The Impact of Public Services on the Pattern of Private Spending in Atlantic Canada

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Introduction

Controversy has arisen regarding the impact of government spending on private economic activity. Many of these studies centre on the Ricardian Equivalence Hypothesis of tax and deficit-financed expenditures on aggregate private activity (Reid 1989; Kormendi 1983; Motley 1987; Rock et al 1989). Others (e.g. Bennett 1983) have looked at the impact on the basis of type or composition of government spending. Several studies have stressed the importance of the question of whether public spending is a substitute for, or a complement to, private spending (Olekalns 1989; Clements 1979; Cerea 1982; Aschauer 1985; Katsaitis 1987; Ihori 1990; Tridimas 1992; Kuehlwein 1998).

This paper examines the effects that government expenditures have on the pattern of private consumption and savings. One key question to be addressed is: Are public goods (services) net complements or net substitutes for private consumption? If public goods are complementary to private goods, increased government expenditure will cause private spending to rise. However, if public goods are substitutes for private goods, increased government spending may actually increase private savings at each income level. A second question considers how the provision of public goods (services) may affect the demand for various commodities differentially for a given level of total consumption. This question is the main focus of the current paper.

The formation of the North American Free Trade Agreement (NAFTA) has raised a number of related issues. One of these is: Does trade creation owing to the formation of the free trade area offset trade diversion, as members trade with each

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other rather than with lower-cost third parties (Wylie and Wylie 1996)? Another is: To what extent do social policies remain an element of non-tariff protection and how may social rights be protected in the face of globalization (Paraskevopoulos 1996)?

It has been postulated as well that continental integration may accentuate national regional tensions with a weakening of the national core and pressures for decentralization and even secession, or alternatively, it may reinforce the national core and the dependence of peripheral regions on transfer payments (Paelinck and Polese 1999). In the context of Canada under NAFTA, some have argued that the impact has been zero (Britton (1998); Wall 1999), but others have suggested that NAFTA may have weakened the east-west linkages in Canada in exchange for international regional linkages (Richardson 1998; Scott 1999; Brox 2001). A detailed investigation of the impact of free trade on Atlantic Canada is provided by Chaundy (2001).

In order to undertake the empirical analysis, a new version of the Almost Ideal Demand System (AIDS) is developed to allow individual demands to be conditional on the amount of public goods being provided, and to be sensitive to changes in structure such as the formation of the North American Free Trade Area. This Conditional Almost Ideal Demand System (CAIDS) is the analog of the variable cost translog model frequently employed in production analysis to allow expenditures on variable factors to be conditional on the current level of the fixed factor. Papers by Selvanathan (1991), Kirk (1991), and Carruth et al (1999) have extensively examined regional differences in consumption patterns using similar modelling techniques.

The rest of the paper is organized as follows. In the following section, some recent developments in the Canadian economy that have motivated this study are analysed. Then, we outline the functional form of the Conditional AIDS model used in this study. A discussion of the data sources and methods of estimation is presented, followed by the empirical estimates and interpretations of the results. Finally, in the conclusions a brief summary and some suggestions for further research are given.

Recent Developments in the Atlantic Canadian Economy

Why would one believe that the formation of the Canada-U.S. free trade agreement and its subsequent expansion to NAFTA might have changed the structure of Canadian consumption patterns? As illustrated in Figure 1, Atlantic Canada has always been a relatively open economy, with significant export and import shares, both internationally and inter-provincially. However, an accelerated rate of growth of both international exports and imports, beginning in the 1990 to 1991 period, clearly indicates that the trade pacts have had a pronounced impact on the Atlantic Canadian economy. International trade is not a closed system and hence the net trade position is of interest. For most of the period under consideration, Atlantic

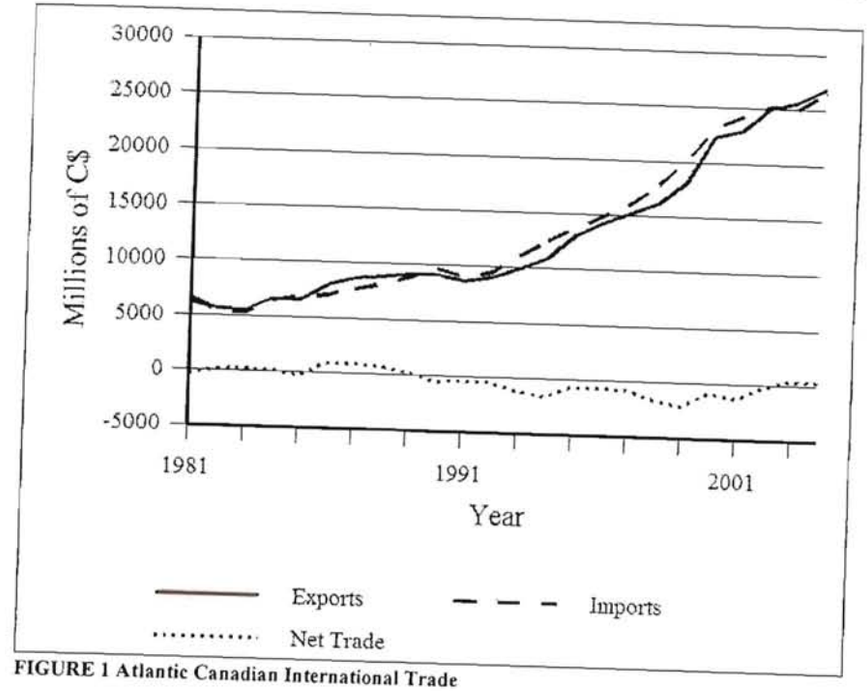

FIGURE 1 Atlantic Canadian International Trade

Canada had a deficit on its total international balance-of-trade position. Of interest to the question of the extent to which trade creation may be offset by trade diversion is the percentage of trade with the United States versus the rest of the world. In 1989, 66 % of Atlantic Canadian merchandise exports went to the United States. By 1999 that percentage had risen to 78 %. The pattern for imports has been similar. It is perhaps difficult to argue that the US is the lowest cost producer available to Canada.

This significant increase in the level of international trade should have led to growing prosperity in Atlantic Canada. However, as shown in Figure 2, the 1990s were not particularly good for Canadian consumers. Real per capita personal disposable income peaked in 1989, declined with the recession thereafter, and did not return to the 1990-peak level until 1998. Per capita consumer spending followed a similar pattern, but with a slightly stronger growth rate. As a result, per capita savings, shown as the distance between the disposable income and consumption lines in Figure 2, declined throughout the decade. Per capita public services expenditures peaked in 1992 and then gradually declined until late in the period.

There were several other potentially important developments in the Atlantic Canadian economy in the period under consideration, which we do not consider

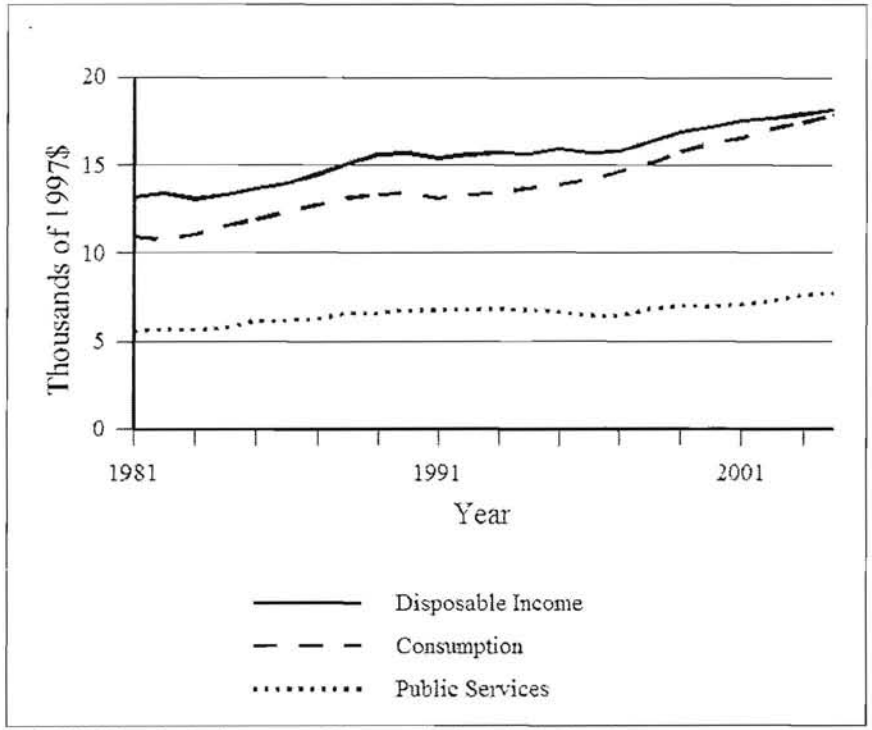

FIGURE 2 Per Capita Income and Consumption in Atlantic Canada
Source: Canadian System of Provincial Accounts

in detail in this study. One was the dramatic collapse and restructuring of the fishery (Crowley and Palsson 1992; Dupont et al 2002). Second was the introduction of the GST and the subsequent harmonization of the GST and the provincial sales taxes (Murrel and Yu 2000). Third were the reforms to federal transfers such as the unemployment insurance program and equalization programs (Dhawan-Biswal 2002; Murrel 2002). Fourth, the development of the off-shore oil and gas sector has had an important impact on the direction of the Atlantic economy. While these issues are not considered in detail in this paper, most would be expected to work through relative prices or changes in the level of personal disposable income and thus would be captured by the model that is described below.

Figure 3 illustrates the patterns of consumer expenditures for the province of New Brunswick, as an example, measured as shares of personal disposable income. The shares of semi- and non-durables appear relatively constant. Durable expenditures appear to follow a cyclical pattern around a stationary mean. The major changes seem to be a substantial increase in the consumption of services combined with a gradual decrease in savings over the entire period.

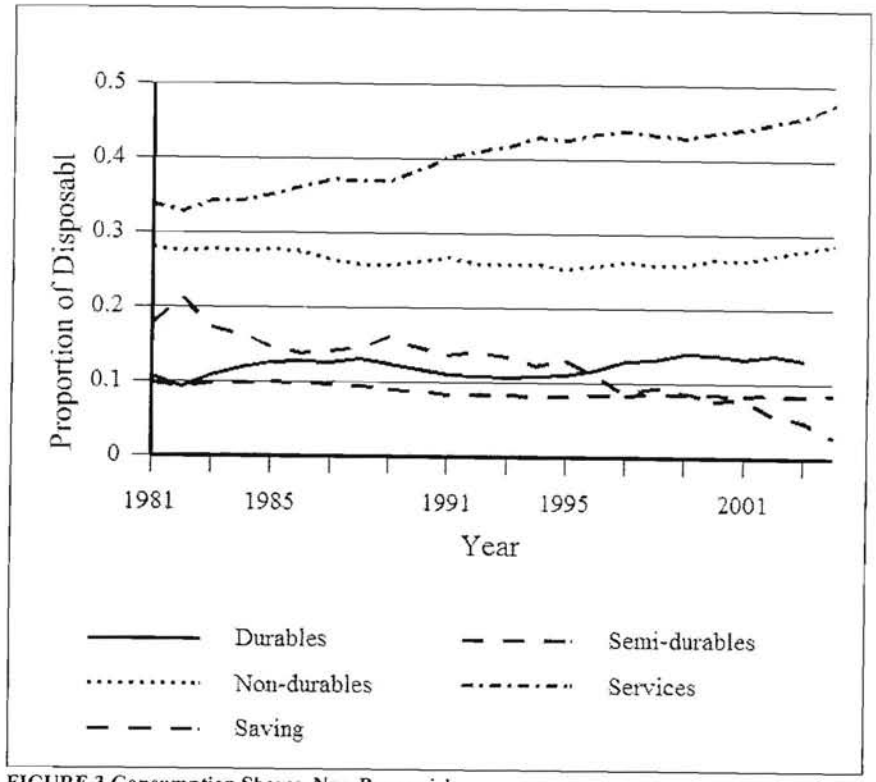

FIGURE 3 Consumption Shares, New Brunswick

Some regional aspects of the changes in consumption patterns are shown in Table 1 for the four Atlantic Canadian provinces. While the same basic pattern of consumption activity is revealed in each province, there is considerable variation. It is interesting to note that in all Atlantic provinces both savings and the share of public services have declined since 1990.[1] Over the entire period, the consumption share for services appears to be growing while that for semi- and non-durables has been declining. The share of durables goods consumption has been more cyclical.

The methodology outlined in the next section allows us to analyze these effects, accounting directly for changes in the levels of total expenditure (wealth) as measured by personal disposable income and for changes in relative prices. The use of provincial data allows us to analyze these differences both through time and differences in the various cross-sections, thus providing greater variability.

1. The share of public goods (services) appears to have begun rising again near the end of the period.

TABLE 1 Provincial Expenditure Patterns as a Share of Personal Disposable Income

	Durables	Semi-durables	Non-durables	Services	Savings	Public Services
Newfoundland						
1981	0.098	0.102	0.316	0.318	0.166	0.366
1986	0.114	0.101	0.338	0.364	0.083	0.440
1991	0.097	0.084	0.296	0.362	0.161	0.427
1996	0.097	0.081	0.287	0.417	0.118	0.410
2001	0.131	0.094	0.289	0.453	0.033	0.436
2004	0.125	0.095	0.296	0.463	0.020	0.451
Nova Scotia						
1981	0.105	0.100	0.276	0.355	0.164	0.478
1986	0.130	0.096	0.271	0.399	0.105	0.493
1991	0.096	0.080	0.270	0.414	0.140	0.468
1996	0.107	0.080	0.262	0.469	0.082	0.440
2001	0.119	0.078	0.267	0.4816	0.054	0.409
2004	0.120	0.081	0.282	0.510	0.007	0.428
Prince Edward Island						
1981	0.111	0.105	0.301	0.363	0.120	0.431
1986	0.116	0.096	0.279	0.376	0.134	0.404
1991	0.093	0.082	0.275	0.404	0.145	0.414
1996	0.104	0.087	0.266	0.452	0.091	0.402
2001	0.119	0.092	0.275	0.484	0.036	0.415
2004	0.113	0.089	0.295	0.508	-0.006	0.447
New Brunswick						
1981	0.107	0.098	0.279	0.341	0.175	0.386
1986	0.127	0.097	0.274	0.365	0.137	0.377
1991	0.110	0.083	0.266	0.404	0.137	0.407
1996	0.116	0.083	0.256	0.436	0.109	0.376
2001	0.133	0.083	0.265	0.441	0.078	0.374
2004	0.126	0.084	0.287	0.475	0.028	0.401

Methodology

The theoretical model employed in this paper is the Almost Ideal Demand System (AIDS), originally developed by Deaton and Muellbauer (1980), and since applied by many authors (e.g., Andrikopoulos et al 1993; Chalfant et al 1991). It belongs to the family of flexible demand systems[2] and is derived from a specific class of preferences known as the PIGLOG class. This class of preferences which permits exact aggregation over consumers is represented by a cost function of the form:

$$\ln C(u,P) = (1 - u) \ln[A(P)] + u \ln[B(P)] \qquad (1)$$

2. For the definition of flexible functional forms, see Diewart (1971), Christensen et al (1973) and Berndt et al (1977).

where u is the utility indicator, the value of which lies between zero and one, and A(P) and B(P) are linear, homogeneous, concave functions of the vector of commodity prices, P. The specific functional form of A(P) and B(P), which satisfies these conditions and leads to a flexible cost (expenditure) function as well as a demand system with the desirable properties, has been chosen to be of the form:

$$\ln A(P) = \alpha_o + \sum_{i=1}^{n} \alpha_1 \ln P_i + 0.5 \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln P_i \ln P_j \qquad (2)$$

$$\ln B(P) = \ln A(P) + \beta_o \prod_{i=1}^{n} P_i^{\beta_i} \qquad (3)$$

By substituting equations (2) and (3) into (1) and rearranging terms, the AIDS cost function takes the form:

$$\ln C(u,P) = \alpha_o + \sum_{i=1}^{n} \alpha_i \ln P_i + 0.5 \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln P_i P_j + \beta_o \prod_{i=1}^{n} P \qquad (4)$$

where α_o, α_i, $, $_o$, $, $_i$ and (_ij are parametric constants.[3] By Shephard's lemma (Shephard 1970), the complete demand system, in share form, becomes:

$$S_i = \alpha_i + \sum_{j=1} \gamma_{ij} \ln P_j + \beta_i u \beta_0 \prod_{i=1}^{n} P_i^{\beta_i} \qquad (5)$$

By substituting the value of u into equation (5), the final form of the share equation is written as:[4]

$$S_i = \alpha_i + \sum_{j=1} \gamma_{ij} \ln P_j + \beta_i \ln(M/P) \qquad (6)$$

3. Given the fact that (1) the cost function gives the minimum cost necessary to obtain a specific level of utility at given prices; and (2) the utility indicator, u, lies between zero and one, equation (4) for u=0 reduces to equation (2). On the other hand, for u=1, equation (4) reduces to equation (3). This suggests that equation (2) and (3) represent the cost of subsistence and bliss, respectively. For further analysis, see Deaton and Muellbauer (1980).

4. By substituting lnM for lnC(u,P) in equation (4) and solving for u, the value of u which is substituted in equation (5) to obtain equation (6) is: $u = (\beta_o \prod_{i=1} P_i^{\beta_i})^{-1} \ln(m/P)$

where M is total expenditure (cost) and P is the price index defined as:

$$\ln P = \alpha_o + \sum_{i=1}^{n} \alpha_1 \ln P_i + 0.5 \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln P_i \ln P_j \tag{7}$$

To conform to the constraints implied by the classical demand theory, the adding-up ($\sum_{i=1}^{n} \alpha_i = 1, \sum_{i=1}^{n} = 0, \sum_{i=1}^{n} \beta_i = 0$), the homogeneity ($\sum_{i=1}^{n} \gamma_{ij} = 0$), and the Slutsky symmetry ($\gamma_{ij} = \gamma_{ji}$) restrictions have been imposed on equation (5). The model equation (5), or, alternatively equation (6), contains enough parameters to belong to the family of flexible complete demand systems. Also, it provides consistent aggregation over individuals and is consistent with the properties of the classical demand theory.[5]

The conditional version of the AIDS model (CAIDS) is derived from the standard AIDS by incorporating Pollak's (1969) quantity constraint hypothesis.[6] Specifically, Pollak's conditional formation hypothesis expresses the demands for commodities as functions of the prices of the commodities of choice and the quantities of the constrained goods. Accordingly, the two price equations (2) and (3) now take the form:

$$\ln A(P) = \alpha_o + \sum_{i=1}^{n} \alpha_1 \ln P_i + 0.5 \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln P_i \ln P_j + \sum_{i=1}^{n} \delta_i \ln P_i \ln PG + \varphi \ln PG \tag{8}$$

$$\ln B(P) = \ln A(P) + \beta_o \prod_{i=1}^{n} P_{it}^{\beta_i} \tag{9}$$

where PG is the quantity of public goods which is assumed to be exogenously predetermined. By substituting equations (8) and (9) into equation (4) and rearranging terms, the conditional AIDS model becomes:

$$\ln C(u,P,PG) = \theta_o + \sum_{i=1}^{n} \alpha_1 \ln P_i + 0.5 \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln P_i \ln P_j + u\beta_o \prod_{i=1}^{n} P_i^{\beta_i} + \sum_{i=1}^{n} \delta_i \ln P_i \ln PG + \phi \ln PG \tag{10}$$

5. For a detailed analysis, see Deaton and Muellbauer (1980).
6. For further analysis see MacKay and Whitney (1980).

By substituting the value of u[7] into equation (10), applying Shephard's lemma in the resulting expression, and following Chalfant et al (1991) in adding a dummy variable to account for shift effects associated with the formation of the Canada-U.S. Free Trade Agreement,[8] the cost-minimizing share equations of the CAIDS become:

$$S_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln P_j + \delta_i \ln PG + \beta_i \ln(M/P) + \eta_i FTA + \tau_i T \qquad i = 1, \ldots, n \tag{11}$$

$$s.t.: \sum_{j=1}^{n} \alpha_i = 1, \sum_{j=1}^{n} \gamma_{ij} = 0, \sum_{j=1}^{n} \beta_i = \sum_{j=1}^{n} \delta_i = \sum_{j=1}^{n} \eta_i = 1 \qquad \gamma_{ij} = \gamma_{ji}, i,j = 1, \ldots, n \tag{12}$$

where P_t is the price index defined, in the present context, as:

$$\ln P_t = \theta_o \ldots + \sum_{i=1}^{n} \alpha_1 \ln P_i + 0.5 \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_i \ln P_i \ln P_j + \sum_{i=1}^{n} \delta_i \ln P_i \ln PG + \varphi \ln PG \tag{13}$$

The restrictions, equation (12), imply that the cost function, equation (10), is well behaved; that is, the adding-up, the homogeneity, and the symmetry restrictions are satisfied.[9]

Since direct economic interpretation of the estimated parameters is not possible, in flexible functional forms, including the CAIDS,[10] we concentrate the analysis on the estimated elasticities which are functions of the parameters, yet which have standard implications. In this paper, we consider the following elasticities:

7. See footnote 3, above.
8. Chalfant et al (1991) use only a time trend to capture changes in tastes, but the modelling procedure used here is similar.
9. Notice that for all $\eta \to 0$ and $\delta_i \to 0$, equation (11) converges to the static AIDS, given by equation (6).
10. See, for instance, Kumbhakar (1990).

$$\varepsilon_{im} = 1 + \frac{\beta_i}{S_i}, i = 1, ..., n \tag{14}$$

$$h_{ij} = \begin{cases} -1 - \beta_i + \dfrac{\gamma_{ii}}{S_i}, i = j \\ \dfrac{\gamma_{ij} - \beta_i S_j}{S_i}, i \neq j \end{cases} \tag{15}$$

$$\varepsilon_{ij} = \begin{cases} -1 + S_i + \dfrac{\gamma_{ii}}{S_i}, i = j \\ S_j + \dfrac{\gamma_{ii}}{S_i}, i \neq j \end{cases} \tag{16}$$

$$\delta_{ij} = \begin{cases} \dfrac{\gamma_{ij} + S_i^2 - S_i}{S_i^2}, i = j \\ 1 + \dfrac{\gamma_{ij}}{S_i S_j}, i \neq j \end{cases} \tag{17}$$

$$\varepsilon_{if} = \frac{\partial x_1}{\partial PG} \cdot \frac{PG}{x_i} = \frac{\delta_i}{S_i} \tag{18}$$

Equation (14) gives the expenditure elasticities. Since the $\$_i$'s, in the AIDS framework can be either positive, indicating luxury commodities, or negative, indicating necessities, no restriction is imposed on the expenditure elasticities. Equations (15) and (16) give the ordinary (uncompensated) and compensated price elasticities of demand, respectively. The ordinary own elasticities of demand, h_{ii}, are expected to be negative at all data points, if the expenditure function, equation (11), is globally concave. No *a priori* restrictions are imposed on the cross-price elasticities of demand, both compensated and uncompensated. The Allen-Uzawa partial elasticities of substitution are given by equation (17). All own partial elasticities of substitution, F_{ii}, are expected to be negative, implying that the postulates of the consumer theory are satisfied. Neither the standard nor the conditional

versions of the AIDS impose any restrictions on the cross-partial elasticities of substitution.[11] Finally, equation (18) gives the elasticity of demand for commodity i, with respect to a change in the exogenously given level of the public good, for a given vector of commodity prices and disposable income.

Data and Estimation Methods

Data and their Sources

The CAIDS model, briefly discussed above, has been estimated for the period 1981 to 2004 using annual data for each of the four Atlantic Canadian provinces taken from the Canadian system of Provincial Accounts. The model utilizes aggregate per capita disposable income as the measure of total expenditure, five categories of consumer choice (i.e., durables, semi-durables, non-durables, services and savings), a time trend with 1981 equal to unity, and a dummy variable (FTA=1 after 1990) to account for changes in preferences since the Canada-U.S. Free Trade Agreement. Total expenditures of all levels of government[12] are used as the proxy for the supply of public services. All expenditures are expressed in nominal terms and all prices are normalized using base year 1992 equal to unity. All exogenous data are normalized by their mean values in keeping with the asymptotic properties of the CAIDS model discussed above.

The data for total value of disposable income, expenditure by category, and total savings have been taken from the Provincial Income and Expenditure Accounts. The prices for the goods and services are taken as the implicit price deflators. The quantity of public goods available has been proxied by the total government expenditures,[13] in constant 1997 dollars, for all levels of government.[14] The price of savings is set equal to the implicit price deflator for total consumption, divided by 1+r, where r is the rate on short-term finance company paper, the best measure of short-term interest rates in the Canadian financial sector.

11. For further discussion, see Allen (1937) and Uzawa (1962). Note that while the parameter restrictions imposed on the AIDS model imply that the matrix of cross-partial elasticities of substitution will be symmetrical, the same is not true for the cross-price elasticities, unless the expenditure shares are equal.
12. These expenditures are for the four Atlantic provinces and federal government expenditures in the same four provinces.
13. Ideally we would use data on "pure public goods", that is, goods that are "non-rivalrous" and "non-excludable" in consumption. Such data does not exist.
14. This refers to total current expenditures only, excluding all categories of government investment and all categories of transfer payments. Transfer payment changes would be included in personal disposable income and thus impact consumption directly via that route.

Estimation Method

For econometric purposes, we assume additive error terms for the cost and input-share equations. These error terms are postulated to have a joint normal distribution with a mean zero vector and a constant variance-covariance matrix. The price and share equations are jointly estimated using the Full Information Maximum Likelihood (FIML) routine contained in Version 9 of the SHAZAM econometric software package. This technique: (1) maximizes the likelihood function for the entire system by estimating all the parameters, subject to all *a priori* restrictions; (2) gives consistent and asymptotically efficient estimates. Since the full set of share equations must sum to unity, the variance-covariance matrix for the full system would be singular. Therefore, only n-1 share equations should be estimated and the parameters of the omitted equation may be calculated using the restrictions implied by the model. The omitted equation in this paper is the expenditure-share equation for savings.[15]

Empirical Results

The theoretical model discussed above is now evaluated in terms of: (1) the signs and the significance of the estimates; (2) the signs, magnitudes, and significance of both the price elasticities and elasticities of substitution; and (3) the consistency (inconsistency) of our findings with those obtained from other studies of the same nature.

It is interesting to test first the main point of this study, that the presence of public goods has a significant impact on the pattern of private expenditures and saving, and that significant changes to the patterns of consumption have occurred since the formation of the FTA. The traditional functional form which ignores the impact of public goods and the FTA shift effects is nested within the current specification under the restriction that all parameters associated with the public good and the shift effects are equal to zero. Thus, the restrictions required to support the no-impact of public goods and no-FTA shift version of the model may be tested by calculating a likelihood ratio test of the form $-2(L_1 - L_2)$, where L_1 is the maximum value of the logarithm of the likelihood function from the restricted model, and L_2 is the maximum value of the likelihood function from the unrestricted model. The test statistic has a chi-squared distribution with degrees of freedom equal to the number of restrictions being tested. At the 1 % probability level, the critical value of the test statistic with eight degrees of freedom is 20.09.

Applying this test to the model with no-FTA shift effects, we find that the test statistic has the value $-2(1675.720 - 1740.191) = 88.942$. Hence, we conclude that the version of the model without the FTA shift variables is rejected. In the case of the version of the model which assumes that private spending is unaffected by

15. For a more detailed analysis see Intriligator (1978). As has been discussed elsewhere, the estimates are invariant to the choice of equation omitted. See, for instance, L.R. Christensen et al (1973).

TABLE 2 Conditional AIDS: Parameter Estimates and Associated t-Statistics

	Durables	Semi-durables	Non-durables	Services	Savings
a_i	0.131	0.112	0.300	0.455	0.002
	(34.04)	(19.69)	(71.75)	(64.99)	(1.23)
β_i	0.089	-0.026	-0.141	0.080	-0.002
	(3.91)	(-2.88)	(-8.59)	(1.90)	(-1.58)
γ_{1i}	0.010	0.023	-0.073	-0.084	0.124
	(0.75)	(2.58)	(-7.72)	(-2.88)	(4.40)
γ_{2i}	0.023	-0.016	-0.011	-0.021	0.025
	(2.58)	(-1.32)	(-1.31)	(-1.00)	(1.56)
γ_{3i}	-0.073	-0.011	0.195	-0.107	-0.004
	(-7.72)	(-1.31)	(13.42)	(-3.91)	(-0.19)
γ_{4i}	-0.084	-0.021	-0.107	-0.138	0.350
	(-2.88)	(-1.00)	(-3.91)	(-1.36)	(4.70)
γ_{5i}	0.124	0.025	-0.004	0.350	-0.495
	(4.40)	(1.56)	(-0.19)	(4.70)	(-6.21)
η_i	0.005	0.016	-0.002	0.003	-0.022
	(2.91)	(2.01)	(-2.10)	(0.78)	(-2.51)
δ_i	0.022	-0.004	-0.012	-0.094	0.088
	(2.29)	(-0.73)	(-1.31)	(-4.15)	(3.83)
τ_i	0.002	0.001	0.003	0.008	-0.014
	(3.75)	(2.70)	(7.28)	(8.41)	(10.93)
Log of the likelihood function = 1740.191					

public services variables, we find a log-likelihood ratio test statistic value of $-2(1625.609 - 1740.191) = 229.164$. Thus we also strongly reject the hypothesis that public goods have no impact on the pattern of private expenditures.[16]

The Estimates of the Model

Table 2 gives the results for the estimation of the CAIDS model. Here, of the fifty parameters, thirty-three are statistically significant at the 5 % level.

Generally speaking, the parameter estimates display the following major features. Of major importance are the public goods estimates, δ_i, and the FTA shift estimates, η_i, and their significance (insignificance). As indicated in Table 2, the public good coefficient is negative and statistically significant for service consumption, positive and significant for durables and savings. This simply suggests that a percentage increase in public goods (services) provided reduces the expenditure share for services, and increases the expenditure share for durables and savings. *Ceteris paribus*, these findings imply that the increase in public goods is

16. The test statistic for both no-public-service and no-FTA impacts is 236.8 which also rejects the similar version of the system.

complementary to durable consumption and savings, and a substitute for private services, with the consumption of semi-durable goods and non-durable goods independent of the level of public services provided.

With reference to the FTA shift effects, for given commodity prices and levels of disposable income, the findings suggest that a shift from non-durable consumption and savings to consumption of durable and semi-durable goods has occurred over the period. The shift variable for services is positive, but not statistically significant. Thus, we conclude that the formation of the free trade agreement has had relatively little impact on the consumption of services.

While we could attempt to draw further inferences from the estimated parameters, it is well known that the AIDS structure is an approximation to the true cost (expenditure) relationship. Hence, it is not clear that these coefficients have standard economic interpretation (Kumbhakar (1990). Accordingly, further analysis will be confined to the implied elasticities which do have traditional meaning.

The Elasticities

In order to assess further the model's ability to describe the expenditure pattern in the Atlantic Canadian consumption, we have computed the own and cross elasticities of demand for the commodities, the Allen own and cross partial elasticities of substitution, and the income elasticities (Table 3).

The own-price elasticities of demand for commodities, estimated at sample means, are found to be negative, less than one, with the exception of savings and semi-durable goods, and statistically significant. These elasticities are consistent with findings in other studies where commodity demands are generally price inelastic.

Nevertheless, our results deviate, in terms of magnitude, from those obtained by Andrikopoulos et al (1984) for all of Canada. In the present study, the own-price elasticity for durables is -0.800, compared to -0.764 as obtained by Andrikopoulos et al The own-price elasticity for semi-durables (-1.094) is somewhat larger than that obtained by the study just cited. (-0.838), and the own-price elasticity for services (-0.929) is quite similar to theirs (-0.925). The estimated own elasticity for savings (-5.443) is high, but in line with many other estimates for the Canadian economy.

With respect to the cross-price effects, the figures in Table 3 indicate first that, with the exception of the observed significant complementarity between durables and non-durables, all commodities display substitutability relationships or indicate negligible effects. Second, the cross-price effect varies considerably between the commodities involved. The Allen partial elasticities of substitution, F_{ij}, reported in Table 3, display the same patterns as the price elasticities of input demand. All own elasticities of substitution are negative, greater than one (except for non-durables), and statistically significant. Inter-commodity complementarity is observed between durables and non-durables and substitutability of various degrees between the other commodities.

TABLE 3 Elasticities Evaluated at Sample Means

	Durables	Semi-durables	Non-durables	Services	Savings
σ_{1i}	-7.010	3.295	-1.287	-0.810	10.987
	(-6.90)	(3.71)	(-4.34)	(-1.29)	(4.84)
σ_{2i}	3.295	-12.245	0.577	0.412	3.576
	(3.71)	(-7.86)	(1.78)	(0.70)	(2.09)
σ_{3i}	-1.287	0.577	-0.090	-0.066	0.861
	(-4.34)	(1.78)	(-0.49)	(0.27)	(1.16)
σ_{4i}	-0.810	0.412	0.066	-2.272	8.880
	(-1.29)	(0.70)	(0.27)	(-3.75)	(5.29)
σ_{5i}	10.987	3.576	0.861	8.880	-50.024
	(4.84)	(2.09)	(1.16)	(5.29)	(-7.42)
ϵ_{1i}	-0.800	0.294	-0.359	-0.331	1.195
	(-6.90)	(3.71)	(-4.34)	(-1.29)	(4.84)
ϵ_{2i}	0.376	-1.094	0.161	0.168	0.389
	(3.71)	(-7.86)	(1.78)	(0.70)	(2.09)
ϵ_{3i}	-0.147	0.052	-0.252	0.027	0.094
	(-4.34)	(1.78)	(-0.49)	(0.27)	(1.16)
ϵ_{4i}	-0.092	0.037	0.018	-0.929	0.966
	(-1.29)	(0.70)	(0.27)	(-3.75)	(5.29)
ϵ_{5i}	1.253	0.320	0.240	3.630	-5.443
	(4.84)	(2.09)	(1.16)	(5.29)	(-7.42)
ϵ_{im}	1.784	0.710	0.495	1.197	0.971
	(8.89)	(5.71)	(8.42)	(11.58)	(4.57)
ϵ_{if}	0.189	-0.047	-0.042	-0.231	0.815
	(2.29)	(-0.74)	(-1.31)	(-4.15)	(3.59)

Using equation (11) and the estimates from Table 2, we have calculated the income (expenditure) elasticities reported in Table 3. All income elasticities are, as expected, positive, and statistically significant. These elasticities provide two kinds of information. First, they indicate the manner by which an anticipated (realized) change in income will affect commodity demands for given relative prices. Second, they provide evidence on the nature of the commodity in question.[17] Specifically, the income elasticity for durables is 1.784 and for services is 1.197, and both are significantly greater than one. These commodities are characterized as a superior goods, suggesting, in the absence of changes in prices and tastes, increased values as income rises. On the other hand, the income elasticities for semi-durables, non-durables and saving are less than unity ($\epsilon_{im} = 0.710$, 0.459 and 0.971), suggesting that consumption of these normal commodities increases by less than the proportional increase in income.

17. Based on the values of income elasticities, a commodity can be characterized as inferior ($h_{im} < 0$), normal ($0 \leq h_{im} \leq 1$), or superior ($h_{im} > 1$).

Table 3 also reports our estimates for the elasticities of demand with respect to changes in the levels of public goods provided (ϵ_{ij}). The estimated elasticities of private expenditures with respect to the provision of public services are significantly different from zero for durable goods, services, and for saving. The estimates show increases in the case of durables and savings, and a negative relationship with respect to services.[18] We conclude that changes in the level of public goods provided have a significant impact on the pattern of private expenditures and savings. Given that saving is positively, but inelastically, related to public goods, we might conclude that some minor crowding out of private investment might accompany increased spending on public services.[19]

Tests for Spurious Correlation

Models estimated using time series data are in danger of appearing to find significant results when in fact none exist. This occurs when the data involved in the regression are nonstationary. However, the power of unit root tests is known to be low as the relevant alternative hypothesis is frequently close to unity. Thus, there is a debate as to whether such models should be estimated in levels, or in some transformed version such as in first differences. The issue is the trade-off between possible spurious correlation versus a misspecification error. "At least asymptotically we are probably better off estimating forecasting models in levels with trends included, because then we get an accurate approximation to the dynamics in the data regardless of the true state of the world, unit root or no unit root." (Diebold 2001: 340).

All of the variables used in this study have been tested for unit roots using the standard Phillips-Perron test. These results are presented in the first column of Table 4. For most of the consumption share series and for the log per-capita disposable income series and the log of per-capita government services, the hypothesis of a unit root cannot be rejected in favour of the stationary alternative. However, for most of the log price terms, the unit root can be rejected. For all of the series, the unit root hypothesis is rejected when the data are first differenced (column 2 of Table 4).

This study has tested and confirmed the presence of a structural break in 1990. Perron (1989) suggests that series which appear to have a unit root may in fact be stationary once possible structural breaks are accounted for. Ewing and Wunnava (2001) use a similar approach, with similar findings, in a study of unemployment rates for the three NAFTA countries. The third column of Table 4 applies the test suggested by Perron (1989) to the series used in this model. Here, for all of the series, the hypothesis of a root unit is rejected. However, it is still appropriate to test whether the system represents a co-integrated relationship.

18. These results are quite plausible. A large component of service expenditures is in the field of health and education and a large proportion of public services in the Canadian context is in the same fields.

19. Crowding-out traditionally is considered in the case of a closed national economy operating near full capacity and thus may not be important in the context of this paper. Additionally, this paper is silent on the effects on corporate and public savings which may dominate the consumer savings analyzed here.

TABLE 4 Unit Root Tests

	P-P test Levels	P-P test 1st diff.	Perron (1989) Structural Break
Share of Durables	-3.769	-9.424	-17.39
Share of Semi-durables	-2.448	-10.64	-39.82
Share of Non-durables	-2.401	-11.14	-25.70
Share of Services	-3.424	-10.62	-26.91
Share of Savings	-3.997	-12.07	-15.25
Log of Real Per-capita Disposable Income	-3.058	-11.13	-48.80
Log of PCD	-3.162	-11.11	-276.06
Log of PCSD	-3.491	-11.04	-550.85
Log of PCND	-3.913	-11.00	-195.05
Log of PCS	-3.798	-10.98	-633.01
Log of PS	-3.824	-11.00	-413.61
Log of Real Per-capita Government	-3.245	-11.29	-42.75
Log of PC	-3.762	-11.01	-601.02

Critical values of P-P test: 10% = -3.13; 5% = -3.41; 1% = -3.96;
Critical values of Perron (1989) test with structural break: 10% = -3.46; 5% = -3.99; 1% = -4.33

TABLE 5 Tests for Spurious Correlations

	D-W Stat	P-P test on residuals
Share of Durables	1.55	-6.027
Share of Semi-durables	1.70	-6.423
Share of Non-durables	1.99	-8.077
Share of Services	1.97	-9.298
Log of PC	2.46	-11.898
(Omitted equation) Share of Savings	1.89	-7.077

Critical values of D-W: 10% = 0.322, 5% = 0.386, 1% = 0.511;
Critical values of P-P test: 10% = -3.13; 5% = -3.41; 1% = -3.96.

If the system is a co-integrated relationship, the residuals of the system will be stationary. If the residuals have followed a unit root process, the Durbin-Watson statistic will have a value of zero. Therefore, we can test the null hypothesis that the residuals follow a unit root by either testing that the D-W statistics are significantly different from zero, or by performing the standard unit roots tests directly on the residuals. The results of these tests are shown in Table 5. In all cases, the Durbin-Watson statistics are significantly greater than zero, and in all cases the Phillips-Perron test rejects the null hypothesis that the residuals follow unit root processes.

Thus, despite some ambiguity in the results, we conclude that the current version of the model, estimated in levels is supported by the data (Hamilton (1994: 562).

Summary and Conclusions

This paper has attempted to study the impact of public goods on the patterns of private expenditures and to test whether this entire structure has changed since the formation of the FTA. The first issue addressed has been the question of whether the presence of public goods has any impact on private spending. We conclude strongly that it does. The t-statistic on individual coefficients is suggestive of this fact. However, the log-likelihood ratio test of the restrictions required to support the null hypothesis of no impact leads to a strong rejection of the no-impact assumption. Essentially the same conclusion is reached with respect to the structural shifts following the formation of the Canada-U.S. free trade agreement.

The empirical results of the conditional demand system are generally in line with those of other studies. We find the expenditure on durable goods and services to be income elastic, and savings and semi-durable consumption to be price elastic. Looking at the cross-elasticity effects, we find that substitutability prevails, with the only significant complementarity found in the case of durables and non-durable goods.

With respect to the provision of public goods, we find that an increase in the quantity of such goods will lead to increased expenditures on durable goods and on savings, with spending on services being reduced. On the question of whether increases in public spending are expansionary, we are largely silent as our model assumes that disposable income is constant. However, increases in the level of public spending increase private savings and thus we conclude that public and private expenditures are substitutes in aggregate.

In this paper all types of government expenditures are considered to be the same form of aggregate public good or service. A clear improvement would be to subdivide government spending by type and by level of government. Future research will follow this procedure.

Despite the limitations of the present study, the main conclusion is clear. The provision of public goods does affect the pattern of private spending, and the pattern of Atlantic Canadian consumption expenditures has changed since the formation of the North American Free Trade Agreement.

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