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The UNIVERSITY *of* WESTERN ONTARIO

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DEBT AND TARIFFS: AN EMPIRICAL INVESTIGATION OF THE EVOLUTION OF REVENUE SYSTEMS

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ABSTRACT

This paper presents a theoretical framework where government chooses fiscal structure so as to maximize political support and where the evolution of fiscal systems is determined by changing economic, political and administrative factors. Estimating equations are derived and the model is used to explain the development of revenue structure in Canada from 1871 to 1913, a period when major revenue sources consisted of the tariff, debt and excises. The empirical analysis distinguishes between government plans and ex-post observations of public revenues and places particular emphasis on the derivation of hypotheses linking economic, political and administrative variables to revenue structure.

1. Introduction

More than six decades ago, Joseph Schumpeter (1918) published an outstanding essay on the fiscal state. He argued that the ability to tax lies at the very heart of political power and that the rise of the modern political state was shaped by fiscal evolution in medieval and post-medieval times. While he was primarily interested in the influence of fiscal power on political power, he also raised another related set of questions, namely what forces shape fiscal structure itself. He clearly recognized that there are three types of influences - economic, political and administrative, but he did not provide a framework of how these factors interact to shape evolving revenue systems, perhaps because he had not yet formed an economic theory of political action.

Schumpeter's essay was published in German and had no influence on the study of public finance in English-speaking countries. It was not until the 1960's that American scholars became interested in the development of revenue systems. The initial work was primarily an outgrowth of the attention devoted to developing countries. Studies by Hinrichs (1966) and Musgrave (1969) fall into this category. Hinrichs was mainly interested in linking stages of economic and fiscal development, while Musgrave emphasized the role of changing opportunities to tax and of administration costs (so-called tax handles) in the evolution of tax structure. Some further contributions were made in the 1970's and 1980's. Kau and Rubin (1981) emphasized the economic limits to fiscal exploitation and the effects of changes in such limits on the development of revenue systems. A study by Hansen (1983) focused on the impact of political factors on the tax system. And a separate literature grew up around selected revenue sources such as the tariff (Caves 1976, Helleiner 1977, Baldwin 1986 and Magee et al 1989) and debt (Barro 1979, 1986).

The present study returns to the broader vision implicit in Schumpeter's essay. We argue that all three basic influences - economic, political and administrative - must be taken into account in understanding the evolution of tax systems. Furthermore, these factors can only be linked systematically if we start with an explicit model of political choice. The model that we employ, and that we have developed elsewhere in greater theoretical detail (Hettich and Winer 1988), falls into the tradition of political analysis initiated by Schumpeter and developed further by writers such as Downs (1957), Stigler (1971) and Peltzman (1976). We use empirical analysis to test the model for an initial period of Canadian fiscal development. The methodology and approach employed in the paper are suitable for the study of later periods of Canadian fiscal evolution and for the analysis of revenue systems in general.

2. A Model of Evolving Revenue Structure

Models falling into the tradition started by Schumpeter include several elements. The government's objective, and therefore political equilibrium, can be represented by the maximization of the expected number of votes, of expected support, or of some similar function (Coughlin et al 1989; Peltzman 1976; Mayhew 1974). Voters evaluate the government according to the net benefits that they expect to receive from the public sector. While all of them count to some degree, the government may weight the probability of receiving an individual's vote according to factors such as the individual's membership in interest groups, the individual's wealth, and other aspects defining his effective political power.

How can this tradition be implemented for the study of fiscal behavior? A complete model of the fiscal system in this tradition would attempt to explain the

structure of public expenditures, the level of public services and the structure of the revenue system. The government would adjust net benefits across voters so as to equalize marginal expected support, taking into account the benefits conferred by public services, the losses in full income generated by the raising of revenue and the political effectiveness of different individuals and interest groups. (For a formal derivation of equilibrium conditions in models of this type, see Hettich and Winer 1988.) Further elaboration could lead to a general theory of governing instruments that would include regulation as a substitute for direct expenditure and taxation as part of the government's optimal political strategy.

The general model requires simplification before it can be applied in empirical work. We introduce the following assumptions in order to adapt the approach for our purpose. First, we restrict ourselves to fiscal instruments. In addition, we take R, the level of revenues, and e, expenditure structure, as predetermined. The primary aim of our study is to explain the development of revenue structure; we do not want to also model the forces determining the size of government and the composition of expenditure programs, a task which would require a study of much larger scope.[1] One way of justifying our more limited approach is to assume that the government sets policy variables in a sequential manner, choosing R and e before determining revenue composition. We shall represent revenue structure by revenues raised from different sources including debt, R_1..., R_J. This treatment abstracts from the role of special provisions in the tax system. Data limitations as well as the complexity of special provisions make it impossible to employ a more comprehensive definition in a historical study of the present kind.

We can represent government behavior in the following way:

$$\underset{\{R_1, \ldots, R_J\}}{\text{Max}} \quad \sum_{i=1}^{n} s_i \tag{1}$$

subject to $$G = R - \sum_{j=1}^{J} A_j \quad \text{and} \quad R = \sum_{j=1}^{J} R_j \tag{1a}$$

where $$s_i = \alpha_i(x) \cdot b_i(G, R_1, \ldots, R_J, e, w) \tag{1b}$$

and $$A_j = A_j(R_j, a). \tag{1c}$$

The government chooses the composition of revenues including debt so as to continually maximize political support, Σs_i, subject to its budget restraint for a predetermined budget size, R, and expenditure structure, e. Support by individual i, as seen by government, depends on two components as indicated by equation (1b). The term $\alpha_i(x)$ is a weight representing political effectiveness. Such effectiveness may be influenced by the costs of political organization, the initial distribution of wealth and income, the cost of voting and other exogenous factors determining political influence, all of which are summarized by x.

The second component, b_i, shows the individual's reaction to government performance, and reflects primarily economic effects associated with fiscal structure. It is influenced by public output, G, by expenditure structure, e, by revenue structure, $R_1, \ldots, R_J$, and by w, the set of exogenous factors determining how much opposition (or loss of support) is created by a given revenue structure. Loss of support depends on the loss in full income from taxation including excess burden.

Since we intend to consider debt as well as taxation, it is important to be specific about the intertemporal nature of the model. We employ a simple intertemporal structure -

the government cares about the future because, and only because, voters do. Support s_i by voters depends on losses in full income stemming from future taxes needed to finance interest payments resulting from budget deficits.[2] Similarly, both current and future levels of public services are assumed to be of concern to individual citizens. We do not impose a constraint on the government's optimizing behavior requiring budget balance in present value terms. The government will respond from period to period to the intertemporal and other concerns of citizens and interest groups. These responses may or may not result in a balanced budget in present value terms when the data is considered ex post.

The budget restraint (1a) shows that administration costs enter the model as a wedge between expenditures on public services, G, and total revenue, R. Administration costs for revenue source j are shown in (1c) to depend on revenue from that source and on exogenous factors, a, which include the costs of monitoring tax evasion, the costs of revising tax legislation and the wages of tax collectors.

We stated in the introduction that the evolution of revenue systems is influenced by three broad classes of exogenous factors - economic factors, represented in the model by w, political factors, represented by x, and administrative factors, represented by a. To make the model a useful framework for studying the evolution of revenue systems empirically, it is necessary to construct time series representing these factors and to predict their impact on the government's choice of revenue structure. This task will be accomplished in Section 4.

3. Derivation of Estimating Equations

There are many reduced form estimating equations consistent with the model we have outlined in the previous section, and we estimate several in order to insure robustness of the results. One reduced form that is useful in explaining the composition of total revenues can be derived by assuming that the objective function (1) is of the Cobb-Douglas type

$$\sum_i s_i = \pi_{j=1}^{J} R_{jt}^{\delta_{jt}} \qquad (1')$$

where the δ_{jt}, which reflect the political costs of raising revenue from source j, are defined by

$$\delta_{jt} = \exp(\theta_j X_{jt}) \qquad (2)$$

where X_j includes all previously defined, predetermined variables x_j, w_j, a_j, R and e, with the subscripts indicating variables that are particular to each revenue source.[3] Maximization of (1′) subject to (1a), (1c) and (2) yields the reduced form

$$\ln(R_{jt}/R_{kt}) = \beta_{jk} X_{jkt} \qquad (3)$$

where $\beta_{jk} = (\gamma_j, -\gamma_k)$ and $X_{jk} = (X_{jt}, X_{kt})'$.

Equation (3) has the convenient property that the ratio of any two revenue sources depends only on factors affecting the political costs of raising revenue from these two sources. It also has the statistically desirable characteristic that the dependent variable consists of the ratio of two revenue sources which, unlike the revenue sources themselves, does not exhibit obvious time trends. Other functional forms for an estimating equation will be introduced below.

In order to complete the derivation of an estimating equation it is necessary to deal with the difference between planned and actual or observed revenues. This is a long-standing problem in the empirical study of government behavior although it is not often confronted directly.

Observed revenue structure reflects two types of influences. It has a planned component, representing deliberate choices by government officials based on information available to them. In addition, it also reflects unanticipated events. Actual tariff revenues, to take an example that will prove useful below, are the result of a tariff structure which was chosen by public officials, given their anticipation of the size of imports and of other factors such as interest group pressure, which determined the relative emphasis that they wanted to place on this source. However, actual collections also reflect the effects of unanticipated fluctuations in international trade and in variables such as domestic income which influence the demand for imports.

We shall conceive of actual tax revenue from any source R^a_j as consisting of two parts, planned revenues R^P_j, which depend on decisions by government based on available information, and an unanticipated component R^u_j, which depends on errors made by the government in forecasting variables such as the size of tax bases.

Since we view our model as explaining decisions of government based on available information, the left side of (3) must be interpreted as $\ln(R^P_{jt}/R^P_{kt})$. But it is only possible to collect data on actual revenue structure, so that (3) must be rewritten to reflect this. We can write

$$\ln(R^a_{jt}/R^a_{kt}) = \beta_{jk}X_{jkt} + \mu_{jkt} \qquad (4)$$

where $$\mu_{jkt} = \ln(R^a_{jt}/R^a_{kt}) - \ln(R^P_{jt}/R^P_{kt})$$

and where the vector X_{jk} must now be interpreted as information, including forecasts, upon which the government bases its revenue plans. The error term μ_{jk} represents the influence of

random developments occurring between the time a revenue plan is made and the time actual revenues are realized.[4]

To estimate (4) it is necessary to approximate the information X_{jk} used by the government in making its fiscal plans and to do so in a manner so that μ_{jk} (or some suitable transformation of it) will have zero mean, be serially uncorrelated and be uncorrelated with X_{jk}. We shall employ a two-pronged approach. In some cases, discussed more fully below, it is both possible and desirable to construct forecasts of key variables underlying fiscal plans using auxilliary regressions and to use these forecasts as explanatory variables. In other cases, we shall simply use values of variables lagged by one period to reflect the basic information available to the government.

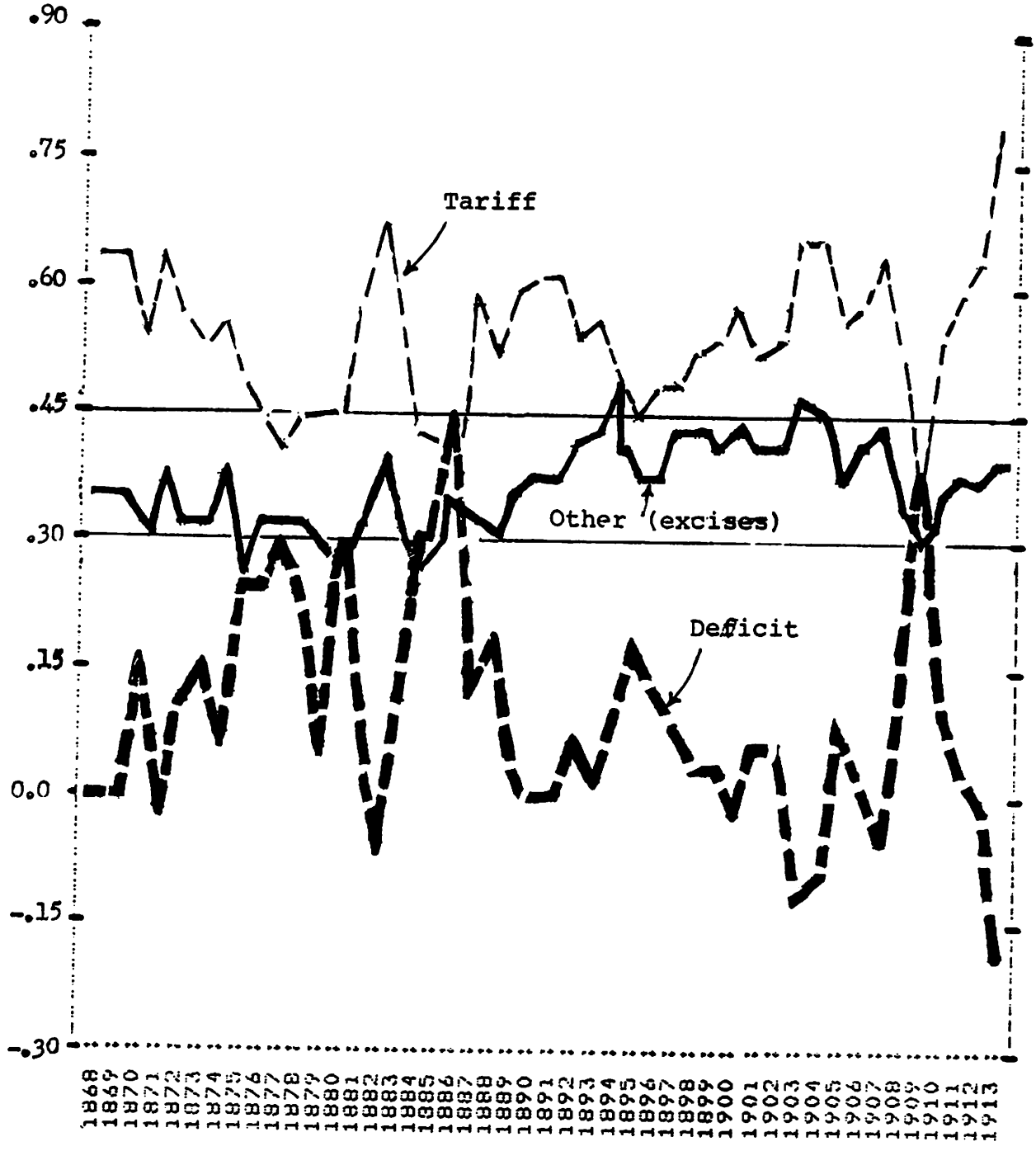
4. Testing the Model

4.1 Choice of Country and Period: Canada, 1871-1913.

Work on tax structure by Hinrichs and Musgrave suggests that the development of revenue systems is linked to broad trends in economic development and that revenue systems pass through several phases. The present paper applies the model to Canada during an early stage of its growth, encompassing the time from the establishment of modern central government to the beginning of the First World War. During this time, no major new revenue sources were introduced at the federal level. The period includes intervals of rapid and sustained growth as well as of prolonged recession.[5]

The evolution of the Canadian federal revenue system from Confederation to the First World War is shown in Figure 1, where annual revenues from different sources are plotted as a percentage of the total. As the figure indicates, there were three major revenue sources: customs duties, borrowing (i.e., the deficit) and excises. Other miscellaneous revenues

FIGURE 1
Major Revenue Sources as a Proportion of Total Financial Requirements, Government of Canada, 1868-1913*



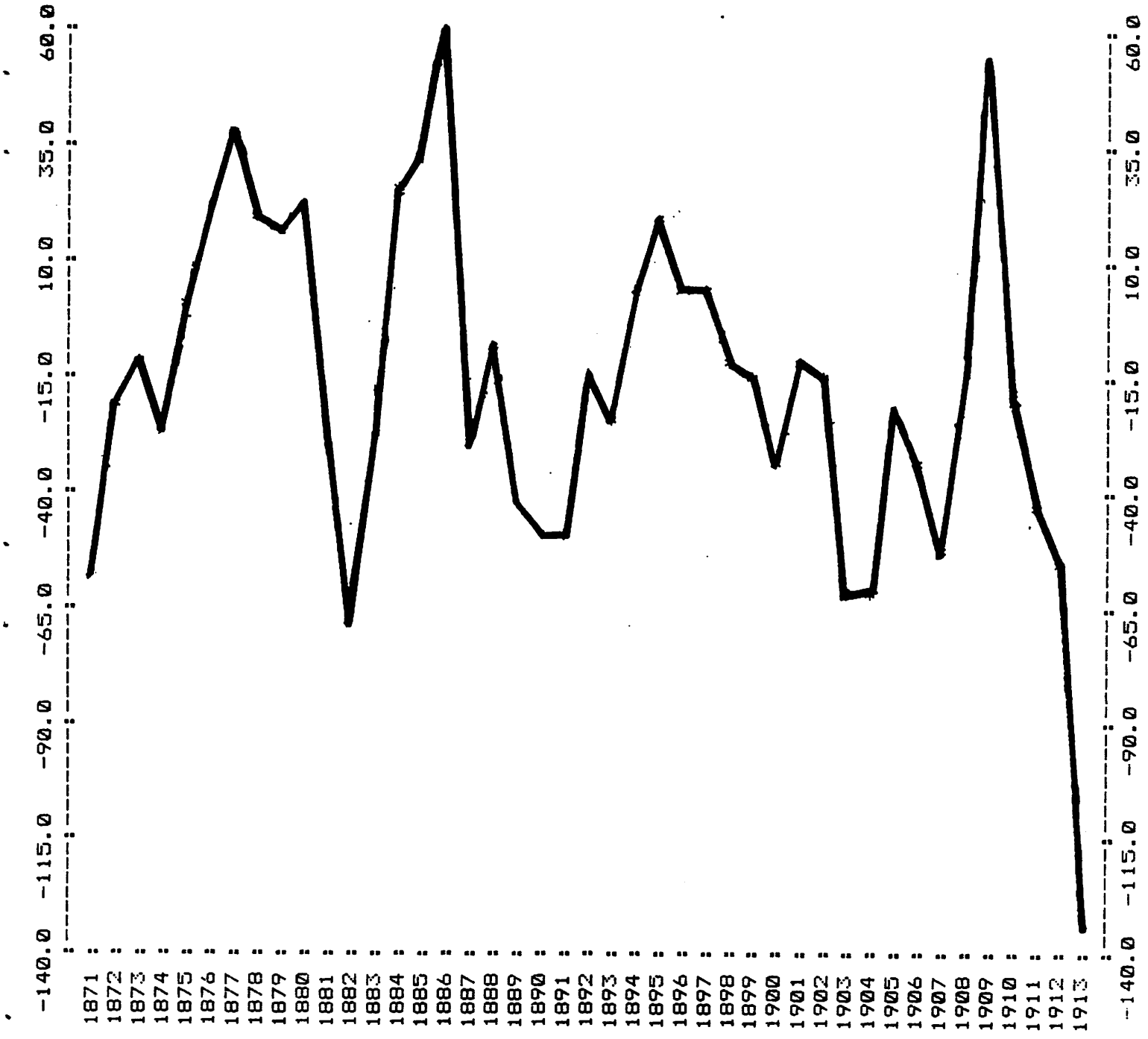
*Source: Gillespie (1985)

constituted a minor share of the total. Unlike modern governments, the Canadian authorities during this period did not have a central bank and did not use money creation as a significant source of revenue.[6] One may note that excises, which were imposed almost exclusively on alcohol and tobacco, accounted for a relatively constant proportion of total revenues. An explanation of evolving revenue structure in 19th Century Canada must therefore focus primarily on borrowing and the tariff.

Estimating equation (4) requires that the dependent variable be expressed as the log of the ratio of revenues from two different sources. In this case, the ratio of obvious interest is the deficit divided by customs duties. However, this ratio assumes negative values when the deficit turns into a surplus (see Figure 1), so that the log cannot be defined for all time periods. We therefore use the log of the ratio of the deficit plus all other non-tariff revenues to tariff revenues as the dependent variable, a choice that seems justified in view of the relative constancy of revenues from other sources. The plot of this dependent variable is presented in Figure 2. One should note the considerable variation in the dependent variable and the absence of any trend that is revealed by the plotted values.

We shall also use the ratio of the deficit to tariff revenues as a second dependent variable. Although this second formulation deviates somewhat from equation (4), it will be useful as a check on the robustness of the empirical results because this dependent variable now excludes excises. A third formulation of the dependent variable is presented in Appendix B, where a complete system of two revenue share equations is estimated instead of one equation for the ratio of revenues. The two revenue shares are for tariffs and for the deficit plus non-tariff revenues, both expressed as a proportion of total financial requirements.

FIGURE 2
Log of Ratio of Deficit Plus Non-Tariff Revenue to
Tariff Revenues, 1871-1913.*



*Data scaled by 100.

4.2 Explanatory Variables

The model proposed in this paper suggests three major types of explanatory variables: economic, political and administrative. In addition, we have exogenous variables related to R and e, since the level and structure of expenditures are treated as predetermined with respect to revenue structure. The explanatory variables considered for inclusion in the estimating equation are listed in Table 1 according to these categories and by major revenue source. Also shown are the predicted signs.[7]

(a) Economic Factors

We start by discussing economic variables for the tariff and borrowing, summarized in equation (1b) by the term w. The focus of the discussion is on three issues. We derive a prediction from the model concerning the nature of such variables; we deal with the question of predicted or estimated values raised earlier in the paper; and we discuss some characteristics of debt which suggest inclusion of two additional variables.

The model predicts that the size of bases is central in explaining changes in revenue shares. In equilibrium, political costs of raising an extra dollar must be the same across all revenue sources. When a base grows, the political costs of raising an extra dollar from that base decline. This is because the marginal dollar can now be raised using a lower tax rate, implying a smaller welfare loss and thus less opposition than before. As a result, the government will reestablish equilibrium in tax structure by increasing total revenue collected from the expanded base while raising less elsewhere (assuming R remains constant).

In making revenue choices the government must estimate the size of tax bases, including the base upon which debt is levied. Since the tariff was a major source of revenue for the Canadian federal government (see Figure 1), we think it reasonable to assume that considerable effort was devoted to making satisfactory forecasts of annual imports.

TABLE 1

Explanatory Variables Considered for Inclusion in Initial Estimating Equation and Predicted Signs*

	Variable Name	Predicted Sign
Economic		
Tariff		
Forecast imports	IMF	-
	IMF1, IMR1	-
Borrowing		
Population	POP-	+
Federal and provincial debt per capita	FDP/N-	-
Liabilities of commercial failures per $GNP	FAL/Y-	+
Political		
Tariff		
Manufacturing output per capita	MFG/N-	?
Membership in farm cooperatives	COOP-	?
No. union locals	UNION-	?
Effective protection	EXEMPT	?
Opposition to tariff	OPP	?
U.S. customs per capita	USC/N-	-
U.S. tariff policy	USTRF	-
Borrowing		
U.S. debt per capita	USD/N-	+
Administrative		
Tariff		
Ad valorem versus specific rates	ADVSE	-
Proportion of high value imports	HV/IM-	+
Borrowing		
Forecasting	YLDF	-
	YLDF1,YLDR1	-
Other		
Extraordinary public capital expenditures	RAIL	+
Public sector size forecast	RF	?

* Variables with names ending in a minus sign are lagged by one year. See the Appendix for precise definitions and data sources.

We model the government's efforts in this regard in two ways, which correspond to different assumptions concerning the government's knowledge of economic structure. In the first we regress imports for the entire period 1871-1913 on two lags of imports, per capita income and a time trend. The predicted values from this regression, IMF, are then used as forecasts of the tariff revenue base. This approach is appropriate if it is assumed that underlying economic structure is unchanged over the period and that the government forms its expectations rationally. Such an interpretation of rational forecasting implies that the residual from the forecasting equation has zero mean and is uncorrelated with IMF. While the errors made by the government in forecasting imports will to some extent influence the difference between planned and actual revenues, such errors are not systematic. Hence this model of government forecasting implies that μ in equation (4) will have zero mean and be uncorrelated with IMF. The sign on IMF is expected to be negative since the dependent variable is expressed as the log of the ratio of the deficit plus other taxes to tariff revenue.[8]

In view of the substantial volatility of imports of the nineteenth century, it may be appropriate to assume more limited knowledge of long-run economic structure on the part of the government. To model the government's behavior in the face of greater uncertainty about long-run trends, we use one-step-ahead-forecasts based on moving regressions. The regressions are constructed as a second order autoregression using five observations. The resulting time series of forecasts is denoted by IMF1 in Table 1, while the time series of forecast errors is called IMR1. Unlike the residual from a regression over the entire sample period, IMR1 will not have zero mean, nor will it be uncorrelated with IMF1. In this case, we include IMR1 as an additional explanatory variable in the estimating equation so that μ will continue to have zero mean and be uncorrelated with the explanatory variables.[9]

The base for the second major revenue source, borrowing, is more difficult to specify. Since deficits create tax liabilities in the future, we can think of the present value of expected future national income as the relevant base. Unfortunately, there is no directly observable measure of this concept that could be forecast in order to construct the analogue to IMF or IMF1 for debt. The economic history of the period suggests, however, that population growth, primarily through immigration, was perceived as an indicator of future growth and prosperity in nineteenth century Canada where labor was scarce in relation of other economic resources. We shall use population lagged one period (POP-) to represent the information underlying forecasts of the base for borrowing. A positive sign on POP- is expected.

Since we wish to think of debt as a tax on future income, we must include the existing stock of government debt in the estimating equation. Outstanding debt represents the extent to which public claims have already been created against future income. Because voters will be concerned with expected tax rates resulting from total liabilities against such income, an additional dollar of public borrowing will imply higher future tax rates and therefore a higher welfare loss, if it occurs in the face of a larger existing stock of public debt. (One may note that this is true whether or not the Ricardian equivalence theorem holds.) Furthermore, provincial governments may also have borrowed in the past against the same expected income stream. The relevant variable is therefore combined federal and provincial debt per capita (FPD/N-) with a negative predicted sign.[10]

There was considerable fluctuation in economic activity during the period under investigation, especially in the years from 1870 to 1895 (see for example Skelton 1913, Ch. 4). When private individuals are faced with sharp fluctuations in income, they even out their consumption streams with the help of borrowing from private sources. In addition they may demand that the government adopt policies to cut tax rates and to issue public debt in order

to help them maintain more stable disposable incomes, especially if they suffer from liquidity constraints. Thus if people put a positive value on greater stability in their consumption streams, the political costs of borrowing will be less in times with more pronounced cyclical downturns in economic activity. We use total liabilities of commercial failures per dollar of GNP (FAL/Y-), an indicator of the state of the business cycle, to represent the demand for consumption smoothing through the public sector. A positive coefficient is predicted.[11]

(b) Political Factors

The second major category of explanatory variables, summarized by x in equation (1b), represents political forces. Constructing proxies for political factors influencing government decisions in a time series context is a particularly challenging task. We distinguish between two types of such factors - those related to the activities of domestic interest groups and those reflecting the impact of U.S. action on Canadian policy. In developing proxies for the effect of interest group activity, we focus on the tariff since political debates in nineteenth century Canada paid primary attention to this revenue source. We also raise a measurement problem not considered in connection with economic variables, namely whether continuous or discontinuous proxies represent a more appropriate way of modelling the influence of political forces. Although they are the best available, the variables introduced below only indirectly represent information underlying the formulation of revenue plans, and we do not attempt to generate explicit forecasts of them.

Table 1 shows three continuous variables standing for the influence of the three most important domestic interest groups (manufacturing output per capita, number of union locals, membership in farm cooperatives). While each one is a somewhat imperfect proxy, they represent reasonable measures of the changing size of these groups given the limited statistical data available for the period. In interpreting the variables, it is important to recall

that the tariff serves a double function. While it is a revenue source, it also provides a means of granting protection to domestic industry. We expect manufacturing interests and unions to have a demand for tariff protection and farm groups to oppose the use of customs duties.

Table 1 predicts no signs for MFG/N-, UNION-, and COOP-. In the model the government would set tax rates below the revenue maximizing point if it were dealing with a tax used only for the raising of revenues.[12] Additional demands for the use of the policy instrument, such as exist for the tariff, may however result in rates placing us on the backward bending portion of the rate-revenue relationship.[13] Predicted signs for the variables representing demand for protection will differ depending on whether we are on the upward or the backward sloping segments of the curve. The same is true for variables standing for the influence of forces opposing the tariff. As a result, no hypotheses about signs can be formed.[14]

Use of the three continuous variables, to the extent that they properly measure the size of the relevant interest groups, implies that the government annually readjusts revenue structure in accordance with the changing relative size of these groups. It is possible, however, that interest groups exercise influence on government fiscal behavior in a different, discontinuous manner, since the dynamics of group formation may result in political pressures that fluctuate and change abruptly (Cassing and Hillman 1986, Oliver et al 1985). Unfortunately, it is not clear what data could be used to represent such fluctuating political pressures. We include two dummy variables, EXEMPT and OPP, with steps in the years when large discontinuous changes occurred in the tariff which can be related to major interest groups, to proxy discontinuous political influence on tariff policy. EXEMPT and OPP can be seen respectively as representing the culmination of pressures of manufacturing interests for

special protection and of consumers and farmers for a lowering of tariff rates. While these variables reflect the result of pressure, rather than the pressure itself, their influence on revenue structure can only be interpreted properly within the context of our theory.

During the period studied, Canada and the United States were competing for both immigrants and capital resources, and outmigration to the U.S. was a concern to the Canadian government. We may regard U.S. tariff structure as imposing limits on Canadian ability to use customs duties as a policy instrument without precipitating politically damaging trade and factor flows. We proxy the influence of U.S. fiscal development of the Canadian tariff in two ways. Since Canadian political debates often include comparisons of particular revenue sources in the two countries, we use U.S. customs collections per capita (USC/N-). A negative sign is expected for this variable on the assumption that a higher U.S. tariff would lower political costs to the Canadian government of relying on this revenue source. It may be, of course, that the influence of U.S. policy operates discontinuously. We introduce the dummy variable USTRF with steps in 1890 and 1897, two years when the United States created substantial new tariff barriers affecting Canada. This is to test for the possibility that certain identifiable U.S. actions led to a strong, abrupt Canadian reaction.[15] Since U.S. actions in 1890 and 1897 should lead to greater reliance on the tariff in Canada, USTRF should have a negative coefficient.

The government's use of the second major revenue source, borrowing, may also be influenced by political pressures. We have not formulated proxy variables for interest group activity in this case since the political debates of the time reveal no clear links between the use of debt and the activities of particular representative groups. We include U.S. debt per capita (USD/N-) to reflect the possible impact of policy in the U.S. since the indebtedness of Canada's neighbor was used as a standard of comparison in debates surrounding Canadian

federal borrowing. Because the deficit enters the numerator of the dependent variable, the expected sign of USD/N- is positive.

(c) Administrative Factors

The third group of explanatory variables in Table 1, represented by the term a in equation (1b), relates to administrative costs. During the period under study, the federal government changed the basis of many tariffs from ad valorem rates to specific per unit excises in the face of declining prices. We represent this switch in policy with a dummy variable having a step in the relevant year (ADVSE). Since frequent adjustments of tariff rates are costly to implement, ADVSE can be given an administrative interpretation. It will be cheaper to maintain revenues in times of falling prices with specific excises than with repeated changes in ad valorem rates. A negative sign is expected.

A second administrative variable relates to the costs of enforcing the tariff. We take the proportion of high value imports in total imports (HV/IM-) to serve as an indicator of such costs, since valuable, low-bulk items are easier to smuggle. An increase in this proportion requires greater enforcement, making the tariff a more costly revenue source, thus suggesting a positive coefficient for the variable.[16]

The final variable in this category relates to the bond yield. We view the bond yield as an administrative cost of borrowing since a higher interest rate for new government debt implies that fewer public services can be provided for a given amount of borrowing. Political discussions of the period suggest that government officials had considerable specialized knowledge of London financial markets where most borrowing took place. We simulate their forecast of the bond yield using a regression including time and two lags of YLD and covering the whole period (YLDF), as well as with one-step-ahead forecasts based on moving regressions (YLDF1). In the latter case, the residual YLDR1 is included in the

estimating equation for the same reasons as IMR1.

(d) Other Determinants

The remaining two explanatory variables in Table 1 related to e and R in equation (1b). RAIL represents extraordinary capital expenditures in two different years associated with major capital projects such as the two transcontinental railway lines. As shown in Figure 1, the magnitude of the deficits in these two years suggests extraordinary fiscal events emanating from the expenditure side. We would expect a lower political cost for borrowing in cases where the increased deficit is clearly linked to the creation of long-lasting capital assets which are expected to contribute to the generation of future income. We use a dummy variable with positive steps in the affected two years and expect a positive sign. Finally, we include the forecast of total financial requirements or total expenditure (RF) based on a regression using time and two lags over the 1871 to 1913 period as a proxy for public sector size.[17] This forecast is predetermined with respect to current tax structure.[18] No sign is predicted since no clear hypothesis can be formed on how public sector size influences tax structure.

5. Estimation and Results

All equations were estimated for the period from 1871 to 1913 using least squares. Estimation of (4), as well as of the two-equation system reported in the Appendix, explicitly enforces the government's budget restraint. Note that since we deal with only two revenue sources, the variance-covariance structure of μ in (4) that results from imposing the budget restraint reduces to the simple homoscedastic case (Beggs and Strong 1982).

Preliminary estimation strongly suggests eliminating several variables because of very low statistical significance or for other reasons. The U.S. debt variable USD/N- reveals a

strong downward trend following the U.S. civil war and as a result is colinear with other variables exhibiting a trend such as POP-. Colinearity also explains why USD/N- was insignificant. U.S. customs (USC/N-) had very low significance indicating that Canadian revenue structure is not influenced on a year-by-year basis by U.S. tariff structure. (Deflating U.S. customs revenue by U.S. income instead of by U.S. population did not change results.) It may be that overall tax burdens rather than specific taxes are the basis for international tax competition and if so, we should not expect variables such as USC/N- to be significant (Hettich and Winer 1984). However, it is difficult to formulate variables reflecting competition that works in this broader manner. Finally, there is the further possibility that the influence of U.S. actions on Canadian policy is intermittent and thus not captured well by a continuous variable.

One can readily see why neither the forecast bond yield (YLDF or YLDF1), nor errors in such forecasts (YLDR1) would be significant. The bond rate fluctuated very moderately over the sample period with the year-to-year change always remaining below one-half percentage point. Thus, the implications of changes in the bond yield for administrative costs were not likely to be of great interest to the government. MFG/N-, the variable representing the demand for protection by manufacturers, also had very low significance.[19] We shall return to this result later.

We also dropped COOP- representing western farm cooperatives from the equation. In some equations this variable had a coefficient significant at 10 percent but with the wrong (i.e., a negative) sign. The problem here is that COOP- grows at a very high rate after 1900, when western settlement, tariff revenue and imports were all increasing very rapidly. These strong trends after 1900 unfortunately make it impossible to separate the effects of the tariff base and of western farm co-ops on revenue structure. Finally the size of government RF

was dropped since its coefficient was not significant in any equation. This suggests government size and revenue structure were determined independently in the nineteenth century.[20]

Four versions of the model with the remaining explanatory variables are presented in Table 2.[21] The difference between versions lies in the definition of the dependent variable and in the variables used to proxy anticipated imports. Additional results are provided in the Appendix, which reports on an approach using revenue shares as dependent variables in a two-equation system.

Table 2 shows estimated standardized (beta-) coefficients and t-values for the various equations. The adjusted values of R^2 vary from 0.76 to 0.82, while the Durbin-Watson and adjusted Box-Pierce statistics generally indicate the absence of serial correlation of the residual. Tests for heteroscedasticity based on the Breusch-Pagan Chi-squared indicate that no problem exists in this regard, and use of White's (1980) heteroscedasticity-consistent estimator yields essentially the same results as those reported in the table.[22]

Table 2 and the Appendix demonstrate that the choice of dependent variable does not substantially affect the estimates, indicating robustness of the results. A similar conclusion holds for the choice of method used to forecast imports. This suggests that forecasts based on the entire sample period and based on moving regressions are both possible descriptions of the manner in which the government predicted developments in its major tax base.

The signs of coefficients in Table 2 are as expected. The economic variables work particularly well. The standardized regression coefficients indicate that the variables representing revenue bases (IMF or IMF1 and POP-) and the extent to which debt has been relied upon in the past (FPD/N-) have a predominate influence on revenue structure and that forecasts of revenue bases are important determinants of fiscal choices. The results for POP-

Table 2

Revenue Structure, Government of Canada, 1871-1913*

Dependent variable: ln(R-CUS)/CUS			Dependent variable: DS/CUS	
Variable	B(STD) (t)	B(STD) (t)	B(STD) (t)	B(STD) (t)
IMF	-1.65 (-4.77)		-0.66 (-2.17)	
IMF1		-1.40 (-4.52)		-0.57 (-2.12)
IMR1		-0.44 (-3.67)		-0.21 (-2.00)
POP-	2.19 (3.23)	2.35 (3.24)	1.48 (2.49)	1.58 (2.51)
FPD/N-	-1.27 (-3.04)	-1.35 (-3.08)	-1.14 (-3.11)	-1.17 (-3.09)
FAL/Y-	0.62 (5.70)	0.58 (5.12)	0.57 (5.94)	0.55 (5.55)
UNION-	-0.59 (-1.36)	-0.85 (-1.86)	-0.40 (-1.04)	-0.54 (-1.36)
EXEMPT	0.60 (3.18)	0.55 (2.82)	0.67 (4.04)	0.64 (3.81)
OPP	0.67 (2.59)	0.69 (2.59)	0.57 (2.53)	0.58 (2.52)
USTRF	-0.33 (-1.17)	-0.34 (-1.16)	-0.62 (-2.49)	-0.62 (-2.45)
ADVSE	-0.03 (-0.11)	-0.01 (-0.05)	-0.18 (-0.88)	-0.20 (-0.89)
HV/IM-	0.01 (0.07)	0.14 (0.79)	0.24 (1.62)	0.30 (2.02)
RAIL	0.25 (2.63)	0.27 (2.47)	0.50 (5.92)	0.52 (5.48)
$\bar{R}^2$	.77	.76	.82	.82
D.W.	1.83	1.86	2.20	2.17
B.P. (10)	10.92	14.77	10.35	10.83
B-P	14.46	13.50	13.04	15.55

*B(STD) = standardized regression coefficient. Constant term not reported.
t - statistics in brackets.
$\bar{R}^2$ is adjusted.
D.W. = Durbin-Watson statistic.
B.P. (10) = adjusted Box-Pierce statistic for lag-length of 10.
B-P = Breusch-Pagan heteroscedasticity test Chi-squared (11 or 12 df.)
A minus sign following a variable indicates a one-period lag.

and FPD/N- suggest strongly that the government was concerned with the future excess burden of current deficits, as well as with the excess burden of current taxation, a conclusion made more forceful by the fact that POP- and FPD/N- are highly significant despite their low variance relative to that of the dependent variable.

Political factors also play a role, although they do not perform as well as the economic variables. Continuous variables representing political factors are not significant with the exception for some equations of the variable representing the influence of labor on the tariff. UNION- in the equations using IMF1 has a t-statistic that reaches -1.86 in column two of Table 2 and -1.98 in the Appendix. The poor performance of continuous political variables raises the question of how to formulate appropriate measures representing the influence of political coalitions. Mueller and Murrell (1985, 24) have argued that the most obvious indicators of interest group strength may not be adequate proxies in many instances. In our case, for example, the size of the manufacturing sector (MFG/N-) may not reflect the political influence of manufacturers since such influence may depend on the nature and size of political contributions. Unfortunately, data on such payments are not available. On the other hand, the power of unions may be related fairly closely to the size of their membership (proxied by UNION-) as long as union members are active voters.

As we have argued before, political influence may exercise a discontinuous impact on government decision making. The variables representing the intermittent influence of two preeminent groups who clearly tried to influence tariff policy in the sample period - manufacturers and farmers - are indeed significant.[23] The influence of U.S. tariff policy also appears to work in a discontinuous manner. Substantial changes in external constraints (USTRF) affect Canadian revenue structure in the expected direction.

The third category of variables, consisting of those measuring administration costs, does not perform as well as the other two. In this case, results depend on the choice of the dependent variable. The t-values are substantially larger and the coefficients have the predicted sign for both HV/IM- and ADVSE when DS/CUS is used as the dependent variable. The weak performance of these variables may reflect the difficulty of formulating proxies which accurately capture the influence of administration costs over time in a developing economy such as nineteenth century Canada. Finally, we note that in the fourth category of variables RAIL is highly significant, indicating a possible relation between revenue and expenditure structure, at least in the case where extraordinary capital expenditures did occur.

The focus of the present paper is on the implementation of a model based on expected vote maximization. While we do not systematically consider the explanation of the data by other possible approaches, one can use the results to comment on the performance of the current model in relation to other frameworks of analysis.

A very simple model of government behavior that does not contain any formal link to an electoral process and that is sometimes used to explain fiscal history assumes that the government passively adjusts to variations in tax bases so as to maintain a predetermined level of public expenditures. The variation in the composition of revenues is then determined mainly by fluctuations in the major tax base, represented in our study by imports. Analysis of our results shows clearly that such a model is dominated by the one that we use. The equations containing both IMF1 and IMR1 include the entire base for the tariff since total actual imports equal the sum of these two variables. While both variables are significant, they are not the only important or significant determinants and, when used by themselves as explanatory variables, produce an adjusted R^2 of no greater than 0.25 regardless of the choice

of dependent variable.

There are alternative models in the literature which integrate economic and political behavior. Most are not suitable, however, for an analysis of tax structure (Hettich and Winer 1989). The median voter model, for example, has a stable equilibrium only in situations where the issue space is uni-dimensional and cannot be used to analyse multi-dimensional choices. The one framework presenting a possible alternative to expected vote maximisation is the Leviathan model (Brennan and Buchanan, 1980; Kau and Rubin, 1981), where the government maximizes revenues and is not constrained by any electoral process. If government acts in this manner, only economic factors matter; political factors will not affect the evolution of tax structure. Although the effects of economic variables predominate in the estimating equations, our results show that the Canadian government was also influenced by political forces. A Lagrange Multiplier test for the joint significance of the variables EXEMPT, OPP, UNION- and USTRF yields a Chi-squared statistic with four degrees of freedom (equal to the sample size times the R^2 from the auxillary regression) of 12.9 which is clearly significant at the 95% level.[24]

6. Conclusion

As economists such as Schumpeter and Musgrave have long recognized, explaining changes in revenue structure must be a major task of positive economics. The paper contributes to this task in several ways. The empirical work is related clearly to expected vote maximization, the most appropriate theoretical framework presently available to analyze multi-dimensional tax issues. We characterize revenue structure in a simple fashion which catches the essence of broad developments in that structure. This is accomplished in a time series context, allowing us to avoid the problems inherent in comparing policies across

countries with differing institutions. One should also note that the government budget constraint is enforced through the choice of the estimating equations and that the analysis contains explicit assumptions concerning the information upon which the government's decisions are based. We distinguish between government plans which are predicted by the model and actual revenues which are given by the data. We also make a systematic attempt to formulate variables reflecting economic, political and administrative factors.

The results demonstrate that a model of revenue structure based on the tradition of political analysis initiated by Schumpeter and since developed by other scholars can be implemented empirically and can be used successfully to explain important aspects of the growth and change of fiscal institutions. There is evidence that economic, political and administrative factors all play a role in shaping revenue structure. Economic variables reflecting factors underlying the excess burden of current and future taxation (i.e. debt) work best, perhaps because they are easiest to measure. The conclusions for the political and administrative variables are somewhat more tentative both because there are difficult data problems to overcome for the period studied and, in the case of political factors, because we still lack a full understanding of the way in which the influence on government policy occurs.

Our findings support the view that the revenue system is an integrated whole and that one must model all major revenue sources including debt or at least allow formally for interdependence among them. In the case of the tariff, there has been a tendency to study it apart from the revenue system as a whole, mainly because the analysis of import duties has been part of international trade rather than of public finance. In nineteenth century Canada, borrowing and the tariff were clearly competing sources of revenue and were used jointly as fiscal instruments by the government.

The framework proposed in this paper provides a broader perspective than is usually adopted in studying fiscal institutions. The empirical application appears to give reasonable support to this broader view. While the data are confined to Canada, the approach has general application and can be used to examine the evolution of fiscal systems in other democratic societies and in nations at all stages of economic development.

NOTES

1. Although we look upon this assumption primarily as a research strategy, it is useful to point out that the separation of the tax and expenditure systems corresponds broadly to institutions existing in representative democracies. A further research difficulty should also be noted here. In a complete model where government size is endogenous and where tax structure is determined by economic, political and administrative factors, estimation requires direct observations on tax administration cost, so that public services can be distinguished from total government expenditure. Such data are not available for the period of Canadian fiscal history which we shall use to test the model.

2. See Feldstein (1985) for discussion of the deadweight losses associated with debt finance.

3. Beggs and Strong (1982) include an additive error term inside the brackets in (2) to reflect imperfect understanding of deterministic forces. This source of error can be included in the error term in the final estimating equation given below.

4. If we allow for imperfect understanding of deterministic forces in the manner indicated in the previous footnote, the error term will reflect this source of error as well as reflecting random development after a revenue plan has been implemented. Such an error structure has been discussed by Lovell (1986, 121).

5. Statistical data on Canada's early revenue system are relatively good. A major source is Perry's work (1955) on the history of the Canadian tax system. Other important sources are new unpublished series on federal tax revenues by Gillespie (1985) and recent estimates of national income statistics for the Nineteenth Century by Urquhart (1984), as well as the well-known Historical Statistics of Canada. An appendix on data sources follows the text of the paper. We should note that this paper is the first part of a larger empirical project covering the history of tax structure in Canada from 1871 until 1984.

6. For further discussion of the issue of uncovered Dominion of Canada notes, see Rich (1978).

7. Table 1 gives a particular formulation for each variable. In some cases alternative formulations were also tried. Results of these experiments are reviewed in later footnotes.

8. The dependent variable also includes excises in the numerator. They were levied primarily on the consumption of tobacco and alcohol and, as shown in Figure 1, constitute a relatively stable share of total revenues. Since the fluctuations in the dependent variable are not associated with developments in excise taxation, we have not emphasized the determinants of revenues from excises. Moreover, it is difficult to find a proxy for the base of excise taxation that is not highly correlated with other explanatory variables. A possible candidate is per capita income, since the consumption of alchol and tobacco appears to be closely related to income. But per capital income is highly correlated with the forecast of imports, which is already included in the equation.

9. The coefficient on IMR1 will only reflect passive adjustment of tariff revenue to unanticipated fluctuations in imports (and the appropriate adjustment of the deficit required by the budget restraint). It does not reflect discretionary adjustment of revenue structure in response to anticipated changes in imports.

10. Like all other variables, debt is measured in current dollars. One should note, however, that the future burden of present debt will be related to price level changes occurring in the future. Deflation will raise the real burden of a given nominal debt. If it were possible to formulate an appropriate expectations variable concerning long-term price level changes, it could be included in the estimating equation. We see no plausible way of formulating such a variable.

11. It may be useful to note here that the type of smoothing reflected in the coefficient on FAL/Y- differs from that discussed by Barro (1979). He argues that the government will issue debt to maintain revenues in the face of short term fluctuations in the tax base. Adjusting rates instead would create higher deadweight losses since the excess burden of any tax tends to increase with the square of the tax rate. In the present context, the government would make use of debt to smooth tariff rates if it expected the change in imports to be temporary. However, any such government action would be reflected in the coefficient on expected imports IMF or IMF1 rather than in the coefficient on FAL/Y-, since the latter is estimated holding expected imports constant.

12. This argument incorporates the elasticity of imports with respect to tariff rates.

13. The same point is developed more formally in a model where the size of government is endogenous in Hettich and Winer (1988).

14. To check whether other continuous variables would work better than MFG/N-, we tried MFG/Y-, manufacturing output divided by GNP, and NM/N-, the ratio of employment in manufacturing to total employment. Neither of these variables was significant or altered other results substantially. We also tried, without success, using the year over year increase and rate of change in the number of union locals rather than the level. It is not clear which of these formulations best represents the political strength of organized labor (or of other interest groups). The lagged level of union locals appears to work best. For discussion of the demand for protection by business interest in 18th and 19th century Canada, see Forster (1986), Dales (1966), McDiarmid (1946) and Porritt (1908). On unionism is the same periods, see Forsey (1982) and Logan (1928). Note that only time series on union locals is available, while data on individual membership is generally unavailable on a continuous basis. We also tried levels, first differences and rates of change in membership in western farm coops and in the Grange, a central Canadian farm movement of the 1870s and 1880s. None of these variables proved successful in the estimating equation. In addition, we considered time series on the number of homesteads instead of membership in western farm co-ops, since newly arrived settlers can be expected to face substantial risks and therefore will be interested in compensatory government action. This proved unsuccessful. For discussion of farm movements, see Wood (1924) and Stiles (1972).

15. In view of the recent Canada-U.S. free-trade agreement, it may be of interest to note that the Dingley tariff of 1897 was imposed by Congress one year after Laurier won office in Ottawa on a free-trade platform.

16. We assume that the average elasticity of imports with respect to tariff rates remains unchanged. We may also regard HV/IM- as one indicator of the elasticity of the base on which the tariff is levied; an increase in any tariff rate is more likely to result in reduction in the taxable base (legal imports) if imports can be easily smuggled instead of declared. If this is so, an increase in HV/IM- will increase the deadweight costs associated with the tariff. Thus, we have another reason why we should expect a positive sign for HV/IM-.

17. Financial requirements, or total expenditures, as in Gillespie (1985, Appendix B), consist of interest payments, purchases of goods and services including administration plus subsidies to the provinces and railroads. Financial requirements are equal to the sum of all tax revenue plus the deficit. Since the size of government exhibits limited volatility, we judged it more

appropriate to use a forecasting equation based on the entire sample in all equations.

18. An estimating equation that includes RF can also be interpreted as the second stage of an instrumental variables approach in which the size of government is treated as endogenous and is replaced by the instrument RF.

19. One should recall the discussion in footnote 14 of several alternatives to these variables which also proved unsuccessful in the estimating equation.

20. Using per capita income YN and population POP- in the forecast of total revenue requirements does not substantially alter the results concerning RF or other variables.

21. Gillespie's data on revenue structure used for the dependent variables are on a fiscal year basis. We believe use of fiscal year data to be more appropriate since we have no information on the pattern of revenues and expenditures within fiscal years. Since the data for explanatory variables is on a calendar year basis, a lag in the response by government of approximately six months is built into the estimating equations.

22. Treating IMR1, FAL/Y- and HV/IM- as jointly endogenous variables using two-stage least squares does not alter results.

23. We also explored the effect of the introduction in 1879 of the system of protective tariffs called the 'National Policy' because of the great deal of attention devoted to this event in Canadian economic history. As expected, the sign on a dummy variable with a step in this year (NATPOL) is negative, although NATPOL is not significant at 10 percent in any of the equations. Results for other variables do not change in a material fashion when NATPOL is added to the equation. The insignificance of NATPOL suggests that the National Policy may have been exclusively directed at tariff structure rather than also being concerned with the raising of revenue. We also considered a dummy variable representing the party in power (Liberal or Conservative), but this variable was not significant.

24. This test is described in Ramamanthan (1989, 297). See also, Engle (1982). For purposes of comparison with the results in the second column of Table 2, we note that estimation without the political variables gives the following (t-statistics are given in brackets):

$$\ln\{(R - CUS)/CUS\} = \underset{(-4.1)}{-1.3\ IMF1} \underset{(-3.4)}{-0.4\ IMR1} + \underset{(3.5)}{1.6\ POP-} \underset{(-1.2)}{-0.5\ FPD/N-}$$

$$+ \underset{(4.1)}{0.5\ FAL/Y-} + \underset{(0.8)}{0.2\ HV/IM-} \underset{(-0.8)}{-0.2\ ADVSE} + \underset{(3.2)}{0.4\ RAIL};$$

adjusted $R^2 = .67$ and $DW = 1.39$.

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APPENDIX

1. Two-Equation System Estimation

The estimating equation developed in the paper uses as the dependent variable the log of the ratio of all revenue less the tariff to tariff revenue. However, another approach to the estimation of the structural model would be to estimate two separate equations, one explaining the share of all revenue except the tariff in total financial requirements, (R-CUS)/R, and one for the share of the tariff in total requirements, CUS/R:

$$(R\text{-}CUS)/R = \beta^0_1 + \beta_1 X + \varepsilon_1 \qquad (B1)$$

$$CUS/R = \beta^0_2 + \beta_2 X + \varepsilon_2 \qquad (B2)$$

subject to (R-CUS)/R + (CUS/R) = 1, where β^0_i is a constant term; β_i is a row vector of coefficients for the column vector of explanatory variables X; ε_i is an error term; and time subscripts have been omitted for convenience. It should be noted that the constraint on the sum of the values of the dependent variables implies $\beta^0_1 + \beta^0_2 = 1$ and $\beta_1 + \beta_2 = 0$, where the latter sum is across the coefficients for a given element of X at each point in time, and that $\varepsilon_1 + \varepsilon_2 = 0$ in each period. These two equations must be estimated under the constraint that the two revenue shares sum to unity in each period, and this can be accomplished by using exactly the same set of explanatory variables in each equation (see for example Bodkin, 1974).[1]

The results for the two-equation system are presented in Table B1 using the same explanatory variables as in Table 2. If a variable such as IMF has a negative coefficient in Table 2 it has a negative coefficient in the equation for (R-CUS)/R, and a positive coefficient in the equation for CUS/R. The opposite is true for variables such as POP- which have positive coefficients in Table 2. The pattern of ssignificance of variables as well as the

relative size of beta coefficients is essentially the same as in Table 2. Thus, estimation of the two-equation system of revenue shares indicates that the results in Table 2 are quite robust.

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Table A1

Estimation of Two-Equation System Explaining Revenue Structure of Government of Canada, 1871-1813*

	Dependent variable: (R-CUS)/R		Dependent variable: CUS/R	
Variable	B(STD) (t)	B(STD) (t)	B(STD) (t)	B(STD) (t)
IMF	-1.56 (-4.57)		1.56 (4.57)	
IMF1		-1.30 (-4.24)		1.30 (4.24)
IMR1		-0.41 (-3.46)		0.40 (3.46)
POP-	2.21 (3.30)	2.32 (3.22)	-2.21 (-3.30)	-2.32 (-3.22)
FPDIN-	-1.27 (-3.11)	-1.34 (-3.08)	1.27 (3.11)	1.34 (3.08)
FAL/Y-	0.65 (6.03)	0.61 (5.41)	-0.65 (-6.03)	-0.61 (-5.41)
UNION-	-0.59 (-1.39)	-0.90 (-1.98)	0.59 (1.39)	0.90 (1.98)
EXEMPT	0.61 (3.29)	0.56 (2.92)	-0.61 (-3.29)	-0.56 (-2.92)
OPP	0.69 (2.70)	0.70 (2.67)	-0.69 (-2.70)	-0.70 (-2.67)
USTRF	-0.34 (-1.22)	-0.34 (-1.18)	0.34 (1.22)	0.34 (1.18)
ADVSE	-0.04 (-0.17)	-0.03 (-0.13)	0.04 (0.17)	0.03 (0.13)
HV/IM-	0.03 (0.15)	0.15 (0.85)	-0.03 (-0.15)	-0.15 (-0.85)
RAIL	0.27 (2.83)	0.29 (2.66)	-0.27 (-2.83)	-0.29 (-2.66)
R^2	.78	.76	.78	.76
D.W.	1.84	1.87	1.84	1.87
B.P. (10)	12.60	15.99	12.60	15.99
B-P	13.33	13.49	13.33	13.49

*See notes to Table 2.

2. Variables and Data Sources

Variable	Definition	Sources*
ADVSE	Dummy variable with positive step in 1886 (switch to specific tariff rates).	3 (Appendix A).
COOP	Membership in western farm coops	11,12
CUS	Tariff revenue of Govt. of Canada	1
DS	Deficit of Govt. of Canada (negative if a surplus)	1
EXEMPT	Dummy variable with positive step in 1883 (tariff exemption granted for many raw materials).	3 (Appendix A).
FAL/Y	Total liabilities of commercial failures per dollar of GNP (a).	4 (p. 194) and Y
FPD/N	Total federal and provincial debt outstanding (cumulated values of DS and provincial deficits) per capita	6 (1932/1933, p. 736) and DS, POP
R	Total financial requirements, Govt. of Canada, consisting of net interest payments, purchases of goods and services including administration, plus subsidies to provinces and railways.	7
RF	Forecast of R based on regression using a constant, time and two lags of R, 1870-1913	
HV/IM	High value, low volume imports (spirits and wine, fancy goods and silks, satins and laces) as proportion of total imports	3 (p. 628-629)
IM	Total imports	2 (series G384)
IMF	Forecast of IM based on regression using a constant, time, two lags of IM and two lags of YN	
IMF1	One-step-ahead forecast of IM based on moving regression using a constant and two lags of IM (with five observations)	
IMR1	Residual from preceeding forecast	

Variable	Definition	Sources*
MFG/N	GNP originating in manufacturing per capita	7 (Table 1) and POP
NATPOL	Dummy variable with positive step in 1879 (introduction of National Policy)	
MN/N	Total employees in manufacturing industries per capita, Census data interpolated linearly	2 (series R21) and POP
OPP	Dummy variable with positive steps in 1894 (tariff reductions on wide class of consumer goods and agricultural implements) and in 1898 (British Preferential Tariff of 33 1/3 percent)	3 (Appendix A)
POP	Total population	5 (p. 240-41)
RAIL	Dummy variable = 1 in 1886 and 1909, = 0 elsewhere	
UNION	Number of union locals (b)	10
USC/N	U.S. tariff revenue per capita	8 (Series Y260, Series A7)
USD/N	Debt of U.S. federal government per capita	8 (Series Y494)
USTRF	Dummy variable with positive steps in 1890 (McKinnley tariff) and 1897 (Dingley tariff)	
Y	GNP at market prices	7 (Table 1)
YLD	Average yield on Dominion Government Bonds	9
YLDF	Forecast of YLD based on regression using a constant, time and two lags of YLD, 1870-1913	

Variable	Definition	Sources*
YLDF1	One-step-ahead forecast of YLD based on moving regression using a constant and two lags of YLD (with five observations)	
YLDF1	Residual from preceeding forecast	
YN	GNP per capita	Y and POP

*Sources:

1. Gillespie (1985) (c)
2. Historical Statistics of Canada (1983), Leacy, FH. ed.
3. Perry (1955) Vol. 2
4. Skelton (1913)
5. Firestone (1958)
6. Canada Year Book (various years)
7. Urquhart (1986)
8. Historical Statistics of the United States
9. Rich (1978)
10. Labor Gazette 1902-03, 1910-11; Labor Organizations in Canada (Department of Labor) 1955; Forsey (1982); Logan (1928)
11. Stiles (1972)
12. Wood (1924)

Notes:

a. Figures for 1871 set to 1872 value, and figures for 1912 and 1913 are set to 1911 value.

b. Figures for 1902 is average of Forsey and Logan figures, with analogous adjustment for 1903-10. We have taken the Logan and Forsey figures as correct when there is a conflict with data from the Labour Gazette.

c. Data on fiscal year basis.