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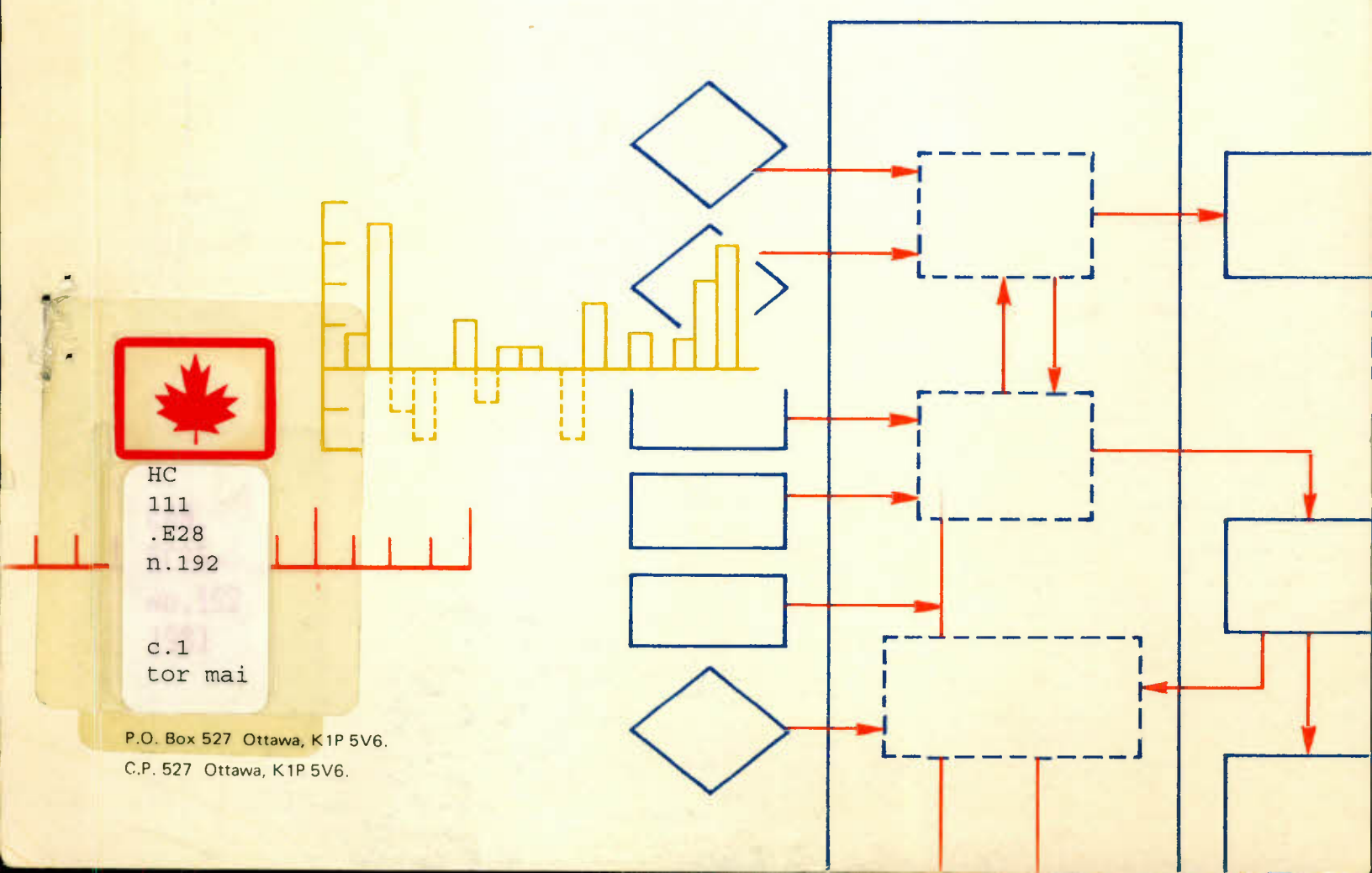

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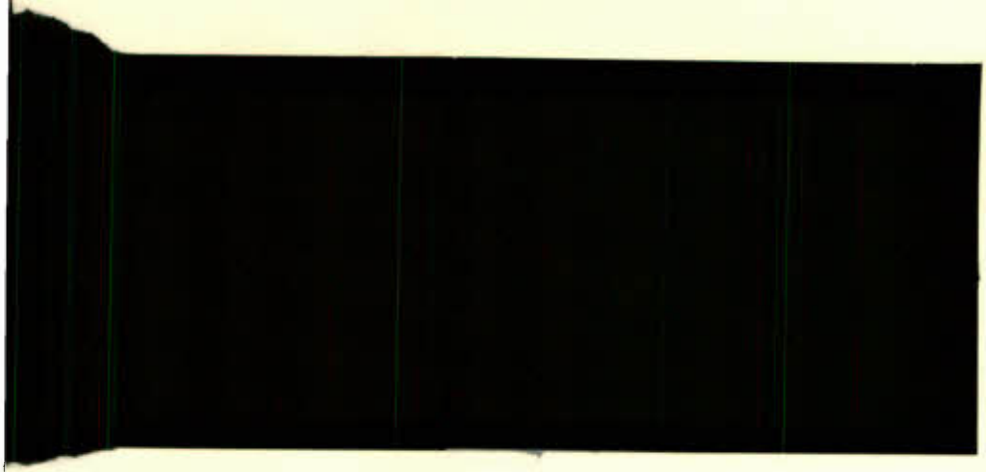

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DISCUSSION PAPER NO. 192

The Effect of Provincial Borrowings from Universal Pension Plans on Provincial and Municipal Government Finance

by Keith Patterson

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Résumé

Cette étude a pour but de déterminer les effets qu'ont eus les emprunts contractés par les provinces auprès des régimes de pensions du Québec et du Canada. Depuis 1966, en effet, ces dernières ont emprunté plus de 18 milliards de dollars de cette source, dont plus de 16 milliards uniquement du Régime de pension du Canada, à des taux d'intérêt inférieurs à ce qu'elles auraient payé sur les marchés de capitaux. En outre, il demeure possible que ces prêts n'aient jamais à être remboursés.

Cette situation a donné lieu à certaines conjectures à l'effet que de tels emprunts pourraient pousser les provinces, et peut-être aussi les administrations municipales, soit à trop investir dans des projets qui sont loin d'être nécessaires, soit à réduire l'épargne des gouvernements provinciaux. La diminution de cette épargne -- suite à l'augmentation des dépenses courantes ou à la diminution du revenu de sources propres à la province, ou les deux -- irait alors à l'encontre de l'objectif même des caisses de retraite.

Selon l'analyse de l'auteur, les emprunts contractés par les provinces de l'Atlantique auprès du Régime de pension du Canada ont incité ces provinces à réduire les revenus provenant de leurs propres sources, à augmenter leurs dépenses et, en conséquence, à accroître la somme globale de leurs emprunts. Bien que toutes les provinces aient augmenté la somme des emprunts par habitant depuis 1966 -- année où les régimes de pensions du Canada et du Québec entrèrent en vigueur -- M. Patterson n'a trouvé aucune preuve définitive à l'effet que cet accroissement a été provoqué par la disponibilité des fonds provenant des régimes de retraite, sauf, bien sûr, dans le cas des provinces de l'Atlantique.

Abstract

The objective of this study is to determine the effect of borrowing by the provinces from the Canada and Quebec Pension Plans. Since 1966, the provinces have borrowed over $18 billion from this source. Over $16 billion was borrowed from the Canada Pension Plan fund at interest rates below that which the provinces would pay on market borrowings. Also, there is the possibility that these borrowings will never have to be repaid.

There has been speculation by some that such borrowings will induce provincial and perhaps municipal governments to either over-invest in sub-optional projects or to reduce provincial government saving. If provincial government savings are reduced, either by increased current expenditure and/or reduced own-source revenue, then the objective of the pension funds will in effect be frustrated.

The analysis of this study indicates that the borrowings from the Canada Pension Plan by the Atlantic Provinces has induced them to reduce own-source revenues and increase expenditures and thereby increase total borrowings. Although all provinces increased borrowing per capita after 1966, when the Canada and Quebec Pension Plans began operation, we could find no convincing evidence that this increase was induced by the availability of borrowings from these plans, except in the Atlantic Provinces.

1 Introduction

Since the inception of the Canada Pension Plan (CPP) and the Quebec Pension Plan (QPP) in 1966, over $18 billion have been lent by the Plans to provincial governments. In the case of CPP, all surplus funds are required by law to be lent to provincial governments in proportion to contributions collected in each province. Surplus funds of QPP are deposited with the Caisse de dépôt et placement du Québec which invests the funds on the open market. As of December 31, 1979 some 67 per cent of the deposits of QPP were invested by the Caisse de dépôt in bonds of or guaranteed by the Government of Quebec and a further 9 per cent in other public sector investments, mostly Quebec municipal and school bonds.

It has been suggested by some that such borrowings will induce provincial (and perhaps also municipal) governments to over-invest in sub-optimal projects, or to reduce provincial government savings by increasing current expenditures or by reducing own-source taxation revenue. As Pesando and Rea correctly point out, a universal pension plan such as CPP and QPP would not have a fund in a meaningful sense if the funds loaned to the province were simply used to increase current expenditure. [Pesando and Rea, 1977, p. 88] Bird, in fact, assumes that provincial governments do use such borrowings to increase provincial government expenditures. His view, which seems to be

held by many, particularly in the business community, is worth quoting at length:

> "... the Canada Pension Plan is at the present time primarily a means of financing provincial expenditures through a regressive payroll tax. In a real sense, what the average taxpayer probably considers to be a purchase of a pension for himself -- or perhaps a payment helping to finance pensions currently being paid to others -- is instead a tax financing sundry provincial government activities. Since the provincial debts are unlikely ever to be repaid, the provinces will most likely want to protect this trouble-free source of cash by raising contribution (but not benefit) rates."
>
> [Bird 1976, p. 177]

There are several reasons why the investment policies of these universal pension plans, particularly the CPP, may induce provincial governments to reduce provincial government savings or to over-invest. As pointed out by Bird, provincial governments may believe that these loans will never have to be repaid. In this case, the cash flow from universal plans acts like a federal government unconditional grant. The CPP Act provides that loans to provinces be at interest rates equal to the yield on Government of Canada marketable bonds of similar maturity. For 20-year bonds issued by the provinces to CPP, the rate is equal to the average yield on Canada bonds with a term to maturity of 20 years or more. To data, all bonds issued by the provinces to the CPP have been 20-year bonds. Since interest yields on Canada bonds are normally less than on provincial bonds of similar term

to maturity, provinces are borrowing from CPP at less-than-market interest rates. This condition was intensified by the fact that until very recently, only two Canada bond series had terms to maturity of 20 years or more -- with coupon rates of 6.50 and 3.75 per cent. [Advisory Committee of the Canada Pension Plan 1975, pp. 13-14] Consequently these bonds trade at a discount and are attractive investments for taxpayers who receive some earnings in the form of capital gains. As a result, the interest rate on CPP loans to the provinces is futher depressed.

A further characteristic of cash flows from these universal plans to provinces that may influence provincial government finances is the predictability of that cash flow. Provincial governments can disregard the vagaries of financial markets to a greater extent than if they were not assured of this cash flow. Some provinces may experience difficulty in borrowing on the open market as much as they desire without unduly pushing up their borrowing rates. For these provinces the borrowings from CPP and QPP could be in addition to private market borrowings rather than a substitute for such borrowings.

ORGANIZATION OF STUDY

In section 2 we review some of relevant literature with emphasis on theories of government behaviour and empirical studies of junior levels of government expenditure determination. In section 3 we look at major sources of non-taxation revenue

for provincial governments -- specifically grants from the federal government and provincial government borrowings.

In section 4 we specify a model of provincial government expenditure and revenue determination. This model takes into consideration simultaneous determination of dependent and explanatory variables and the results of estimation by a simultaneous equation technique is given in section 5. Section 6 presents the conclusions.

2 Literature Review

Important as the subject is, no comprehensive study has yet been published on the effect of borrowing from universal pension plans on provincial government finances. As noted earlier, Bird [1976] simply assumes that provincial governments will behave in an irresponsible manner and spend all monies borrowed from pension plans on increased government consumption. Pesando and Rea [1977] are more careful and point out the consequences if such lending were to reduce government savings.

The most complete statement to date is given in Pesando [1978]. He suggests several reasons why the cash flow from universal pension plans might decrease provincial government savings (by increasing total borrowing). First, since interest rates charged by CPP are less than provinces would pay on the open market, provinces might increase investment.

> "In the case of public investment opportunities, for example, rational governments would undertake those projects for which the social rate of return exceeds the cost of funds. Present funding arrangements, by lowering the cost of funds, could lead directly to a higher level of public investment."
>
> [Pesando 1978, p. 88]

Second, he argues that for the case of Ontario, its

> "desire to maintain this [Triple A] credit rating, combined with an apparent tendency for major financial institutions in the United States to adopt a

> target proportion and/or ceiling on Canadian debt issues, may limit the actual volume of funds that the province can raise at any point in time in the United States."
>
> [Pesando 1978, p.89]

As a consequence, he argues, the availability of CPP funds could lead to higher levels of total borrowing and spending.

A further point worth noting is the importance placed on this source of funds by provincial governments. When the CPP was being set up in the early 1960s, provincial governments were very anxious to assure themselves of exclusive rights to these funds. This may be explained in part, however, by the fact that, at the time, the provinces were anticipating borrowing needs far in excess of any previous levels of borrowing, largely to finance expanding education and health facilities. [See for example Simeon 1972, for a discussion of the negotiations prior to the enactment of CPP/QPP legislation.]

In order to study the question of the effect of borrowings from CPP/QPP on provincial government finance, the borrowing must be placed in the context of a model of provincial government revenue and expenditure determination. We follow with a brief discussion of the literature on government behaviour and empirical studies of expenditure and revenue determination.

THEORIES OF GOVERNMENT BEHAVIOUR: A BRIEF OVERVIEW

Theories of the behaviour of economic agents can be either prescriptive -- describing how the agents ought to behave to achieve some objective, or descriptive -- describing how the agents do, in fact, behave. In consumer theory, for example, the descriptive theory is derived from the prescriptive by the assumption of rational behaviour and the fact that the agent who makes decisions is the same person as the agent whose welfare is directly affected by the decision. In the case of governments, the agents whose welfare ought to be maximized -- the citizenry of the state -- are not the makers of government decisions on a day-to-day basis. As a consequence, the behaviour of governments is difficult to model. This difficulty has resulted in a variety of approaches to the specification of models of government behaviour.

The most elegant approach is the "normative" theory of public finance which assumes that the government maximizes a social welfare function whose arguments are the utilities of its citizens. Problems of the existence of such a function, and the mechanism by which information is transmitted from the citizens to decision-makers, are assumed away and the analysis of government behaviour becomes amenable to the traditional tools of neo-classical microeconomics. Whereas few would suggest that this approach completely describes government behaviour, alternative approaches usually only partially describe government activity or are not based on a theory of choice.

A number of alternative hypothesis have been put forward about the actual behaviour of governments. We now consider several of these hypothesis which are intended to explain government behaviour.

One of the oldest hypothesis concerning government expenditure is "Wagner's Law" [Wagner 1958] which explains government expenditure as a generalization of historical evidence rather than by inferences based on the theory of public choice. The "Law" originally asserted that, in a progressive state, the share of total economic activity attributable to government tended to increase over time. Wagner attributed this increasing government involvement to two characteristics of a growing economy. First, he believed there was an increasing need to centralize administration. The resultant bureaucratric organization was less efficient and therefore more costly than a decentralized administration. Second, since public goods were supplied at a nominal or zero price to the consumer, the share of goods and services provided by governments would increase. Although not given a precise quantitative definition by Wagner, the law is now generally interpreted to mean that the elasticity of per capita real government expenditure with respect to per capita real income is greater than one. [Henning and Tussing 1974]

Peacock and Wiseman [1961] introduce a further explanation of the increasing share of economic activity by Western governments. They hypothesize that during times of social disturbance there is

a need for governments to increase revenue in order to deal with the agitation. After the disturbance is over, people will have become accustomed to the increased tax burden and the extra revenue can be used to finance expansion in government expenditures and increased involvement in the economy. Thus the trend in government expenditure is displaced upwards as a result of periodic disturbances. They claim to find evidence of this "displacement effect" for Great Britain and cite increased expenditure after wars.

The "revenue led" hypothesis [Foot 1977, p. 172] postulates that the primary constraint on government expenditure is the revenue constraint. The hypothesis assumes a two-stage government decision process. The first stage determines the amount of revenue (including borrowing) that is politically feasible. The second stage determines the allocation of such revenue among the various government projects. The assumption is that revenues will expand subject only to the politically-imposed revenue constraint. Perceived need for expenditure enters into the allocation decision, not the decision of how much revenue is to be raised. Some forms of revenue may be politically less costly than others. Thus there would be less political cost associated with borrowing from the CPP fund which is collected by the federal government (and furthermore may never have to be repiad) than from borrowing on open markets or increasing revenue by taxation.

Most empirical work to date has been based on so-called "positive" theory of government expenditure and revenue. This theory is based on the assumption that community preferences for public goods are revealed by government expenditures and therefore there ought to be a stable relationship between government expenditures and economic, demographic and other variables. This implies that the community's preferences can be empirically determined and much work has been done in this area, mostly in the form of "expenditure determinant" studies. Rather than build from a theory of choice, these studies for the most part have simply been empirical searches for variables which statistically "explain" as much public expenditure as possible. We will discuss them in more detail below.

EMPIRICAL STUDIES

The seminal work on the determinants of expenditure by junior levels of government is by Fabricant [1952] in his analysis of the growth of government expenditure in the United States. His approach was to explain the interstate differences in per capita expenditures on ten expenditure categories as functions of income per capita, urbanization and density of population using 1942 data for 48 states.

In the individual cross-section regressions, per capita income tended to be the most significant explanatory variable whereas urbanization tended to be insignificant. By comparing actual

1903 average state expenditures with estimated average state expenditures he concludes that

> "... the data are not inconsistant with the hypothesis that the 1942 relationship is applicable to the 1903 data and the 1903-42 changes, subject only to the addition of a time trend factor."
>
> [Fabricant 1952, p. 136]

Fabricant's study was followed by a large number of similar studies in the United States and elsewhere. (By 1967, Bahl [1969] could list 66 such studies without claiming to be exhaustive.) Most of the U.S. studies employed cross-section regression techniques and were concerned largely with identifying new determinants rather than attempting to improve upon estimation techniques or relating the particular study to public finance theory. So extensive has the list of possible determinants become that Weicher and Emerine [1973] regress their various expenditure categories for 204 central cities in 1960 on 21 independent variables. Of the 126 estimated slope coefficients, only 40 were significant at the 5 per cent level. Sacks and Harris [1964] introduced federal aid variables and found that federal aid was more important in determining state expenditures than density and urbanization.

Danzau [1975] criticizes much of this work for

> "... lack of co-ordination among these efforts -- the later works do not seem to build upon prior efforts. Many types of cross-sectional data

> employing differing units of observation (district, state, nation) have been utilized, with few studies using the same data base. Different dependent variables have been analyzed, often with little attempt to argue the appropriateness of the particular choice."
>
> [Danzau 1975, p. 241]

In Canadian sutdies of this kind, the small number of provinces does not allow cross-section regressions of provincial expenditures. Michas [1969] attempts to avoid this restriction by pooling cross-section and time series data for 1951, 1956 and 1961. His expenditure categories and independent variables are similar to those used by Fabricant. Per capita income was the most significant determinant of expenditure, and urbanization tended to be more important than population density. This study along with other studies pooling cross-section and time series data where dummy variables are introduced to explain inter-section differences, has been criticized for not appropriately specifying the error term. As a result, the estimation technique is inefficient and may lead to biased coefficient estimates.

A further problem with most determinant studies is that many of the explanatory variables are jointly determined with the dependent variables. This problem is particularly severe where intergovernmental aid is considered. Recently a few studies have been attempted, specifying and estimating simultaneous models of government expenditure. [See, for example, Broida 1977.]

Intergovernmental aid, in the form of conditional or unconditional grants from a senior level of government, is one of the major determinants of junior-level-of-government expenditure. Federal grants to the provinces have been a long-time feature of Canadian federal-provincial relations. In recent years, conditional grants have become more important than unconditional grants as the federal government attempts to bring uniformity to a number of provincial services. Unconditional grants since World War II are discussed in detail in Carter [1971].

The major empirical issue, particularly in the United States, is the extent to which a grant causes expenditure on the aided public good to expand. If expenditures expand by less than the grant, then part of the grant, in effect, becomes available to reduce revenue or increase non-aided expenditures. If the expenditures on the aided public good increase by more than the grant, then either expenditures on unaided public goods must be reduced or own-source revenues must be increased. There is to date no consensus on the overall impact on expenditures of intergovernmental aid. In a recent Canadian study, Hardy found that

> "... federal grants have been successful in stimulating expenditures, although to varying degrees, depending upon the program and the province being considered."
>
> [Hardy 1976]

In most cases the coefficients on conditional grants were greater than one indicating that the grants expanded expenditures on the aided program by more than the grant.

3 Provincial Borrowing

The most direct approach to answering the fundamental question of this study is to simply analyze provincial government borrowings from sources other than universal pension plans. If borrowings from CPP/QPP fully substituted for other borrowings so that total borrowings remained unaffected, then the cash flow from CPP/QPP would have no effect on provincial government finance. If borrowing from CPP/QPP augmented other borrowings so that total borrowings increased, then either provincial government savings declined or provincial government investment increased as a result of the cash flow from CPP/QPP. Whereas this approach can provide useful information, it does not provide conclusive evidence of any effects.

Total net new bond issues by province in 1971 dollars per capita are given in Table 3-1. After the inception of CPP/QPP in 1966, per capita borrowings substantially increased in all provinces except Saskatchewan where the increase was quite small. The new borrowings from CPP/QPP by province in 1971 dollars per capita are given in Table 3-2. Total borrowings exclusive of borrowings from CPP/QPP in 1971 dollars per capita are given in Table 3-3. This shows that with the exception of Saskatchewan, these other borrowings on average increased after 1966 also. The percentage increase in the Atlantic provinces averaged about twice the percentage increase in the other provinces. Although Ontario and Prince Edward Island did not follow the pattern.

Table 3-1

Total Net New Bond Issues by Province in 1971
Dollars Per Capita -- Three-Year Averages --
1960-1977

	1960-62	1963-65	1966-68	1969-71	1972-74	1975-77
Newfoundland	65	99	207	206	239	272
Prince Edward Island	34	47	129	77	16	90
Nova Scotia	39	14	155	158	119	190
New Brunswick	62	69	156	74	134	317
Quebec	47	98	85	73	95	206
Ontario	29	23	92	123	151	210
Manitoba	95	73	118	152	240	304
Saskatchewan	74	50	63	11	25	183
Alberta	57	68	123	153	66	234
British Columbia	106	54	88	105	116	272

Source Based on unpublished data from Bank of Canada.

Table 3-2

Net New Bond Issues to CPP/QPP by Province
in 1971 Dollars Per Capita -- Three-Year Averages --
1966-1977[1]

	1966-68	1969-71	1972-74	1975-77
Newfoundland	27	34	35	37
Prince Edward Island	21	31	33	36
Nova Scotia	35	45	46	49
New Brunswick	33	42	41	45
Quebec[2]	26	28	32	37
Ontario	55	64	65	67
Manitoba	42	53	55	56
Saskatchewan	33	46	46	48
Alberta	42	53	54	55
British Columbia	51	60	60	61

[1] CPP/QPP commenced operations in 1966. Errors due to rounding of net new issue data used in calculations will be large in small provinces, particularly Prince Edward Island.

[2] Includes borrowings from CPP and increase in Quebec and Guaranteed Bonds of the General Fund of the Caisse de dépôt et placement du Québec.

Source Based on unpublished data from the Bank of Canada and Annual Reports of the Caisse de dépôt et placement du Québec.

Table 3-3

Total Net New Bond Issues by Province (Exclusive of Bonds Issued to CPP/QPP) in 1971 Dollars Per Capita -- Three-Year Averages -- 1960-1977

	1960-62	1963-65	1966-68	1969-71	1972-74	1975-77	Average Percentage Increase [1] After 1966
Newfoundland	65	99	180	172	204	235	141
Prince Edward Island	34	47	108	46	-17	54	18
Nova Scotia	39	14	110	113	73	141	313
New Brunswick	62	69	123	32	93	272	98
Quebec	47	98	59	45	63	169	16
Ontario	29	23	37	59	86	143	213
Manitoba	95	73	76	99	185	248	81
Saskatchewan	74	50	30	-35	-21	135	-56
Alberta	57	68	81	100	12	179	49
British Columbia	106	54	37	45	56	211	9

[1] The "Average Percentage Increase" is the percentage increase in the mean of the 1966-77 period over the mean of the 1960-65 period.

Source Based on unpublished data from Bank of Canada and Annual Reports of the Caisse de dépôt et placement du Québec.

There are several reasons why provincial borrowings increased after 1966 by such a large amount. One of the most important reasons is the changing age structure of the Canadian population. In the mid-to-late-1960s, the "baby boom" of the 1950s was just entering university. This required expansion of post-secondary educational facilities. Further increasing the strain on existing facilities was the increasing percentage of students continuing on past secondary school and into university. In Ontario, the situation was intensified by the position of the Ontario government that a university education was a right to all who qualified. As a consequence, capital expenditures on post-secondary educational establishments encouraged heavy provincial borrowing. With the coming of the 1970s, capital expenditures on education became less important than in the later 1960s but increased capital expenditures were required in health and energy fields.

We should not leave this discussion of provincial borrowing without noting that there is a serious lack of appropriate data available for researchers in this field. The most complete data available on provincial (and municipal) expenditures is from Statistics Canada financial management series. [Statistics Canada 1957 to 1974 (a), (b) and (c).] However, the expenditure data are not broken down into current and capital expenditures. A further difficulty is that provincial public accounts are not on a consistent accounting basis across provinces so that data from this source is difficult to use for inter-provincial comparisons.

4 The Model

In this section we outline the model of junior government revenue and expenditure on which estimation is based. Ideally we ought to specify a model based on theory of public choice from which we would derive demand equations for public goods. These equations should then be estimated by simultaneous equation techniques in order to avoid biased estimates resulting from simultaneous determination of explanatory and dependent variables.

There are problems which render this approach difficult for the present study. First, demand equations derived from a theory of choice will have the prices of public goods as explanatory variables. Since public goods do not normally trade on freely-operating markets, prices do not exist. Borcherding and Deacon [Borcherding and Deacon 1972, and Deacon, 1978] have attempted to overcome this problem by specifying a model in which the marginal cost of public goods depends only on the price of labour inputs. They assume that capital is perfectly mobile between political units and that therefore the cost of capital is constant across political units. They then assume that the public goods production process is Cobb-Douglas which, given the constant cost of capital assumption, renders the marginal cost of efficiently-produced output proportional to the cost of labour.

This is an attractive solution for a cross-sectional study if it is reasonable to assume that the cost of capital is constant

across political units and the cost of labour inputs can be identified. However, for the present study, this solution is less attractive since a pure cross-section analysis of provincial expenditure and revenue would contain only ten observations. In order to have sufficient degrees of freedom, time series data will be required. We cannot assume that the cost of capital remains constant over time. Furthermore, since this study looks at all expenditure of provincial governments, identification of labour input costs would be difficult, if not impossible.

Second, the units of measurement of many public goods are not well-defined. Any study specifying demand equations would have to use statistical proxies in many instances to measure the provision level of public goods. This would introduce a large amount of measurement error into the data which would make estimation more difficult.

Third, in order to estimate a complete model by simultaneous equations techniques, sufficient data on a consistent basis must exist for each political unit. At the present, many of such data series are not readily available on provincial basis.

Data limitations make the estimation of a full system of structural equations impractical. Therefore a model, based on available data, is specified. The problem here is to strike a judicious balance between the need to fully specify the

expenditure and revenue equations and the need to retain identified equations.

We assume that total government expenditure per capita is a function of per capita current personal income, y, population density, D, the population's median age, A, general purpose grants, G, and specific purpose grants, S, from the federal government and the cash flow from CPP/QPP, f. We write the expenditure equation (with time subscripts) as:

$$E_t = E_t(A_t, D_t, G_t, S_t, y_t, f_t) \qquad [4.1]$$

Total revenue is assumed to be a function of the unemployment rate, U, the real interest rate, r, per capita personal income, general and specific-purpose grants from the federal government and the cash flow from CPP/QPP. We write the own-source revenue equation as:

$$R_t = R_t(U_t, r_t, G_t, S_t, y_t, f_t) \qquad [4.2]$$

The revenue constraint is:

$$E_t = R_t + G_t + S_t + A_t - A_{t-1} \qquad [4.3]$$

where A is the net assets of the junior level of government.

The conditional grants equation is

$$S_t = S_t^* + \alpha E_t^* \qquad [4.4]$$

where S_t^* is the exogenously-determined per capita portion of conditional grants, E_t^* is the portion of per capita total expenditure eligible for a cost-sharing conditional grant, and α is a weighted average of federal percentage shares.

We assume that we can approximately specify income as

$$y_t = y_t(y_{t-1}, E_t, R_t, U_t, r_t, H_t) \qquad [4.5]$$

where H_t is the proportion of population aged 20 to 64.

The endogenous varibles in equations [4.1] and [4.2] are S_t, and y_t and the predetermined variables in the system are A_t, D_t, G_t, f_t, u_t, r_t, A_{t-1}, Y_{t-1}, and H_t. Strictly speaking, in a fully-specified system the cash flow from CPP/QPP should be treated as an endogenous variable since it is determined, in part, by per capita income. However, this would be true also of several other variables including both the unemployment and interest rates. If these variables were treated as endogenous, the revenue and expenditure equations would become underidentified. We have therefore chosen as endogenous only those variables directly affected by revenue or expenditure levels. The other variables such as the cash flow from CPP/QPP are only indirectly affected by revenue and expenditure levels

and we therefore treat them as exogenous. The results, together with some modifications to facilitate estimation, will be given in the next section.

5 Estimation of the Model

In this section we describe the estimation of the expenditure and revenue equations. First we describe the data used in the estimation, then the estimation procedure and finally we discuss the estimates of the model.

THE DATA BASE

Loans from the CPP are made only to provincial governments and we would expect that the major impact of such loans, if any, would be on provincial rather than municipal governments. Estimation would be rendered difficult if only provincial data were used since interprovincial comparability would be difficult. The reason is that under the British North America Act, municipal governments are creatures of their provincial government and consequently, the split between provincial and municipal jurisdiction, with respect to both revenue and expenditure, is quite arbitrary. For example, education and welfare are part of provincial expenditures in some provinces and municipal expenditures in other. Over time, expenditure and revenue categories also shift between provincial and municipal governments. For example, in 1967 New Brunswick, which previously split education expenditures about 50-50 between province and municipalities, took over nearly all education expenditure at the provincial level. Ontario, Quebec and Saskatchewan split education expenditures about 50-50 between

province and municipalities, while Newfoundland municipalities pay only about one per cent of education costs.

To overcome this problem, provincial and municipal revenues, expenditures and liabilities were consolidated by adding the provincial and municipal quantities and netting-out intergovernmental grants and liabilities. The data used is from Statistics Canada Financial Management Series [Statistics Canada 1957 to 1974 a, b and c] which is the only available source for such data at present. Two problems are introduced by their use. First, expenditure data do not distinguish between current and capital expenditure. Since we have no capital expenditure data on a provincial basis, the data were not corrected for this. Second, provincial data are for fiscal years ending March 31 but the municipal data are for the year ending nearest December 31. Thus the data do not quite match for some provinces with respect to year ends. We believe that the error introduced by consolidation, however, will be much less than the errors introduced by using provincial data only.

The model specifies revenue to be "own-source" revenue of the provincial and municipal governments. In order to make the data as comparable as possible across provinces and over time, own-source revenue was defined to include grants in lieu of taxes and tax rental proceeds from the federal government. "Revenues" exclude employee contributions to employer pension plans and "expenditures" exclude employee pension payments.

The liabilities are defined to be "net" liabilities of provincial and municipal governments. These figures were calculated by subtracting total financial assets from total liabilities. All government finance data is deflated by the G.N.E. deflator for current government expenditure (1971=100).

The real interest rate variable is the McLeod, Young and Weir "average of ten provincials" interest yield less the expected rate of inflation from CANDIDE Model 2.0. This expected rate of inflation variable was obtained by regressing the actual rate of price increase on the rate of price increase lagged one year and the rate of increase in the money supply lagged one and two years.

Cash flow from the CPP was calculated by subtracting estimated interest payments to the CPP from the increase in provincial bonds held by the CPP. The estimated interest was calculated by distributing total interest received by the CPP in proportion to beginning-of-period total bonds of provinces held by the CPP. The cash flow to Quebec from the QPP was the increase in Quebec and municipal bonds held by the Caisse de dépôt et placement du Québec general fund less interest payments. This calculation would slightly overestimate the cash flow to Quebec from the QPP since about 5 per cent of the liabilities of the Caisse de dépôt general fund are for accounts other than the QPP. These cash flows were also deflated by the GNE deflator for current government expenditure.

ESTIMATION PROCEDURE

Since the data consisted of 18 time periods and many explanatory variables were highly collinear in some provinces, the pooling of cross-section and time series data was necessary in order to obtain sufficient degrees of freedom. The pooling method chosen was the error components procedure. A note on error component models is given in the Appendix.

The error components procedure as outlined in the Appendix is a single equation generalized least-squares method of estimation. For the estimation of the model a modified two stage least squares procedure was used in which the endogenous variables entering the revenue and expenditure equations were regressed on all exogenous variables using the "error components" procedure. The estimated values for the endogenous variables were then used as data in place of the observed endogenous variables in the revenue and expenditure regressions, again using the "error components" procedure.

It seems reasonable to assume that provincial government behaviour is different in the rich than in the poor provinces. In order to test for this, the sample was divided into the five rich and the five poor provinces on the basis of average per capita general-purpose grants from the federal government. (The Atlantic provinces plus Saskatchewan made up the poor group and the other provinces the rich group.) Suspecting that behavioural

differences may still exist between the Atlantic provinces and Saskatchewan, regressions were also run on the Atlantic provinces only. Since Quebec has opted-out of a number of conditional-grant programs, and since the investment of QPP funds are handled in a different way than CPP funds, we also ran the regressions with Quebec out of the rich group.

ESTIMATION RESULTS

Before discussing the estimation results, we should point out some of the difficulties with the model. As pointed out in section 4, the nonavailability of some data on a provincial basis renders the estimation of a simultaneous system difficult. In order to retain overidentified equations, the number of variables entering the revenue and expenditure equations had to be limited. As a result, some variables were arbitrarily omitted. In the specification of the model we assumed that the endogenous variables were specific-purpose grants and personal income. During estimation, a number of alternative specifications were made in order to overcome the high degree of collinearity among variables in the second stage, particularly between personal income and general- and specific-purpose grants. Collinearity between general-purpose grants and estimated specific-purpose grants was reduced by replacing general-purpose grants by provincial and municipal debt service expenditure (which can be regarded as predetermined in any year) in the list of predetermined variables when estimating the equations of the first stage. This revised list was used throughout all regressions. The estimates are given in Tables 5-1 to 5-4.

Equation 2 (expenditure) is as specified in the previous section. In order to reduce collinearity between specific-purpose grants and the income variable, estimated personal income was replaced by lagged personal income (Equations 1 and 5). It might be argued that some parts of specific-purpose grants are not exogenous but depend on expenditures and taxation. In Equations 3 (expenditure) and 6 (revenue) we treat specific- purpose grants as endogenous. In order to further reduce collinearity between estimated specific-purpose grants and general-purpose grants we added them to get total grants and treated this variable as endogenous (Equations 4 and 7).

Personal income is the most significant explanatory variable in all revenue equations and in the expenditure equations for the rich provinces. In the poor provinces with and without Saskatchewan, personal income is an insignificant explanatory variable in the expenditure equations (Tables 5-1 and 5-2). The income elasticities are given in Table 5-5. A possible explanation for the low-income elasticity in the poor provinces, and the Atlantic provinces in particular is that their expenditures are determined by the federal grant structure to such an extent that conditions within these provinces have little to do with the determination of expenditures. Specific-purpose grants are the most important determinant in the expenditure equations for the poor provinces. As noted earlier, however, in the second-stage regressions high degrees of collinearity existed between the two grant variables. As a consequence, the

Table 5-1

Parameter Estimates
Total Consolidated Provincial and Municipal Expenditure and Own-Source Revenue --
Atlantic Provinces and Saskatchewan[1]

	EXPENDITURE				REVENUE		
	Equation Number						
	1	2	3	4	5	6	7
Constant	-1144.474 (5.21)	-1172.074 (5.20)	-1004.365 (3.619)	-1130.360 (3.88)	-236.700 (4.14)	-211.550 (2.79)	-288.658 (5.41)
Median Age	60.528 (5.32)	62.047 (5.33)	49.389 (3.49)	57.314 (3.94)			
Density	- 4.899 (3.94)	- 5.022 (3.98)	- 2.874 (1.68)	- 3.800 (2.00)			
Unemployment Rate					- 0.351 (0.14)	1.011 (0.39)	0.023 (0.01)
Interest Rate					11.612 (1.75)	8.051 (0.72)	20.862 (3.29)
General-Purpose Grants	1.065 (5.41)	1.083 (5.45)	- 0.186* (0.35)		- 0.292 (1.48)	- 1.22* (1.74)	
Specific-Purpose Grants	3.634* (6.98)	3.692* (7.22)	2.979* (4.32)		- 0.072* (0.19)	0.869* (1.07)	
Total Grants				1.825* (5.75)			- 0.311* (2.01)
Personal Income		- 0.045* (0.88)	0.087* (1.41)	0.031* (0.49)		0.306* (9.59)	0.336* (12.31)
Personal Income Lagged	- 0.040 (0.74)				0.327 (10.40)		
CPP Cash Flow	0.276 (0.40)	0.292 (0.43)	0.607 (0.69)	1.964 (2.21)	0.451 (0.63)	- 0.500 (0.61)	0.241 (0.36)
R^2 Adjusted	0.924	0.924	0.802	0.838	0.871	0.892	0.899
Degrees of Freedom	78	78	78	79	78	78	79

[1] Absolute t values in parenthesis.

Note An asterisk (*) indicates the coefficient of an endogenous variable.

Table 5-2

Parameter Estimates
Total Consolidated Provincial and Municipal Expenditure and Own-Source Revenue --
Atlantic Provinces[1]

	EXPENDITURE				REVENUE		
	Equation Number						
	1	2	3	4	5	6	7
Constant	-1489.387 (3.02)	-1316.202 (2.41)	-533.928 (0.86)	-720.203 (1.16)	-219.911 (3.83)	-260.972 (3.30)	-254.965 (5.16)
Median Age	80.230 (2.84)	70.134 (2.25)	26.669 (0.75)	36.953 (1.06)			
Density	- 6.103 (2.62)	- 5.294 (2.06)	- 2.177 (0.74)	- 2.369 (0.86)			
Unemployment Rate					- 0.153 (0.07)	0.356 (0.16)	0.670 (0.31)
Interest Rate					11.181 (1.59)	17.235 (1.46)	15.683 (2.62)
General-Purpose Grants	1.312 (5.45)	1.322 (5.41)	0.622* (0.83)		- 0.238 (0.94)	0.305* (0.30)	
Specific-Purpose Grants	3.176* (4.35)	2.923* (3.60)	2.068* (2.18)		0.526* (1.81)	0.055* (0.08)	
Total Grants				1.943* (3.50)			0.143* (0.93)
Personal Income		- 0.034* (0.32)	0.133* (0.89)	0.030* (0.22)		0.254* (7.66)	0.258* (8.37)
Personal Income Lagged	- 0.072 (0.72)				0.266 (8.74)		
CPP Cash Flow	0.716 (1.01)	0.814 (1.15)	0.844 (0.96)	0.999 (0.96)	- 0.314 (0.44)	- 0.525 (0.77)	- 0.490 (0.72)
R^2 Adjusted	0.945	0.945	0.911	0.919	0.896	0.892	0.894
Degrees of Freedom	61	61	61	62	61	61	62

[1] Absolute *t* values in parenthesis.

Note An asterisk (*) indicates the coefficient of an endogenous variable.

Table 5-3

Parameter Estimates
Total Consolidated Provincial and Municipal Expenditure and Own-Source Revenue --
Quebec, Ontario, Manitoba, Alberta and British Columbia[1]

	EXPENDITURE				REVENUE		
	Equation Number						
	1	2	3	4	5	6	7
Constant	369.835 (2.04)	320.380 (1.79)	341.283 (2.05)	262.485 (1.56)	-413.704 (4.85)	-438.358 (5.84)	-307.858 (4.04)
Median Age	-23.703 (3.25)	-20.76 (2.92)	-20.514 (3.12)	-16.266 (2.42)			
Density	- 3.526 (0.87)	- 2.696 (0.68)	- 0.432 (0.11)	2.490 (0.62)			
Unemployment Rate					- 5.707 (0.75)	- 10.819 (1.59)	- 2.979 (0.45)
Interest Rate					21.235 (2.53)	33.070 (4.25)	12.573 (2.02)
General-Purpose Grants	2.110 (5.46)	2.025 (5.26)	2.952* (5.12)		1.893 (5.187)	2.934* (5.70)	
Specific-Purpose Grants	1.254* (2.23)	1.404* (2.56)	1.345* (2.67)		0.025* (0.04)	- 0.434* (0.76)	
Total Grants				2.562* (6.18)			1.399* (3.58)
Personal Income		0.303* (8.64)	0.262* (7.61)	0.264* (6.25)		0.331* (9.47)	0.258* (7.92)
Personal Income Lagged	0.305 (8.60)				0.335 (8.18)		
CPP/QPP Cash Flow	0.326 (0.60)	- 0.040 (0.07)	0.307 (0.59)	0.071 (0.14)	1.171 (2.34)	0.951 (2.17)	0.546 (1.21)
R^2 Adjusted	0.898	0.899	0.899	0.903	0.787	0.796	0.823
Degrees of Freedom	78	78	78	79	78	78	79

[1] Absolute t values in parenthesis.

Note An asterisk (*) indicates the coefficient of an endogenous variable.

Table 5-4

Parameter Estimates
Total Consolidated Provincial and Municipal Expenditure and Own-Source Revenue --
Ontario, Manitoba, Alberta and British Columbia[1]

	EXPENDITURE				REVENUE		
	Equation Number						
	1	2	3	4	5	6	7
Constant	271.380 (1.66)	259.468 (1.63)	338.099 (1.89)	424.946 (2.81)	-247.619 (2.97)	-232.233 (2.31)	-275.213 (3.37)
Median Age	-15.661 (2.56)	-14.077 (2.34)	-17.535 (2.59)	-20.367 (3.69)			
Density	- 5.529 (1.73)	- 4.851 (1.55)	- 5.198 (1.45)	- 0.395 (0.12)			
Unemployment Rate					- 4.247 (0.55)	- 2.368 (0.26)	- 1.005 (0.13)
Interest Rate					2.776 (0.33)	2.537 (0.22)	8.545 (1.27)
General-Purpose Grants	0.263 (0.72)	0.179 (0.49)	0.764* (1.07)		0.884 (1.82)	0.481* (0.50)	
Specific-Purpose Grants	2.598* (5.83)	2.719* (6.31)	2.003* (4.88)		1.72* (2.69)	1.696* (2.29)	
Total Grants				2.082* (7.05)			1.249* (3.11)
Personal Income		0.236* (8.85)	0.243* (10.25)	0.232* (9.29)		0.238* (6.16)	0.249* (7.89)
Personal Income Lagged	0.261 (8.76)				0.249 (6.31)		
CPP Cash Flow	- 0.058 (0.12)	- 0.315 (0.66)	0.035 (0.09)	0.089 (0.21)	0.511 (1.07)	0.314 (0.48)	0.544 (1.21)
R^2 Adjusted	0.929	0.931	0.931	0.935	0.801	0.820	0.818
Degrees of Freedom	61	61	61	62	61	61	62

[1] Absolute *t* values in parenthesis.

Note An asterisk (*) indicates the coefficient of an endogenous variable.

Table 5-5

Estimated Income Elasticities of Expenditure and Own-Source Revenue

	EXPENDITURE				REVENUE		
	Equation Number						
	1	2	3	4	5	6	7
Atlantic and Saskatchewan	-0.110	-0.132	0.277	0.091	1.614	1.595	1.751
Atlantic Only	-0.195	- .096	0.353	0.085	1.456	1.467	1.490
Quebec, Ontario, Manitoba, Alberta and British Columbia	1.156	1.107	1.017	0.826	1.457	1.501	1.169
Ontario, Manitoba, Alberta and British Columbia	0.932	0.882	0.965	0.867	1.096	1.082	1.142

coefficients of the grants variables are poor. Adding the grants' variables together (Equations 4 and 7), does little to improve their performance.

The effect of the CPP/QPP cash flow variable is ambiguous in all provincial groupings except the Atlantic province group (Table 5-2). Here, while no individual coefficient of the CPP cash flow is significant, all coefficients in the expenditure equations are positive and all coefficients in the revenue equations are negative. What is important, however, is whether or not the coefficients of the expenditure equations are significantly different from the coefficients of the revenue equations. An analysis of the absolute differences between revenue and expenditure coefficients (Table 5-6) indicates that the coefficients generally are significantly different in the expenditure equations from values in the revenue equations. This indicates that the cash flow from CPP has driven a wedge between expenditures and revenues in the Atlantic provinces thereby increasing total borrowing.

Table 5-6

Absolute Differences Between CPP Cash Flow Coefficients in Expenditure and Revenue Equations
Atlantic Provinces

		EXPENDITURE EQUATIONS			
		1	2	3	4
REVENUE EQUATIONS	5	*1.030*	*1.128*	*1.158*	**1.313
	6	**1.241**	**1.339**	**1.369*	**1.524*
	7	**1.206**	**1.304**	**1.334*	**1.489*

Note A single asterisk (*) indicates a significant value at the 10 per cent confidence level. A double asterisk (**) indicates a significant value at the 5 per cent confidence level. Asterisks preceding the value indicate significance based on standard error in the revenue equation, and asterisks after the value indicate significance based on standard error in the expenditure equation. Thus the third value in the second row (**1.369*) indicates that the coefficient in Equation 3 (Expenditure) is significantly different from the coefficient of Equation 6 (Revenue) at the 10 per cent level based on the expenditure estimate. But the coefficient in the revenue equation is significantly different from the coefficient in the expenditure equation at the 5 per cent level based on the revenue estimate.

6 Conclusions

This study has been directed at determining the effects of borrowing from universal pension plans on provincial and municipal finance. To this end, we have looked directly at the borrowings of provinces and have estimated a model of provincial and municipal government expenditure and revenue. We conclude that the major effect of the cash flow from universal pension plans was to increase provincial government borrowings in the Atlantic provinces.

In support of this conclusion, we have shown that total per capita borrowings have, on average, increased more rapidly in the Atlantic provinces than elsewhere in Canada. Since the Atlantic provinces borrow at higher market rates than other provinces do, their borrowings from CPP are less costly relative to other sources of funds. The Atlantic provinces, in attempting to prevent tax rates from becoming too high relative to tax rates in other provinces, would find increased borrowing a more attractive solution than increasing tax rates -- providing funds were available at a reasonable cost. The availability of funds from the CPP facilitated such increased borrowing. If these funds were not available, it is probable that the Atlantic provinces would have borrowed more from other sources, but not as much as from the CPP. Expenditures would likely also have been reduced and own-source revenue increased.

The estimation results provide evidence suggesting that the cash flow from CPP has increased total borrowing in the Atlantic provinces but not in other provinces. In this model, the grants programs tend to increase expenditure by more than the grant. Since grants from the federal government constitute nearly 50 per cent of total revenue in the Atlantic provinces and a much lesser amount in other provinces, the tendency for the grants programs to expand revenue needs puts a more severe strain on revenue sources in the Atlantic provinces than in the other provinces. A further indication of this is that personal income had little, if any, explanatory power in the expenditure equations for the Atlantic provinces.

terms. There are T time periods and N sections for a total of NT observations. Let

$$y = \begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_N \end{pmatrix}, \quad X = \begin{pmatrix} X_1 \\ X_2 \\ \vdots \\ X_N \end{pmatrix}, \quad u = \begin{pmatrix} u_1 \\ u_2 \\ \vdots \\ u_N \end{pmatrix}$$

We can now write the model as:

$$y = X\beta + u \qquad [A.2]$$

We assume that u_{it}, the error term in period t for section i is composed of three independent components:

$$u_{it} = \mu_i + \lambda_t + \nu_{it} \qquad [A.3]$$

and that

$$E(\mu_i \mu_j) = \begin{cases} \sigma_\mu^2, & i=j \\ 0, & i \neq j \end{cases}$$

$$E(\lambda_i \lambda_j) = \begin{cases} \sigma_\lambda^2, & i=j \\ 0, & i \neq j \end{cases} \qquad [A.4]$$

$$E(\nu_{it} \nu_{jl}) = \begin{cases} \sigma_\nu^2, & i=j \text{ and } t=l \\ 0 & \text{otherwise} \end{cases}$$

where E is the expectation operator. [For a discussion of the justification of this formulation see Nerlove 1971, p. 360] Nerlove [1971 b, p. 385] has shown that the variance-covariance matrix of u can be written

Appendix: Note on Error Components Models

When insufficient observations are available in either time series or cross section form to adequately estimate a relationship, a time series of cross sections data is sometimes available to provide sufficient degrees of freedom. The procedure usually used in the past and sometimes even now is to "pool" the data and add section and/or time dummy variables. The common objection to this procedure is that the dummies explain too much, i.e., the dummies will explain systematic differences which should be explained by the other explanatory variables. Also it is difficult to interpret the dummy variables. [Maddala 1971] Another problem is that the introduction of dummy variables reduces the degrees of freedom. Nerlove [1971, b] has shown that the estimates may also be biased.

One approach that is becoming popular is the error components model developed largely by Balestra and Nerlove [1966], Wallace and Hussain [1969] and Nerlove [1971, b]. The specification of the model is as follows:

$$y_i = X_i\beta + u_i \qquad (i=1\ldots N) \qquad \text{[A.1]}$$

where y_i is a Tx1 vector of dependent variables, X_i is a TxK matrix of explanatory variables, β is a Kx1 vector of coefficients to be estimated and u_i is a Tx1 vector of error

$$E(uu') = \sigma^2\Omega = \sigma^2\left[(1-\rho-\omega)I_{NT} + \rho(I_N \otimes e_T e_T') + \omega(e_n e_n' \otimes I_T)\right] \qquad [A.5]$$

where

$$\begin{aligned} \sigma^2 &= \sigma_\mu^2 + \sigma_\lambda^2 + \sigma_\nu^2 \\ \rho &= \sigma_\mu^2 / \sigma^2 \\ \omega &= \sigma_\lambda^2 / \sigma^2 \end{aligned} \qquad [A.6]$$

and I_{NT}, I_N and I_T are identity matrices of order NT, N, and T respectively, and e_{NT}, e_N and e_T are vectors consisting of ones of order NTx1, Nx1, and Tx1 respectively.

Nerlove [1971 b, p. 392] has further shown that Ω^{-1} can be written:

$$\begin{aligned} \Omega^{-1} = {} & \frac{1}{\lambda_1}\frac{e_{NT}e_{NT}'}{NT} + \frac{1}{\lambda^2}\left[\frac{e_N e_N'}{N} \otimes I_T - \frac{e_{NT}e_{NT}'}{NT}\right] \\ & + \frac{1}{\lambda^3}\left[I_N \otimes \frac{e_T e_T'}{T} - \frac{e_{NT}e_{NT}'}{NT}\right] \\ & + \frac{1}{\lambda^4}\left[I_{NT} - \frac{e_N e_N'}{N} \otimes I_T - I_N \otimes \frac{e_T e_T'}{T} + \frac{e_{NT}e_{NT}'}{NT}\right] \end{aligned} \qquad [A.7]$$

where

$$\begin{aligned} \lambda_1 &= 1-\rho-\omega+\omega N+\rho T \\ \lambda_2 &= 1-\rho-\omega+\omega N \\ \lambda_3 &= 1-\rho-\omega+\rho T \\ \lambda_4 &= 1-\rho-\omega \end{aligned} \qquad [A.8]$$

(λ_1, λ_2, λ_3 and λ_4 are the four distinct roots of Ω).

The generalized least-squares estimate of β is given by

$$\hat{\beta} = [X'\hat{\Omega}^{-1}X]^{-1}X'\hat{\Omega}^{-1}y \qquad [A.9]$$

where $\hat{\Omega}$ is the same as Ω except that the λ's are formed from estimates of σ_μ^2, σ_λ^2 and σ_ν^2 obtained by the following formula (from Wallace and Hussain [1969] p. 65).

$$\hat{\sigma}_\nu^2 = \frac{1}{(N-1)(T-1)} \sum_{i=1}^{N} \sum_{t=1}^{T} \left(\hat{\varepsilon}_{it} - \frac{1}{T}\hat{\varepsilon}_{i\cdot} - \frac{1}{N}\hat{\varepsilon}_{\cdot t} \right)^2 \qquad [A.10]$$

$$\hat{\sigma}_\mu^2 = \frac{1}{T} \left(\sum_{i=1}^{N} \frac{\hat{\varepsilon}_{i\cdot}^2}{T(N-1)} - \hat{\sigma}_\nu^2 \right) \qquad [A.11]$$

$$\hat{\sigma}_\lambda^2 = \frac{1}{N} \left(\sum_{t=1}^{T} \frac{\hat{\varepsilon}_{\cdot t}^2}{N(T-1)} - \hat{\sigma}_\nu^2 \right) \qquad [A.12]$$

which are consistent estimates of σ_ν^2, σ_μ^2 and σ_λ^2. $\hat{\varepsilon}_{it}$ is the residual for section i, period t from an ordinary least-squares regression on (A.2) and $\hat{\varepsilon}_{i\cdot} = \sum_{t=1}^{T} \hat{\varepsilon}_{it}$ and $\hat{\varepsilon}_{\cdot t} = \sum_{i=1}^{N} \hat{\varepsilon}_{it}$.

Bibliography

Advisory Committee of the Canada Pension Plan. The Rate of Return on the Investment Fund of the Canada Pension Plan. Ottawa: 1975.

Auld, D.A.L. "Provincial Grants and Local Government Expenditure" Public Finance Quarterly, Vol. 4 No. 3, July 1976.

Bahl, Roy W. "Studies on Determinants of Public Expenditure: A Review," in Selma J. Mushkin and John F. Cotton, Sharing Federal Funds for State and Local Needs. New York: Praeger, 1969.

Balestra, Pietro and Marc Nerlove. "Pooling Cross Section and Time Series Data in the Estimation of a Dynamic Model: The Demand for Natural Gas." Econometrica, Vol. 34 No. 3, July 1966.

Barth, James R., James T. Bennett and John Kroft. "An Econometric Analysis of a Federal Revenue-Sharing Allocation Formula", Public Finance Quarterly, Vol. 4 No. 1, January 1976.

Beaton, W. Patrick. "The Determinants of Police Protection Expenditures." National Tax Journal, Vol. XVII No. 2, June 1974.

Bird, Richard M. Charging for Public Services: A New Look at an Old Idea. Toronto: Canadian Tax Foundation, 1976.

Booms, Bernard H. and Teh-Wei Hu. "Towards a Positive Theory of State and Local Public Expenditures: An Empirical Example." Public Finance, Vol. XXVI No. 3, 1971.

Borcherding, Thomas E. and Robert T. Deacon. "The Demand for the Services of Non-Federal Governments." The American Economic Review, Vol. LXII No. 5, December 1972.

Breton, Albert and Anthony Scott. The Economic Constitution of Federal States. Toronto: University of Toronto Press, 1978.

Broida, Michael S. "Government Revenue/Expenditure Models: A Case for the Simultaneous Equations Technique." Public Finance Quarterly, Vol. 5 No. 1, January 1977.

Carter, George E. Canadian Conditional Grants Since World War II. Toronto: Canadian Tax Foundation, 1971.

Chetty, V.K. "Pooling of Time Series and Cross Section Data." Econometrica, Vol. 36 No. 2, April 1968.

Deacon, Robert T. "A Demand Model for the Local Public Sector." The Review of Economics and Statistics, Vol. LX No. 2, May 1978.

Denzau, Arthur T. "An Empirical Survey of Studies on Public School Financing." National Tax Journal, Vol. XXVIII No. 2, June 1975.

Fabricant, Solomon. The Trend in Government Activity in the United States Since 1900. New York: National Bureau of Economic Research, 1952.

Greene, Kenneth V. "Spillovers, Migration and Public School Expenditures: The Repetition of an Experiment." Public Choice, Vol. XXIX, Spring 1977.

Greytak, David, Richard Gustely and Robert J. Dinkelmeyer. "The Effects of Inflation on Local Government Expenditures." National Tax Journal, Vol. XXVII No. 4, December 1974.

Hanson, Eric T. Fiscal Needs of the Canadian Provinces. Toronto: Canadian Tax Foundation, 1961.

Hardy, H.M. "Budgetary Responses of Individual Governmental Units to Federal Grants." Public Finance Quarterly, Vol. 4 No. 2, April 1976.

Haskell, Mark A. "Decentralization or Concentration of Power? The Revenue Sharing Paradox." Journal of Economic Issues, Vol. XI No. 2, June 1977.

Hartle, Douglas C. The Expenditure Budget Process in the Government of Canada. Toronto: Canadian Tax Foundation, 1978.

Henning, John A. and Dale A. Tussing. "Income Elasticity of the Demand for Public Expenditures in the United States." Public Finance, Vol. XXIX No. 3, 1974.

Hirsch, Werner Z. The Economics of State and Local Government. New York: McGraw-Hill, 1970.

Kelley, Allan C. "Demographic Change and the Size of the Government Sector." Southern Economic Journal, Vol. 43 No. 2, October 1976.

La Forest, Gerard V. The Allocation of Taxing Powers Under the Canadian Constitution. Toronto: Canadian Tax Foundation, 1967.

Maddala, G.S. "The Use of Variance Components Models in Pooling Cross Section and Time Series Data." Econometrica, Vol. 39 No. 2, March 1971.

_____ and T.D. Mount. "Comparative Study of Alternative Estimators for Variance Components Models." Journal of the American Statistical Association, Vol. 68 No. 342, June 1973.

Maxwell, James A. Financing State and Local Governments. Washington: The Brookings Institution, 1965.

McDougall, Gerald S. "Hedonic Prices and the Demand for Local Public Goods." Public Finance, Vol. XXXI No. 2, 1976.

Marsk, Lawrence C. "Weicher's State Aid and Expenditure Model and the Simultaneous Equations Controversy." National Tax Journal, Vol. XXVIII No. 4, December 1975.

Michas, Nicholas A. "Variations in the Level of Provincial - Municipal Expenditures in Canada: An Econometric Analysis." Public Finance, No. 4, 1969.

Musgrave, Richard and Peggy B. Musgrave. Public Finance in Theory and Practice. New York: McGraw-Hill, 1973.

Nathan, Richard P. "The Uses of Shared Revenue." Journal of Finance, Vol. XXX No. 2, May 1975.

Nerlove, Marc, "Further Evidence on the Estimation of Dynamic Economic Relations From a Time Series of Cross Sections." Econometrica, Vol. 39 No. 2, March 1971 a.

_____ "A Note on Error Components Models." Econometrica, Vol. 39 No. 2, March 1971 b.

Peacock, Allan T. and Jack Wiseman. The Growth of Public Expenditure in the United Kingdom. New York: National Bureau of Economic Research, 1961.

Pesando, J.E. and S.A. Rea Jr. Public and Private Pensions in Canada: An Economic Analysis. Toronto: Ontario Economic Council, 1977.

Pesando, James E. "The Canada Pension Plan as a Financial Intermediary" in James E. Pesando and Lawrence B. Smith, Government in Canadian Capital Markets. Montreal: C.D. Howe Research Institute, 1978.

Pidot, George B. Jr. "A Principal Components Analysis of the Determinants of Local Government Fiscal Patterns." The Review of Economics and Statistics, Vol. LI No. 2, May 1969.

Pommerehne, Werner W. and Bruno S. Frey. "Two Approaches to Estimating Public Expenditures." Public Finance Quarterly, Vol. 4 No. 4, October 1976.

Prest, Wilfred. "Intergovernmental Relations: Some Implications for Australia of Recent Developments in U.S.A. and Canada." Australian Economic Papers, December 1976.

Rasmussen, Jan. "The Allocative Effects of Grants-in-Aid, Some Extensions and Qualifications." National Tax Journal, Vol. XXIX No. 2, June 1976.

Sacks, Seymour and Robert Harris. "The Determinants of State and Local Government Expenditure and Intergovernmental Flows." National Tax Journal, March 1964.

Simeon, Richard. Federal-Provincial Diplomacy The Making of Recent Policy in Canada. Toronto: University of Toronto Press, 1972.

Sloan, Frank A. "A Model of State Income Maintenance Decisions." Public Finance Quartely, Vol. 5 No. 2, April 1977.

Statistics Canada, Local Government Finance. Cat. 68-204 Various Issues 1957-1974 a.

Statistics Canada, Provincial Government Finance, Revenue and Expenditure. Cat. 68-207 Various Issues 1957-1974 b.

Statistics Canada, Provincial Government Finance, Assets, Liabilities, Sources and Uses of Funds. Cat. 68-209 Various Issues 1957-1974 c.

Tresch, Richard. "Estimating State Expenditure Functions: An Empirical Test of the Time Series Informational Content of Cross Section Estimates." Public Finance, No. 3-4, 1974.

Wagner, Adolph. "Three Extracts on Public Finance" in Richard A. Musgrave and Allan T. Peacock Eds., Classics in the Theory of Public Finance. London: MacMillan, 1958.

Wallace, T.D. and Ashiq Hussain. "The Use of Error Components Models in Combining Cross Section with Time Series Data." Econometrica, Vol. 37 No. 1, January 1969.

Weicher, John C. and R.J. Emerine II: "Econometric Analysis of State and Local Aggregate Expenditure Functions." Public Finance, No. 1, 1973.

Wilde, James A., "Grants-in-Aid: The Analytics of Design and Response." National Tax Journal, Vol. XXIV No. 2, June 1971.

Wilensky, Gail. "Determinants of Government Expenditure", in John P. Crecine Ed. Financing the Metropolis. Beverly Hills: Sage, 1970.

_____ "Current Problems in Public Finance: Discussion." Journal of Finance, 30(2), May 1975.

Zimmerman, Dennis. "On the Relationship between Public Goods Theory and Expenditure Determinant Studies." National Tax Journal, Vol. XXVIII, No. 2, June 1975.