

The Ricardian Equivalence Theorem:
A Test for Canada

by

Ivory Yong

051187

Major Paper presented to the
Department of Economics of the University of Ottawa
in partial fulfillment of the requirements of the M.A. Degree

Supervisor: Professor Serge Coulombe

ECO 7997

Ottawa, Ontario

December, 1987

List of Contents

	Introduction	1
1.	The Theory	3
2.	Empirical Tests	15
	2.1 Are Future Taxes Anticipated?	15
	2.2 An Empirical Investigation of the Extent of Tax Discount	19
	2.3 Government Deficit and Aggregate Demand	21
	2.4 Are Future Taxes Discounted?	29
	2.5 New Test of the Life-Cycle and Tax Dis- count Hypotheses	33
	2.6 Saving Out of Different Types of Income	35
3.	A Test for Canada	39
	3.1 Are Future Taxes Discounted in Canada?	39
	3.2 Government Deficits and Aggregate Demand in Canada	46
	Conclusions	53
	Bibliography	i

Introduction

When, for the expenses of a year's war, twenty millions are raised by means of a loan, it is the twenty millions which are withdrawn from the productive capital of the nation. The million per annum which is raised by taxes to pay the interest of this loan is merely transferred from those who pay it to those who receive it, from the contributor to the tax to the national creditor. The real expense is the twenty millions, and not the interest which must be paid for it. Whether the interest be or not be paid, the country will neither be richer nor poorer. Government might at once have required the twenty millions in the shape of taxes; in which case it would not have been necessary to raise annual taxes to the amount of a million. This, however, would not have changed the nature of the transaction. An individual, instead of being called upon to pay 100 l. per annum, might have been obliged to pay 2000 l. once for all. It might also have suited his convenience rather to borrow this 2000 l., and to pay 100 l. per annum for interest to the lender, than to spare the larger sum from his own funds. In one case, it is a private transaction between A and B, in the other government guarantees to B the payment of interest to be equally paid by A. If the transaction had been of a private nature, no public record would be kept of it, and it would be a matter of comparative indifference to the country whether A faithfully performed his contract to B or unjustly retained the 100 l. per annum in his own possession.

The above quotation is from *The Principles of Political Economy and Taxation* by David Ricardo (1817, page 161). The analysis presented by Ricardo was later "rediscovered" by Robert Barro (1974) and since then, the Ricardian equivalence theorem (RET) has been extensively discussed in the macroeconomic literature. The purpose of this paper is to review and analyze the RET, and to apply it empirically to the Canadian economy.

The first part of this essay contains an explanation of the theory underlying the RET, its implications and its criticisms. In the second part, we present a review of some empirical tests which have been developed in recent years. In the third part, we develop two tests of the RET for Canada, based on two specifications previously used to test the theory for the United States. While both of these tests use a consumption function containing a measure of government indebtedness as an explanatory variable, the two tests differ in one important respect. In the first test the explanatory variable is a flow (government deficit) and in the other, it is a stock (the value of government debt). We demonstrate in this section that the results obtained suggest that the Ricardian equivalence theorem does not hold for the case of Canada. We should, however, look at these conclusions very carefully because our proxy for wealth in the second test is incomplete and this fact may bias the results.

1. The Theory

The traditional Keynesian vision of public finance states that for a given level of government expenditure, a substitution of debt for tax finance has a positive effect on aggregate demand. This is because the increase in government debt implies an increase in household's perceived wealth. This increase in wealth will, in turn, imply an increase in desired consumption with respect to savings and so leads to an increase in aggregate demand. The RET, contrary to the traditional Keynesian vision, postulates that the effect of government expenditure is measured by its size and not by the way it is financed. Whether the deficit is financed by increasing taxes or by issuing bonds, the effect on aggregate demand is the same. This is because consumers, who are assumed to be rational, perceive that current government debt implies future taxes.

If bonds are issued to finance a deficit, consumers know that the government will eventually need new tax receipts in order to pay the resulting interest and principal. For this reason, a typical rational household will save all the income made available to it by a bond issue. The household will believe that the interest paid on these savings and the savings themselves will certainly be taxed away to finance, respectively,

the interest paid on the new public debt and the eventual repayment of the principal. As a consequence, the consumption patterns of households remain unaltered.

On the other hand, if the government finances its deficit by printing money, this will produce a general increase of prices such that the real quantity of money remains constant. If new money is expected to be printed regularly, rational households will know that their real cash holdings are going to be reduced. They will, therefore, save in advance for this inflation tax in order to keep their real cash holdings constant.

As a result of the above arguments, the RET concludes that regardless of the form deficit financing takes, the effect on the economy is the same. The balanced budget multiplier always applies. This position has been sustained by several economists for many decades. For example, Klein - in *The Keynesian Revolution* - explains that the neutrality problem was discussed by the Macmillan Committee in the 1930's (1966).

Some of the implications of the RET for macroeconomic theory and policy, as outlined by Tobin (1980) and Feldstein (1982), are described below:

- (a) The RET rejects the traditional Keynesian vision according to which a tax reduction and an increase in transfer

payments increase aggregate demand. The Ricardian view denies the potency of deficit-financed compensatory fiscal policy. According to the RET, the effect on aggregate demand will be the same whether the expenditure is financed by taxes or by borrowing. The balanced budget multiplier will always apply.

- (b) According to the RET, in addition to being ineffective, the government deficit is also innocuous in that it does not crowd-out private capital formation or foreign investment.
- (c) The RET states that the burden of the debt for current government expenditures cannot be transferred to future generations because the capital stock will not be crowded-out by the government deficit. As Tobin says: "Ricardians believe that deficit spending is futile in the short run and innocuous in the long run" (1980, page 52).
- (d) Regarding the "real balance effect" or "Pigou effect", the RET states that a permanent reduction in the price level, following a money-financed deficit, equally increases the real value of the government's non-monetary obligations and the real value of the associated tax liabilities.
- (e) The RET states that the multiplier associated with social security and transfers payments is equal to zero since savings will increase by an equivalent amount since government debt incurred by the transfer payments has to be financed in the future.

A digression regarding the proper accreditation of the equivalence theorem is necessary before continuing. In most of the literature, the alleged neutrality of public sector financing is called the "Ricardian equivalence theorem" because Buchanan in 1976, pointed out that Robert Barro's position (Barro, 1974) was not new, but only a restatement of Ricardo's. It is also true that Ricardo clearly described the theorem and that following the description he rejected it. With respect to financing of government expenditures, Ricardo considered the differences between borrowing and tax increases and stated that:

in point of economy, there is no real difference in either of the modes ... But people who pay taxes never so estimate them, and therefore do not change their private affairs accordingly. We are too apt to think, that the war is burdensome only in proportion to what we are at the moment called to pay it in taxes, without reflecting on the probable duration of such taxes. It would be difficult to convince a man possessed of 20,000 l., or any other sum, that a perpetual payment of 50 l. per annum was equally burdensome with a single tax of 1000 l. (Ricardo, 1951:4, pages 185-186)

In other words, Ricardo perceived the two methods of financing as equivalent, but he also recognized that taxpayers suffer from "fiscal illusion". Therefore the title of the theory is some what controversial. An article entitled "The Ricardian Non-equivalence Theorem" (O'Driscoll, 1977) explains why Buchanan was incorrect when he labeled Barro's position as Ricardian. Other authors also do not accept the use of the term "Ricardian equivalence theorem". James Tobin (1980), after analyzing

Ricardo's theory, argues that the "Neo-Ricardian equivalence theorem" should be relabeled as "Non-Ricardian equivalence theorem" and that Ricardo's doctrine should be called "Ricardian non-equivalence theorem". In the same way, Feldstein (1982) refers to it as the "pre-Ricardian equivalence hypothesis or proposition". Pre-Ricardian because Ricardo did not support it and he prefers the words "hypothesis" or "proposition" rather than "theorem" in order to avoid the implication that it is provable and true. Most of the authors, however, called it the "Ricardian equivalence theorem" and for ease of reference we shall do the same.

In 1952, James Tobin posed the following thoughts regarding the question whether public debt is considered part of net wealth or not:

How is it possible that society merely by the device of incurring a debt to itself can deceive itself into believing that it is wealthier? Do not the additional taxes which are necessary to carry the interest charge reduce the value of other components of private wealth? Additional taxes on the returns from income-producing property reduce, at a given rate of discount, the present value of that property. The higher tax rate to meet these increased outlays means that the stimulus to private demand from the increase in real value of the debt is offset, at least in part, by changes in private wealth which are unfavorable to spending. (1952, page 117)

During the 1960's, Bailey (1962), Patinkin (1965), and Johnson (1962) restated the problem. Bailey claimed that it is possible that households regard a deficit financed by issuing

bonds as equivalent to taxation because their rationality will allow them to predict the future tax receipts the government require to pay the interest and eventually the principal. On the other hand, Fatinkin highlighted the need to understand how households react to the real value of bonds issued by the government in order to analyze any wealth effect. Finally, Johnson conducted a literature review on monetary theory. He stated that government debt should not be considered part of net wealth because of the government's ability to manage the necessary resources to pay the interest on its debt, through its power to impose taxes.

However, it is not until the 1970's that the problem is brought forward, mainly through an article written by Robert Barro (1974) in the Journal of Political Economy entitled "Are Government Bonds Net Wealth?" In this article, Barro criticizes two arguments which implies that the offset of future tax obligations may be only partial. As an alternative, Barro presents a model to prove that the offset is complete. The first argument is concerned with the existence of imperfect capital markets, which implies differential individual discount rates. The argument states that given the high discount rate of some individuals, taxes to finance government debt are not going to be completely capitalized and, therefore, an issue of government bonds will imply some wealth effect. Barro, however, proves that the wealth affect is positive if and only if the government is

more efficient than the private sector in carrying out this sort of loan.

The second argument, which is the most interesting, deals with the concept of finite lives. This argument supposes that, given the fact that people have finite horizons, the burden of the debt may be transferred to future generations. Barro, however, presents a model of "overlapping-generations" in which individuals have finite lives and concludes that current generations act effectively as if they were infinite-lived. In this model the present generation is connected with future generations by a chain of inter-generational transfers. In other words, they are connected by bequests. In Barro's model, the marginal utility of each individual depends not only on his own consumption, but also on the utility of his immediate descendants. Thus, the utility of each generation depends indirectly on the utility of all future generations. Under this assumption, the creation of a public debt generates an asset for the current generation and a liability for future generations. The current generation will reject the transfer of consumption power from its descendants by increasing their bequests by an amount sufficient to ensure that these descendants are not worse-off. The extra bequest just offsets the positive effect that the debt had on the current generation.

This article provoked such a strong reaction that in the future, any discussion on the neutrality problem will have to refer to it. The article was criticised in papers by Buchanan (1976) and Feldstein (1976). Buchanan centers his criticisms on two main issues. The first is the ambiguous way Barro states the public debt issue. In particular he objects to the way Barro builds his model without a government and then super-imposes an issue of public debt without offsetting compensating changes. The second issue is the incompleteness of Barro's analysis. Buchanan argues that in the neutrality problem there are two different questions: one, whether or not the future tax obligations are fully capitalized, and two, even if they are capitalized, does this necessarily imply that fiscal policy has no effect on total expenditures. Buchanan claims that Barro completely omits the fact that in order to state that expenditures remain unchanged it is not sufficient to concentrate solely on tax capitalization. The differential impacts of taxation and debt issue must be considered as well. For these reasons Buchanan argues that Barro's article would not be as relevant to economic policy as it seemed to be. Additionally, Buchanan mentions that Barro's conclusions may be questioned on the grounds of empirical research.

Feldstein (1976) emphasizes that Barro's conclusions reflect his crucial assumptions of constant population and the absence of

economic growth. Feldstein abandons these assumptions and analyzes two cases: (a) when the real rate of interest on government debt (called r) is no greater than the rate of economic growth (called g), that is when $r < g$ and (b) when the rate of interest is greater than the rate of growth, that is when $r > g$. In both cases Feldstein concludes that Barro's conclusions do not hold. In addition, he remarks that for most families, voluntary and intentional inter-generational transfers are not necessarily in the form of a bequest on death. Instead, it often takes the form of support during childhood of those who will eventually inherit. Part of this support may be through aid in financing post-secondary school education, or a similar form of investment in human capital. Consequently, the form or nature of the transfers makes Barro's results even less likely.

Barro answers this criticism (1976) by analyzing both of Feldstein's cases himself. According to Barro, if $r > g$, the results are straightforward and identical to his original results. He claims that Feldstein's contrary results are just the product of an error made when calculating the present value of future tax obligations. He did, however, concede that if $r < g$, then, effectively, debt issue may be seen as net wealth and it may, therefore, increase aggregate demand. Both, Barro and Feldstein, however, agree that the possibility of an economy where $r < g$ is quite remote.

Some other criticisms of Barro's model come from James Tobin (1980) and Tobin and Buiter (1980). These criticisms are related to the life-cycle hypothesis, to liquidity constraints, and to the assumption of lump-sum taxes. With respect to the life-cycle hypothesis, certainly it is true that if the consumers' horizons do not go beyond their own life time or, if they are simply indifferent to their heirs' living standard, tax deferment to the next generation will increase the consumption of the current generation. However, even if the consumers' horizons are infinite, the inter-generational chain which Barro maintained would preserve neutrality, can be broken for several reasons. Among these are the follow:

- (a) The current generation may prefer to increase its consumption if it knows that some generation may not have children or may not care about them.
- (b) Since some families are childless or do not care about their children they will increase their consumption if they have the chance to defer tax payments. At an aggregate level, taking into account these kinds of parents, the effect on aggregate demand will be positive.
- (c) On the other hand we should consider that children's bequests depend in some way on the parents' wealth and not only on the endowment that the children will face. Thus, the bequest may not change even if the future endowment does.

(d) The chain may be broken if some parents decide that the optimal bequest is a negative one. Since they cannot force this situation, they may decide on a nil bequest and consume more if there is the possibility of tax deferment. This situation is possible when the parents consider that, because of natural social progress, their children will be much better off than they are.

With respect to liquidity constraints, the critic states that even in affluent societies households have liquidity as well as wealth constraints. Under these circumstances, the possibility to defer a tax payment will be attractive. Even if the same family has to pay it back later, it will prefer to increase consumption now.

The final critic is concerned with the form taxation takes. Barro assumes lump-sum taxes. This is too simplistic an assumption and when it is relaxed, we can find results contrary to Barro's for two reasons. First, if taxes are on wealth, income, family size, and other individual characteristics, rather than on the individual himself, expectations of future taxes will depend on the expectations of these characteristics as well. Second, non-lump-sum taxes generally induce a tax-reducing behaviour.

A point related to the RET is the effect of social security benefits on aggregate demand. The life-cycle hypothesis implies that social security benefits reduce the amount of saving during working years because it provides income during retirement years. The RET states, however, that the decrease in savings during working years is compensated by the increased savings produced by the tax discount. Many papers have been published on this topic. In fact, literature, both theoretical and empirical, is more abundant in this area than in the neutrality problem. For example, Feldstein (1974) presents a theoretical analysis centered on the impact of social security on the individual's simultaneous decisions about retirement and savings.

In the next section, we shall present a review of the literature regarding empirical tests of the RET. We will emphasize the two articles which contain the empirical framework used to test the RET for Canada in the present paper. These are the articles by Feldstein (1982) and Kochin (1974).

2. Empirical Tests

2.1 Are Future Taxes Anticipated?

In his article "Are future taxes anticipated by consumers?", Lewis Kochin (1974) analyzes the effect of including the federal government deficit in the consumption function. In this way he tries to answer the question of whether fiscal policy affects real income and if so in which way. This paper was the first empirical study in fifteen years that tried to discover whether or not government bonds are considered part of private wealth.

Kochin's hypothesis is that households anticipate the future taxes which are implied by current deficits, and that the consumption level by households varies in such a way that the effect of the deficit is almost completely offset. According to Kochin this explains the high level of saving in the United States during the period analyzed. It was the reaction of rational agents to the high level of the federal deficit. The method he uses is ordinary least squares to estimate a consumption function that includes among its explanatory variables the federal deficit.

Kochin found a positive correlation between the ratios of deficit/disposable income and savings/disposable income for the

years 1961-71 in the United States. This is shown in Figure 1. The correlation implies that deficit and savings moved in the same direction. If one increased the other increased as well, and vice versa. We should note that a graph such as this shows us only the correlation between the two variables. It does not show us anything with respect to causality. If we analyze the same graph for Canada, we do not observe the positive correlation. Figure 2 contains the two ratios for Canada and it can be seen that they show a completely different behaviour.

Kochin looks for other methods since the graph is not enough evidence. He estimates the consumption function for the years 1952-71 using ordinary least squares and using the permanent-income hypothesis as the basic theoretical formulation. According to this hypothesis, consumption is a fixed proportion of permanent income. He uses the following as a proxy of this relation:

$$(1) \text{ Consumption}_t = a_0 + a_1 \text{ Income}_t + a_2 \text{ Consumption}_{t-1} + u_t$$

The equation to estimate, including government deficit among the explanatory variables is:

$$(2) C_t = a_0 + a_1 Y_t + a_2 \text{ DEF}_t + a_3 C_{t-1} + u_t$$

Since it is possible to consider consumption of durable goods to be a part of a household's accumulation rather than proper consumption (for example purchase of automobiles), Kochin uses only consumption expenditures on non-durable goods and services (C) as a proxy for household's consumption. For the other variables, we have disposable income (DY) for income and federal deficit (DEF) for deficit. All the variables are deflated by the implicit price index for consumption expenditures. The results are as follows ⁽¹⁾:

$$(3) \quad C_t = 5.560 + 0.283 DY_t - 0.224 DEF_t + 0.643 C_{t-1}$$

(1.81) (3.79) (2.56) (5.12)

$$R^2 = 0.998$$

$$SE = 2.230$$

$$DW = 0.680$$

The sign of the coefficient of the federal deficit supports the RET, as it is negative. However the Durbin-Watson statistic indicates that there is positive autocorrelation ⁽²⁾. Assuming a first order pattern with rho=1, the equation is re-estimated as ⁽³⁾:

¹ The number below the coefficient is the t ratio.

² The values for three regressors (excluding the intercept) and twenty observations for a 5% of significance are $d_L = 0.998$ and $d_U = 1.676$ (Kmenta, 1986).

³ Here dX_t means the first difference of the variable X_t , it is defined as $dX_t = X_t - X_{t-1}$

$$(4) \quad dC_t = 2.88 + 0.392 dDY_t - 0.109 dDEF_t + 0.218 dC_{t-1}$$

(3.44) (7.86) (2.95) (2.42)

$$R^2 = 0.892$$

$$SE = 1.260$$

$$DW = 1.790$$

The results still indicate a negative relationship between deficit and consumption since the coefficient of the deficit is still negative ⁴. Kochin also introduces the change in the monetary base (dMON) as an explanatory variable, but this variable does not appear to affect consumption:

$$(5) \quad C_t = 6.68 + 0.256 DY_t - 0.276 DEF_t + 0.669 C_{t-1}$$

(1.83) (2.60) (2.30) (4.98)

$$+ 0.544 dMON_t$$

(0.65)

$$R^2 = 0.998$$

$$SE = 2.270$$

$$DW = 0.780$$

$$(6) \quad dC_t = 2.84 + 0.395 dDY_t - 0.96 dDEF_t + 0.218 dC_{t-1}$$

(3.28) (7.63) (1.99) (2.35)

$$+ 0.14 dMON_t$$

(0.43)

$$R^2 = 0.886$$

$$SE = 1.290$$

$$DW = 1.870$$

This result is what he expected because if the monetary base is just another form of government debt, then, given the size of

⁴ The critical t value for seventeen degrees of freedom at 99% of confidence is 2.567 (Kmenta, 1986).

the total debt, a change in monetary base would not imply a change in the future tax burden.

Thus, Kochin's conclusion is that in the United States consumers tend to spend less and save more when, *ceteris paribus*, the federal government increases its deficit. In other words, the decrease in consumption tends to offset partially the effect of the federal deficit. The theory is that consumers, being aware of the current government deficit, will tend to save because they foresee future tax increases.

This explanation, however, is open to questioning on the grounds of causality. Kochin claims that the government deficit causes a decrease in consumption. It is possible, however, to arrive at a different causal relationship starting with the same facts. If there is a recession the income level decreases and consequently consumers spend less. Meanwhile the same decline in income lowers tax receipts which causes the government to increase its deficit to make up for lost revenues. In other words, in this scenario, the rising deficit and declining level of consumption are not cause and effect, but are both effects resulting from a mutual cause.

2.2 An Empirical Investigation of the Extent of Tax Discount

In this article, Yawitz and Meyer (1976) criticise the

estimations made by Tanner (1970) and Kochin (1974) and propose a new specification to test the RET.

Their criticism of Kochin is centered around the fact that even when his aim is to measure the contribution of government bonds to wealth, Kochin does not include either of these two variables in his analysis. According to Yawitz and Meyer, Kochin's specification reflects only the effect of a change in the stock of government bonds on the level of consumer expenditure. They point out that the value of this stock is also affected by changes in interest rates and by open market operations. Moreover, the authors affirm that even if one assumes that the deficit variable reflects the wealth effect associated with government bonds, complete tax discounting would imply that it should have a zero coefficient rather than a negative one.

Yawitz and Meyers' specification is based upon the life-cycle hypothesis (and assuming that future income is equal to present income). This implies that consumption is a function of income and wealth. They separate government bonds from other forms of wealth:

$$(7) \quad C_t = a_1 Y_t + a_2 A'_{nt-1} + a_3 B_{gt-1} + u_t$$

where C_t is consumption, Y_t is income, B_{gt} is the market value of private sector holdings of government securities and A'_{nt} is

household net wealth minus B_0 . All the variables are in real terms.

By comparing the relative size of the coefficients, the authors measure the net worth contribution of the debt. Taxes are completely discounted if $a_3 = 0$ and tax discount does not exist if $a_2 = a_3$. The estimated version of equation (7) is:

$$(8) \quad C_t = 0.75 Y_t + 0.03 A'_{nt-1} + 0.05 B_{0t-1} + u_t$$

(17.31) (3.60) (3.88)

$$R^2 = 0.9999$$

$$DW = 1.82$$

The results do not provide support for the RET since the coefficient of B_0 is larger than the coefficient on A'_n and the F-test does not allow them to reject the hypothesis that $a_2 = a_3$. However, the authors warn that the results are not definite because of the narrow variability of the government debt series.

2.3 Government Deficit and Aggregate Demand

In his 1982 article "Government Deficit and Aggregate Demand", Martin Feldstein analyzes whether or not the effect of fiscal policies is reduced or eliminated by the way consumers react to these policies. His position is that the RET exaggerates when it assumes that the public will be able to foresee higher taxes in the future because of the current government deficit. Feldstein concludes that consumers do not regard taxes and transfers as equivalent to a change in government debt and,

moreover, that consumers do consider government debt and future social security benefits as part of their net wealth.

On the other hand, Feldstein remarks that government expenditures would not have any effect on aggregate demand if the change in expenditures induces an equal change in private savings. He also claims that there is no reason to think that all the changes in savings should be completed in a single year. Feldstein proves that this *ex-ante* crowding-out is small in magnitude.

Feldstein mentions three reasons why the RET does not hold. First, it is not realistic. The degree of foresight and rationality required are not possible in the real world. Second, parents who care about their children will not necessarily decide to leave them a bequest. If the parents think that their children are going to be better-off because of natural social progress they may decide to leave them no bequest at all. It is obvious that most of the population receives no bequest. Third, even if households react to a decrease in taxes by increasing their bequest to the future generation, it is important to analyze the form of the transfer. If households decide on a transfer in kind, the change in taxes will not reduce aggregate demand.

In order to test whether the RET holds or not, Feldstein analyzes the effect of several fiscal variables on consumption

expenditure. He estimates a consumption function for the United States for the years 1930-77 (the years 1941-46 are omitted). All the variables are real and in per capita terms:

$$(9) \quad C_t = a_0 + a_1 Y_t + a_2 W_t + a_3 SSW_t + a_4 G_t + a_5 T_t \\ + a_6 TR_t + a_7 D_t + u_t$$

C consumption expenditures
 Y permanent income
 W market value of private wealth at the beginning of the year t, including D_t
 SSW a measure of the value of future social security benefits
 G government expenditures on goods and services (including local, state and federal government)
 T tax revenues
 TR government transfers to individuals
 D local, state and federal government net debt.

Since any exogenous increase in consumption will imply an increase in taxes, the tax variable can be seen as endogenous. Feldstein, therefore, uses the method of instrumental variables to estimate equation (9). He chooses T_{t-1} as an instrument. This variable is highly correlated with T_t , but not with C_t (5). Feldstein uses both disposable income and national income as a proxy for Y, the former because he considers it the right proxy and the latter in order to allow a comparison with other estimates that also use national income.

⁵ Feldstein does not give detail about the other instruments.

Feldstein proposes five different hypotheses in order to analyze whether the RET holds or not. If national income is used, the first hypothesis deals with the direct effect of a change in government expenditures on the level of consumption. The RET implies that the coefficient is negative on this variable, or that there is a negative relationship between government expenditures and consumption. The question is whether or not a_4 is equal to minus one.

The second hypothesis (more "Ricardian" in spirit) says that a change in taxes has no effect on consumption when government expenditures and transfers are kept constant. Therefore, the coefficient a_5 is zero. The alternative hypothesis is that an increase in taxes will decrease consumption, in other words, that the coefficient a_5 is negative.

The third hypothesis deals with government transfers. The Ricardian hypothesis implies that transfers have no effect on consumption expenditures, that is to say the coefficient a_6 is zero. The alternative hypothesis says that transfers will increase consumption, therefore the coefficient a_6 will be greater than zero.

The fourth hypothesis refers to social security benefits. The Ricardian hypothesis argues that a promise of future social security benefits will not have any effect on consumption because

taxes needed to finance those benefits are a liability to households and over a period of time their present value is as big as the benefits themselves. The alternative hypothesis argues that anticipated social security benefits induce individuals to reduce their own retirement savings and increase their consumption. Thus, the null hypothesis is the coefficient a_3 equal to zero and the alternative hypothesis is the coefficient a_3 greater than zero.

The fifth and last hypothesis deals directly with government debt. The Ricardian vision argues that public debt is not considered part of private wealth by households. This implies that both variables have the same coefficient but with opposite signs. In other words, given that the wealth variable does include the value of government debt, the coefficient should show $a_7 = -a_2$. The alternative hypothesis is that households consider public debt as part of their wealth, that is $a_7 + a_2 > 0$ even if $a_7 < 0$.

A summary of the null hypotheses is: $a_3 = 0$, $a_4 = -1$, $a_5 = 0$, $a_6 = 0$, and $a_7 + a_2 = 0$. The alternative hypotheses are: $a_3 > 0$, a_4 different from minus one, $a_5 < 0$, $a_6 > 0$, and $a_7 + a_2 > 0$, even if $a_7 < 0$.

If we use personal disposable income, the null hypotheses are: $a_5 > 0$, $a_6 < 0$, $a_4 < 0$, $a_3 = 0$, and $a_7 = -a_2$; while the

alternative hypotheses are: $a_5 = 0$, $a_6 = 0$, $a_4 = 0$, $a_3 > 0$, and $a_7 = 0$. There is a difference in the hypotheses because disposable income is net of taxes and includes transfers.

Feldstein's results are reproduced on Table 1. Equation (9.1) estimates the consumption function by ordinary least squares. Feldstein argues that the results are not clear enough to support or reject the RET. For us, however, the main problem with this equation is the Durbin-Watson statistic. Since it falls into the region of indeterminacy ⁶ there may be a problem of autocorrelation. This problem should be corrected in order to avoid misinterpretations. The autocorrelation problem is common to all equations except equation (9.10). If there is autocorrelation, the least squares estimators of the regression coefficients are still unbiased and consistent but they are no longer the best linear unbiased estimators (BLUE) ⁷. It is surprising that Feldstein does not consider this a problem. Furthermore, the analysis of the t's shows that coefficients a_3 and a_6 are not significantly different from zero and so we can not reject the null hypotheses regarding those coefficients. Coefficient a_6 is, however, positive and coefficient a_4 is different from minus one, thus, the null hypotheses should be

⁶ The critical values for seven regressors and forty-five observations at 5% of confidence are: $d_L = 1.189$ and $d_U = 1.895$ (Kmenta, 1986).

⁷ Kmenta 1986, chapter 8, specially pages 302-311.

rejected ^(e). Then, we can agree with Feldstein that there is not a complete ex-ante crowding-out, but it is also true that there is some.

The second equation has the same specification but it considers the tax variable as endogenous and uses the instrumental variables method. Here Feldstein argues that the RET is not supported in four out of five tests because of the following reasons: First, the government expenditures coefficient is small and not significant. Second, the tax coefficient is high and significant. Third, the hypothesis $a_7 + a_2 = 0$ is not supported by the results. Fourth, the transfers coefficient is close to unity, thus $a_6 = 0$ is rejected.

Fifth, the social security benefits coefficient is positive, thus $a_3 = 0$ is rejected. In conclusion the results seem to reject the RET. We do not agree with the analysis of coefficients a_6 and a_3 . Since the t ratios of both coefficients are below their critical values, the coefficients are not significantly different from zero and, instead of rejecting the RET -as Feldstein says- gives it further support.

In equation (9.3), Feldstein omits the debt variable because it is not significant in equation (9.2). He does not believe that

^e We can not analyze the hypothesis regarding debt and wealth because of a lack of information

this changes the general results; however, it should be noted that once this variable is eliminated, a_6 becomes significant at the 90% level of confidence. In equation (9.4), Feldstein introduces the accruing losses on real government debt. This seems to have no effect on consumption expenditures and Feldstein maintains that it does not affect the coefficients of the other variables. We can see, however, that because of the addition of this variable a_6 is once again not significantly different from zero. In equation (9.5) Feldstein examines if there is the same propensity to consume out of retained earnings as out of other forms of income. As the t statistic from this test is equal to unity, the null hypothesis can not be rejected. Once again, a_6 becomes significantly different from zero, this time at the 95% of confidence. In equation (9.6) government expenditures are omitted because they are systematically not significant and because they are not crucial to the testing of the RET. The results are in general the same. In equation (9.7) the income and tax variables are considered as being endogenous. When lagged income is used as an additional instrumental variable, the results are again unchanged.

In equations (9.8) to (9.11), personal disposable income is used as a proxy for income. Equation (9.8) is analogous to equation (9.2). It has all the correct signs to reject the RET, except a_3 . This coefficient should be positive, however it is shown to be not significantly different from zero. Feldstein

omits the debt variable from equation (9.9) because he wants to reduce collinearity among regressors and focus his attention on the tax and government expenditures variables. The result of this new equation is a smaller standard error and we are presented with further evidence that the RET is invalid. In equation (9.10) income is considered endogenous. In other words, equation (9.10) is analogous to equation (9.7). Equation (9.11) is analogous to equation (9.6). In both cases there is no change in the estimated coefficients.

As a conclusion, Feldstein claims that contrary to the RET, changes in government expenditures and taxes may have a substantial effect on aggregate demand and moreover, that each one of the RET basic hypothesis is contradicted by the facts. However, we do not agree that those conclusions can be drawn directly from his results. These results are not clear and all the equations (except equation (9.10)) may have autocorrelated errors.

2.4 Are Future Taxes Discounted?

In his 1982 paper, Seater empirically analyzes the question of whether future taxes are discounted. His hypothesis is that households do not perceive public bonds as part of their wealth. In order to test this hypothesis, he estimates three equations which are presented below.

The first equation is a consumption function based on the life-cycle hypothesis. Seater uses total consumption expenditure (CON) as the dependent variable and introduces the non-monetary deficit into the consumption function. The specification, which seems quite complicated is as follows:

$$\begin{aligned}
 (10) \text{ CON}_t = & a_0 + a_1 (\text{YD}_t + \text{RE}_t) + a_2 (\text{YD}_{t-1} + \text{RE}_{t-1}) + \\
 & a_3 \text{UYD}_t + a_4 \text{DUR}_t + a_5 \text{AS}_t + a_6 \text{M}_t + \\
 & a_7 [\text{CORPBY}_t (1 - \text{PERMTRAV}_t) - \text{P}_t] + \\
 & a_8 [(\text{CORPBYC}_{t+1} - \text{CORPBYC}_t) / \text{CORPBYC}_t] \text{AS}_t + \\
 & a_9 (\text{DEF}_t - \text{MON}_t) + a_{10} \text{MON}_t + a_{11} (\text{DM}_t - \text{MON}_t) + \\
 & a_{12} \text{MVG}_t + a_{13} [\text{MVG}_{t+1} - \text{MVG}_t - (\text{DEF}_t - \text{DM}_t)] + \\
 & a_{14} \text{SSW}_t + u_t
 \end{aligned}$$

CON	total real per capita consumption expenditures
YD	real per capita disposable income
RE	real per capita corporate retained earnings
UYD	the product of unemployment rate (U) and disposable income (YD)
DUR	real per capita stock of durable goods, beginning of year
AS	real per capita private wealth; constructed by scaling up the market value of corporate stocks and bonds
M	real per capita monetary base, beginning of year
CORPBY	annual average corporate bond rate
PERMTRAV	fifteen-year moving average of PERMTR (the personal marginal income tax rate), centered on current year
P	expected rate of inflation, generated by $P_t = a P_{t-1} + (1-a) P^*_{t-1}$, where P^* is the actual rate of inflation and b is chosen to maximize R^2
CORPBYC	December corporate bond rate
DEF	real per capita current total deficit of government sector
MON	real per capita current government deficit that has been monetized by the Federal Reserve System
DM	change in real per capita monetary base

MVG real per capita market value of outstanding
 government debt
 SSW Feldstein's measure of social security wealth

In equation (10), disposable income, lagged disposable income and UYD are proxies for expected income. The moving average of current marginal taxes is a proxy for expected taxes. The $[(CORPBYC_{t+1} - CORPBYC_t) / CORPBYC_t] AS_t$ variable is a proxy for capital losses on private wealth which is included to capture changes in the expected value of the returns to capital. The $[MVG_{t+1} - MVG_t - (DEF_t - DM_t)]$ variable is a measure of the capital gain on government debt. Regardless of whether the tax discount hypothesis is verified or not, the expected signs for coefficients a_1 to a_8 are: $a_1 > 0$, $a_2 > 0$, $a_3 > 0$, $a_5 > 0$, $a_6 > 0$, and $a_8 < 0$. The coefficients a_0 , a_4 , and a_7 may be positive or negative. To test for whether tax discounting occurs, the important coefficients are a_9 to a_{14} . Thus, the null hypotheses are: $a_9 < 0$, $a_{12} = a_{13} = a_{14} = 0$, and also $a_{10} < 0$ and $a_{11} = 0$ (if a money effect is anticipated) or $a_{10} = 0$ and $a_{11} > 0$ (if it is not). The alternative hypothesis are $a_9 = 0$, $a_{12} > 0$, $a_{13} > 0$, $a_{14} > 0$ and also $a_{10} = 0$ and $a_{11} < 0$ (if money effect is anticipated) or $a_{10} > 0$ and $a_{11} = 0$ (if it is not).

Seater's results seem to support the tax discount hypothesis ($a_9 < 0$ and a_{12} , a_{13} , a_{14} , a_{10} , and a_{11} are not significantly different from zero). However, there are some problems with this specification, such as the possible simultaneity bias. Seater

tries to correct this by introducing another equation and estimating the system by two stage least squares. He claims to find basically the same results, but this equation is not shown.

Seater's second equation has the same specification as his first one, but consumption expenditures on non-durable and services (CND) is used instead of total consumption expenditures. In this case, the results reject the tax discount hypothesis. Coefficients a_7 , a_{10} , a_{11} , are not significantly different from zero, while a_{12} and a_{13} are significantly positive. Coefficient a_{14} is positive only when one-half of the sample is used.

In the third estimation, he uses total net assets as an independent variable. The proxy used for total net assets is the sum of the market value of corporate stocks and bonds plus bank loans. He also omits the capital gains on government debt variable. The results of this estimation are confused and do not lead to any conclusion on the tax discount hypothesis.

In conclusion Seater proposes a new explanation for the fact that the tax discount hypothesis is not completely verified. This explanation is derived from a combination of the permanent income hypothesis and the efficient markets assumption. He postulates that households will initially consider government bonds as part of their wealth and so they will increase their

consumption expenditures. Later, however, as they face the new taxes, they discover the truth and reduce their consumption.

Seater's ambiguous results seem to be largely due to an extremely complicated specification of the consumption function. The more complicated a model is, the more difficult it is to obtain clear-cut results and the higher the probability of introducing biases. For this reason we believe that Seater's study cannot be considered as either a proof or disproof of the tax discount hypothesis.

2.5 New Test of the Life-Cycle and Tax Discount Hypotheses

Seater and Mariano (1985) used the combined Barro (1983) and Beveridge-Nelson (1981) specification in an attempt to find support for the tax discount hypothesis. The basic consumption function used is $C=C(Q^P, Q, G^P, G, r, \dots)$ where the variables are real consumption (C), permanent real gross income (Q^P), permanent real government expenditures on goods and services (G^P), real government expenditure on goods and services (G), and the after-tax real rate of interest (r). The signs of the consumption function derivative with respect to each variable are $C=C(+, -, -, -, \dots)$. They use the normal levels of these variables as proxies for the permanent values. To obtain these normal levels, they estimated an ARIMA model for each variable and then computed the stochastic steady state values for each period. The final specification used in the estimation is:

$$(11) \text{CE}_t / \text{POP}_t = a_0 + a_1 Q^*_t / \text{POP}_t + a_2 (Q_t - Q^*_t) / \text{POP}_t + \\ a_3 G^*_t / \text{POP}_t + a_4 (G_t - G^*_t) / \text{POP}_t + \\ a_5 \text{AMTR}_t + a_6 \text{RS}_t + a_7 \text{RL}_t + u_t$$

CE	consumption expenditures
POP	population
Q*	steady state values for income, used as a proxy for permanent real gross income
Qt-Qt*	a measure of transitory income
Gt*	steady state values for government expenditures on goods and services, used as a proxy for permanent real government expenditures on goods and services
Gt-Gt*	transitory government expenditures, used instead of Gt to avoid collinearity
AMTR	marginal federal income tax rate
RS	short run interest rate (one year)
RL	long run interest rate (twenty years)

The expected signs for the coefficients if there is tax discount, are $a_1 < 0$, $a_2 = 0$, $a_3 < 0$, $a_4 < 0$, $a_5 < 0$, $a_6 < 0$, $a_7 < 0$. The equation is estimated by two stages least squares. It is estimated twice, once using total consumption expenditures and once using expenditures on non-durable goods and services as a proxy for C. The results using total consumption suggests that taxes are effectively discounted since $a_4 < 0$ and $a_3 < 0$. Using expenditures on non-durable goods and services, a_4 is still negative but a_3 is not significantly different from zero.

Seater and Mariano also use another specification which includes tax collection, (T), real transfers, (TR) the real

market value of outstanding government debt, (D) and social security wealth, (SSW):

$$\begin{aligned}
 (12) \quad CE_t/POP_t = & a_0 + a_1 Q^*_t/POP_t + a_2 (Q_t - Q^*_t)/POP_t + \\
 & a_3 G^*_t/POP_t + a_4 (G_t - G^*_t)/POP_t + \\
 & a_5 AMTR_t + a_6 RS_t + a_7 RL_t + a_8 T_t/POP_t + \\
 & a_9 TR_t/POP_t + a_{10} D_t/POP_t + a_{11} SSW_t/POP_t + \\
 & u_t
 \end{aligned}$$

If taxes are not discounted, the expected signs of the coefficients are $a_8 < 0$, $a_9 > 0$, $a_{10} > 0$, and $a_{11} > 0$. Using either total consumption or consumption on non-durable goods, these four coefficients are not significantly different from zero. This suggests that taxes are effectively discounted. However, it should be noted that the Durbin-Watson statistic is very low, denoting positive autocorrelation.

Seater and Mariano also criticize Feldstein's (1982) estimation. They re-estimate his equations and conclude that Feldstein's analysis has methodological errors and once these are corrected, his results support the tax discount hypothesis.

2.6 Saving Out of Different Types of Income

In his 1971 paper, Taylor does not address directly the RET problem, but some evidence regarding our topic can be found. Consequently, we shall review it. Taylor attempts to discover whether the propensity to save out of different types of income

is the same. The usual distinction is between propensity to save out of labour and property income, but Taylor tries to focus his analysis around the differences between propensities to save out of transfer payments, personal contributions to social insurance, and personal taxes. He uses a national income identity and a saving function according to the "zero-depreciation" theory:

$$(13) YD = L + P + TR - SI - T$$

$$(14) S_t = a_0 + a_1 A_t + s YD_t + u_t$$

YD disposable income
 L labour income
 P property income
 TR transfer payments
 SI contributions to social insurance
 T personal tax and non-tax payments
 S personal saving
 A stock of financial assets

From (13) and (14), Taylor derives a saving function with separate marginal propensities to save:

$$(15) S_t = a + b A_t + s_1 L_t + s_2 P_t + s_3 TR_t + s_4 SI_t + s_5 T_t + u_t$$

The expected coefficients, according with the traditional Keynesian vision, are $b < 0$, $s_1 > 0$, $s_2 > 0$ (and $s_2 > s_1$), $s_3 > 0$ (but very small), $s_4 < 0$, and $s_5 < 0$. Finally, Taylor estimates equation (16) shown below. In this equation all the variables are in first differences and the stock of financial assets has been

omitted in order to avoid the problems related to its construction:

$$(16) S_t = a S_{t-1} + s_1 dL_t + s_2 dP_t + s_3 dTR_t + s_4 dSI_t + s_5 dT_t + u_t$$

Taylor estimates the equation in aggregate and per capita terms. The data are quarterly and the sample period covers the period 1953:1 through 1969:4. The results are as follows:

$$(17) S_t = 0.971 S_{t-1} + 0.429 dL_t + 0.340 dP_t + 0.863 dTR_t \\ (58.28) \quad (4.18) \quad (1.08) \quad (2.73) \\ - 2.200 dSI_t - 0.908 dT_t + 18.311 dr_t \\ (3.33) \quad (4.78) \quad (1.95) \\ R^2 = 0.845 \\ SEE = 10.75$$

$$(18) S_t = 0.955 S_{t-1} + 0.449 dL_t + 0.277 dP_t + 0.893 dTR_t \\ (43.79) \quad (4.21) \quad (0.86) \quad (2.86) \\ - 2.159 dSI_t - 0.901 dT_t + 3.651 dr_t \\ (3.30) \quad (4.87) \quad (2.03) \\ R^2 = 0.899 \\ SEE = 2.010$$

We can see that the results obtained with aggregate data and per capita data are very similar. In both of these cases: $s_1 > 0$, $s_3 > 0$, $s_4 < 0$, $s_5 < 0$. However, s_2 is not significantly different from zero in either case. Taylor does not mention this.

He says that it is positive '9'. There are, however, some results that are unusual (and against Taylor's hypothesis): (a) the marginal propensity to save out of labour income is higher than that out of property income, and (b) the marginal propensities to save out of transfers, out of tax and non-tax payments, and out of personal contributions to social security are very high.

These results seem to support the tax discount hypothesis. They suggest that consumers are able to foresee higher taxes in the future because of a current increase in transfers or a decrease in taxes. However, Taylor recognizes that his results should be taken carefully.

* The t test is below even the critical value at 90% of confidence, which is equal to 1.282 (Kmenta, 1986).

3. A Test for Canada

In order to test the Ricardian equivalence theorem for Canada, we used as a base the tests developed by Kochin (1974) and Feldstein (1982). We also tried to replicate the tests of Seater (1982) and Seater and Mariano (1985). We were, however, unable to find all the necessary data. Our main problems were with the variables: steady state values for income and government expenditures, stock of durable goods, personal marginal income tax rate, and the value of social security wealth. We also had some problems with Feldstein's tests. We could not find the base information necessary to construct the value of social security benefits.

3.1 Are Future Taxes Anticipated in Canada?

As it was already explained, Kochin's basic specification is

$$(1) \quad C_t = a_0 + a_1 DY_t + a_2 C_{t-1} + a_3 DEF_t + u_t$$

We used this specification to test whether or not future taxes are discounted in Canada. The equation was first estimated using quarterly data for the period 1970:1 through 1984:4. However, with such a small periods we could not draw a clear conclusion. Quarterly income hardly affects consumption in the

same period and it is also difficult to see quarterly changes in the deficit. We, therefore, finally decided to use annual data and so the equation was estimated for the years 1954-84. The data were obtained from CANSIM - Statistics Canada. Following Kochin, we used consumption on non-durable goods and services, personal disposable income, and federal government deficit. All these variables were deflated, as in Kochin's study, by the implicit price deflator for consumer expenditure on goods and services. The results for the estimation of equation (1) are shown below:

$$(2) \quad C_t = 26.2969 + 0.0422 DY_t + 0.7480 C_{t-1} - 0.1159 DEFFED_t$$

(2.184)
(3.188)
(7.779)
(2.151)

$$R^2 = 0.991$$

$$SEE = 11.13$$

$$F = 10274.6$$

$$n = 30$$

$$DW = 1.401$$

$$ndf = 26$$

The above equation displays a relatively high autonomous consumption level compared with Kochin's estimation (Kochin's is equal to 5.56) and it also has a relatively low coefficient on disposable income when compared to Kochin's coefficient on DY of 0.283. Another problem with equation (2) is that the coefficient on DY is much too small if compared with the coefficient of lagged consumption. This problem does not occur in Kochin's estimation. There is also a negative coefficient of the debt variable which suggests a degree of tax discount. The Durbin-Watson statistic, however, falls into the indeterminate region, which means that we should not reject the hypothesis of

autocorrelation. To remove this problem, we re-estimated the equation using first differences:

$$(3) \quad dC_t = 14.0966 + 0.0578 dDY_t + 0.2702 dC_{t-1} - 0.0206 dDEFFED_t$$

(2.510) (3.290) (1.551) (0.2674)

R ² = 0.5221	SEE = 11.72
F = 10.832	n = 28
DW = 2.079	ndf = 24

Now, we have a lower autonomous consumption (14.0966 versus 26.2969), the coefficient of lagged consumption is much lower (0.2720 versus 0.7480)¹⁰, and the coefficient of disposable income is still low. In addition, we now find that the coefficient of debt is not significantly different from zero (t ratio is equal to 0.2674). This suggests that future taxes are not discounted in Canada. Moreover, we find that the deficit does not affect consumption as it does in the USA. This can be explained by the differences in the way the variables were measured. Kochin explains that he uses non-durable and services because consumption on durable goods is more nearly savings than consumption. However, he does not say anything about the intermediate category of consumption on semi-durable goods. To test whether this category makes a difference or not in the definition of the consumption variable, we re-estimated the equation including semi-durable goods as a component of consumption:

¹⁰ But the coefficient is significant only at the 90% level of confidence.

$$(4) \quad C_t = 40.0794 + 0.0557 DY_t + 0.7031 C_{t-1} - 0.1795 DEFFED_t$$

(2.270) (3.026) (6.076) (2.790)

R ² = 0.9988	SEE = 14.41
F = 7788.05	n = 30
DW = 1.305	ndf = 26

Here we have similar results to those found in equation (2). The only difference is the autonomous consumption which in equation (4) is much higher. Since the Durbin-Watson falls in the region of indeterminacy, we assumed that there is autocorrelation. Thus, it was necessary to re-estimated the equation using first differences before analyzing the results:

$$(5) \quad dC_t = 18.1904 + 0.0779 dDY_t + 0.1450 dC_{t-1} - 0.0873 dDEFFED_t$$

(2.897) (3.551) (0.812) (0.933)

R ² = 0.5354	SEE = 14.02
F = 11.372	n = 28
DW = 1.792	ndf = 24

Once again, upon substituting first differences for the actual values of the variables, we notice a decrease in autonomous consumption (from 40.0794 to 18.1904). We also notice decrease in the coefficient of lagged consumption (from 0.7031 to 0.1450)¹¹ and a slight increase in the coefficient of disposable income (from 0.0557 to 0.0779). The most notable result is that the coefficient of the federal deficit is not

¹¹ Now, however, the t ratio is even lower, it is not significantly different from zero.

significantly different from zero. It appears, therefore, that regardless of how consumption is defined, the results do not support the hypothesis of tax discount in Canada.

To test this result further, we substituted total government deficit (DEFIC) for the federal deficit and found no change in our results. Total government deficit includes local, provincial and federal deficit. The specification and results were as follows:

$$(6) \quad C_t = 30.1984 + 0.0436 DY_t + 0.7296 C_{t-1} - 0.0810 DEFIC_t$$

(2.769) (3.336) (7.851) (2.094)

R ² = 0.9991	SEE = 11.17
F = 10194.1	n = 30
DW = 1.427	ndf = 26

These results are similar to those from equations (2) and (4). The level of autonomous consumption falls between the levels attained in equation (2) and equation (4). The coefficient of the deficit is slightly lower. However, as we again have a Durbin-Watson in the region of indeterminacy, we re-estimated the equation using first differences:

$$(7) \quad dC_t = 14.1663 + 0.0590 dDY_t + 0.2569 dC_{t-1} - 0.0064 dDEFIC_t$$

(2.515) (3.392) (1.537) (0.108)

R ² = 0.5209	SEE = 11.73
F = 10.7857	n = 28
DW = 2.111	ndf = 24

+ 0.2398 dMON_t
(5.091)

R² = 0.9995
F = 15097.8
DW = 2.055

SEE = 7.957
n = 30
ndf = 25

Surprisingly, the coefficient in debt is now significantly negative at the 95% level of confidence. This contradicts our earlier results and gives support to the tax discount hypothesis. But as the coefficient is very low and it implies only a discount of \$0.07 per dollar of deficit, we cannot really say that there is a 100% discount of future taxes. Moreover, the coefficient of the change in monetary base is significantly different from zero. This rejects the RET with respect to the money financing of the deficit. We should notice that this equation does not have autocorrelated errors which makes us suspect that the problems of autocorrelation we encountered previously were problems of misspecification. In this equation we have results that differ from those of Kochin since his estimation displays autocorrelation even when including the change in monetary base. Also, this variable was not significant in his study and so could not explain consumption.

Finally, we used the change in debt as a proxy for the deficit. Here we used the market value of government debt from Cox and Haslag (1986). The results were not different from those obtained using the standard measure of deficit. The estimation using original values had autocorrelation problems and when we

re-estimated it using first differences we found a positive coefficient for deficit (t equals 2.782). This coefficient, however, is very low, implying a discount of only 0.1 cents per dollar of deficit:

$$(9) \quad C_t = 48.5282 + 0.0566 DY_t + 0.6255 C_{t-1} + 0.0002 DEFICIT_t$$

(4.274) (3.959) (6.103) (0.392)

R ² = 0.9989	SEE = 12.04
F = 8773.3	n = 30
DW = 1.058	ndf = 26

$$(10) \quad dC_t = 9.2987 + 0.0697 dDY_t + 0.2839 dC_{t-1} + 0.0012 dDEFICIT_t$$

(1.792) (4.839) (2.033) (2.782)

R ² = 0.6376	SEE = 10.20
F = 16.832	n = 28
DW = 2.251	ndf = 24

As a conclusion, we can say that future taxes are not discounted in Canada. This result differs from the one by Kochin, but this fact should not surprise us since we have already seen Figures 1 and 2.

3.2 Government Deficits and Aggregate Demand in Canada

In testing Feldstein's specification, we encountered several problems. The first one was concerned with the construction of the variables. Feldstein's test is more "data demanding" than Kochin's. We used personal expenditure on consumer goods and services in current dollars (deflated by its own implicit price

deflator ¹²) for the consumption variable (C). For Y we used, as Feldstein, two measures: personal disposable income deflated by the implicit price deflator for consumption, and gross domestic product deflated by its own implicit price deflator. For G, we used current government expenditures on goods and services, for T we used total tax revenues (which are equal to indirect plus direct taxes) and for TR we used total transfers to persons. These last three variables are the aggregate of the federal, provincial and local government levels and were deflated by the implicit price deflator for government expenditures on goods and services. For debt we used the market value of gross federal debt.

For wealth, Feldstein used the beginning-of-year household net worth developed by the MIT-Penn-SSRC Model, but we could not find any similar series for Canada. Thus, we constructed it by adding up the real money base and the market value of privately held domestic direct debt ¹³. We were also supposed to use a measure of equities issued by private firms, but this information was available only for the period after 1977. We recognize that our proxy for wealth is very weak, however, we hope it can still help us to test whether the Ricardian theorem holds or not. We

¹² Feldstein does not give details about the deflator used. We decided to use a set of deflators according with the data available.

¹³ This represents the net indebtedness of the government to the private sector.

also had trouble finding a good proxy for the value of future social security benefits. We could not find all the base information to build this variable for Canada. Thus, we decide to omit the variable on the basis that it was not crucial to our test.

All the data, except the market value of government debt, was taken from CANSIM - Statistics Canada. The variable market value of government debt was taken from Cox and Haslag (1986). They report monthly market value series for Canada over the period 1937-84. This work is similar to the one by Seater (1981) that reports market value of government debt for the United States over the period 1919-75. We used the new data because, as Boothe and Reid (1986, page 44) affirm:

these relationships [if government debt is net wealth] have received little attention in Canada primarily because of the lack of reliable data on the market value of government debt held by the private sector. To perform reliable tests of whether the private sector views government debt as a component of its net wealth, it is necessary to have such market-value data.

We should mention also that these authors, who also report market value series for government of Canada debt, after finding the series, analyze whether the par-values provide a reasonable approximation for market values. In general the correlation is very high. It appears that par-value measures contain considerable information about market values and that the use of such series would not lead to serious problems. However, they

find also that after 1975 the divergence is higher because of the increased interest-rate volatility.

Our first test used personal disposable income. Our hypotheses, derived from Feldstein, are: $a_3 = 0$, $a_4 = 0$, $a_5 = 0$, and $a_6 + a_2 > 0$. These hypotheses imply a rejection of the Ricardian equivalence theorem. The alternative hypotheses are: $a_3 < 0$, $a_4 > 0$, $a_5 < 0$, and $a_6 + a_2 = 0$. We should notice that the last hypothesis implies a linear combination of two coefficients¹⁴. The results were:

$$(11) \quad C_t = 110.3193 + 0.8126 PDY_t + 0.0170 W_t + 0.6894 G_t \\
\quad \quad \quad (7.408) \quad (8.945) \quad (2.797) \quad (2.029) \\
\quad \quad \quad - 0.1169 TX_t - 0.3381 TR_t - 0.0150 DEBT_t \\
\quad \quad \quad (-0.7114) \quad (-1.122) \quad (-2.847) \\
\quad \quad \quad R^2 = 0.9980 \quad \quad \quad SEE = 21.44 \\
\quad \quad \quad F = 2437.9 \quad \quad \quad n = 30 \\
\quad \quad \quad DW = 1.8117 \quad \quad \quad ndf = 23$$

This regression has a Durbin-Watson statistic which is just at its critical value, and so we can accept the hypothesis of non

¹⁴ To test this hypothesis we calculated the following expression, which has a t distribution and compared it with the critical value of the one-tailed statistic t:

$$\frac{a_6 + a_2}{s * [1 - r^2]^{-1/2} * [(1/S_6)^2 + (1/S_2)^2 - (2r/S_6 * S_2)]^{1/2}}$$

where s is the standard deviation, r the coefficient of correlation and S_i is the square root of the summation of the deviations with respect to the mean for the variable X_i (Theil, 1978).

autocorrelation only at a 1% degree of confidence. We can observe that the coefficient for government expenditures is significantly positive and the coefficients for taxes and transfers are not significantly different from zero. The value of the t statistic for the combination of a_2 and a_6 is 3.097, well above its critical value. These results suggest that fiscal policy is effective ⁽¹⁵⁾ and that the Ricardian equivalence theorem does not hold for Canada. This results must, however, be looked upon with care because of the weakness of our data. They do, however, confirm our earlier results.

We tested Feldstein's specification with GDP as well. The hypotheses to support the ineffectiveness of fiscal policy and the Ricardian equivalence theorem are: $a_3 = -1$, $a_5 = 0$, $a_6 = 0$, and $a_6 + a_2 = 0$. The alternative hypotheses are: a_3 different from minus one, $a_4 < 0$, $a_5 > 0$ and $a_6 + a_2 > 0$. The results were:

$$(12) C_t = 23.7757 + 0.6044 GDP_t - 0.0017 W_t - 0.2085 G_t$$

(2.862) (16.96) (-0.6092) (-0.9486)

$$- 0.3395 T_t + 0.9653 TR_t + 0.0002 DEBT_t$$

(-3.504) (6.077) (0.081)

$$R^2 = 0.9993$$

$$F = 7362.4$$

$$DW = 1.159$$

$$SEE = 12.34$$

$$n = 30$$

$$ndf = 23$$

¹⁵ The hypothesis is $a_3 = 0$; however a positive coefficient implies not only a rejection of the ineffectiveness of fiscal policy, but a crowding-in effect.

This equation has autocorrelated errors since the Durbin-Watson statistic is only equal to 1.159. We tried to correct this problem by re-estimating the equation using first differences with less than satisfactory results:

$$(13) \quad dC_t = -0.7463 + 0.5486 dGDP_t - 0.0035 dW_t - 0.0747 dG_t \\
\begin{array}{cccc}
(-0.1315) & (11.48) & (-0.9791) & (-0.3626) \\
-0.1356 dT_t + 0.6769 dTR_t + 0.0022 dDEBT_t \\
(-1.401) & (3.437) & (0.6744)
\end{array}$$

$R^2 = 0.8569$	$SEE = 11.64$
$F = 28.939$	$n = 29$
$DW = 1.743$	$ndf = 22$

We can see that we still may have autocorrelation and this, strictly speaking, means that our results are not valid. In this equation we have the following results. We cannot reject the hypothesis that the coefficient of government expenditures is equal to minus one ¹⁶. We cannot reject the hypothesis that the coefficient of tax revenues is different from zero. Nor can we reject the hypothesis that $a_6 + a_2$ is equal to zero. We can, however, accept the hypothesis that a_5 is greater than zero. In other words, except for the coefficient of transfers, the results seem to support the inefficacy of fiscal policy and the Ricardian equivalence theorem.

¹⁶ Since $-1.074/0.206=5.217$, which is well above its critical value.

The contradiction between the two tests may be due to the weakness of our variables, especially wealth. We should notice also that this variable is highly correlated with the variable debt. This fact is probably causing some multicollinearity and we can see this in the relatively high F statistic and relatively low t statistics.

In conclusion, the results seems to reject the Ricardian equivalence theorem. It must be remembered, however, that the kind of tests used are very sensitive to the type of data used and, therefore, it is very difficult to arrive at a definite conclusion.

4. Conclusions

In this paper we have analyzed the theory underlying the Ricardian equivalence theorem, presented a review of some empirical tests developed for the United States, and applied two of those tests to the Canadian economy.

We have shown that according to the RET, the effect of government expenditures is measured by its size and not by the way it is financed. This is because households are assumed to be rational and, therefore, able to foresee future tax increases implied by a current government deficit.

The different tests developed for the United States had several results. Taylor (1971), Kochin (1974), and Seater and Mariano (1985) found support to the RET, while Yawitz and Meyer (1976) and Feldstein (1982) found no evidence of the RET. Seater (1982), however, proposed a new explanation compatible with his results.

Our two tests for Canada, however, suggest that the RET is not valid. The difference of our results with respect to those found for the American economy may be due to the differences between the two countries. It must be noticed, however, that the

tests used are very sensitive to the type of data used and, therefore, it is very difficult to arrive at a definite conclusion. Future results might be more conclusive if the problem of data construction mentioned above could be solved.

It should be noticed, also, that the type of tests developed is open to questioning on the grounds of causality. We have explained how the decrease in consumption and the increase in government indebtedness can be explained as effects of a mutual cause.

These results against the RET give further support to the criticisms presented in the first section of this paper. The assumptions needed for the RET are certainly not realistic. For example to assume hyper-rationality, or that households have no liquidity and wealth constraints, or to assume lump-sum taxes is not realistic.

BIBLIOGRAPHY

- BAILEY, M.J. (1962) National Income and the Price Level (New York:McGraw-Hill)
- BARRO, R. (1974) "Are government bonds net wealth?" Journal of Political Economy 84, 1095-1117.
- BARRO, R. (1976) "Reply to Feldstein and Buchanan." Journal of Political Economy 84, 343-349
- BARRO, R. (1983) Macroeconomics (New York:Wiley)
- BEVERIDGE, S. and C. NELSON (1981) "A new approach to decomposition of economic time series into permanent and transitory components with particular attention to measurement of the 'business cycle'." Journal of Monetary Economics 7, 151-174
- BOOTHE, P.M. and B. REID (1986) "The market value and maturity structure of Government of Canada debt, 1967-83." Canadian Journal of Economics 19, 443-468
- BUCHANAN, J. (1976) "Barro on the Ricardian equivalence theorem." Journal of Political Economy 84, 337-342
- BUIITER, W. and J. TOBIN (1979) "Debt neutrality: A brief review of doctrine and evidence." In G. von Furstenberg, ed., Social Security versus Private Saving in Post Industrial Societies (Cambridge:Ballinger Publishing Company)
- COX, M. and J. HASLAG (1986) "The market value of government of Canada debt: monthly, 1937-1984." Canadian Journal of Economics 19, 469-497
- DARBY, M. (1974) "The permanent income theory of consumption: a restatement." Quarterly Journal of Economics 88, 228-250
- DAVID, P. and J. SCADDING (1974) "Private saving: Ultra rationality, aggregation and 'Denison's Law'." Journal of Political Economy 82, 225-249
- FELDSTEIN, M. (1974) "Social security, induced retirement and aggregate capital accumulation." Journal of Political Economy 82, 905-926

- FELDSTEIN, M. (1976) "Perceived wealth in bonds and social security: A comment." Journal of Political Economy 84, 331-336
- FELDSTEIN, M. (1982) "Government deficit and aggregate demand." Journal of Monetary Economics 9, 1-20
- HALL, R. (1978) "Stochastic implications of the life-cycle permanent income hypothesis: theory and evidence", Journal of Political Economy 86, 971-987
- JOHNSON, H. (1962) "Monetary theory and policy review." American Economic Review 52, 335-384
- KATSAITIS, D. (1987) "On the substitutability between private consumer expenditure and government spending in Canada", Canadian Journal of Economics 20, 533-543
- KLEIN, L.R. (1968) The Keynesian Revolution (London:Macmillan)
- KMENTA, J. (1986) Elements of Econometrics (New York:Macmillan)
- KOCHIN, L. (1974) "Are future taxes anticipated by consumers?" Journal of Money, Credit and Banking 27, 385-394
- KORMENDI, R. (1973) "Government debt, government spending and private sector behaviour." American Economic Review 73, 994-1010
- MISHAN, E.J. (1963) "How to make a burden of the public debt" Journal of Political Economy 71, 529-542
- MODIGLIANI, F. (1961) "Long-run implications of alternative fiscal policies and the burden of the national debt." Economic Journal 71, 730-755
- O'DRISCOLL, G. (1977) "The Ricardian non-equivalence theorem." Journal of Political Economy 85, 207-210
- PATINKIN, D. (1965) Money, Interest and Prices (New York:Harper and Row)
- RICARDO, D. (1821) Principles of Political Economy and Taxation (London:Everyman's Library)
- RICARDO, D. (1951) The Works and Correspondence of David Ricardo Edited by Piero Sraffa. (Cambridge:Cambridge University Press)
- SEATER, J. (1981) "The market value of outstanding government debt: 1919-1975." Journal of Monetary Economics 8, 85-101

- SEATER, J. (1982) "Are future taxes discounted?" Journal of Money, Credit and Banking 14, 376-389
- SEATER, J. and R. MARIANO (1985) "New tests of the life cycle and tax discounting hypotheses." Journal of Monetary Economics 15, 195-215
- TANNER, J.E. (1970) "Empirical evidence on the short-run real balance effect in Canada." Journal of Money, Credit and Banking 2, 473-85
- TAYLOR, L. (1971) "Saving out of different types of income." Brooking Papers on Economic Activity 2, 383-415
- THEIL, H. (1978) Introduction to Econometrics (New Jersey: Prentice Hall, Inc)
- TOBIN, J. (1952) "Asset holdings and spending decisions." American Economic Review: Papers and Proceedings 42, 109-122
- TOBIN, J. (1980) Asset Accumulation and Economic Activity (Oxford: Basil Blackwell)
- TOBIN J. and W. BUITER (1980) "Fiscal and monetary policies, capital formation and economic activity." In G. von Furstenberg, ed., The Government and Capital Formation (Cambridge: Ballinger Publishing Company)
- YAWITZ, J. and L. MEYER (1976) "An empirical investigation of the extent of tax discount." Journal of Money, Credit and Banking 8, 247-256