC | 0.0557014 | 0.015802 | 3.52[a] |
| QUE*RNFCSHC | –0.0046615 | 0.0125064 | –0.37 |
| ONT*RNFCSHC | –0.0497131 | 0.0266576 | –1.86[b] |
| MAN*RNFCSHC | –0.0398704 | 0.013959 | –2.86[a] |
| SASK*RNFCSHC | –0.0242135 | 0.0088301 | –2.74[a] |
| BC*RNFCSHC | 0.0248109 | 0.0221565 | 1.12 |
| NFLD*RGDPC | –0.0021963 | 0.0013538 | –1.62 |
| PEI*RGDPC | –0.003922 | 0.0015786 | –2.48[a] |
| NS*RGDPC | 0.0032419 | 0.0008278 | 3.92[a] |
| NB*RGDPC | –0.0062494 | 0.0013965 | –4.48[a] |
| QUE*RGDPC | –0.000395 | 0.0011012 | –0.36 |
| ONT*RGDPC | 0.0004341 | 0.0008301 | 0.52 |
| MAN*RGDPC | –0.0008468 | 0.0016365 | –0.52 |
| SASK*RGDPC | –0.0017405 | 0.0010155 | –1.71 |
| BC*RGDPC | –0.0008188 | 0.0009566 | –0.86 |
| BC65CHRG87 | –7.87298 | 3.931578 | –2.00[a] |
| BCREFPRC | –4.986812 | 5.751065 | –0.87 |
| AB65CHRG94 | –20.68465 | 4.354438 | –4.75[a] |
| SK65CHRG93 | –39.94079 | 6.175536 | –6.47[a] |
| MBGPINTR96 | 12.61766 | 6.798001 | 1.86[b] |
| ONGPINTR95 | 8.765432 | 7.980607 | 1.10 |
| ON65CHRG96 | –3.251536 | 8.741581 | –0.37 |
| PQGPINTR97 | –11.3566 | 5.792598 | –1.96[a] |
| NB65CHRG83 | 6.582539 | 6.385735 | 1.03 |
| NB65CHRG96 | –38.06962 | 7.664834 | –4.97[b] |

(Table 4 is concluded on the next page.)

**TABLE 4 Concluded**

| Variable | Estimated coefficient | Standard error | T-ratio |
|---|---|---|---|
| NS65CHRG90 | –7.36209 | 5.301908 | –1.39 |
| NS65CHRG93 | –11.64049 | 5.709757 | –2.04[a] |
| PE65INTR86 | 4.899692 | 5.384336 | 0.91 |
| NF65INTR80 | –4.322733 | 4.431723 | –0.98 |
| yr1976 | 3.415065 | 2.914351 | 1.17 |
| yr1977 | 2.764039 | 3.436304 | 0.80 |
| yr1978 | 2.632239 | 4.099027 | 0.64 |
| yr1979 | 5.519671 | 4.927204 | 1.12 |
| yr1980 | 3.805177 | 5.916246 | 0.64 |
| yr1981 | 6.897883 | 6.701623 | 1.03 |
| yr1982 | 9.067033 | 7.754965 | 1.17 |
| yr1983 | 15.20597 | 8.473914 | 1.79 |
| yr1984 | 18.98992 | 8.861266 | 2.14[a] |
| yr1985 | 23.95497 | 9.473225 | 2.53[a] |
| yr1986 | 32.72504 | 9.942761 | 3.29[a] |
| yr1987 | 39.15708 | 10.50631 | 3.73[a] |
| yr1988 | 47.04345 | 11.06491 | 4.25[a] |
| yr1989 | 54.39872 | 11.54549 | 4.71[a] |
| yr1990 | 59.36237 | 11.7585 | 5.05[a] |
| yr1991 | 62.81844 | 12.14303 | 5.17[a] |
| yr1992 | 65.79055 | 12.15237 | 5.41[a] |
| yr1993 | 69.05754 | 12.32237 | 5.60[a] |
| yr1994 | 68.33875 | 12.27932 | 5.57[a] |
| yr1995 | 75.03113 | 12.54852 | 5.98[a] |
| yr1996 | 76.82944 | 12.56326 | 6.12[a] |
| yr1997 | 79.02451 | 12.83744 | 6.16[a] |
| yr1998 | 89.19156 | 13.25261 | 6.73[a] |
| yr1999 | 102.8663 | 13.58656 | 7.57[a] |
| yr2000 | 114.4798 | 13.97712 | 8.19[a] |
| Constant | –75.56335 | 67.00823 | –1.13 |

R-squared = 0.9672
F = 106.07

[a] Significant at the 5 percent level
[b] Significant at the 10 percent level.

was responsible for a decrease in real per capita provincial government drug expenditures of $33.[50] The same variable was associated with an increase of $33 in Nova Scotia and a decrease of $64 in New Brunswick.

The provinces also appear to differ in their allocation of additional federal transfers between drug insurance programs and other spending priorities. Per capita federal cash transfers appear to have led to increased drug program spending in New Brunswick but to decreased spending in Nova Scotia, Ontario (the results in this case are significant at the 10 percent level only), Manitoba, and Saskatchewan. In the remaining provinces, the effect of federal transfers on drug spending was not statistically significant. The regional variation in the economic impact of federal cash transfers on provincial drug spending was modest. Given the increase in transfers between 1975 and 2000,[51] real per capita provincial government drug expenditures increased by $47 in New Brunswick and decreased by $20 in Nova Scotia, $29 in Manitoba, and $7 in Saskatchewan. Thus our results suggest that simply increasing federal cash transfers to the provinces may not necessarily boost provincial government drug expenditures. Finally, we note that provincial government drug expenditures appear to be more sensitive to changes in federal cash transfers than they are to changes in own-source income.[52]

Relative to the 0-17 age group, provincial government drug expenditures are associated positively with the proportions of population in the 45-64 age group (at the 10 percent level) and the 65-74 age group. They are associated negatively and significantly with the proportion of population in the 75+ age group. These results suggest that the relation between drug expenditures and age is somewhat complex. Provincial government real per capita drug expenditures are $1,664 higher for the 65-74 age group than they are for the 0-17 age group. For the 75+ group, however, drug expenditures are about $1,200 lower than they are for the 0-17 age group. This outcome may be attributable to sample selection: seniors who are still alive and not hospitalized at age 75 may be in better health and hence have lower drug expenditures. Grootendorst and Levine report similar findings on the basis of estimates of average drug use by community-dwelling Canadians by age group, estimates that use data from the Statistics Canada National Population Health Survey.[53] Average drug use, as measured by the number of different drugs, increases steadily from age 35, plateaus by age 75, and then begins to decline. This does not necessarily mean that total drug expenditures drop after age 74; it is possible that the drug expenditures of institutionalized persons increases after age 74.

The cost-control measures introduced by the provincial drug programs appear to have achieved their intended effects. The introduction of drug co-payments for senior beneficiaries of the British Columbia drug program in 1987 had a negative and significant impact on provincial government drug expenditures, whereas the impact of reference pricing was negative but not significant at the 5 percent level. The increase in the seniors' co-payment in Alberta in 1994 depressed expenditures by nearly $21 per capita. In Saskatchewan, the increase in 1993 in the co-payments for both seniors and the general population also depressed expenditures quite significantly—by approximately $40 per capita. The introduction of drug coverage

for the non-elderly and non-indigent in Manitoba in 1996 and Ontario in 1995 increased real per capita provincial government drug expenditures, but for Manitoba the results are significant only at the 10 percent level.[54] In Quebec, the introduction of a co-payment requirement for seniors and social-assistance recipients in August 1996 and the introduction of a universal drug plan four months later significantly depressed provincial government drug expenditures.[55] The effects of increases in co-payments in Nova Scotia in 1993 and New Brunswick in 1996 are negative and significant. In Newfoundland, the introduction in 1980 of coverage for low-income seniors had no significant impact on expenditures. Overall, the results for these policy variables suggest that the introduction of senior beneficiary co-payments or increases in them has reduced provincial government drug program expenditures, as one would expect, yet the introduction of universal drug plans in Ontario and Manitoba does not appear to have increased per capita expenditure greatly .

The relation between prescribing physicians per capita and drug expenditures is negative and not significant. The 1990s did witness a decline in the number of physicians per capita in Canada, especially among family physicians. The relation between the share of health spending in hospitals and provincial drug expenditures is also negative but not significant at the 5 percent level. The provincial indicators suggest that, other things being equal, per capita provincial government drug expenditures are significantly higher relative to expenditures in Alberta only in Prince Edward Island (at the 10 percent level) and Saskatchewan.

Finally, the estimated coefficients for the year indicator variables suggest that the combined effects of the unmodelled time-varying factors increased real per capita provincial government drug expenditures between 1975 and 2000, although the rate of increase varied over the period. Figures 8 and 9 depict the estimated year effects (relative to 1975) and their respective confidence intervals; the vertical lines indicate the onset of Bills C-22 (1987) and C-91 (1993). It is clear from the figures that the patent term extensions did not have any obvious immediate impact on expenditures. Indeed, expenditures were growing before the introduction of Bill C-22, and the rate of growth actually declined in the early 1990s. It was not until four years after the introduction of Bill C-91 that expenditure growth accelerated. Per capita drug expenditures in 1987 were $39 higher than they had been in 1975; in 1993 they were $69 higher than the 1975 amount, and in 2000 they were $114 higher. The large increase after 1993 may be attributable to the changes in patent legislation in Bill C-22 and Bill C-91. Patent extensions may have resulted in drug prices that were higher than they would have been in the absence of the extensions. The extensions may also have led to increased spending on drugs by encouraging increased research and development and hence the introduction of new drugs. However, given the long lag between basic research and the market introduction of a new drug, it is unlikely that the patent changes resulted in new drugs being commercially available prior to 2000, the end of our sample period. Of course, recent increases in per capita spending may instead be attributable to the introduction of drugs that would have been introduced even had the patents not been extended. To the extent that the increases in expenditure have been induced by the changes in the patent

**FIGURE 8 Year Effects (OLS with OLS S.E.)**

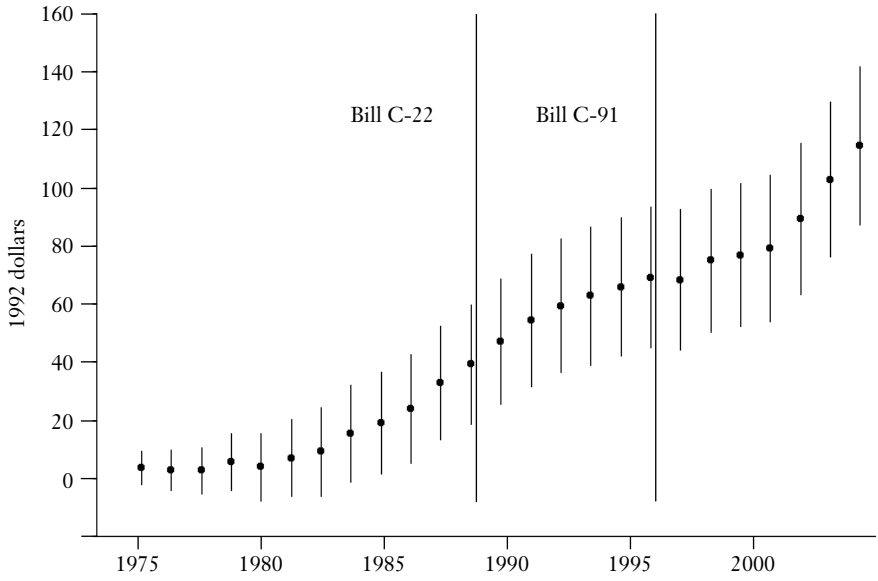
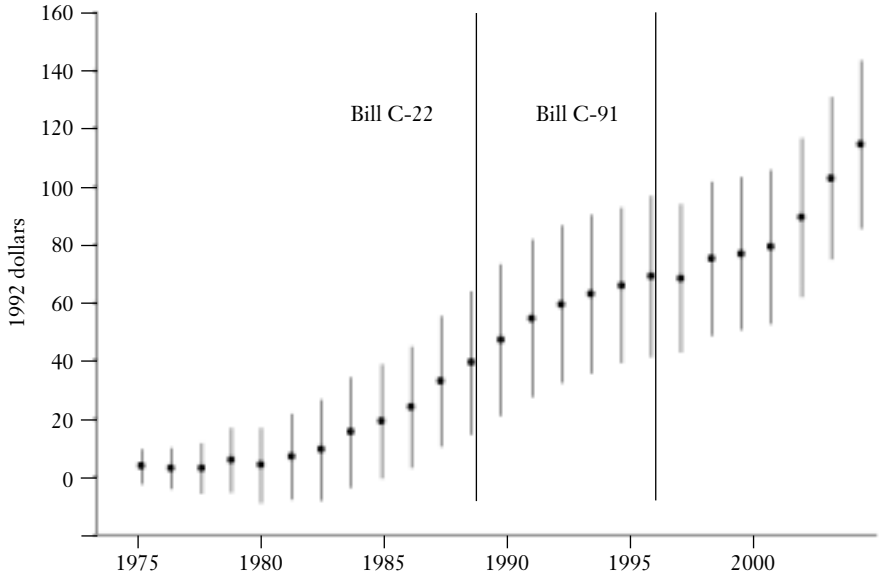



**FIGURE 9 Year Effects (OLS with robust S.E.)**



legislation, it is difficult to say which changes lead to the expenditure increase. It may be that the effects of Bill C-22, introduced in 1987, took some time to be felt, or it may be that Bill C-91 produced the larger effective increase in patent protection and hence in drug expenditure.

An important use of the estimated model is to forecast how real per capita provincial government drug expenditures may evolve over time. This is a difficult task, given not only the large number of drug policy variables but also the need to forecast both real provincial GDP and federal transfer payments. It is a relatively straightforward matter, however, to estimate the effects of age and secular trends alone on real per capita provincial government drug expenditures, given that the effects of all other variables are constant. Demographic projections of population and age structure are now available from Statistics Canada for the period 2000-2026; table 5 shows the projections for the 65-74 and over-74 age groups relative to total population in each province in 2011.[56] We used these projections with the coefficient estimates in the model to calculate the increase in real per capita drug expenditures that is attributable to the aging of the population over the period 2000 to 2011.[57] Table 6 shows the results of this calculation. For some provinces (Ontario, Saskatchewan, and Alberta), there is actually a decline in real per capita spending, since population growth in the 75+ age group counters growth in the 65-74 age group.

We also fitted a linear trend line to the year coefficients over the period 1976-2000 and used the resulting regression to estimate forecast secular trends over the period 2001-2025. Figure 10 depicts the results of this forecast in the form of 95 percent confidence-interval estimates. Between 2001 and 2025, secular trends alone will add approximately $195 per capita to provincial government drug expenditures. One must take this forecast with a great deal of caution, however, given the many changes that can occur over 25 years across a great many variables and across provincial jurisdictions.

Between 2000 and 2011, secular trends are expected to add approximately $71 per capita to real per capita provincial government drug expenditures. Table 6 adds the contribution of secular trends to the contribution for age to present a combined forecasted estimate of real per capita provincial government drug expenditures on the basis of aging and trend effects. The table suggests that relative to the effects of technological change and other factors comprising the secular trends population aging will account for very modest increases in real per capita provincial government drug expenditures. If the residual secular trends observed to date continue into the future, the bulk of the increases in per capita drug expenditure will be fuelled by technological change (the introduction of new drugs) or increases in prices that are attributable to patent extension. Average real per capita provincial government expenditure will rise from $109 in 2000 to $188 by 2011, but only $9 of this increase (11 percent) will be attributable to the aging of the population, whereas about $70 (89 percent) will be attributable to the time effect. It is unclear how changes in the other determinants of drug expenditure, such as federal transfers, income, and future changes in provincial drug plan benefits, will affect future expenditures.

**TABLE 5 Demographic Variables**

| | Proportion 65-74 | | Proportion 75+ | |
|---|---|---|---|---|
| | 2000 | 2011 | 2000 | 2011 |
| Newfoundland | 0.066 | 0.089 | 0.051 | 0.063 |
| Prince Edward Island | 0.069 | 0.082 | 0.063 | 0.064 |
| Nova Scotia | 0.070 | 0.087 | 0.063 | 0.070 |
| New Brunswick | 0.069 | 0.086 | 0.062 | 0.071 |
| Quebec | 0.073 | 0.088 | 0.055 | 0.071 |
| Ontario | 0.071 | 0.076 | 0.056 | 0.066 |
| Manitoba | 0.069 | 0.076 | 0.068 | 0.072 |
| Saskatchewan | 0.072 | 0.073 | 0.074 | 0.081 |
| Alberta | 0.057 | 0.066 | 0.044 | 0.057 |
| British Columbia | 0.070 | 0.077 | 0.060 | 0.069 |

Source: Statistics Canada, *Population Projections for Canada, Provinces and Territories 2000-2026*, catalogue no. 91-520-XPB, 142.

## CONCLUSION

This article has estimated the determinants of real per capita provincial government drug expenditures. Our results suggest that the impact of per capita income and federal cash transfers on these expenditures varies across provinces in terms of direction and significance. The results also suggest that drug expenditures by provincial governments are generally more sensitive to federal cash transfers than they are to private income. The age variables are important determinants of per capita provincial government drug expenditures; the results suggest that the aging of the population will increase drug expenditures for the 65-74 age group. This is not surprising; seniors aged 65 or older are the single largest beneficiary group of the provincial drug plans; people under 65 receive provincial subsidies only if they are indigent or incur large drug costs relative to income. What is surprising is the decline in expenditures for the 75+ age range, a result that may be a consequence of the "healthy survivor" effect or that may arise because hospital drug expenditures, which our drug expenditure measure does not include, are higher for this age group than they are for other groups.

The introduction of provincial drug co-payment plans has generally served to depress per capita drug expenditures, yet the extension of government drug plans to new groups has not greatly increased expenditures.[58] Thus extensions of coverage, such as in Newfoundland and Manitoba, do not necessarily crowd out private drug expenditures. In Newfoundland's case, however, the plan's failure to increase public spending significantly may also reflect the fact that the plan benefited only low-income persons, since many low-income seniors could instead claim drug benefits under welfare programs that had already been around for a decade. Moreover, when Newfoundland introduced its program in 1980 fewer drugs were available than are available now; consequently, the increase in drug use induced by the plan may have been smaller than it would be now. The Manitoba plan consisted of two

**TABLE 6 Projections of Real per Capita Provincial Government Drug Expenditures**

| | Expenditures in 2000 (1992 $) | Expenditures in 2011 (age effect only) (1992 $) | Expenditures in 2011 (age effect plus time effect) (1992 $) | Average annual growth, 2000 to 2011 (%) |
|---|---|---|---|---|
| Newfoundland | 117 | 141 | 211 | 7.3 |
| Prince Edward Island | 90 | 111 | 181 | 9.2 |
| Nova Scotia | 122 | 141 | 212 | 6.7 |
| New Brunswick | 87 | 104 | 175 | 9.2 |
| Quebec | 120 | 125 | 196 | 5.6 |
| Ontario | 144 | 140 | 211 | 4.2 |
| Manitoba | 91 | 98 | 169 | 7.8 |
| Saskatchewan | 88 | 81 | 152 | 6.6 |
| Alberta | 110 | 109 | 180 | 5.8 |
| British Columbia | 124 | 125 | 195 | 5.2 |
| Average | 109 | 118 | 188 | 6.8 |

policy changes: the province extended coverage, with deductibles, to all residents, but this change came at the expense of seniors, who typically received less generous insurance than they had enjoyed previously.

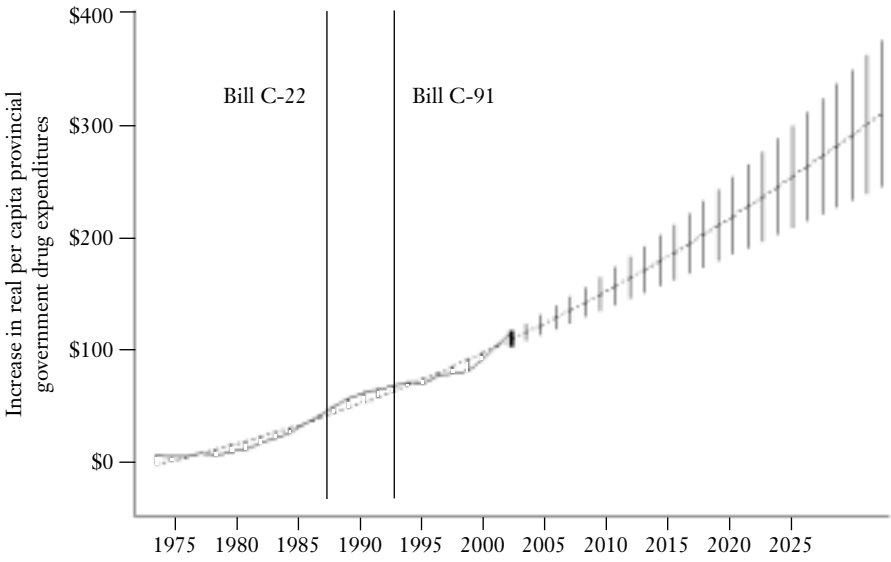
In addition, the year indicator variables suggest that any significant effects of the patent-term extensions of 1987 (Bill C-22) and 1993 (Bill C-91) on provincial drug expenditures occurred after 1995. It is possible that over the period 1987-1994 the impact of the patent extensions on expenditure was muted by unobserved provincial government schemes for controlling the cost of drugs. Alternatively, it is possible that the PMPRB was effective during this period in limiting the rate at which drug prices increased. In any case, our analysis suggests that either Bill C-91 had a more pronounced effect on drug expenditures than did Bill C-22, or the effect of the earlier legislation on drug expenditures operated with a lag, or the legislation had little effect on drug costs, and the post-1995 increase in drug expenditures is due to other factors, such as the introduction of new drugs that would have been introduced irrespective of Canada's patent legislation. Finally, simple projections of the effect of population aging and residual secular trends on provincial drug expenditures suggest that the effect of population aging is very modest relative to that of technological change and the other time-varying factors captured in the time trend.

## APPENDIX: A NOTE ON PROVINCIAL GDP AND FEDERAL CASH TRANSFERS

### Provincial GDP

Two CANSIM series were available for the provinces for provincial GDP at market prices (income-based). Over the period 1981-1996, we found the second series to be higher than the first by an average across the provinces of 3 percent. We constructed

**FIGURE 10 Time Effects, Actual and Forecast, 1975-2025**




Note: The results for the actual increase in real per capita provincial government drug expenditures since 1975 refer to 1976-2000 and are estimated from the linear regression model; the forecast results, with 96 percent confidence intervals, refer to 2001-2025.

the provincial GDP series for each province by using the first series for the period 1975 to 1980 and multiplying it by the average ratio of the second series divided by the first series for the period 1981-1985 for each province. For the period 1981-2000, we used the second series. Table A1 shows our results.

## Federal Cash Transfers

Two separate CANSIM series were available for the periods 1961-1995 and 1989-2000. The series for 1961-1995 was for cash transfer payments to the provinces. The data for 1989-2000 divided into general and specific cash transfer payments to the provinces and summed together to obtain total cash transfers. There were some differences in the two series for the overlap period. In an effort to generate a more consistent series and a cash transfer variable that was oriented more specifically to health expenditure, we used data for 1975-2000 from the Department of Finance to construct a federal "health" cash transfer variable from equalization cash transfers, the cash component of EPF, the cash component of the CHST entitlement, and the value of health grants for the two years before the onset of EPF. Table A2 shows the results of this exercise.

**TABLE A1 Estimated Provincial GDPs, 1975-2000**

| | Nfld. | PEI | NS | NB | Que. | Ont. | Man. | Sask. | Alta. | BC |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | *millions of dollars* | | | | | |
| 1975 | 2,311 | 497 | 3,947 | 3,229 | 41,263 | 69,150 | 7,157 | 6,927 | 19,097 | 19,623 |
| 1976 | 2,746 | 615 | 4,582 | 3,789 | 48,068 | 79,319 | 8,136 | 7,882 | 21,893 | 23,152 |
| 1977 | 3,109 | 649 | 4,983 | 4,111 | 52,617 | 85,887 | 8,593 | 8,154 | 25,079 | 25,827 |
| 1978 | 3,344 | 735 | 5,644 | 4,627 | 58,574 | 93,751 | 9,530 | 9,286 | 29,745 | 28,934 |
| 1979 | 4,053 | 847 | 6,176 | 5,587 | 65,444 | 105,873 | 10,680 | 10,498 | 36,432 | 33,595 |
| 1980 | 4,248 | 912 | 6,377 | 5,208 | 72,782 | 116,658 | 11,579 | 12,436 | 44,306 | 38,508 |
| 1981 | 5,162 | 1,073 | 7,984 | 6,355 | 80,765 | 130,866 | 13,613 | 14,769 | 53,346 | 44,849 |
| 1982 | 5,618 | 1,161 | 9,210 | 7,056 | 85,468 | 138,424 | 14,040 | 14,999 | 56,739 | 45,011 |
| 1983 | 5,998 | 1,365 | 10,381 | 8,050 | 92,056 | 154,282 | 15,096 | 15,958 | 58,344 | 47,463 |
| 1984 | 6,381 | 1,397 | 11,449 | 8,823 | 100,583 | 172,316 | 16,975 | 17,016 | 62,214 | 49,821 |
| 1985 | 6,653 | 1,454 | 12,412 | 9,375 | 107,604 | 188,481 | 18,504 | 17,904 | 66,685 | 53,519 |
| 1986 | 7,248 | 1,636 | 13,410 | 10,463 | 117,321 | 207,681 | 19,213 | 17,734 | 57,845 | 56,606 |
| 1987 | 7,766 | 1,736 | 14,440 | 11,564 | 128,628 | 229,950 | 20,353 | 18,182 | 59,942 | 62,483 |
| 1988 | 8,471 | 1,926 | 15,301 | 12,431 | 140,939 | 255,315 | 21,966 | 18,817 | 63,803 | 69,331 |
| 1989 | 8,999 | 2,063 | 16,312 | 13,123 | 148,429 | 277,580 | 23,294 | 19,947 | 67,212 | 75,519 |
| 1990 | 9,218 | 2,177 | 16,987 | 13,437 | 153,299 | 281,534 | 24,103 | 21,182 | 73,077 | 79,227 |
| 1991 | 9,590 | 2,258 | 17,644 | 13,624 | 155,134 | 281,570 | 23,948 | 21,176 | 72,713 | 81,766 |
| 1992 | 9,550 | 2,331 | 18,071 | 14,029 | 158,357 | 285,101 | 24,420 | 21,102 | 74,748 | 87,066 |
| 1993 | 9,767 | 2,460 | 18,308 | 14,676 | 162,093 | 291,733 | 24,604 | 23,028 | 80,973 | 93,822 |
| 1994 | 10,257 | 2,515 | 18,628 | 15,261 | 170,148 | 309,031 | 25,871 | 24,443 | 87,637 | 100,149 |
| 1995 | 10,649 | 2,663 | 19,263 | 16,349 | 177,107 | 327,246 | 26,837 | 26,334 | 91,634 | 105,319 |
| 1996 | 10,403 | 2,814 | 19,436 | 16,580 | 180,199 | 335,843 | 28,319 | 28,927 | 98,197 | 108,454 |
| 1997 | 10,462 | 2,763 | 20,195 | 16,779 | 187,862 | 357,300 | 29,407 | 29,046 | 106,518 | 113,596 |
| 1998 | 11,232 | 2,851 | 21,110 | 17,457 | 193,695 | 372,630 | 29,966 | 28,828 | 106,174 | 113,945 |
| 1999 | 12,110 | 2,994 | 22,407 | 18,390 | 204,062 | 396,775 | 30,995 | 30,143 | 116,990 | 118,783 |
| 2000 | 12,718 | 3,192 | 23,623 | 19,332 | 216,695 | 426,900 | 32,686 | 31,824 | 126,935 | 125,623 |

Source: CANSIM Series 1, 1961-1996: D31544, D31588, D31572, D31586, D31600, D31614, D31628, D31642, D31656, D44000;
CANSIM Series 2, 1981-2000: D24022, D24034, D24046, D24058, D24070, D24082, D24094, D24106, D24118, D24130

**TABLE A2 Federal "Health" Cash Transfer Variable, 1975-76 Through 2000-1**

| | Nfld. | PEI | NS | NB | Que. | Ont. | Man. | Sask. | Alta. | BC |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | *millions of dollars* | | | | | |
| 1975-76 ..... | 264 | 62 | 359 | 277 | 1,949 | 1,147 | 291 | 122 | 257 | 339 |
| 1976-77 ..... | 322 | 72 | 433 | 348 | 1,322 | 1,387 | 324 | 164 | 302 | 402 |
| 1977-78 ..... | 343 | 76 | 444 | 353 | 2,165 | 994 | 368 | 171 | 205 | 260 |
| 1978-79 ..... | 400 | 88 | 495 | 427 | 2,411 | 1,154 | 441 | 166 | 242 | 313 |
| 1979-80 ..... | 435 | 101 | 564 | 422 | 2,791 | 1,303 | 510 | 227 | 289 | 369 |
| 1980-81 ..... | 463 | 113 | 616 | 492 | 3,150 | 1,427 | 547 | 197 | 332 | 413 |
| 1981-82 ..... | 536 | 131 | 691 | 579 | 3,729 | 1,578 | 596 | 195 | 385 | 472 |
| 1982-83 ..... | 588 | 145 | 759 | 640 | 4,191 | 1,770 | 664 | 223 | 361 | 553 |
| 1983-84 ..... | 682 | 156 | 818 | 692 | 4,587 | 2,026 | 725 | 263 | 471 | 664 |
| 1984-85 ..... | 730 | 162 | 849 | 728 | 4,793 | 2,159 | 759 | 291 | 516 | 743 |
| 1985-86 ..... | 813 | 169 | 840 | 802 | 4,546 | 2,263 | 724 | 319 | 576 | 806 |
| 1986-87 ..... | 842 | 174 | 872 | 848 | 4,831 | 2,331 | 781 | 576 | 661 | 848 |
| 1987-88 ..... | 972 | 200 | 988 | 930 | 5,065 | 2,323 | 1,041 | 594 | 689 | 865 |
| 1988-89 ..... | 1,008 | 215 | 1,098 | 984 | 5,375 | 2,353 | 1,119 | 760 | 715 | 891 |
| 1989-90 ..... | 1,072 | 232 | 1,160 | 1,106 | 5,426 | 2,433 | 1,294 | 950 | 748 | 907 |
| 1990-91 ..... | 1,091 | 233 | 1,220 | 1,087 | 5,684 | 2,522 | 1,244 | 832 | 727 | 912 |
| 1991-92 ..... | 1,046 | 225 | 1,122 | 1,188 | 5,559 | 2,757 | 1,182 | 777 | 738 | 959 |
| 1992-93 ..... | 1,062 | 208 | 1,186 | 1,095 | 5,743 | 2,899 | 1,209 | 794 | 769 | 989 |
| 1993-94 ..... | 1,074 | 214 | 1,166 | 1,060 | 6,038 | 2,923 | 1,237 | 788 | 753 | 1,004 |
| 1994-95 ..... | 1,128 | 231 | 1,337 | 1,148 | 6,084 | 2,869 | 1,413 | 702 | 733 | 1,009 |
| 1995-96 ..... | 1,095 | 231 | 1,403 | 1,091 | 6,380 | 2,791 | 1,374 | 554 | 723 | 1,045 |
| 1996-97 ..... | 1,374 | 280 | 1,690 | 1,420 | 8,680 | 4,787 | 1,724 | 724 | 1,112 | 1,843 |
| 1997-98 ..... | 1,376 | 300 | 1,734 | 1,451 | 8,644 | 3,885 | 1,560 | 625 | 878 | 1,724 |
| 1998-99 ..... | 1,344 | 299 | 1,653 | 1,450 | 8,257 | 3,810 | 1,600 | 910 | 894 | 1,827 |
| 1999-2000 ..... | 1,431 | 325 | 1,762 | 1,565 | 9,140 | 4,700 | 1,805 | 905 | 1,308 | 2,226 |
| 2000-1 ..... | 1,424 | 347 | 1,921 | 1,661 | 9,381 | 5,104 | 1,896 | 807 | 1,382 | 2,359 |

## NOTES

1 Canadian Institute for Health Information, *Health Care in Canada 2002* (Ottawa: CIHI, May 2002 (available on the Web at http://secure.cihi.ca/).

2 In 1975, total health expenditures were $12.201 billion and total drug expenditures were $1.076 billion. In 2000, total health expenditures are estimated at $95.881 billion and total drug expenditures at $14.312 billion. As for spending by provincial and territorial governments, the figures for total health spending and drug spending were $8.710 and $0.142 billion respectively in 1975 and $63.126 and $4.408 billion in 2000. See Canadian Institute for Health Information, *National Health Expenditure Trends, 1975-2000* (Ottawa: CIHI, 2000) and *Drug Expenditure in Canada, 1985-2000* (Ottawa: CIHI, 2001).

3 Provincial and Territorial Ministers of Health, *Understanding Canada's Health Care Costs: Final Report* (Provincial and Territorial Ministers of Health, August 2000), 17.

4 W. Davidson, W. Molloy, and M. Bédard, "Physician Characteristics and Prescribing for Elderly People in New Brunswick: Relation to Patient Outcomes" (1995) vol. 152, no. 8 *Canadian Medical Association Journal* 1227-34.

5 The bulk of provincial government drug expenditure is for seniors. For example, total spending by the British Columbia Pharmacare program on prescription drugs in 1999 (the most recent available year) was $455.1 million. Of this amount, 20 percent was spent on drugs for welfare recipients, 58 percent on drugs for seniors, and the balance on drugs for the general population, residents of facilities for long-term care, and the beneficiaries of a variety of smaller programs. See British Columbia, Ministry of Health Services, *Pharmacare Trends 2000* (Victoria: Ministry of Health Services, 2001).

6 See Richard A. Musgrave, Peggy B. Musgrave, and Richard M. Bird, *Public Finance in Theory and Practice*, 1st Cdn. ed. (Toronto: McGraw-Hill Ryerson, 1987).

7 For an overview, see Sherman Folland, Allen C. Goodman, and Miron Stano, *The Economics of Health and Health Care*, 3d ed. (Upper Saddle River, NJ: Prentice-Hall, 2001).

8 See Sule Alan, Thomas F. Crossley, Paul Grootendorst, and Michael R. Veall, "The Effects of Drug Subsidies on Out-of-Pocket Prescription Drug Expenditures by Seniors: Regional Evidence from Canada" (2002) vol. 21 no. 5 *Journal of Health Economics* 805-26.

9 Mark Stabile, "Private Insurance Subsidies and Public Health Care Markets: Evidence from Canada" (2001) vol. 34, no. 4 *Canadian Journal of Economics* 921-42.

10 Geoffrey M. Anderson, Kerry J. Kerluke, Indra R. Pulcins, Clyde Hertzman, and Morris L. Barer, "Trends and Determinants of Prescription Drug Expenditures in the Elderly: Data from the British Columbia Pharmacare Program" (1993) vol. 30, no. 2 *Inquiry: The Journal of Health Care Organization, Provision, and Financing* 199-207.

11 Steve Morgan, "Statistics and Drug Utilization: Are Prescribing Rates Really That High?" (2001) vol. 165, no. 11 *Canadian Medical Association Journal* 1507-8.

12 For details of drug classifications, see the Web site of the Patented Medicines Prices Review Board at http://www.pmprb-cepmb.gc.ca/.

13 Frank R. Litchtenberg, *The Effect of Pharmaceutical Utilization and Innovation on Hospitalization and Mortality*, NBER Working Paper no. 5418 (Cambridge, MA: National Bureau of Economic Research, January 1996).

14 See, for example, the following review: Ashley Wazana, "Physicians and the Pharmaceutical Industry: Is a Gift Ever Just a Gift?" (2000) vol. 283, no. 3 *Journal of the American Medical Association* 373-80.

15 John A. Rizzo, "Advertising and Competition in the Ethical Pharmaceutical Industry: The Case of Antihypertensive Drugs" (1999) vol. 42, no. 1 *The Journal of Law & Economics* 89-116, uses

data on name-brand anti-hypertensive drugs marketed in the United States during 1988-1993 and finds that advertising decreases these drugs' price elasticity of demand.

16 James J. McRae and Francis Tapon, "Compulsory Licensing as a Policy Instrument" (1984) vol. 10, no. 1 *Canadian Public Policy* 74-77.

17 Bill C-22, An Act To Amend the Patent Act and To Provide for Certain Matters in Relation Thereto; SC 1987, c. 41.

18 See Industry Canada, *Review of the Patent Act Amendment Act, 1992 (Bill C-91)* (Ottawa: Industry Canada, February 1997) (available on the Web at http://strategis.ic.gc.ca/pics/ph/billc91.pdf).

19 Bill C-91, the Patent Act Amendment Act, 1992; SC 1993, c. 2.

20 This section draws heavily from *Review of the Patent Act Amendment Act*, supra note 18.

21 Barbara Sibbald, "Drug Patent Protection: How Long Is Long Enough?" (2001) vol. 164, no. 9 *Canadian Medical Association Journal* 1331.

22 M. Anderson, C. Auld, C. Bolton, A. Gregory, and J. McBride, *The Economic Impact of Bill C-91 on the Cost of Pharmaceuticals in Canada* (Kingston, ON: Queen's University, Queen's Health Policy Research Unit, January 1997).

23 In 1986, the average annual drug costs for a low-income senior was $540, of which the senior was expected to pay $24. By 1997, this figure had risen to $174—a 625 percent increase. In general, the literature suggests that higher user fees for drugs are associated with lower rates of drug use. See P. Grootendorst, G.M. Anderson, and D. Feeny, "Do Provincial Drug Plans Matter? Effects of Provincial Drug Plan Eligibility on Drug Utilization Among the Elderly," final report submitted to the National Health Research and Development Program pursuant to grant 6606-6404-NPHS (2000). D. Willison, P. Grootendorst, and J. Hurley, *Variation in Pharmacare Coverage Across Canada*, Working Paper no. 98-08 (Hamilton, ON: McMaster University Centre for Health Economics and Policy Analysis, 1998) simulated the costs incurred by a typical senior, with a given profile of province of residence, marital status, income, and drug consumption characteristics. Their results reveal that over the period 1990-1997 most seniors in every province faced increasing expenditures for the same bundle of drugs. The only exceptions were low-income senior Nova Scotians, whose drug expenditures decreased by $20. The average increase in annual out-of-pocket costs for low-income seniors across the provinces was between $101 and $119, figures that represent proportional increases of 66 to 97 percent, depending on the level of drug consumption. The corresponding range for high-income seniors was $183 to $257, figures that represent proportional increases of 69 to 94 percent.

24 In our statistical models of drug expenditure, we dealt with this omission by including a variable for the hospital sector's share of total health expenditures. See below.

25 We used the Health Care Components Price Index, in which 1992 = 100, to deflate provincial government drug expenditures for figures 1, 4, and 5.

26 A number of factors account for the increase over the period 1975-2000 in Ontario's share of all provincial government drug expenditures. In 1977, Ontario extended coverage to all seniors; it had previously covered only low-income seniors. Ontario was also the last province to introduce beneficiary co-payments, and its co-payment rates are among the lowest in the country. Ontario's share of provincial government drug expenditures is now quite close to its national population share.

27 There are difficulties in defining drug-price indices for models of drug use. For example, traditional price indices are not sensitive to price deflation caused by generic drug substitution or price inflation caused by the substitution of newer, more expensive drugs for older, less expensive drugs that are often equally effective. See Morgan, supra note 11. For our regressions, we have opted to deflate for general inflation in the health-care sector, and we use for this purpose the Government Current Expenditure Implicit Price Index of CPI from the CIHI. We therefore model drug expenditures rather than levels of drug use; this approach is

advantageous, given that many of our model covariates, such as changes in patent law, affect both the prices of drugs and the quantities of drugs used, both of which affect expenditures.

28 There is a well-developed international literature on the empirical determinants of health expenditures. See Ephraim Kleiman, "The Determinants of National Outlay on Health," in Mark Perlman, ed., *The Economics of Health and Medical Care* (New York: Wiley, 1974), 66-81; Joseph P. Newhouse, "Medical Care Expenditure: A Cross-National Survey" (1977) vol. 12, no. 1 *The Journal of Human Resources* 115-25; Robert E. Leu, "The Public-Private Mix and International Health Care Costs," in A.J. Culyer and Bengt Jönsson, eds., *Public and Private Health Services: Complementarities and Conflicts* (Oxford: Basil Blackwell, 1986), 41-63; David Parkin, Alistair McGuire, and Brian Yule, "Aggregate Health Care Expenditures and National Income: Is Health Care a Luxury Good?" (1987) vol. 6, no. 2 *Journal of Health Economics* 109-27; Ulf-G. Gerdtham, Jes Søgaard, Fredrik Andersson, and Bengt Jönsson, "An Econometric Analysis of Health Care Expenditure: A Cross-Section Study of the OECD Countries" (1992) vol. 11, no. 1 *Journal of Health Economics* 63-84; Kwame P. Gbesemete and Ulf-G. Gerdtham, "Determinants of Health Care Expenditure in Africa: A Cross-Sectional Study" (1992) vol. 20, no. 2 *World Development* 303-8; Theo Hitiris and John Posnett, "The Determinants and Effects of Health Expenditure in Developed Countries" (1992) vol. 11, no. 2 *Journal of Health Economics* 173-81; Rose M. Rubin and Kenneth Koelln, "Determinants of Household Out-of-Pocket Health Expenditures" (1993) vol. 74, no. 4 *Social Science Quarterly* 721-35; N.R. Vasudeva Murthy and Victor Ukpolo, "Aggregate Health Care Expenditure in the United States: Evidence from Cointegration Tests" (1994) vol. 26, no. 8 *Applied Economics* 797-802; Paul Hansen and Alan King, "The Determinants of Health Care Expenditure: A Cointegration Approach" (1996) vol. 15, no. 1 *Journal of Health Economics* 127-37; and Livio Di Matteo and Rosanna Di Matteo, "Evidence on the Determinants of Canadian Provincial Government Health Expenditures: 1965-1991" (1998) vol. 17, no. 2 *Journal of Health Economics* 211-28.

29 A.J. Culyer, *Health Care Expenditures in Canada: Myth and Reality; Past and Future*, Canadian Tax Paper no. 82 (Toronto: Canadian Tax Foundation, 1988), 5. The interpretation of health care as a luxury good because its estimated income elasticities are high has been criticized because intuition suggests that health care is more of a necessity than a luxury (Culyer, ibid., at 20). Also, since health care is heavily subsidized in most countries, individual ability to pay may be less important in this context as a determinant of expenditure than it is in other contexts. Culyer, ibid., and Hansen and King, supra note 28, at 136, suggest that the view of health care as a luxury good may be based on a misspecification, including the omission of variables, in the model of health-care expenditure.

30 Di Matteo and Di Matteo, supra note 28.

31 It should be noted that there are alternate approaches to time series on the basis of the issue of stationarity. A stationary time series is one whose mean and variance do not change over time—that is, there is no trend upward or downward. If the variables in a regression are non-stationary, there is an implication that any positive correlations among the variables may be spurious. If any subset of regressors is non-stationary and the error term is stationary, then the regressors are said to be "cointegrated," in which case the variables exhibit a long-term relationship and the error term represents short-term deviations from that relationship. Tests for stationarity are available, but their power is limited by both the quality and the time span of the data. See Allan W. Gregory and Alfred Haug, *Conflicts Among Tests for Cointegration*, Working Paper no. 973 (Kingston, ON: Queen's University, Institute for Economic Research, 1998); Peter Kennedy, *A Guide to Econometrics*, 3d ed. (Cambridge, MA: MIT Press, 1993), 250-54; Terence C. Mills, *Time Series Techniques for Economists* (Cambridge, UK: Cambridge University Press, 1994), 92-103 and 273-79; Russell Davidson and James G. MacKinnon, *Estimation and Inference in Econometrics* (Oxford: Oxford University Press, 1993), 715-22; David F. Hendry, "Econometric Modelling with Cointegrated Variables: An Overview" (1986) vol. 48, no. 3 *Oxford Bulletin of Economics and Statistics* 201-12; and V.A. Muscatelli and S. Hurn, "Cointegration and Dynamic Time Series Models" (1992) vol. 6, no. 1 *Journal of Economic Surveys* 1-43.

Some recent studies of the determinants of expenditures on health care have criticized the time-series literature on the basis of the issue of stationarity and applied a cointegration approach. Hansen and King, supra note 28, used a model based on Hitiris and Posnett, ibid., and a complete data set for 20 Organisation for Economic Co-operation and Development (OECD) countries over the period 1960-1987 to show that the variables in a "standard" model of health-care expenditure for the 20 OECD members were not collectively stationary in levels. They applied the Augmented Dickey Fuller (ADF) test to their data and found that two-thirds of the variables tested were non-stationary in levels—a result that implied that any positive correlations among the variables might be spurious. Murthy and Ukpolo, supra note 28, applied cointegration techniques to time-series data for the United States over the period 1960-87 and found that per capita income, the age of the population, the number of practising physicians, and public financing of health care were important determinants of health-care spending. Their results do not contradict from the main body of literature, since they found that the income elasticity of health-care spending is not significantly different from one. As well, recent research suggests that stationarity is not a serious problem in panel data. Therefore, "researchers studying national health expenditures need not be as concerned as previously thought about the presence of unit roots in the data." (Suzanne K. McCoskey and Thomas M. Selden, "Health Care Expenditures and GDP: Panel Data Unit Root Test Results" (1998) vol. 17, no. 3 *Journal of Health Economics* 369-76, at 375).

32 Income is essentially a measure of the potential resources available to a jurisdiction for public expenditures. Although the actualization of these resources requires taxation, a strict government-revenue variable is not appropriate, since it omits the potential for governments to raise resources by borrowing. Most provinces had large deficits during the period under examination. In the end, income is a better measure of the ability to pay.

33 Federal transfers to the provinces consist of both a cash component and revenue from tax points that the federal government surrendered to the provinces with the creation of EPF in 1977. The provinces do not consider it legitimate to count the tax-point value as part of the CHST transfer each year, given that the tax points are now firmly part of their tax room. See Provincial and Territorial Ministers of Health, supra note 3.

34 Equalization is provided to provinces with below-average fiscal capacity. The current recipients are all of the provinces except British Columbia, Alberta, and Ontario.

35 See "Federal Transfers to Provinces and Territories," October 2002, on the Department of Finance Web site at http://www.fin.gc.ca/FEDPROV/FTPTe.html.

36 Under the original provisions of medicare, which Canada's provinces entered between 1968 and 1970, the federal contribution was to be a per capita payment for provincial residents enrolled in the plan equal to one-half of the average national per capita cost. The use of national per capita cost benefited provinces whose spending was below the national average. For a discussion of the trials and tribulations involved in the adoption of medicare in Canada, see J. Harvey Perry, *A Fiscal History of Canada—The Postwar Years*, Canadian Tax Paper no. 85 (Toronto: Canadian Tax Foundation, 1989), 623-77.

37 For additional information on EPF and transfers, see George E. Carter, "Established Programs Financing: A Critical Review of the Record" (1988) vol. 36, no. 5 *Canadian Tax Journal* 1225-43; George E. Carter, "Federal Restraints on the Growth of Transfer Payments to the Provinces Since 1986-87: An Assessment" (1994) vol. 42, no. 6 *Canadian Tax Journal* 1504-32; and Perry, supra note 36, at 446-53 and 651-52.

38 For example, Newfoundland and Quebec have traditionally committed an above-average share of their health expenditures to hospital and institutional care, which are more capital-intensive than most other health-care activities.

39 P. Grootendorst, "Beneficiary Cost Sharing Under Canadian Provincial Prescription Drug Benefit Programs: History and Assessment" (2002) vol. 9, no. 2 *Canadian Journal of Clinical Pharmacology* 79-99.

40 Frank T. Denton and Byron G. Spencer, "Health-Care Costs When the Population Changes" (1975) vol. 8, no. 1 *Canadian Journal of Economics* 34-48, at 38. For additional discussion of the impact of aging on Canada's health care costs, see Frank T. Denton and Byron G. Spencer, "Population Aging Future Health Costs in Canada" (1983) vol. 9, no. 2 *Canadian Public Policy* 155-63; Frank T. Denton, S. Neno Li, and Byron G. Spencer, "How Will Population Aging Affect the Future Costs of Maintaining Health Care Standards?" in Victor W. Marshall, ed., *Aging in Canada: Social Perspectives*, 2d ed. (Markham, ON: Fitzhenry and Whiteside, 1987), 553-86; and Frank T. Denton and Byron G. Spencer, "Demographic Change and the Cost of Publicly Funded Health Care" (1995) vol. 14, no. 2 *Canadian Journal on Aging* 174-92.

41 M.L. Barer, I.R. Pulcins, R.G. Evans, C. Hertzman, J. Lomas, and G.M. Anderson, "Trends in the Use of Medical Services By the Elderly in British Columbia" (1989) vol. 141, no. 1 *Canadian Medical Association Journal* 39-45.

42 Daniel R. Waldo, Sally T. Sonnefeld, David R. McKusick, and Ross H. Arnett, "Health Expenditures by Age Group, 1977 and 1987" (1989) vol. 10, no. 4 *Health Care Financing Review* 111-20; and R.A. Schrimper and R.L. Clark, "Health Expenditures and Elderly Adults" (1985) vol. 40, no. 2 *Gerontology* 235-43.

43 M.S. Marzouk, "Aging, Age-Specific Health Care Costs and the Future Health Care Burden in Canada" (1991) vol. 17, no. 4 *Canadian Public Policy* 490-506, at 490.

44 Assuming of course that age-specific health-care utilization rates remain constant.

45 For evidence on the effect of crowding out, see Esel Y. Yazici and Robert Kaestner, *Medicaid Expansions and the Crowding Out of Private Health Insurance*, NBER Working Paper no. 6527 (Cambridge, MA: National Bureau of Economic Research, April 1998).

46 Reference-based pricing was introduced by the British Columbia health ministry in 1995. It limited the reimbursement for a prescribed drug to the cost of the lowest-priced product within the therapeutically equivalent class of drugs. See Paul Grootendorst and Anne Holbrook, "Evaluating the Impact of Reference-Based Pricing" (1999) vol. 161, no. 3 *Canadian Medical Association Journal* 273-74.

47 See Stabile, supra note 9.

48 There are several possible reasons why the sign of the income variable differs across provinces. Some provinces may be more likely than others are to substitute transfers for own-source revenues. Preferences may differ across provincial jurisdictions. Or the differences may arise from errors in specifying the model.

49 Indeed, the interaction terms between Alberta and both the income variable and the transfers variable were so insignificant that we dropped them from the model.

50 We obtained this figure by multiplying the coefficient estimate by the change in income over the period.

51 Between 1975 and 2000, real average per capita federal cash transfers to the provinces rose from $910 to $1,367. This average increase masks differences across the provinces: transfers to Ontario and Alberta decreased, whereas transfers to the other provinces increased. Thus transfers to New Brunswick increased from $1,169 to $2,014, transfers to Manitoba increased from $887 to $1,603, and transfers to Saskatchewan increased from $475 to $751.

52 The phenomenon in which a dollar's worth of grant income stimulates public spending more than does a dollar's worth of private income is called the flypaper effect. See Harvey S. Rosen, Paul Boothe, Bev Dahlby, and Roger S. Smith, *Public Finance in Canada* (Toronto: McGraw-Hill Ryerson, 1999), 132.

53 Paul Grootendorst and Mitchell Levine, "Do Drug Plans Matter? Effects of Drug Plan Eligibility on Drug Use Among the Elderly, Social Assistance Recipients and the General Population," final report submitted to the Health Transitions Fund National Health Research and Development Program pursuant to grant NA227 (revised April 17, 2001) (available on the Web at http://www.thecem.net/projectsframe.html).

54 Manitoba increased the co-payment for most seniors when it introduced its universal drug plan.

55 It should be noted that Quebec's drug expenditures under its universal plan are not included in the CIHI data.

56 Statistics Canada, *Population Projections for Canada, Provinces and Territories. 2000-2026*, catalogue no. 91-520-XPB. Statistics Canada provides projections on the basis of high, medium, and low birth and immigration rates. The simulations in table 5 use the "medium" demographic projections, which are termed "Projection 2."

57 For example, between 2000 and 2011 the proportion of people aged 65-74 in Newfoundland's population is projected to rise from 0.066 (that is, 6.6 percent) to 0.089 and the proportion of people aged 75 and over is projected to rise from 0.051 to 0.063. Thus we calculated the increase in expenditures as 1664.104*(0.089 – 0.066) – 1204.028*(0.063 – 0.051) = $23.83. We repeated this process for each province.

58 It is possible that centrally controlled single-payer systems are better able to control costs or that costs have been shifted.