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The Tax-Spend Debate: The Case of Canada

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The Tax-Spend Debate: The Case of Canada

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ABSTRACT

This paper examines the time series relationship between revenues, expenditures, and GDP in the case of Canada. Utilizing the Johansen-Juselius multivariate cointegration procedure and error correction modeling we find that revenues follow a time path independent of expenditures and GDP. On the other hand, expenditures respond to budgetary disequilibrium in that budget imbalances would be corrected by expenditure changes. Moreover, evidence suggests that expenditures also respond to GDP.

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I. Introduction

Canada has the highest debt to GDP ratio of industrialized countries with the exception of Italy. Recently, the Canadian government has taken fiscal steps to resolve the problem of large budget deficits and the growth of debt. The government has taken the approach of cutting government spending more so than raising taxes as a means to solve the budgetary dilemma (Martin, 1996). The task of this paper is to extend the literature on the tax-spned debate to the situation prevailing in Canada.

In order to understand the effectiveness of fiscal policy actions to reduce budget deficits one needs to examine the time series behavior of government revenues and government expenditures and their interdependence. Several hypotheses have been set forth in the discussion of the causal link between revenues and expenditures. The tax-spend hypothesis suggests that changes in revenues induce changes in expenditures. The spend-tax hypothesis suggests the opposite in that changes in expenditures induce changes in revenues. The fiscal synchronization hypothesis suggests that revenue and expenditure decisions are made jointly. Another view relates to the institutional separation of the expenditure and taxation decisions of government. This perspective suggests that revenues and expenditures are independent of one another. Understanding these hypotheses is crucial in gaining further insight on relationship between government spending, taxation and the role of the government in the distribution of resources.

We wish to test the validity of these hypotheses in the case of Canada. Utilizing the Johansen-Juselius multivariate cointegration analysis and error correction models inferences can be made concerning the respective hypotheses set forth. Section II will provide a brief overview of the hypotheses along with a review of the empirical literature on the tax-spend debate. Section III discusses the methodology and data used in the analysis. Section IV provides the empirical results while section V makes concluding remarks.

II. Literature on the Tax-Spend Debate

Several hypotheses have been set forth to describe the temporal relationship between revenues and expenditures [1]. First, the tax-spend hypothesis advanced by Friedman (1978) argues that changes in government revenues lead to changes in government expenditures. Friedman suggests that tax increases will only lead to expenditure increases resulting in the inability to reduce budget deficits. Buchanan and Wagner (1978) agree that taxes affect government expenditures but in a slightly different way. Within the Buchanan-Wagner framework increases in government spending are due to indirect taxation. When spending is financed by other means than direct taxation the public perceives the price of government spending to be less with indirect taxation than what it would be under direct taxation. Indirect taxation originates through higher interest rates associated with higher government spending (crowding out) and inflation. Buchanan and Wagner would argue that fiscal illusion results in that higher taxes lead to a decrease in government spending, opposite the result set forth by Friedman.

Second, the spend-tax hypothesis suggests that changes in government expenditures lead to changes in government revenues. Peacock and Wiseman (1979) argue that temporary increases in government expenditures due to "crises" can lead to permanent increases in government revenues. Barro (1978) argues that fiscal illusion referred to by Buchanan and Wagner does not exist. Utilizing the Ricardian equilvalence proposition Barro suggests that government borrowing today results in an increased future tax liability which is fully capitalized by the public. Thus, under Barro's analysis increases in government spending leads to increases in taxes.

Third, Musgrave (1966) as well as Meltzer and Richard (1981) suggest that voters compare the marginal benefits and marginal costs of government services when formulating a decision in terms of the appropriate levels of government revenues and expenditures. Thus, revenue and expenditure decisions are jointly determined under this fiscal synchronization hypothesis. A fourth hypothesis mentioned by Baghestani and McNown (1994) relates to the institutional separation of the expenditure and taxation decisions of government. This perspective suggests that revenues and expenditures are independent of one another.

The empirical literature on the tax-spend debate has yielded mixed results due in part to the various time periods analyzed, lag length specifications, and methodology. The bulk of the empirical literature has focused on the US budgetary process with the exception of papers by Provopoulos and Zambaras (1991) and Owoye (1995) analyzing Greece and G-7 countries, respectively [2]. The methodology used in these studies has been to test for Granger causality within a vector autoregressive model while some of the studies test for Granger causality within an error-correction framework.

Table 1 summarizes the empirical studies to date and their results. The tax-spend hypothesis has been supported in five studies, the spend-tax hypothesis in five studies, the fiscal synchronization in three studies, and independence between revenues and expenditures in one study. As one can see there appears to be some disparity in the results of the studies reported. The task of this paper is to extend this line of literature to the case of Canada. Though the methodology pursued in other studies has varied we wish to explore the methodology set forth by Baghestani and McNown (1994) as well as Ross and Payne (1996) for several reasons.

These studies examine the role of budgetary disequilibrium in the time series behavior of expenditures and revenues. The residuals from cointegrating regressions between expenditures and revenues may be considered as "budgetary disequilibrium" which may aid in explaining the time path of expenditures and revenues in their correction toward a budgetary balance. A budgetary balance in this context does not necessarily mean a balanced budget but rather a stable relationship between revenues and expenditures. The existence of cointegration implies a long run relationship in that revenues and expenditures do not deviate too far from one another. Hence, these error correction residuals represent short-term deviations from the long run time path of these series. If revenues respond to budgetary disequilibrium than budget imbalances would be corrected in revenue changes. On the other hand, if expenditures respond to budgetary disequilibrium, budget imbalances would be corrected by expenditure changes.

Another variable important to this process is GDP. Revenue and expenditure growth should be related to the overall conditions in the economy. In addition to the budgetary disequilibrium term, a fiscal disequilibrium term must be specified for both expenditures and revenues. The residuals from cointegrating regressions between expenditures and GDP would represent expenditure-GDP disequilibrium in measuring how responsive expenditures are to deviations from its long run time path with respect to GDP. The residuals from cointegrating regressions between revenues and GDP would represent revenue-GDP disequilibrium in measuring how responsive revenues are to deviations from its long run time path with respect to GDP.

The following section will elaborate on the methodology to be used in generating these disequilibrium terms along with a description of the data.

III. Methodology and Data

The following variables will be used in this study. The annual data cover the period 1950 to 1994 collected from International Financial Statistics. All variables have been deflated by the GDP implicit price deflator.

RR	Real Government Revenues
RE	Real Government Expenditures
RGDP	Real Gross Domestic Product

Given our discussion in the previous section let us briefly outline the approach taken to determine the presence of cointegration and the resulting error correction terms to be used in formulating both the budgetary and fiscal disequilibrium terms.

Granger (1986), Engle and Granger (1986), Engle and Yoo (1987), Johansen (1988), Stock and Watson (1988), as well as Johansen and Juselius (1990) have examined the casual relationship between two variables when a common trend exists between them. If two time series are respectfully nonstationary, but some linear combination of them is a stationary process than the two time series are said to be cointegrated. A time series is said to be covariance stationary if its mean, variance, and covariances are all invariant with respect to time, in other words, it is integrated of order zero, I(0). If the time series requires first-order differencing to achieve stationarity, it is integrated of order one, I(1). Any linear combination of two I(1) time series will also be an I(1) series. However, if there exists some linear combination of the two series which is I(0), then cointegration is present.

In order to examine the stationary of the respective time series in this study the following Augmented Dickey-Fuller (ADF) test was performed on each series:

$$(1) \quad \Delta X_t = \alpha + \beta t + (\rho - 1)\, X_{t-1} + \sum_{i=1}^{N} \rho_i\, \Delta X_{t-1} + \epsilon_t$$

where Δ is the first difference operator; ϵ_t is a covariance stationary random error and N was set at two lags to ensure serially uncorrelated residuals. The null hypothesis is that X_t is a nonstationary series and is rejected if $(\rho-1) < 0$ and statistically significant. If the respective time series are difference stationary, I(1), then cointegrating regressions can be undertaken to determine whether or not linear combinations of the series are stationary.

The Johansen-Juselius multivariate cointegration procedure is used next to determine the number of cointegrating vectors and appropriate error correction terms. Consider the following vector autoregressive model:

$$(2) \quad \mathbf{X}_t = \Pi_1\, \mathbf{X}_{t-1} + \ldots + \Pi_k\, \mathbf{X}_{t-k} + \epsilon_t \qquad t=1, \ldots, t$$

where $\mathbf{X}_t$ is a vector of variables and ϵ_t is a vector of error terms with zero mean and constant variance. Equation (2) expressed in first-differences is expressed below:

$$(3) \quad \Delta\mathbf{X}_t = \Gamma_1\, \Delta\mathbf{X}_{t-1} + \ldots + \Gamma_{k-1}\, \Delta\mathbf{X}_{t-k+1} - \Pi\, \mathbf{X}_{t-k} + \epsilon_t$$

where $\Gamma_i = -I + \Pi_1 + \ldots + \Pi_i \qquad i=1, \ldots, k-1$

$\Pi = I - \Pi_1 - \ldots - \Pi_k$

The Π matrix contains information about the long-run relationships between the variables in the vector. If the p x p martix Π has rank zero, $r = 0$, then all elements of X_t are nonstationary. Hence, cointegration is absent among the variables. On the other hand, if the matrix is of full rank, $r = p$, then all elements of X_t are stationary. Therefore, any combination of the variables results in a stationary series (cointegrated). In the intermediate case, $r < p$, there are r nonzero cointegrating vectors among the elements of X_t and $p - r$ common stochastic trends.

The matrix Π can be factored into $\alpha\beta'$ where α is a $p \times r$ matrix of the vector error correction parameters and β is a $p \times r$ matrix of cointegrating vectors. The cointegrating vector can be found as an eigenvector, λ , via a maximum likelihood procedure by solving the following eigenvalue problem:

$$(4) \quad \left| \lambda S_{kk} - S_{ko} S_{oo}^{-1} S_{ok} \right| = 0$$

where S_{OO} is the residual moment matrix from the OLS regression of ΔX_t on $X_{t-1}, \ldots, \Delta X_{t-k+1}$; S_{KK} is the residual moment matrix from an OLS regression of X_{t-k} on ΔX_{t-k+1}; and S_{ok} is the cross product moment matrix.

Johansen-Juselius provide two differnt tests to determine the number of cointegrating vectors: maximum eigenvalue and trace tests. To test the hypothesis that there are at most r cointegrating vectors one calculates the following trace statistic:

$$(5) \quad \lambda_{trace}(r) = -T \sum_{r+1}^{p} \ln(1-\lambda_i)$$

where $\lambda_{r+1}, \ldots, \lambda_p$ are the $p - r$ smallest eigenvalues. The null hypothesis is that the number of cointegrating vectors is less than or equal to r against a general alternative. The test statistic λ_{trace} equals zero when all $\lambda_i = 0$. The further the eignevalues are from zero the more negative is $\ln(1 - \lambda_i)$ thus the larger the λ_{trace} statistic. The maximum eigenvalue test is based on the null hypothesis that the number of cointegrating vectors is r against the alternative of r + 1 cointegrating vectors. The maximum eigenvalue test statistic is given by the following:

(6) $\lambda_{max}(r,r+1) = -T \ln(1-\lambda_{r+1})$

The maximum eigenvalue test λ_{max} equals zero when all $\lambda_i = 0$. As in the case of the trace test the further the eigenvalues are from zero the more negative is $\ln(1-\lambda_{r+1})$ thus the larger the λ_{max} statistic. Johansen and Juselius (1990) provide critical values of the trace and maximum eigenvalue test statistics.

IV. Empirical Results

Table 2A presents the ADF unit root test statistics for the variables in both levels and first-differences. Based on the ADF test statistics, all variables are integrated of order one which means the respective time series are stationary in first-differences. Table 2B reports the λ_{max} and λ_{trace} statistics for the number of cointegrating vectors found in the Π matrix [3]. Both the maximum eigenvalue and trace tests reject the null hypothesis of no cointegrating vector in favor of the alternative of at least one cointegrating vector. Moreover, both the maximum eigenvalue and trace tests reject the null hypothesis of one cointegrating vector in favor of the alternative of at least two cointegrating vectors.

Given that two cointegrating vectors exist, the original vectors can be transformed to eliminate one of the three variables from each cointegrating equation. This transformation allows one to to examine the independent responses of each fiscal variable to budgetary disequilibrium as well as to departures from their respective long run relationship with real GDP. Table 2C displays the bivariate vectors normalized by the expenditure and revenue variables estimated via maximum likelihood. Saving the residuals from these bivariate cointegrating equations as error correciton terms, we will now proceed to estimate error correction models. The residuals from the normalized equations between expenditures and revenues contain the budgetary disequilibrium error correction terms while the residuals from the normalized equations between each fiscal variable and GDP contain the fiscal disequilibrium error correction terms.

Table 3 presents the results of the OLS regression estimates on both the revenue and expenditure equations. The revenue equation contains laggd revenue, expenditure, and GDP variables to capture short-run dynamics. In addition, the budgetary disequilibrum term, RERES(-1), is incorporated to measure the response of revenues to disequilibrium present between revenues and expenditures. The fiscal disequilibrum term, RYRES(-1), is also included to capture the response of revenues to disequilibrium present between revenues and GDP. Although serial correlation is absent in the revenue equation as evidenced by the Lagrange multiplier chi-square statistic the overall equation performs poorly with respect to the adjusted R^2 and F-statistics. The budgetary disequilibrium term, RERES(-1) is insignificant at the 10 percent level while the fiscal disequilibrium term, RYRES(-1), is significant at the 1 percent level.

The expenditure equation performs much better than the revenue equation with respect to the adjusted R^2 and F-statistics along with the absence of serial correlation. However, as in the case of the revenue equation, the variables capturing the short-run dynamics are insignificant. The budgetary disequilibrum term, ERRES(-1), is significant at the 10 percent level while the fiscal disequilbrium term, EYRES(-1), is significant at the 1 percent level.

V. Concluding Remarks

This paper has attempted to extend the literature on the tax-spend debate to the case of Canada. Although the error correction model for revenues is not robust we find some evidence that revenues responds to disequilibrium between revenues and GDP. On the other hand, the error correction model for expenditures provides a higher R^2 and significant overall F-statistic than the revenue equation. With respect to the expenditure equation both budgetary disequilibrium and fiscal disequilibrium terms are statistically significant. These results are contrary to the fiscal synchronization results reported by Owoye. The results of this study suggest that expenditures respond to budgetary disequilibrium with respect to revenues in that imbalances are corrected by expenditure changes. This finding coincides with the current fiscal actions taken by the Canadian government (Martin, 1996). Moreover, expenditures appear to respond to disequilibrium with respect to the time path of GDP. The difference in results when compared to Owoye can be attributed to several factors. First, Owoye did not take into account overall movements in the economy as measured by GDP. Second, though both studies use annual data our study encompasses a longer time frame. Third, the methodology differs in that the Johansen-Juselius procedure provides a unified framework for the estimation and testing of cointgrating relationships in the context of vector autoregressive error correction models.

Given the numerous studies on the tax-spend debate in the case of the US perhaps future research should be directed towards the tax-spend issue of both industrialized as well as less developed countries.

TABLE 1
SUMMARY OF EMPIRICAL STUDIES

AUTHOR	PERIOD	METHODOLOGY	RESULTS
Anderson, et.al. (1986)	(A) 1946-1983	Granger causality	spend-tax
Manage and Marlow (1986)	(A) 1929-1982	Granger causality	fiscal sychronization
Von Furstenberg, et.al. (1986)	(Q) 1954-1982	VAR	spend-tax
Blackley (1986)	(A) 1929-1982	Granger causality	tax-spend
Ram (1988)	(A) 1929-1983 (Q) 1947-1983	Granger causality	tax-spend
Trehan and Walsh (1988)	(A) 1890-1986	Johansen-Juselius multivariate cointegration	intertemporal budget constraint satisfied
Miller and Russek (1989)	(A) 1947-1986 (Q) 1947-1986	Engle-Granger error-correction	fiscal synchronization
Bohn (1991)	(A) 1792-1988	Johansen-Juselius multivariate cointegration	tax-spend
Jones and Joulfaian (1991)	(A) 1792-1860	Engle-Granger error-correction	spend-tax
Provopoulos Zambaras (1991) (Greece)	(Q) ?	Granger causality	spend-tax
Hoover and Sheffrin (1992)	(Q) 1955-1989	VAR-structural breaks	tax-spend
Baghestani and McNown (1994)	(Q) 1955-1989	Johansen-Juselius multivariate cointegration	independent

TABLE 1
(continued)

Owoye (1995) G-7 countries	(A)	1961-1990	Engle-Granger error correction	fiscal synchronization Canada, France, Germany, UK, US tax-spend Italy and Japan
Ross and Payne (1996)	(Q)	1955-1994	Johansen-Juselius multivariate cointegration ARCH model	spend-tax

Notes:
(A) annual data
(Q) quarterly data
(?) time frame not given

Table 2A
ADF Unit Root Tests

Variables	Levels	First-differences
RR	-.99140	-4.8700*
RE	-.25998	-4.4808*
RGDP	-.61961	-5.3390*

* Exceeds 95 percent critical value as reported by MacKinnon (1991).

Table 2B
Maximum Likelihood Estimates
of Number of Cointegrating Vectors

Null	Alternative	λ_{max}	λ_{trace}
r = 0	r ≥ 1	20.1039*	39.0313*
r ≤ 1	r ≥ 2	15.6184*	18.9274*

* Exceeds 95 percent critical value as reported by Johansen and Juselius (1990).

Table 2C
Maximum Likelihood Estimates
of Normalized Cointegrating Vectors

Variables

RR	RE	RGDP
-1.0000	.91350	0
-1.0000	0	1.2906
0	-1.0000	1.3396
1.9047	-1.0000	0

Table 3
OLS Estimates of Error Correction Models
t-statistics in parentheses

	ΔRR	ΔRE
constant	-.6929 (-2.544)	-.5858 (-2.986)
ΔRR(-1)	-.0664 (-.3085)	-.1436 (-.9652)
ΔRE(-1)	.1992 (.8169)	.1009 (.6364)
ΔRGDP(-1)	.3697 (.8260)	.0502 (.1918)
RERES(-1)	-.0444 (-1.646)	
RYRES(-1)	-.3610 (-2.744)*	
ERRES(-1)		-.2025 (-1.764)***
EYRES(-1)		-.3103 (-3.401)*
R^2 =	.2037	.3997
Adj.R^2 =	.0931	.3163
F =	1.842	4.794*
S.E. =	.0708	.0461
χ^2_4 =	1.0809	6.1179

* significant at 1 percent level
** significant at 5 percent level
*** significiant of 10 percent level
χ^2_4 LaGrange multipher chi-square statistic for serial correlation.

FOOTNOTES

[1] In addition to the literature pertaining to the U.S. federal level of government there has been numerous studies at the state and local levels of government. For a more detailed discussion of this topic see the studies by Manage and Marlow (1987, 1988), Chowdhury (1988), Ram (1988), Miller and Russek (1989), Joulfaian and Mookerjee (1990), Payne (1996).

[2] A related line of research dealing with the sustainability of budget deficits will not be examined in this paper. For a more detailed discussion of this topic see the studies by Hamilton and Flavin (1986), Kremers (1988, 1989), Wilcox (1989), Hakkio and Rush (1991), Smith and Zin (1991), Haug (1991, 1995).

[3] Two lags were used in the estimation. The model was estimated with a trend in the cointgrating space given the possibility of deterministic trends in the individual time series. The trend model allows for linear trends not only in the variables but also in the cointegration space.

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