CAHIERS DE RECHERCHE / WORKING PAPERS

02-07

Effects of government debt on interest rates: evidence from causality tests in johansen-type models

Pene KALULUMIA

UNIVERSITÉ DE SHERBROOKE
Faculté des lettres et sciences humaines
Département d'économique

CAHIERS DE RECHERCHE / WORKING PAPERS

02-07

Effects of government debt on interest rates: evidence from causality tests in johansen-type models

Pene KALULUMIA

UNIVERSITÉ DE SHERBROOKE
Faculté des lettres et sciences humaines
Département d'économique

EFFECTS OF GOVERNMENT DEBT ON INTEREST RATES: EVIDENCE FROM CAUSALITY TESTS IN JOHANSEN-TYPE MODELS

by

Pene Kalulumia

Department of Economics
University of Sherbrooke
Sherbrooke (Qc), Canada J1K 2R1
Tel: (819) 821-7236
Fax: (819) 821-7237
E-mail: pkalulum@hotmail.com

July 2002

EFFECTS OF GOVERNMENT DEBT ON INTEREST RATES: EVIDENCE FROM CAUSALITY TESTS IN JOHANSEN-TYPE MODELS

ABSTRACT

This paper examines the impact of government debt on interest rates in the United States, Germany, the United Kingdom and Canada, using the sequential causality test procedures suggested by Toda and Phillips (1994) in the Johansen error-correction model (ECM). The general portfolio balance model, which allows for both direct and indirect tests of the link between public debt and interest rates, is used as the economic framework. Indirect tests in this model consist of investigating the debt impact on interest rates through the effects of debt on the exchange rate and money demand. The evidence generally indicates the absence of causality in the long-run, between government debt and interest-rate related variables for all four countries under study. This suggests the neutrality of public debt on interest rates and is consistent with the Ricardian equivalence hypothesis.

I. INTRODUCTION

Since the early 1970s many industrialized countries have experienced large shifts in their government debt and deficits while the international capital flows have grown tremendously in world financial markets. These events raise a number of questions, particularly, whether such government debt and incumbent deficits affect interest rates and private demand in the presence of international capital flows. The macroeconomic literature has addressed this issue in two interesting and separate frameworks. According to various versions of Keynesian and Neoclassical models, an increase in government debt which makes households wealthier, stimulates both output and employment, and causes higher interest rates. The driving up of interest rates, however, crowds out private investment with deleterious impact on long-term growth.

In the last two decades, this traditional view has been cast into doubt through the reawakening of another theory of public debt's effects, the Ricardian overlapping generation model, suggesting that government debt implies future tax liabilities with a present value equal to the value of the debt. Rational agents recognize this debt/tax equivalence and act as if the debt does not exist, resulting in the debt having no effect on interest rates nor any of the effects attributed to them by traditional models. Which of those two views is appropriate bears an important implication for macroeconomic policy-making.

Empirical work, intended to quantify the relationship between government debt or deficits and interest rates, has reached disconcertingly different conclusions using US postwar data. First, Barth, Iden and Russek (1985), Zahid (1988), Cebula and Cock (1991, 1994), Bahmani-Oskooee (1994), and Miller and Russek (1996), among others, concluded that public debt and incumbent deficits increase interest rates (long-run rates were mostly used). They tend to support the Keynesian hypothesis. Second, Evans(1985, 1987), Barro (1987), Deravi, Hegji and Morbely (1990), Seater (1993) and Gulley (1994), among others, found no evidence linking government debt or deficits and interest rates (short-run rates were often used). They then tend to support the Ricardian equivalence hypothesis.

At the heart of these two puzzles, noted in previous empirical results, are the fiscal variables and statistical techniques employed to assess the interest rate effects of government debt. As to the fiscal variable specification, it is now well documented in the literature that the total outstanding debt is the most appropriate variable for assessing the Ricardian equivalence. Fiscal variables such as budget deficits and government spending used in other empirical studies are misleading [see Seater (1985, 1993) for discussion][1].

[1] Seater (1985, 1993) discussed this issue and suggested that the key fiscal variable in empirical analyses of the Ricardian equivalence is the total outstanding debt. Fiscal variables such as budget deficits and government spending are misleading. For

On the other hand, statistical techniques used in previous studies can be divided into two categories. The first method, which has been widely utilized, is the interest rate regression approach. It consists in regressing some measure of the nominal interest rate on various independent variables, including measures of government debt. As pointed out by Deravi *et al.* (1990) and Gulley (1994), interest rate regressions lead to weak tests of debt effects on interest rates since any link between these two variables can be clouded either by an inflow of capital which occurs before interest rates respond to public debt and deficits or by the monetary policy that often targets the nominal interest rates, lowering its variability. The second approach, proposed in empirical literature, indirectly examines the effect of government debt or deficits on interest rates through the impact of debt or deficits on any relevant variable which is closely related to the nominal interest rate. This helps to avoid problems caused by interest rate regressions. Along this line of thought, Evans (1985), Deravi *et al.* (1990) and Gulley (1994) propose an approach which attempts to estimate money demand functions which include a measure of government debt to account for the wealth effect. This procedure indirectly analyzes the impact of government debt on interest rates through the effect of debt on money demand. In the same vein, Seater (1993) suggests a test of the relationship between public debt and exchange rates as a more direct assessment of the debt-interest rate linkage under higher international capital flows that may offset interest rate effects of public debt. Following Evans(1985) and Seater (1993), if the private sector is not Ricardian, both money demand and the exchange rate will be positively related to government debt even in the presence of early capital flows and/or that of a monetary policy that targets interest rates.

Although the indirect methodology is adequate, previous studies which applied it analyzed the effect of debt on interest rate-related variables, using mostly the Engle and Granger (1987) procedure or single-equation models that produce inefficient estimation and test results [see Johansen and Juselius (1992) for discussion]. Furthermore, tests of theories of government debt's effects, developed in earlier research, do not correctly address the issue of the timing of tax perceptions as documented by Seater (1985, pp.123). They mostly assume that at least a fraction of public debt is perceived to be net wealth and this perception lasts forever. For instance, suppose the government issues a perpetuity whose interest payments all are paid by taxes. Although no one recognizes these implied future taxes when the perpetuity is issued, as time passes everybody will observe that taxes are persistently higher and will eventually adjust their tax anticipations accordingly. As such, government debt will have no effects in the long run (or steady state), though it will

---

instance, deficits can ensue from an increase in expenditure contradicting therefore the Ricardian equivalence hypothesis that assumes a constant path of government purchases. Also, deficits may be financed not only by interest-bearing government debt, but also by monetary issue. The latter financing means may actually lower interest rates.

have a short-run effects before full tax perception occurs, and the Ricardian equivalence hypothesis will hold. Therefore, the way to clearly differentiate between the Ricardian hypothesis and the Keynesian and Neoclassical models is to investigate the long-run effects of government debt on interest rates. A non rejection of a short-run debt-interest rate linkage cannot necessarily be an indication of a rejection of the Ricardian equivalence.

The objective of this paper is to examine the effects of government debt on interest rates in order to contribute to the debate on the theory of government debt's effects. The paper improves upon previous studies in three important ways. Firstly, it uses an economic model which embodies indirect tests of interest rate effects of government debt à la Evans (1985) and Seater (1993), as well as a standard direct test from interest rate equations. Secondly, tests of government debt's effects are preformed by means of more robust causality tests suggested by Toda and Phillips (1994) in the Johansen (1988) error-correction model (ECM). These full-information test procedures, which are modified in this paper to include deterministic terms, allows one to distinctively test for short-run noncausality and long-run noncausal effects (or neutrality) among series. For instance, transitory debt effects relates to short-run causality, while long-run effects refers to long-run causality. Thirdly, while previous studies focus on the United States (US), the current paper includes other industrial countries comprising Canada, Germany and the United Kingdom (UK).

The paper is organized as follows. It starts with a description of the economic framework and data, then presents a brief discussion of the Toda and Phillips (1994) test procedures, followed by the outcome of preliminary unit root and model specification tests. Section V is devoted to the analysis of empirical results. The paper ends with concluding remarks.

II. MODEL AND DATA DESCRIPTION

Regarding the purpose of this paper, we consider the following generalized asset market representation of the exchange rate for a small open economy:

$$e_t = d_1(m_t - m_{ft}) + d_2(y_t - y_{ft}) + d_3(i_t - i_{ft}) + d_4(b_t - b_{ft}), \quad d_1, d_2, d_4 > 0, \text{and } d_3 < 0, \tag{2.1}$$

where e is the bilateral exchange rate, m is the nominal M1, y is the national income measured by the real GDP, i is the nominal interest rate measured by long-term government bond yields, and b is the stock of domestic asset (or government bonds) proxied by the total government outstanding debt (federal plus state liabilities). Subscripts f denote foreign variables. Since (2.1) defines the long-run equilibrium exchange rate which clears both real and financial markets, m is also interpreted in this framework as the demand for home money.. The rational behind the choice of this theory is that, in the error-correction framework, model (2.1) allows for not only direct tests of debt-interest rate effects, but also for indirect tests suggested by Evans (1985) and Seater (1993), in a context of high capital mobility.

We use quarterly and seasonally unadjusted data from 1957:1 to 1993:4, for Canada, Germany, the UK and the US. The series are expressed in natural logs except the domestic and foreign interest rates. All the data are taken from the IMF *International Financial Statistics* (IFS) and the OECD *Main Economic Indicators*. In all cases the US series are used as foreign variables, whereas those for the US model are obtained from German data. Accordingly, the bilateral exchange rates are expressed in terms of national currency per unit of US dollar, while for the United States it is given by \$US per unit of Mark. Here, an increase in the exchange rate level is defined as a currency appreciation. It is worth noting that the choice of the 1957-1993 period was motivated by the will to provide more weight for the period during the Reagan-Bush regime, characterized by large and persistent public deficits. In what follows, since the US is a large open economy, we exclude from its model all foreign variables of no interest and keep only the interest rate differential that captures the impact of international capital flows. The series are then stacked in a vector as follows: $Y_t = [m_t, y_t, i_t, i_{ft}, b_t, e_t]$ for the US, and $Y_t = [m_t, m_{ft}, y_t, y_{ft}, i_t, i_{ft}, b_t, b_{ft}, e_t]$ for the other countries.

III. CAUSALITY TESTS IN THE JOHASEN-TYPE ECM

In this section we briefly describe the causality test procedures derived by Toda and Phillips (1994) in the Johansen-type ECM. We modify these tests to include various choices of deterministic components in the model as documented by Osterward-Lenum (1992). Consider the p-dimensional VAR(k) model in error-correction form

$$\Delta Y_t = \Gamma(L)\Delta Y_{t-1} + \Phi D_t + \alpha(\beta' Y_{t-1} + \delta_0 + \delta_1 t) + \varepsilon_t, \quad t = 1,\ldots,T, \tag{3.1}$$

where Y_t is a I(1) series vector, $\Gamma(L) = \sum_{h=1}^{k-1}\Gamma_h L^{h-1}$, ε_t are i.i.d $N(0,\Sigma)$, and $\Pi = \alpha\beta'$ is the long-run impact matrix, where α and β are $p\times r$ matrices of full rank r, $0 \le r \le p-1$ (there is no α or β if $r=0$). The deterministic part of the model is assumed to be $\Phi D_t = \gamma_0 + \gamma_1 t$, and the coefficients γ_i and δ_i are defined as in Osterward-Lenum (1992, p.464), $\gamma_i = (\alpha_\perp'\alpha_\perp)^{-1}\alpha_\perp'\mu_i$ and $\delta_i = (\alpha'\alpha)^{-1}\alpha'\mu_i$, $i = 0,1$, where $\alpha_\perp$ is $p\times(p-r)$ matrix orthogonal to α, and γ_i and δ_i are referred to as the projections of the original deterministic part of the model $\mu_0 + \mu_1 t$ on the spaces spanned by α and $\alpha_\perp$. A number of sub-models can be derived from the general model (3.1). They include, among others, a model without an intercept ($\mu_0 = \mu_1 = 0$), a model with a constant term both in ΔY and the long-run relationship ($\mu_1 = 0$ or $\gamma_1 = \delta_1 = 0$), a model where both ΔY and the long-run relationship evolves around a linear trend ($\mu_0 \neq \mu_1 \neq 0$), a model with a drift only in the error-correction term ($\mu_1 = \gamma_0 = 0$), and a model with a linear trend in the error-correction terms and a drift in ΔY ($\gamma_1 = 0$).

Assume now that we want to test whether there are causal effects from the last p_3 series (y_{3t}) of Y_t to the first p_1 series (y_{1t}), and partition Y_t into sub-vectors $Y_t = (y_{1t}', y_{2t}', y_{3t}')'$ with selector matrices $S_1' = (I_{p_1}\ 0')$ and $S_3' = (0'\ I_{p_3})$, as in Toda and Phillips (1994). Then the null hypothesis of Granger noncausality in the ECM (3.1) is formulated as

$$H^*: \Gamma_{1,13} = \dots = \Gamma_{k-1,13} \text{ and } \alpha_1 \beta_3' = 0 \tag{3.2}$$

where $\Gamma_{13}(L) = \sum_{h=1}^{k-1} \Gamma_{h,13} L^{h-1}$ is the $p_1 \times p_3$ upper-right sub-matrix of $\Gamma(L)$, α_1 is the first p_1 rows of the loading matrix α, and β_3 the last p_3 rows of the cointegrating vectors β. The firts part of the hypothesis relates to short-run noncausality, and the second half is referred to as long-run causality. Long-run causality also refers to neutrality in the macroeconomic literature. Furthermore, four sub-hypotheses are also suggested in order to construct the sequential causality test procedures. They are formulated, respectively, as:

$$H_{\Gamma}^*: \Gamma_{1,13},\dots,\Gamma_{k-1,13} = 0,\ H_1^*: \alpha_1 = 0,\ H_3^*: \beta_3 = 0, \text{and } H_{13}^*: \alpha_1 \beta_3' = 0 \tag{3.3}$$

and allow one for testing separately for the two parts of the noncausality hypothesis (3.2).

The Toda and Phillips (1994) Wald statistics for testing the hypotheses (3.2) and (3.3) are based on the Johansen (1988) maximum likelihood (ML) approach. To illustrate these test procedures in the ECM (3.1) that includes deterministic terms, we need to introduce some notation. Let $\hat\beta^* = (\hat\beta', \hat\delta_0, \hat\delta_1)'$ denote the ML estimator of $\beta^* = (\beta', \delta_0, \delta_1)'$, the eigenvectors corresponding to the r largest eigenvalues, and let $\hat\beta_z^* = (\hat\beta_z', \hat\delta_{0z}, \hat\delta_{1z})'$ be the eigenvectors corresponding to the *p-r* smallest eigenvalues, where both $\hat\beta^*$ and $\hat\beta_z^*$ are normalized as in Johansen (1988, p.235). Then the ML estimator of $(\Gamma_1,\dots,\Gamma_{k-1}, ?, \alpha)$ is computed as

$$(\hat\Gamma_1,\dots,\hat\Gamma_{k-1}, \hat{?}, \hat\alpha) = \Delta Y' \hat Z_1 (\hat Z_1' \hat Z_1)^{-1}$$

where $\Delta Y' = (\Delta Y_1,\dots,\Delta Y_T)$, $\hat Z_1' = (\hat z_{11},\dots,\hat z_{1T})$ with $\hat z_{1t}' = (\Delta Y_{t-1}',\dots,\Delta Y_{t-k+1}', D_t', (\hat\beta^{*\prime} Y_{t-1}^*)')$. Here, according to the general ECM in (3.1), $Y_{t-1}^{*\prime} = (Y_{t-1}', 1, t)$ and $D_t' = (1, t)$, but their specific expressions depend on the defined deterministic-term specifications. Now, let us define $\hat Z_2' = (\hat z_{21},\dots,\hat z_{2T})$ with $\hat z_{2t}' = \hat\beta_z^{*\prime} Y_{t-1}^*$ and $\hat\Omega_c = (\hat\alpha' \hat\Sigma \hat\alpha)^{-1}$. Moreover, denote by $\hat\Sigma$ the ML estimator of Σ in (3.1), and let $\hat P$ be the following partitioned matrix

$$\hat P = \begin{pmatrix} I_{k-1} \otimes S_3' \otimes S_1' & \hat{?} \otimes S_1' & 0 & 0 \\ 0 & 0 & \hat\beta_3 \otimes S_1' & \hat\beta_{3z} \otimes \hat\alpha_1 \end{pmatrix}$$

where $\hat{\beta}_3$ and $\hat{\beta}_{3z}$ are the last p_3 rows of $\hat{\beta}$ and the last p_3 rows of $\hat{\beta}_{3z}$, respectively. Thus, the ML estimator of the joint variance-covariance matrix of all parameters in the ECM (3.1) is given by

$$\hat{\Omega} = \begin{pmatrix} (\hat{Z}_1'\hat{Z}_1)^{-1} \otimes \hat{\Sigma} & 0 \\ 0 & (\hat{Z}_2'\hat{Z}_2)^{-1} \otimes \hat{\Omega}_c \end{pmatrix}$$

and the Wald statistic for testing the joint hypothesis (3.2) of noncausality is computed as

$$F^* = \mathrm{vec}(\hat{\Phi}')' \, (\hat{P}\hat{\Omega}\hat{P}')^{-1} \, \mathrm{vec}(\hat{\Phi}') \tag{3.4}$$

where $\hat{\Phi} = (\Gamma_{1,13},\ldots,\Gamma_{k-1,13}, \hat{?}, \hat{\alpha}_1\hat{\beta}_3')$. The statistics for testing the sub-hypotheses defined in (3.3) are calculated, respectively, as follows:

$$F_1^* = \mathrm{vec}(\hat{\alpha}_1)' \, (S_1'\hat{\Sigma}S_1 \otimes \hat{\Sigma}_{?})^{-1} \, \mathrm{vec}(\hat{\alpha}_1), \text{ where } \hat{\Sigma}_{?} = T^{-1}I_r \tag{3.5}$$

$$F_3^* = \mathrm{vec}(\hat{\beta}_3)' \, [\hat{\beta}_{3z}(\hat{Z}_2'\hat{Z}_2)^{-1}\hat{\beta}_{3z}' \otimes \hat{\Omega}_c]^{-1} \, \mathrm{vec}(\hat{\beta}_3)$$

$$F_{13}^* = \mathrm{vec}(\hat{\alpha}_1\hat{\beta}_3')' \, [S_1'\hat{\Sigma}S_1 \otimes \hat{\beta}_3\hat{\Sigma}_{?}\hat{\beta}_3' + \hat{\alpha}_1\hat{\Omega}_c\hat{\alpha}_1' \otimes \hat{\beta}_{3z}(\hat{Z}_2'\hat{Z}_2)^{-1}\hat{\beta}_{3z}']^{-1} \, \mathrm{vec}(\hat{\alpha}_1\hat{\beta}_3')$$

$$F_J^* = \mathrm{vec}(\hat{\Phi}_J)' \, [S_1'\hat{\Sigma}S_1 \otimes (I_{k-1} \otimes S_3')\hat{\Sigma}_J(I_{k-1} \otimes S_3)]^{-1} \, \mathrm{vec}(\hat{\Phi}_J)$$

where $\hat{\Phi}_J = (\hat{\Gamma}_{1,13},\ldots,\hat{\Gamma}_{k-1,13})$ and $\hat{\Sigma}_J$ is the $p(k-1)\times p(k-1)$ upper-left block matrix of $(\hat{Z}_1'\hat{Z}_1)^{-1}$. Under the null hypotheses (3.2) and (3.3), the Wald statistics in (3.4) and (3.5) admit the following chi-squared asymptotic distributions provided by Theorem 2 and Proposition 1 in Toda and Phillips (1994, p.268):

$F^* \xrightarrow{d} \chi^2_{p_1p_3k}$ if $rank(\alpha_1) = p_1$ or $rank(\beta_3) = p_3$; $F_1^* \xrightarrow{d} \chi^2_{p_1r}$; $F_3^* \xrightarrow{d} \chi^2_{p_3r}$; $F_{13}^* \xrightarrow{d} \chi^2_{p_1p_3}$ if $rank(\alpha_1) = p_1$ or $rank(\beta_3) = p_3$; and $F_J^* \xrightarrow{d} \chi^2_{p_1p_3(k-1)}$.

The authors suggest three sequential testing procedures P1, P2 and P3 based on the above-defined Wald statistics. Simulation results indicate that they outperform conventional causality tests based on VARs in levels an in differences, and among the sequential procedures, P1 performs better than P2 and P3 for all cases, when sample sizes are greater than 100 and $k>1$. Since in this paper we deal with the case of $p_1 = 1$, $p_3 = 1$ and $k>1$, and because we are interested in distinguishing between debt short-run and long-run causal effects, we will use both P1 and P3 sequential test procedures, as defined further in the paper (in section V).

IV. PRELIMINARY ANALYSIS

4.1 Time-series Properties of the Data

The statistical model (2.1) requires that the order of integration of variables is at most one. Nevertheless, some economic series also exhibit substantial seasonality. We then use the test procedure developed by Hylleberg, Engle, Granger and Yoo (1990) [HEGY] for quarterly data, which allows one to jointly test for both seasonal and nonseasonal unit roots. This approach contains the Dickey-Fuller test as a special case. To perform the HEGY tests for each series x_t, one estimates by ordinary least squares the following equation:

$$\varphi^{*}(B)y_{4t} = \pi_1 y_{1t-1} + \pi_2 y_{2t-1} + \pi_3 y_{3t-2} + \pi_4 y_{3t-1} + \sum_{i=1}^{n} \varphi_i y_{4t-i} + \mu_t + \varepsilon_t, \tag{4.1}$$

where

$$y_{1t} = (1+B+B^2+B^3)x_t,\ y_{2t} = -(1-B+B^2-B^3)x_t,\ y_{3t} = -(1-B^2)x_t,\ y_{4t} = (1-B^4)x_t, \text{ and } \varphi^{*}(B) = 1.$$

Equation (3.1) includes the linear trend μ_t, and n additional lags of y_4 to whiten the error terms ε_t. Hypotheses about various unit roots are tested as follows. For frequencies 0 and π, one examines the t-statistics for $\pi_1 = 0$ and $\pi_2 = 0$ against $\pi_1<0$ and $\pi_2<0$, respectively. For the frequency $\pi/2$, one jointly tests $\pi_3 = 0$ and $\pi_4 = 0$ with an F-statistic. Critical values for the t- and F-statistics are provided in HEGY. There will be nonseasonal unit roots if π_2 and either π_3 or π_4 are different from zero. This therefore requires the rejection of both the test for $\pi_2 = 0$ and the joint test for $\pi_3 = 0$ and $\pi_4 = 0$ $(\pi_3 \cap \pi_4)$. To conclude that the series exhibits no unit roots at all and is therefore stationary, we must find that each of the π's is different from zero (except possibly either $\pi_3 = 0$ or $\pi_4 = 0$). Table 1 reports the results of HEGY tests for the four countries. As indicated in column 4, there is no series for which the t-statistic for π_1 rejects at the 5 percent level the null hypothesis of a unit root at the nonseasonal frequency. Furthermore, the last five columns show that no series exhibits seasonal unit roots for all countries since all test statistics are significant.

4.2 Model Specification and Estimation

The Johansen VAR model is also based on two other important assumptions which are independence over time and normality of disturbance terms. We therefore test for those assumptions to determine the optimal autoregressive order (k) of the model applied to each country. We start by estimating VAR models with lag lengths k running from 2 to 12, and retain the shortest lag length for which all equations are left with white noise residuals. To save space, we only report in Table 2 the diagnostic test results for the most satisfactory lag length specification for each country. The computed statistics indicate that almost all the estimated residuals are normally distributed, free from serial correlation problems, and do not exhibit conditional heteroscedasticity when k=8 for the US, k=4 for the UK, k=4 for Germany and k=6 for Canada.

Tests for the cointegration ranks and deterministic trends are performed simultaneously. Table 3 reports the LR statistics for the cointegration ranks. Since, for all cases, both ?max and trace tests did not contradict each other, we only present the results for the trace tests to save space (those for ?max tests are available upon request). The results support at the 5% significance level, r=2 for the US, r=3 for Germany, r=3 for the UK, and r=3 for Canada. The Johansen (1995) LR tests for deterministic trends to be compared with a $?^2_{p\&r}$, suggest an ECM including a constant term for all cases (see the first line of Table 3). The LR test values are as follows, the number in parentheses being the p-values: 4.36 (0.359),7.70 (0.103), 4.39 (0.355), 8.94 (0.062), respectively, for Canada, the UK, Germany, and the US.

V. EMPIRICAL RESULTS

Up to now we have been concerned with the specification and the estimation of an adequate ECM for each country. In this section we now deal with the main purpose of this study, which is to examine by means of sequential causality tests given in section III, the debt-interest rate relationship directly, and indirectly through the effects of debt on the exchange rate and money demand. In our empirical analysis, we first test for the null hypothesis of noncausality (3.2) using the most performing sequential test procedure P1, defined in Toda and Phillips (1994) as follows.

$$\text{(P1) Test } H_1^(\begin{cases} \text{If } H_1^(\text{ is rejected, test } H^(. \\ \text{Otherwise, test } H_Ð^(. \end{cases}$$

If the null hypothesis of noncausality is rejected by the sequential procedure P1, we will use a modified P3 test procedure in order to identify the source of that causality among variables. As previously indicated, causality may ensue from two potential sources: the first part of hypothesis (3.2) or short-run noncausality which measures the impact of past changes in series values (sub-test $H_Ð^($), and the second half which assesses variable neutrality or long-run noncausality (sub-tests $H_1^($, $H_3^($, and $H_{13}^($). Accordingly, the P3 sequential test procedure is defined in this application as follows:

$$\text{(P3) Test } H_Ð^(\text{ and } H_3^(\begin{cases} \text{If } H_Ð^(\text{ is rejected, reject the short\&run noncausality and hence } H^(\text{ in (3.2).} \\ \text{If both } H_3^(\text{ and } H_1^(\text{ in (P1) are rejected,} \\ \quad \text{test } H_{13}^(\text{ as } r\$1\text{, and if } H_{13}^(\text{ is rejected, reject neutrality and hence } H^(. \\ \quad \text{Otherwise, accept neutrality.} \end{cases}$$

In particular, the latter test procedure will help in assessing whether the causality from government debt to the three variables of interest (*m, i, e*) holds only in the short-run or long-run, or in both periods of time. This will provide a clear test for the Ricardian equivalence hypothesis.

Table 4 reports the results of sequential causality tests P1 and P3 for all countries, while the ML estimates of the ECMs for money, domestic interest rates and the exchange rate are provided for information in Panel A of Table 5. To save space, we only present the coefficients of lagged debt variables that are of primary interest to the current study. Cointegrating vectors are also given for information in Panel B of Table 5. They embody most of the expected theoretical signs assumed by the economic model (2.1). As pointed out by Johansen and Juselius (1990) however, it is quite difficult to find all the expected signs in each cointegrating vector since their choice is mainly based on the stationarity assumption.

For the US, the P1 test procedure in column 2 of Table 4 fails to reject the null hypothesis of noncausality at the 5% level for the exchange rate and money equations, while it does for the interest rate equation. Examining the source of causality, the results of the P3 test procedure indicates that F^*_{Δ} sub-tests fail to reject the null hypothesis of short-run noncausality in all cases at 5% percent significance level. In turn, the F^*_{13}-test rejects the neutrality hypothesis H^*_{13} for the interest rate equation at 2.5%, while it fails in the other cases (*m* and *e*). These findings imply that the causality from government debt to interest rates (direct test) holds in the long run. However, the sign of the long-run impact coefficient to debt is negative[2], $\hat{\pi}_{35} = -1.248$, suggesting that debt lowers interest rates, which is in contradiction with the predictions of all public debt theories including the Keynesian and Neoclassical frameworks. As indicated earlier in this paper, the latter finding may be attributed to the offsetting impact of premature capital inflows on interest rates or/and a monetary financing of a part of deficits and debt. In sum, the test results for the US fail to reject the Ricardian equivalence hypothesis. They are therefore consistent with previous studies that have found no evidence of positive debt-interest rate linkage in the short and long-run, using postwar US data and both direct and indirect tests.

For Germany, the P1 causality test procedure rejects the null hypothesis of noncausality for both money and the exchange rate equations, while it fails for the interest rate ECM. This suggests causality from

[2] The long-run impact coefficient to the debt variable in the interest rate equation is computed as $\hat{\pi}_{35} = \hat{\alpha}_{51}\hat{\beta}_{15} + \hat{\alpha}_{52}\hat{\beta}_{25}$, which is equal to $\hat{\pi}_{35} = 0.091(-7.68) + 0.0612 \times (-8.976) = -1.248$. Seater (1993, pp.183) argues that, the empirical literature generally support the Ricardian prediction that debt and deficits will have no effects on any variable of interest; the tests that reject Ricardian equivalence find an effect on interest rates that is the opposite of that predicted by traditional theory.

debt to only interest rates in this country. These relationships, however, does not last in the long-run, as indicated by the results of P3 tests in all equations. The sequential sub-tests $F_1^{(}$, $F_3^{(}$ and $F_{13}^{(}$ cannot reject the null hypotheses of debt neutrality at the 2.5% significance level. This implies that short-run effects of debt disappear over time possibly as full tax perception occurs, canceling the net wealth effect of debt in the long-run. Thus, the results for Germany also indicate evidence of the debt/tax equivalence hypothesis since government debt effects do not hold in the steady state. For the UK, the results for P1 causality tests clearly indicate the absence of causal effects from debt to money demand, interest rates and the exchange rate, respectively. The P3 test procedure confirms those findings by indicating that all three variables of interest (*m*, *i*, and *e)* hardly adjust to the dynamics of public debt, both in short and long run, which is supportive of the Ricardian equivalence hypothesis. For Canada, as the results of the P1 test procedure indicate, indirect tests (*m* and *e* equations) reject the null hypothesis of debt-interest rate noncausality, while direct tests from the *i* equation reject it. The analysis of the source of causality from P3 tests shows that debt affects *m* and *e* only in the short-run since the tests fail to reject the sub-hypothesis of long-run noncausality in all cases. This suggests that government debt is neutral in all cases for Canada, i.e it does not affect any variable of interest in the long run. These findings are not against the debt/tax equivalence hypothesis.

The above findings all indicate a strong evidence of debt-interest rate noncausality in the long-run from both direct tests and indirect test approaches à la Evans (1985) and Seater (1993). In the rare cases where we find evidence of Granger causality between debt and interest-rate related variables, the tests show that the relationship holds only in the short-run and disappears in the long-run, probably as individuals fully perceive that government debt implies future taxes whose present value equals the current value of debt. Public debt seems to be non neutral in the sole case of the US, but its impact on interest rates is negative. Thus, for the US, the UK, Germany and Canada, the results seem to support the Ricardian equivalence hypothesis. While we did not undertake a Monte Carlo simulation to study the power of sequential test procedures P1 and P3 for ECMs with deterministic terms, our application supports the rejection powers suggested by Toda and Phillips (1994, p.276). We find no contradiction between P1 and P3 test procedures when the rejection power is set to 5% for P1, $F_1^{(}$ and $F_3^{(}$ in P3, and to 2.5% for $F_{13}^{(}$ in P3.

VI. CONCLUSION

This paper explored the impact of government debt on interest rates in the United States, Germany, the United Kingdom and Canada. One feature of the study was to address the issue using the sequential causality test procedures suggested by Toda and Phillips (1994) in the Johansen-type models. The paper also used the general portfolio balance framework which allows for both direct and indirect tests of the relationship between debt and interest rates. Indirect tests of the debt effects on interest rates were investigated through the impact of debt on the exchange rate and money demand.

We found an overwhelm evidence of long-run noncausality or neutrality of government debt on interest rates from both direct and indirect test techniques. The only exception was the finding of an opposite sign of the debt effect on interest rates for the US in long run, which contradicts the predictions by all traditional debt theories. This result is not against the Ricardian equivalence and is well documented in the empirical literature on the debt theory. As pointed out by Seater (1993, pp. 183), previous studies that rejected the Ricardian equivalence mostly found a negative effect of debt on interest rates. The evidence also indicated short-run causal effects from government debt to interest rates for Germany, as well as to money demand and the exchange rate for Canada.

Overall, our results are generally consistent with previous studies supporting the Ricardian equivalence hypothesis that government debt has no lasting positive effects on any variable of interest, such as interest rates, money demand and the exchange rate [Seater (1993), Barro (1987), and Evans (1985)].

Table 1. Tests For Seasonal Unit Roots

Variables	**Period**	**Lags**	**`t' :** p_1 **0**	**`*t*' :** p_2 p	**`*t*' :** p_3 p / 2	**`*t*' :** p_4 p / 2	**`*F*':** $p_3 - p_4$
				United States			
m	57:1-93:4	6	-1.11	-1.29	1.74	3.72*	8.74*
y	57:1-93:4	9	-1.56	-3.84*	4.76*	4.41*	21.44*
i	57:1-93:4	4	-1.39	-3.37*	3.80*	4.53*	19.66*
b	57:1-93:4	2	-1.85	-3.04*	3.40*	5.02*	20.71*
e	57:1-93:4	2	-2.86	-5.86*	5.85*	3.11*	21.95*
				Germany			
m	57:1-93:4	1	-2.37	-5.77*	5.49*	5.17*	28.54*
y	57:1-93:4	1	-2.10	-5.03*	5.91*	4.04*	24.90*
i	57:3-93:4	1	-1.83	-6.88**	4.59*	4.64*	21.33*
b	57:1-93:4	2	-1.16	-3.62*	4.27*	4.24*	22.38*
e	57:1-93:4	3	-1.64	-3.31*	4.27*	0.99	9.86*
				United Kingdom			

m	57:1-93:4	1	-2.30	-5.35*	6.58*	3.83*	29.01*
y	57:1-93:2	1	-2.32	-4.59*	5.77*	4.41*	26.31*
i	57:3-93:4	1	-1.14	-6.71*	5.71*	6.05*	30.83*
b	57:1-93:4	1	-2.70	-2.66*	4.29*	2.58*	12.44*
e	57:1-91:4	10	-2.95	-2.82*	4.66*	1.22	11.99*
				Canada			
m	57:1-93:4	1	-1.57	-5.46*	9.21*	2.99*	46.88*
y	57:1-93:4	1	-0.12	-7.19*	6.32*	6.93*	44.41*
i	57:1-93:4	17	-1.43	-2.25*	3.00*	3.89*	12.05*
b	57:1-93:4	1	-1.69	4.00*	4.07*	4.70*	19.36*
e	57:1-93:4	7	-2.94	-4.98*	3.14*	0.68	5.13*

Notes:
1. The superscripts * and ** indicate respectively the rejection at 5% and 10% level of the null hypothesis.
2. Lags is the number of lagged values of the dependant variable included in the regression.
3. We use critical values presented in Hylleberg et *al.* (1990) for the regressions including a constant and time trend.
4. The results from regressions including a constant and/or seasonal dummies yield just slight changes in figures, without affecting our conclusions about unit root tests.

Table 2. Error term diagnostics

Equations	Normality	Ljung-Box Q(l)	GARCH	Normality	Ljund-Box Q(l)	GARCH
	United States (k=8)[c]			**Germany (k=4)**		
m	1.24	20.38	5.58	3.70	8.76	1.67
m_f				4.13	7.54	5.02
y	1.00	18.95	3.79	3.13	6.60	2.11
y_f				3.64	4.78	7.49
i	5.61	19.40	2.07	0.45	7.08	7.64
i_f	2.12	17.57	4.01	1.47	6.28	9.11
b	1.30	21.96	3.22	4.26	7.21	8.35
b_f				2.87	3.46	7.65
e	5.17	12.05	3.91	0.57	6.54	4.68
	United Kingdom (k=4)			**Canada (k=6)**		
m	1.42	3.12	1.00	7.1	18.03	6.83
m_f	7.45	20.51	3.75	0.86	11.83	7.68
y	1.97	15.10	11.60	0.70	16.90	5.93
y_f	5.96	18.72	8.67	0.67	4.67	11.52
i	2.47	21.35	5.59	1.43	18.42	14.51
i_f	10.72	16.18	3.23	1.11	21.64	8.48
b	3.72	12.91	5.31	1.35	15.71	5.41
b_f	6.69	11.67	4.71	0.78	15.20	6.43
e	4.52	20.70	1.75	2.26	14.01	2.47

Notes: [a]The GARCH and normality tests are distributed, respectively, as $?^2_{(k)}$ and $?^2_{(2)}$ variables. At the 5% level, their respective critical values are $?_{(2)}$ ' 5.99, $?_{(4)}$ ' 9.49, $?_{(6)}$ ' 12.59 and $?_{(8)}$ ' 15.51. All tests fail to reject the null of skewness.

[b]Ljung-Box Q(l)-statistics, are asymptotically distributed as a $?^2_{(l)}$ whose critical value is 23.69 at the 5% level, for l=14.

[c]All foreign variables are excluded in the US model, except the interest rate differential that captures the impact of capital flows.

Table 3: Tests for the Cointegration Rank

D-tr	United States μ_0%aß)$X_{t\&1}$		Germany μ_0%aß)$X_{t\&1}$		United Kingdom μ_0%aß)$X_{t\&1}$		Canada μ_0%aß)$X_{t\&1}$	
Ho	Trace	Tcrit	Trace	Tcrit	Trace	Tcrit	Tarce	Tcrit
r#0	119.65*	94.15	276.52*	192.89	341.46*	192.89	316.62*	192.89
r#1	80.20*	68.52	191.13*	156.00	205.71*	156.00	228.62*	156.00
r#2	46.94	47.21	131.07*	124.24	133.36*	124.24	146.33*	124.24
r#3	26.18	29.68	76.50	94.15	86.76	94.15	92.90	94.15
r#4	13.19	15.14	46.13	68.52	55.33	68.52	60.80	68.52
r#5	1.37	3.76	22.94	47.21	33.02	47.21	35.30	47.21
r#6			8.21	29.68	15.96	29.68	18.20	29.68
r#7			3.13	15.41	5.94	15.41	7.65	15.41
r#8			0.03	3.76	2.55	3.76	1.34	3.76

Notes: [a]Superscript * indicates a rejection at the 5% level of the null hypothesis of at most $r=q$ stationary linear combinations of the series against the alternative of $r>q$ such combinations ($q<p$). D-tr are the deterministic trends in EC Models.
[b]Critical values are from Osterwald-Lenum (1992, p.468-70). The US model includes p=6 variables.

Table 4: Results of Sequential Causality Tests in ECMs

EC equations	*m*		*i*		*e*	
Sequential tests	P1	P3	P1	P3	P1	P3
US (*k*=8, *r*=2)	$F_1^{(}$ ' 2.13(0.345) accept $H_1^{(}$ $F_{Ð}^{(}$ ' 12.06(0.098) accept $H^{(}$ of NC	$F_{Ð}^{(}$ ' 12.06(0.098) accept $H_{Ð}^{(}$ & SNC $F_3^{(}$ ' 314.3(0.000) $F_{13}^{(}$ ' 0.65(0.420)* accept LNC& NC	$F_1^{(}$ ' 17.26(0.000) reject $H_1^{(}$ $F^{(}$ ' 20.50(0.009) reject $H^{(}$ of NC	$F_{Ð}^{(}$ ' 12.24(0.093) accept $H_{Ð}^{(}$ & SNC $F_3^{(}$ ' 314.3(0.000) $F_{13}^{(}$ ' 16.52(0.000) (reject LNC&NC	$F_1^{(}$ ' 2.36(0.308) accept $H_1^{(}$ $F_{Ð}^{(}$ ' 7.30(0.398) accept $H^{(}$ of NC	$F_{Ð}^{(}$ ' 7.30(0.398) accept $H_{Ð}^{(}$ &SNC $F_3^{(}$ ' 314.3(0.000) $F_{13}^{(}$ ' 1.11(0.291)* accept LNC&NC
Germany (*k*=4, *r*=3)	$F_1^{(}$ ' 10.03(0.018) reject $H_1^{(}$ $F^{(}$ ' 4.41(0.353) accept $H^{(}$ of NC	$F_{Ð}^{(}$ ' 4.27(0.233) accept SNC&NC $F_3^{(}$ ' 8.72(0.033) $F_{13}^{(}$ ' 0.84(0.358) (accept LNC&NC	$F_1^{(}$ ' 3.88(0.274) accept $H_1^{(}$ $F_{Ð}^{(}$ ' 17.33(0.001) reject $H^{(}$ of NC	$F_{Ð}^{(}$ ' 17.33(0.001) reject SNC&NC $F_3^{(}$ ' 8.73(0.033) $F_{13}^{(}$ ' 2.46(0.117) (accept LNC	$F_1^{(}$ ' 11.22(0.011) reject $H_1^{(}$ $F^{(}$ ' 3.76(0.440) accept $H^{(}$ of NC	$F_{Ð}^{(}$ ' 1.89(0.595) accept SNC $F_3^{(}$ ' 8.73(0.033) $F_{13}^{(}$ ' 2.95(0.086) (accept LNC
UK (*k*=4, *r*=3)	$F_1^{(}$ ' 17.39(0.001) reject $H_1^{(}$ $F^{(}$ ' 5.27(0.261) accept $H^{(}$ of NC	$F_{Ð}^{(}$ ' 5.056(0.168) accept $H_{Ð}^{(}$ & SNC $F_3^{(}$ ' 33.74(0.000) $F_{13}^{(}$ ' 0.44(0.508)* accept LNC&NC	$F_1^{(}$ ' 9.64(0.0219) reject $H_1^{(}$ $F^{(}$ ' 7.22(0.125) accept $H^{(}$ of NC	$F_{Ð}^{(}$ ' 4.60(0.203) accept $H_{Ð}^{(}$ & SNC $F_3^{(}$ ' 33.74(0.000) $F_{13}^{(}$ ' 3.80(0.051)* accept LNC&NC	$F_1^{(}$ ' 2.58(0.462) accept $H_1^{(}$ $F_{Ð}^{(}$ ' 4.62(0.202) accept $H^{(}$ of NC	$F_{Ð}^{(}$ ' 4.62(0.202) accept $H_{Ð}^{(}$ & SNC $F_3^{(}$ ' 33.74(0.000) $F_{13}^{(}$ ' 1.44(0.231)* accept LNC&NC
Canada (*k*=6, *r*=3)	$F_1^{(}$ ' 3.25(0.354) accept $H_1^{(}$ $F_{Ð}^{(}$ ' 17.77(0.003) reject $H^{(}$ of NC	$F_{Ð}^{(}$ ' 17.77(0.003) reject SNC&NC $F_3^{(}$ ' 159.5(0.000) $F_{13}^{(}$ ' 1.42(0.234)* accept LNC&NC	$F_1^{(}$ ' 10.61(0.014) reject $H_1^{(}$ $F^{(}$ ' 7.21(0.125) accept $H^{(}$ of NC	$F_{Ð}^{(}$ ' 3.27(0.352) accept $H_{Ð}^{(}$ & SNC $F_3^{(}$ ' 159.5(0.000) $F_{13}^{(}$ ' 1.61(0.204)* accept LNC &NC	$F_1^{(}$ ' 33.12(0.000) reject $H_1^{(}$ $F^{(}$ ' 20.19(0.003) reject $H^{(}$ of NC	$F_{Ð}^{(}$ ' 17.85(0.003) reject $H_{Ð}^{(}$ & SNC $F_3^{(}$ ' 159.5(0.000) $F_{13}^{(}$ ' 0.74(0.389)* accept LNC

Notes: The numbers in parentheses are the test p-values. NC refers to noncausality, SNC to short-run noncausality, and LNC refers to long-run noncausality or neutrality.

*As in Toda and Phillips (1994) probability of rejection for $F_{13}^{(}$ is set to 2.5% to avoid distortions between P3 and P1 procedures. Here, $F_{13}^{(}$ is a $?_1^2$ random variable (rv), $F_1^{(}$ and $F_3^{(}$ are both $?_r^2$ rvs, $F_{Đ}^{(}$ is a $?_{k\&1}^2$, and $F^{(}$ is a $?_k^2$ r.v.

Table 5: A. Selected Estimation Results of Error-Correction Models

Equations		$\hat{ß}_1^{()}Y_{t\&1}^{(}$	$\hat{ß}_2^{()}Y_{t\&1}^{(}$	$\hat{ß}_3^{()}Y_{t\&1}^{(}$	*b(t-1)*	*b(t-2)*	*b(t-3)*	*b(t-4)*	*b(t-5)*	*b(t-6)*	*b(t-7)*
US	*m*	8E-4	6E-4		-0.008	-0.053	0.012	-0.006	0.002	-0.002	0.201
		(1.67)	(1.26)		(-0.07)	(-0.95)	(0.12)	(-0.04)	(1.09)	(-0.98)	(1.79)
	i	0.091*	0.061		-6.736	2.291	-5.378	25.362*	-0.370*	0.099	-2.538
		(2.66)	(1.78)		(-0.82)	(0.52)	(-0.81)	(2.53)	(-2.77)	(0.76)	(-0.32)
	e	-2E-4	-1E-4		-0.073	-0.074	-0.054	0.276	-0.004	-9E-4	0.156
		(-0.33)	(-0.18)		(-0.39)	(-0.72)	(-0.35)	(1.19)	(-1.17)	(-0.31)	(0.86)
Germany	*m*	0.002*	0.001	6E4	-0.487*	-0.231	-0.088				
		(2.66)	(1.54)	(0.77)	(-5.39)	(-1.93)	(-0.44)				
	i	-0.003	-0.009	0.053	4.213	-1.78	-8.99*				
		(-0.09)	(-0.33)	(1.94)	(1.41)	(-0.44)	(6.60)				
	e	-0.003*	0.001	-0.002*	0.039	0.162	-0.017				
		(-2.42)	(1.22)	(-1.96)	(0.33)	(1.05)	(-0.07)				
UK	*m*	-0.008*	-0.003	0.001	-0.169	0.367	-0.064				
		(-3.87)	(-1.54)	(-0.28)	(-1.81)	(1.81)	(-0.17)				
	i	0.072	-0.114*	0.007	-0.448	-0.625	-0.603				
		(1.65)	(-2.61)	(0.15)	(-0.22)	(-0.14)	(-0.075)				
	e	-0.001	7E4	-0.001	-0.050	-0.039	0.120				
		(-1.01)	(0.61)	(-1.09)	(-1.00)	(-0.36)	(0.61)				
Canada	*m*	-2E4	-0.001	0.002	-0.335	-0.008	0.010*	0.474*	0.381		
		(-0.14)	(-0.82)	(1.60)	(-0.82)	(-1.43)	(2.19)	(2.34)	(1.27)		
	i	0.110*	-0.021	-0.022	-8.019	-0.047	0.010	6.912	-3.518		
		(3.14)	(-0.61)	(-0.63)	(-0.64)	(-0.27)	(0.07)	(1.12)	(-0.39)		
	e	-0.004*	-0.002*	7E4	-0.115	0.014*	-0.013*	0.284	-0.541*		
		(-5.20)	(-2.32)	(0.82)	(-0.38)	(3.44)	(-3.83)	(1.88)	(-2.43)		

Notes: The numbers in parentheses are the values of the t-tests. Superscript * indicates significance at the 5% level.

Table 5 (Continued)
B. Estimated Cointegrating Vectors

	Variables								
	m	m_f	*y*	y_f	*i*	i_f	*b*	b_f	*e*
					United States (*r*=2)				
$\hat{\beta}$)	-25.258		27.664		0.529	-0.154	-7.679		16.812
	-27.477		30.520		-1.027	0.127	-8.976		6.320
					Germany (*r*=3)				
$\hat{\beta}$)	6.702	4.334	0.010	-17.889	0.040	0.442	0.068	7.015	1.000
	1.005	0.091	-0.005	-1.012	-0.036	0.016	-0.001	0.148	1.000
	0.577	-1.675	-0.012	1.738	-0.012	-0.018	-0.045	-0.411	1.000
					United Kingdom (*r*=3)				
$\hat{\beta}$)	1.363	-1.228	-0.661	-0.050	-0.016	0.044	0.004	-0.763	1.000
	-0.271	3.914	3.716	-3.853	-0.090	-0.039	0.056	-3.559	1.000
	-1.385	-4.060	-16.331	8.906	-0.079	0.195	0.386	16.446	1.000
					Canada (*r*=3)				
$\hat{\beta}$)	0.025	0.275	-1.414	1.707	-0.061	0.044	-0.255	-0.499	1.000
	0.465	0.817	-1.111	-0.463	-0.043	0.067	0.733	0.092	1.000
	1.080	-2.999	-3.194	2.674	-0.119	0.132	-3.130	3.228	1.000

Note: [a]For simplicity, cointegrating vectors are divided by the coefficient to the exchange rate in the case of Germany, the UK and Canada.

REFERENCES

Bahmani-Oskooee, M. and Payesteh S., "Do Budget Deficits cause Capital Inflows? Evidence from the United States." *The Quarterly Review of Economics and Finance*, Volume 34, No.1, (Spring 1994), pp. 63-74.

Barro, R. J., "Government Spending, Interest Rates, Prices, and Budget Deficits in the United Kingdom, 1701-1918." *Journal of Monetary Economics*, Volume 20, (1987), pp. 221-247.

Barth, J. R., Iden, G. and Russek, F. S., "Federal Borrowing and Short-term Interest Rates: Comment." *Southern Economic Journal*, Volume 52, (1985), pp. 554-559.

Cebula, R. J. and Koch, J. V., "Federal Budget Deficits, Interest Rates, and International Flows." *The Quarterly Review of Economics and Finance*, Volume 34, No.1, (Spring 1994), pp. 113-116.

Cebula, R. J. and Koch, J. V., "Federal Budget Deficits, Interest Rates, and International Flows." *The Quarterly Review of Economics and Business*, Volume 29, No.1, (1991), pp. 119-126.

Deravi, M. K., Hegji, C. E. and Moberly, H. D., "Government Debt and the Demand for Money: An Extreme Bound Analysis." *Economic Inquiry*, Volume 28, (1990), pp. 390-401.

Engle, R. F. and Granger, C. W. J., "Cointegration and Error Correction: Representation, Estimation and Testing." *Econometrica*, Volume 55, (March 1987), pp. 251-276.

Evans, P., "Do Large Deficits Produce High Interest Rates?" *American Economic Review*, Volume 75, (1985), pp. 68-67.

Evans, P., "Do Budget Deficits Raise Nominal Interest Rates? Evidence from Six Countries." *Journal of Monetary Economics*, Volume 20, (1987), pp. 281-300.

Gulley, O. D., "An Empirical Test of the Effects of Government Deficits on Money Demand" *Applied Economics*,Volume 26, No.26, (1994), pp. 239-247.

Hylleberg, S., Engle, R. F., Granger, C.W.J. and Yoo, B.S., "Seasonal Integration and Cointegration." *Journal of Econometrics*, Volume 44, (1990), pp. 215-238.

Johansen, S., "Statistical Analysis of Cointegration Vectors." *Journal of Economic Dynamics and Control*, Volume 12, (1988), pp. 231-254.

Johansen, S., "Cointegration in Partial Systems and the Efficiency of Single-Equation Analysis." *Journal of Econometrics*, Volume 52, No.3, (June 1992), pp. 389-402.

Johansen, S. and Juselius, K., "Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money." *Oxford Bulletin of Economics and Statistics*, Vol. 52, No.2, (1990), pp. 169- 210.

Johansen, S., "Likelihood-Based Inference in Cointegrated Vector Autoregressive Models." Oxford: Oxford University Press, (1995).

Miller, S.M., "Monetary dynamics: An Application of Cointegration and Error-Correction Modelling." *Journal of Money, Credit and Banking*, Vol. 23, No. 2 (May 1991), pp. 139-153.

Miller, S.M. and Russek, F.S., "Do Federal Deficits Affect Interest Rates? " *Journal of Macroeconomics*, vol. 18, No. 3, (1996), pp. 403-428.

Osterwald-Lenum, M., "A Note with Quantiles of the Asymptotic Distribution of the Maximum Likelihood Cointegration Rank Test Statistics." *Oxford Bulletin of Economics and Statistics*, Vol. 54, No.3, (1992), pp. 461-472.

Seater, J.J., "Does Government Debt Matter? A Review." *Journal of Monetary Economics*. Vol. 16, No. 2, (1985), pp. 121-131.

Seater, J.J., "Ricardian Equivalence." *Journal of Economic Literature*, Vol. 31, (March 1993).

Toda, H.Y. and Phillips, Peters. C.B., "Vector Autoregression and Causality: A Theoretical Overview and Simulation Study." *Econometric Reviews*, Vol. 13, (1994), pp. 259-285.

Zahid, K. H., "Government Budget Deficits and Interest Rates: The Evidence Since 1971 Using Alternative Deficits Measures." *Southern Economic Journal,* Volume 54, (1988), pp. 725-731.

94-01 BILODEAU, Marc et Al SLIVINSKI, ***Toilet Cleaning and Department Chairing: Volunteering a Public Service***.

94-02 ASCAH, Louis, ***Recent Retirement Income System Reform: Employer Plans, Public Plans and Tax Assisted Savings.***

94-03 BILODEAU, M. et Al SLIVINSKI, ***Volunteering Nonprofit Entrepreneurial Services.***

94-04 HANEL, Petr, ***R&D, Inter-Industry and International Spillovers of Technology and the Total Factor Productivity Growth of Manufacturing Industries in Canada, 1974-1989***.

94-05 KALULUMIA, Pene et Denis BOLDUC, ***Generalized Mixed Estimator for Nonlinear Models: A Maximum Likelihood Approach.***

95-01 FORTIN, Mario et Patrice Langevin, ***L'efficacité du marché boursier face à la politique monétaire***.

95-02 HANEL, Petr et Patrice Kayembe YATSHIBI, ***Analyse de la performance à exporter des industries manufacturières du Québec 1988.***

95-03 HANEL, Petr, ***The Czech Republic: Evolution and Structure of Foreign Trade in Industrial Goods in the Transition Period, 1989-1994.***

95-04 KALULUMIA, Pene et Bernard DÉCALUWÉ, ***Surévaluation, ajustement et compétitivité externe : le cas des pays membres de la zone franc CFA.***

95-05 LATULIPPE, Jean-Guy, ***Accès aux marchés des pays en développement***.

96-01 ST-PIERRE, Alain et Petr HANEL, ***Les effets directs et indirects de l'activité de R&D sur la profitabilité de la firme***.

96-02 KALULUMIA, Pene et Alain MBAYA LUKUSA, ***Impact of budget deficits and international capital flows on money demand: Evidence From Cointegration and Error-Correction Model.***

96-03 KALULUMIA, Pene et Pierre YOUROUGOU, ***Money and Income Causality In Developing Economies: A Case Study Of Selected Countries In Sub-Saharan Africa***.

96-04 PARENT, Daniel, ***Survol des contributions théoriques et empiriques liées au capital humain (A Survey of Theoretical and Empirical Contributions to Human Capital)***.

96-05 PARENT, Daniel, ***Matching Human Capital and the Covariance Structure of Earnings***.

96-06 PARENT, Daniel, ***Wages and Mobility : The Impact of Employer-Provided Training***

97-01 PARENT, Daniel, ***Industry-Specific Capital and the Wage Profile : Evidence From the NLSY and the PSID***.

97-02 PARENT, Daniel, ***Methods of Pay and Earnings: A Longitudinal Analysis***.

97-03 PARENT, Daniel, ***Job Characteristics and the Form of Compensation***.

97-04 FORTIN, Mario et Michel BERGERON, Jocelyn DUFORT et Pene KALULUMIA, ***Measuring The Impact of Swaps on the Interest Rate Risk of Financial Intermediaries Using Accounting Data***.

97-05 FORTIN, Mario, André LECLERC et Claude THIVIERGE, ***Testing For Scale and Scope Effects in Cooperative Banks: The Case of Les Caisses populaires et d'économie Desjardins.***

97-06 HANEL, Petr, ***The Pros and Cons of Central and Eastern Europe Joining the EU***

00-01 MAKDISSI, Paul et Jean-Yves DUCLOS, ***Restricted and Unrestricted Dominance Welfare, Inequality and Poverty Orderings***

00-02 HANEL, Petr, John BALDWIN et David SABOURIN, ***Les déterminants des activités d'innovation dans les entreprises de fabrication canadiennes : le rôle des droits de propriété intellectuelle***

00-03 KALULUMIA, Pene, ***Government Debt, Interest Rates and International Capital Flows: Evidence From Cointegration***

00-04 MAKDISSI, Paul et Cyril TÉJÉDO, ***Problèmes d'appariement et politique de l'emploi***

00-05 MAKDISSI, Paul et Quentin WODON, ***Consumption Dominance Curves: Testing for the Impact of Tax Reforms on Poverty.***

00-06 FORTIN, Mario etAndré LECLERC, ***Demographic Changes and Real Housing Prices in Canada.***

00-07 HANEL, Petr et Sofiene ZORGATI, ***Technology Spillovers and Trade: Empirical Evidence for the G7 Industrial Countries.***

01-01 MAKDISSI, Paul et Quentin WODON, ***Migration, poverty, and housing: welfare comparisons using sequential stochastic dominance***. Avril 2001, 23 p.

01-02 HUNG Nguyen Manh et Paul MAKDISSI, ***Infantile mortality and fertility decisions in a stochastic environment***. Mars 2001, 12 p.

01-03 MAKDISSI, Paul et Quentin WODON, ***Fuel poverty and access to electricity: comparing households when they differ in needs***. Juin 2001, 19 p.

01-04 MAKDISSI, Paul et Yves GROLEAU, ***Que pouvons-nous apprendre des profils de pauvreté canadiens ?*** Juillet 2001, 47 p.

01-05 MAKDISSI, Paul et Quentin WODON, ***Measuring poverty reduction and targeting performance under multiple government programs***. Août 2001, 16 p.

01-06 DUCLOS, Jean-Yves et Paul MAKDISSI, ***Restricted inequality and relative poverty***. Août 2001, 31 p.

01-07 TÉJÉDO, Cyril et Michel TRUCHON, ***Serial cost sharing in multidimensional contexts***. Septembre 2001, 37 p.

01-08 TÉJÉDO, Cyril, ***Strategic analysis of the serial cost sharing rule with symmetric cost function.*** Février 2001, 25 p.

01-09 HANEL, Petr, ***Current intellectual protection practices by manufacturing firms in Canada***. Septembre 2001, 57 p.

02-01 DUCLOS, Jean-Yves, Paul MAKDISSI et Quentin WODON, ***Socially-efficient tax reforms***, Janvier 2002, 47 p.

02-02 MAKDISSI, Paul, ***La décroissance démographique : Pourquoi pas?***, Février 2002, 20 p.

02-03 LECLERC, André et Mario FORTIN, ***Production et rationalisation des intermédiaires financiers : leçons à tirer de l'expérience des caisses populaires acadiennes***, Février 2002, 24 p.

02-04 HANEL, Petr et Snezana VUCIC, ***L'impact économique des activités de recherche de l'Université de Sherbrooke,*** Février 2002, 44 p.

02-05 TÉJÉDO, Cyril et Michel TRUCHON, ***Monotonicity and bounds for cost shares under the path serial rule***, Mars 2002, 18 p.

02-06 PORET, Sylvaine et Cyril TÉJÉDO, ***Analyse horizontale du marché des biens illicites***, Mai 2002, 15 p.

02-07 KALULUMIA, Pene, ***Effects of government debt on interest rates : evidence from causality tests in Johansen-type models***, Juillet 2002, 21 p.

02-08 MAKDISSI, Paul et Quentin WODON, ***Can safety nets offset the impact of risk on wage inequality and social welfare?*** Août 2002, 12 p.

02-09 DUCLOS, Jean-Yves, Paul MAKDISSI et Quentin WODON, ***Poverty-reducing tax reforms with heterogeneous agents***, Février 2002, 10 p.

02-10 MAKDISSI, Paul et Quentin WODON, ***Fuzzy targeting indices and orderings***, Mai 2002, 11 p.

02-11 DUCLOS, Jean-Yves, Paul MAKDISSI et Quentin WODON, ***Poverty-efficient transfer programs : the role of targeting and allocation rules***, Mai 2002, 25 p.

02-12 MAKDISSI, Paul et Quentin WODON, ***Environmental regulation and economic growth under education externalities***, Août 2002, 8 p.

* *Tous ces cahiers de recherche sont disponibles sur notre site WEB (www.usherbrooke.ca/economique) ou au Centre de documentation de la FLSH A3-330 (UdeS).*

Prière d'adresser vos commentaires ou demandes d'exemplaires d'un cahier de recherche antérieur (1976 à 1990) à monsieur Cyril TÉJÉDO, coordonnateur des Cahiers de recherche du Département d'économique, Tél : 819) 821-7233 Télécopieur : 819) 821-7237 Courriel : Cyril.Tejedo@USherbrooke.ca

Comments or requests for copies of previous Working Papers (1976 to 1990) should be made to the Working Papers Coordinator at the Département d'économique, Mr. Cyril TÉDÉDO. Tel: (819) 821-7233 FAX:819) 821-7237 E-mail: Cyril.Tejedo@USherbrooke.ca.

Révisé le 30-10-02