IMF WORKING PAPER

WP/87/51

INTERNATIONAL MONETARY FUND

Research Department

Fiscal Policy and Private Sector Saving Behavior: Tests of Ricardian Equivalence in Some Developing Economies

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July 31, 1987

Abstract

Tax or debt financing of a given rate of government expenditures would, according to the now well-known Ricardian Equivalence proposition, have equivalent effects on aggregate demand. Among the reasons for a deviation from the equivalence is the possibility that the government and the private sector have different planning horizons. The paper finds no empirical support for differing planning horizons across sectors in a group of 16 developing economies and, therefore, provides empirical evidence for the equivalence hypothesis.

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*The author is grateful to Willem Buiter, Mansoor Dailami, Mohsin Khan, Ricardo Martin, Peter Montiel, Assaf Razin and Sweder van Wijnbergen for helpful comments and discussions.

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Summary

The large and growing fiscal deficits in both developing and industrial countries have revived interest in the links between fiscal policy variables and private sector saving and investment decisions. Broadly speaking, conventional analysis has assumed that consumption decisions are based on a notion of disposable or after-tax income. According to this view, consumption is sensitive to current taxation but not to current accumulation of debt by the government, even though such an accumulation may represent taxation in the future. Thus, the method of financing of a deficit--whether by current taxation or by current debt--would have different real consequences for the economy.

Recent theoretical studies have shown that, in view of the possibility of future taxation implied by increases in the current stock of debt, the financing of a given path of government expenditures through government debt would have the same effects on private sector saving as would financing through taxation. This equivalence of the two forms of government financing would not obtain if, among other things, consumers and the government had different planning horizons. The paper develops an empirical model of consumer behavior in a rational expectations setting for testing the equivalence proposition. Specifically, the hypothesis is tested that planning horizons of consumers and government are different. Evidence from 16 developing countries suggests that the planning horizons and, therefore, the discount rates of the two sectors are not different, thus providing support for the equivalence hypothesis.

I. Introduction

The traditional, and perhaps still predominant view of fiscal policy holds that, in a closed economy, all government expenditures regardless of the use to which they are put or how they are financed, affect aggregate demand with a multiplier of at least as great as one. According to this view, fiscal policy has effects on the real sector and is an important tool not only for stabilization but also for generating growth. This traditional approach, however, is based largely on assumptions that imply asymmetric perceptions of fiscal policy variables on the part of the private sector. 1/ Consumers are assumed to fully discount current taxation in making their consumption (or saving) decisions, since these consumption decisions are a function of disposable income, which is defined to be current after-tax income. Future taxation which may be implied by the financing needs for the servicing and retirement of current debt is, however, assumed to have no effect on consumer decisions. Consequently, consumers regard current spending that is not financed by current taxation but by debt accumulation, the servicing of which could imply future taxation, differently from current spending that is financed by current taxation alone. Private sector consumption decisions, according to this view, are thus sensitive to the financing decisions of the government. Even when the expected tax implications of tax and debt financing for a given path of government expenditures are the same in present value terms, the level of private sector consumption would be different when debt financing rather than tax financing is utilized by the government. The level of private sector consumption would be reduced with increases in current taxation but would be insensitive to increases in current debt of the government.

Even in a forward-looking analysis using future disposable income which includes some notion of anticipated taxation, generally the stock of government debt in private hands continues to be regarded as part of private wealth. In either case the implicit assumption that is made is that households or the private sector is unable to perceive the future tax implications of a current expansion in government debt. Consequently this view subscribes to systematic errors in private sector perceptions of government fiscal policy. In this manner private sector perceptions are not viewed to be rational.

The traditional view essentially ignores the intertemporal budget constraint of the government that requires the difference between the present value of all expected taxation in the future and the present value of the path of expected government expenditures to be equal to the current stock of government debt. Viewed in this manner any increases in the current stock of government debt would, for a given path of future government expenditures require an increase in taxes in the future for the servicing and retirement of the additional debt incurred today. An increase in current government debt therefore represents

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1/ See Kormendi (1983).

merely a shift in the timing of tax collection from the current period to the future. To the extent that the future tax implications of this shift is not fully perceived by the private sector, there will be a net wealth effect leading to an increase in consumption and hence a decline in saving. Eventually this decline in saving should translate into a slower rate of capital accumulation and growth. If, on the other hand, the future tax implications of current government spending are fully perceived, current saving would be increased to allow for the anticipated taxation. Bequest motives for saving to provide future generations for the perceived tax could lead to a situation where the expected taxation is fully discounted for in the present period. 1/ Saving would thus increase to provide for this tax need in the future. Private consumption would then decline by the full extent of the increase in government debt leaving aggregate demand unaffected. Government debt would therefore be absorbed in the economy without any real effects. 2/

The proposition that a given level of government expenditures may be financed either by taxation or by debt accumulation with equivalent real consequences is due to David Ricardo and has therefore come to be known as Ricardian Equivalence. This equivalence proposition has, in recent years, received a great deal of attention owing to the prevalence of large deficits in developed as well as developing countries. Large fiscal deficits in industrial countries are thought to have contributed to the persistence of high real interest rates, while at the same time large fiscal deficits in developing countries served to increase their external indebtedness. As external financing became scarce, earlier this decade the latter group of countries were required to reduce their fiscal deficits to bring them more in line with available financing. This required reduction in fiscal imbalances has rekindled an interest in the possibility of an additional contractionary effect at a time when the external financing constraint has already adversely affected growth. For the regeneration of growth in these countries in the coming period when external financing is likely to remain severely limited, it would be important to determine whether the needed increases in fiscal savings would help improve domestic resource mobilization. If Ricardian equivalence holds total saving would remain unchanged in the face of increased public savings.

Barro (1974) revived the equivalence proposition by arguing that individuals, because of their concern for their children, would provision for future taxation when making their current consumption decisions. Even if increased taxation in the future was not expected in their lifetimes, strong altruistic feelings for their children would impel individuals to leave bequests to meet such tax needs. Such individuals will therefore behave as if they were infinitely lived and make

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1/ The classic article by Barro (1974) develops this line of reasoning to motivate the equivalence proposition that is being outlined here (see also Carmicheal (1982)).

2/ See Buiter (1977) and Bailey (1962, 1971).

their consumption decisions taking into account the intertemporal budget constraints of the government. Blanchard (1985) noted that the planning horizons of the government and individuals may not be the same if individuals recognized the possibility of death or dynastic extinction. In this case, individual discount rate may be higher than that of the government, leading to current taxation being treated differently from future taxation.

To date the empirical testing of the equivalence proposition has been conducted mainly for the United States and, as discussed below, these tests have yielded mixed results. Most of these tests have, however, not been based on any optimizing model of consumer behavior but have relied mainly on the introduction of government variables in the consumption function and deciding the relevance of Ricardian Equivalence on the basis of the sign and significance of the coefficients obtained. This paper represents the first attempt at testing this important proposition for a group of developing countries. Furthermore, in doing so, this paper develops an empirical approach that allows the Blanchard model to be tested in a rational expectations setting. It is therefore possible to test whether there are differences in the planning horizons of the government and the citizens of a country in the context of an optimizing model of consumer behavior are their rational expectation setting.

The rest of the paper is divided into four sections. A review of the literature in the section that follows sketches the factors that could lead to a deviation from equivalence and notes the results of some of the tests that have been conducted for the U.S. 1/ Section 3 develops an empirical version of the Blanchard model that has recently been acquiring prominence in this literature in a rational expectations setting. 2/ The results of the rational expectations model are present in Section 4, and the conclusions of the study in Section 5.

II. Do Fiscal Deficits Matter?

The Ricardian Equivalence proposition suggests that the method of financing a given path of government expenditures has no important real consequences. Since the issuance of new debt is associated with anticipation of future taxation in the perceptions of rational agents, debt financing or maintaining a balanced budget to finance a given path of expenditures would have equivalent effects on aggregate demand. In other words, because of the anticipated taxation implied by increases in

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1/ For an excellent recent survey of the growing literature in this area see Leiderman and Blejer (1986) (see also Seater (1985)).

2/ Blanchard (1983) developed the theoretical framework following an approach used by Yaari (1965). Frenkel and Razin (1986) and Buiter (1986) have provided extensive analyses to study fiscal policy using this approach.

public debt, the substitution of debt for taxes would leave private sector wealth and consumption unchanged. Debt financing in private sector perceptions is, therefore, only a shift in the timing of tax collection. As such the change in the timing of tax collection would leave private sector wealth and consumption unchanged provided that the present value of the stream of taxation that the alternative modes of financing imply are equivalent. 1/

The equivalence proposition is, however, based on certain assumptions which when relaxed, not surprisingly lead to deviations from equivalence. The key assumptions to obtaining equivalence are the existence of perfect capital markets with no borrowing constraints, a tax structure which is nondistortionary, certain knowledge of future taxation and expenditures, and an equivalent planning horizon for private and public sectors. 2/ Hayashi (1985) has shown that although borrowing constraints may be an important source of a deviation from equivalence, they do not necessarily lead to such deviations; Ricardian equivalence could hold despite borrowing constraints.

A necessary condition for the equivalence proposition to hold is that households and the government have the same planning horizons and use the same discount factors in their present-value calculations. Barro (1974) showed that the concern of individuals for future generations would induce behavior similar to that which would obtain if individuals were infinitely-lived. A strong bequest motive would, therefore, ensure that the planning horizons of both individuals and governments, or society at large were infinite. These "infinitely-lived" individuals would recognize in their decision-making that eventually the accumulated government debt has to be repaid.

Blanchard (1984, 1985) has proposed that the probability of death or dynastic extinction could result in effective private sector subjective discount rates that exceed the pure rate of time preference, and in effective private sector market discount rates that exceed the government interest rate. In particular, private human wealth is discounted differently from nonhuman wealth owing to the fact that the human wealth dies with the individual. In this case, a shift in the timing of taxation towards the future could have real consequences owing to the higher and differential discounting of the future by the private sector. This model has as yet only been subjected to limited empirical testing, 3/ and here we are able to test this model for 15 developing countries.

1/ See Barro (1974, 1978) and Leiderman and Blejer (1986).

2/ See Leiderman and Blejer (1986) for a detailed discussion of the implications of relaxing these assumptions.

3/ Except for Razin and Leiderman (1986) and van Wijnbergen (1986) as noted below.

Empirical testing of the Ricardian Equivalence hypothesis has been carried out mainly for the industrial countries. 1/ The empirical approach that has been used has, however, not been based on any explicit optimizing model of consumer behavior. The assumptions of the equivalence proposition have as a result not been explicitly tested. The approach most generally used has been to include fiscal deficit variables in a regression of private consumption on income and wealth to test if the alternative methods of financing have the same effects on private consumption. Although the equivalence argument is primarily based on expectations of future fiscal behavior, no attempts have been made to explicitly incorporate anticipated fiscal variables or expectations behavior into the estimating model. Perhaps for these reasons the accumulated empirical evidence that remains inconclusive. While Barro (1978), Kochin (1974), Kormendi (1983), Seater and Mariano (1985), and Tanner (1979) report evidence supporting the Ricardian Equivalence proposition, Blinder and Deaton (1985), Feldstein (1982), Modigliani (1984), and Reid (1985) provide evidence against equivalence.

Testing of the Ricardian proposition in the context of a dynamic optimizing framework is a recent phenomenon. Leiderman and Razin (1986), in an approach similar to this paper estimate a version of the Blanchard's (1985) model using monthly data from Israel. Their tests provide evidence in favor of the Blanchard hypothesis of different planning horizons of the government and private citizens, and therefore against Ricardian Equivalence. However, as outlined below their approach suffers from certain weaknesses in the presence of which their results are hard to interpret. The only other attempt at empirically testing the Blanchard-Yaari model has been made by van Wijnbergen (1986). 2/ Recognizing that the Blanchard-Yaari approach essentially implied that the discount rates of the private sector and the government were different, he tested for such differences for the OECD countries. The results of this test which also assumed static expectations suggested strong evidence in favor of the Blanchard-Yaari approach.

III. A Model of Fiscal Policy and Private Saving

The Blanchard-Yaari approach assumes that individuals owing to a finite and known probability of death (or survival), have a planning horizon that is different from that of the government, which represents the society at large. Whereas society at large has an infinite horizon for its decision-making, individuals recognize the finiteness of their planning horizons. The finiteness of life could be interpreted more

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1/ The only exception being Leiderman and Razin (1986) who test for Ricardian equivalence in Israel using an approach similar to this paper.

2/ Since Blanchard (1985) used Yaari's (1985) model of finite lived consumers to study fiscal policy, the modelling approach used here is interchangeably attributed to Blanchard and to Blanchard and Yaari.

broadly as a possibility of dynastic extinction. 1/ Barro's (1974) hypothesis that bequest motives could lead individuals to behave as if they were infinitely-lived and therefore to a situation where government debt was fully discounted and complete Ricardian equivalence prevailed, may not hold if individuals recognize this probability of dynastic extinction. Blanchard (1984, 1985) has shown that this finiteness of individual lives results in higher effective discount rate for human capital that dies with the concerned individual than for nonhuman wealth that lives on. This difference in discount rates implies nonneutrality of debt and deficits.

For the purposes of this paper we shall consider developing an empirical version of the Blanchard model both in the static and Rational Expectation cases. The main reasons for developing and estimating the static expectation case are computational ease of estimating such models and the fact that a version of the static expectation model is the one that has been typically estimated. 2/

1. Static expectations

In each time period we assume that a new generation is born while each existing generation faces a probability of death (or survival). Thus, while the size of the older generation is constantly being reduced, a new generation is being added each period. Consequently in our model there are overlapping generations of finitely lived individuals. Denoting the consumption of an individual of age a at time t by $C_{a,t}$ and using a constant relative risk aversion utility function, utility in period t, may be written as 3/

$$(1) \quad U_t = \frac{1}{1-\theta} \sum_{k=0}^{\infty} \delta^k \, c_{a+k,\, t+k}^{1-\theta}$$

where δ denotes the subjective discount factor and θ is the reciprocal of the intertemporal elasticity of substitution σ (i.e., $\theta = \frac{1}{\sigma}$).

In each period, each individual is assumed to face a known probability of survival denoted γ, which, for mathematical convenience, is assumed to be independent of age. Thus the probability that an individual survives k periods is γ^k. Expected utility in period t is therefore the discounted sum of expected utilities in the future:

$$(2) \quad E_t U_t = \frac{1}{1-\theta} E_t \sum_{k=0}^{\infty} \delta^k \, c_{a+k,\, t+k}^{1-\theta} = \frac{1}{1-\theta} \sum_{k=0}^{\infty} (\gamma\delta)^k \, c_{a+k,\, t+k}^{1-\theta}$$

1/ See Buiter (1986).

2/ See Leiderman and Razin (1986) and van Wijnbergen (1986).

3/ For simplicity this section does not consider the case of uncertainty but develops only the case of static expectations in the case of perfect certainty.

Effectively the probability of survival raises the subjective rate of discount, thereby tilting consumption towards the present. 1/

Following Blanchard (1985) we assume that insurance companies exist that at the time of death cover outstanding debt while assuming the estate. Competition among insurance companies ensures that the insurance premium equals $1-\gamma$. Given a constant interest rate denoted r, the effective borrowing rate in the presence of the probability of death and the insurance arrangement, is $\frac{1+r}{\gamma}$.

Assuming no constraints on borrowing, the lifetime budget constraint can be written as:

$$(3) \quad w\sum_{k=0}^{\infty} (\gamma\alpha)^k c_{a+k,\,k} = \sum_{k=0}^{\infty} (\gamma\alpha)^k (y_k - \tau_k) - (\gamma\alpha)^{-1} b_{a-1,1}$$

$$= w_{a,0}$$

where $\alpha = \frac{1}{1+r}$ and $w_{a,0}$ is the wealth of an individual of age a at period zero.

In deriving this budget constraint, use has been made of the solvency requirement that at the limit as k approaches infinity the present value of the debt commitment is zero, i.e.,

$$(4) \quad \lim_{k\to\infty} (\gamma\alpha)^k b_{a+k,\,k} = 0$$

It can be seen from equation (3) that current wealth consists of two components: human wealth, which is the discounted sum of the future stream of disposable incomes; and financial or nonhuman wealth equivalent to interest plus the repayment of principal or past debt commitments (which may be negative or positive). Since human wealth is specific to the individual it disappears from the system when the individual dies. Because of the insurance mechanism financial wealth is retained within the system. The two types of wealth are, therefore, discounted differently.

The individual problem is to maximize the discounted sum of lifetime expected utility (2) subject to the lifetime budget constraint (3). The following consumption function is derived from this maximization.

$$(5) \quad c_{a+t,t} = (1 - s)\, w_{a,t}$$

1/ See Blanchard (1985) and Frenkel and Razin (1986).

with s being defined by

$$(6) \quad s = \gamma\delta^{\sigma}\alpha^{1-\sigma}$$

since there are overlapping generations of individuals in this society, to derive the aggregate consumption function we must determine the size of each cohort and sum across all cohorts. Normalizing the population such that at birth each cohort consists of one individual who is assumed to be born without debt, the size of each cohort of age a is γ^a. Thus in each period there are γ^a members of the cohort of individuals of age a. The size of the population is therefore a constant given by

$$(7) \quad \sum_{a=0}^{\infty} \gamma^a = \frac{1}{1-\gamma}.$$

Per capita aggregate wealth is therefore the sum of the wealth of all individuals from all cohorts divided by the total population.

$$(8) \quad W_t = (1-\gamma) \sum_{a=0}^{\infty} \gamma^a w_{a,t}.$$

In terms of its human and nonhuman components per capita aggregate wealth can be rewritten as the sum of the value of human wealth in that period (H_t) net of interest and principal payments on past private sector debt ($\alpha^{-1} B^p_{t-1}$).

$$(9) \quad W_t = H_t - \alpha^{-1} B^p_{t-1}$$

where

$$(10) \quad H_t = (1-\gamma) \sum_{a=0}^{\infty} \gamma^a \sum_{k=t}^{\infty} (\gamma\alpha)^{k-t} (y_k - \tau_k) = \sum_{k=t}^{\infty} (\gamma\alpha)^{k-t} (y_k - \tau_k)$$

and

$$(11) \quad B^p_t = (1-\gamma) \sum_{a=0}^{\infty} \gamma^{a-1} b_{a-1,\, t-1}$$

The per capita value of aggregate human wealth is defined as the discounted sum of the stream of future per capita disposable incomes computed by using the effective (risk-adjusted) rates of incomes computed by using the effective (risk-adjusted) rates of interest. It may be noted that in contrast with the individual budget constraint (3)

where the rate of interest applicable to individual debt was the risk adjusted rate, the rate applicable to per capita national debt in (11) is the risk-free rate.

Similarly aggregate per capita consumption is the sum of the consumption of all individuals from all cohorts divided by the total population:

$$(12) \quad C_t = (1-\gamma) \sum_{a=0}^{\infty} \gamma^a c_{a,t}$$

Aggregate consumption as a function of aggregate wealth may therefore be written as:

$$(13) \quad C_t = (1 - s) W_t.$$

Equation (13) contrasted with equation (6) shows that the marginal propensity to consume remains invariant across aggregation.

Using the per capita relationships that we have developed we can also derive the economy-wide per capita budget constraint by aggregating individual budget constraints across cohorts for period t.

$$(14) \quad C_t = B_t^p - \alpha^{-1} B_{t-1}^p + Y_t - T_t.$$

where Y_t denotes per capita real income and T_t is real per capita taxes.

Substituting the definition of per capita consumption function, (13) and the definition of aggregate wealth (9), into the budget constraint (14) we have

$$(15) \quad B_t^P = \alpha^{-1} B_{t-1}^P + (1-s) (H_t - \alpha^{-1} B_{t-1}^P) - Y_t + T_t.$$

With static expectations per capita human wealth may be written as

$$(16) \quad H_t = \frac{1}{1-\gamma\alpha} (Y_t - T_t)$$

Substituting (16) into 15 and rearranging we obtain

$$(17) \quad B_t^P = -s (H_t - \alpha^{-1} B_{t-1}^P) + \gamma\alpha H_t$$

Lagging equation (17) one period, multiplying by α^{-1}, and using the definition of wealth given by (9), the consumption function can be rewritten as follows:

$$(18) \quad C_t = s\alpha^{-1}C_{t-1} + (1-s)\,H_t - \gamma\,(1-S)\,H_{t-1}$$

using (16) to substitute for H_t and H_{t-1} yields

$$(19) \quad C_t = s\alpha^{-1}C_{t-1} + \frac{(1-s)}{1-\gamma\alpha}\,(Y_t - T_t) - \frac{\gamma(1-s)}{1-\gamma\alpha}\,(Y_{t-1} - T_{t-1})$$

We have, therefore, an estimable form of the consumption function with lagged consumption, current disposable income and lagged disposable income as independent variables. In their formulation Leiderman and Razin (1986) maintained the assumption of perfect foresight when differencing to eliminate debt but later switched to static expectations. The inconsistency of assumptions regarding expectations in their derivation resulted in their having missed out the lagged disposable income term in their specification of the final consumption function.

At this point it is worth noting three important considerations about equation (19). First, it offers us a convenient specification for testing for Ricardian Equivalence. Rewriting equation (19) as

$$(20) \quad C_t = \beta_0 C_{t-1} + \beta_1(Y_t - T_t) + \beta_2(Y_{t-1} - T_{t-1})$$

where $\beta_0 = s\alpha^{-1}$

$$\beta_1 = \frac{1-s}{1-\gamma\alpha}$$

$$\beta_2 = -\frac{\gamma(1-s)}{1-\gamma\alpha}$$

From the definitions of the parameters it is readily apparent that if β_1 is equal to β_2 then γ has to be equal to one and Ricardian equivalence holds. Alternatively, given adequate data one could also obtain direct estimates of s, α, and γ by using a nonlinear estimation technique. Second, with β_0 equal to one and $\beta_1 = \beta_2$ equation (20) reduces simply to the Hall (1978) specification in which current consumption and last period's consumption differ only by the extent of the forecast

error in current disposable income. 1/ In the case of static expectations the forecast error is merely the actual increase in disposable income since it was expected that last period's disposable income would be obtained this period. Third, the only way in which other government variables could be entered into the consumption function is via the tax variable in disposable income. Given static expectations and assuming no monetization of deficits the government budget constraint can be written as

$$(21) \quad \frac{\alpha^{-1}}{\alpha^{-1}-1}(T - G) = \alpha^{-1}B^{G}_{t-1}$$

where $\alpha^{-1}B^{G}_{t-1}$ is last period's borrowing plus the interest paid on it.

Solving for T in (21) one can then substitute into (20). However, it must be remembered that the model only gives us three parameters to estimate (s, α, and γ). In its constrained form the consumption function with the government budget constraint substituted in will give us nothing more than what estimating (20) would give us. To estimate it in its unconstrained form would allow us to violate among other things the government budget constraint. The essential point to be made is that there is no gain to substituting for taxes in equation (20). The parameter γ, or what is more important to testing for Ricardian Equivalence whether γ equals one or not can be implemented using equation (20). Moreover, for the developing economies where data shortages are acute, especially when it comes to an adequate length of reliable time series of fiscal variables, it is certainly advantageous to be able to do without them.

2. Rational expectations

Unlike the deterministic case, in a stochastic environment there is no closed form solution to the consumer's optimization problem. 2/ Consequently following convention, the stochastic version of our consumption function is posited by adding on an error term to the consumption function derived above. The consumption function of the last section may therefore be rewritten as

$$(22) \quad C_t = (1-s)\, W_t + u_t$$

1/ Hall (1978) argued that consumption was essentially a random walk, in that current consumption was expected to be the same as last period's consumption but for a random element. However, Flavin (1981) correctly pointed out that consumption would be an exact random walk only if the transitory component of income were identically equal to zero. In our specification the counterpart of the Flavin transitory component is the expected change in income over the two periods.

2/ See Hayashi (1982).

Assuming that future disposable incomes are not known human capital is now the discounted sum of expected future disposable incomes:

$$(23)\quad H_t = \sum_{k=t}^{\infty} (\gamma\alpha)^{k-t} E_t(Y_k - T_k)$$

Alternatively, this expression for human capital may be expressed as a stochastic difference equation:

$$(24)\quad H_t = \frac{1}{\gamma\alpha} (H_{t-1} - Y_{t-1} + T_{t-1}) + e_t$$

where e_t is the forecast error in predicting future disposable incomes.

$$(25)\quad e_t = \sum_{k=0}^{\infty} (\gamma\alpha)^k [E_t(Y_{t+k} - T_{t+k}) - E_{t-1}(Y_{t+k} - T_{t+k})]$$

Substituting (22) into the budget constraint (14) we have

$$(26)\quad B_t^p = \alpha^{-1} B_{t-1}^p + (1-s)(H_t - \alpha^{-1} B_{t-1}^p) + T_t - Y_t + u_t$$

Using the definition of human wealth in stochastic difference form, i.e., equations (22) and (26) may be rewritten

$$(27)\quad B_t^p = -s(H_t - \alpha^{-1} B_{t-1}^p) + (\gamma\alpha)(H_t - e_t) + u_t$$

Multiplying the lagged version of (27) by α^{-1} and subtracting both sides from H_t and using the consumption function (22)

$$(28)\quad C_t = s\alpha^{-1} C_{t-1} + (1-\gamma)(1-s) H_t + (1-s)\gamma e_t - \alpha^{-1} u_{t-1} + u_t$$

The unobservable H_t can be eliminated by multiplying the lagged value of equation (28) by $\frac{1}{\gamma\alpha}$, subtracting from equation (28), and using the stochastic difference equation for human capital

$$(29)\quad C_t = \alpha^{-1}(s + \tfrac{1}{\gamma}) C_{t-1} - \frac{s\alpha^{-2}}{\gamma} C_{t-2} - (1-\gamma)(1-s)\frac{\alpha^{-1}}{\gamma}(Y_{t-1} - T_{t-1})$$
$$+ (1-s)[e_t - \frac{\alpha^{-1}}{\gamma} e_{t-1} + u_t - \alpha^{-1} u_{t-1} + \frac{\alpha^{-2}}{\gamma} u_{t-2}]$$

Equation (29) gives us an estimable form of the consumption function that requires only a series for consumption and disposable income and will allow us to test whether or not there are differences in subjective rates of time preference of the individuals in a society and of society. Using a nonlinear method direct estimates of the three parameters of interest, s, α, and γ, could be derived. However, if interest is only in seeing if the Ricardian hypothesis holds or not, and not in the parameter estimates per se, an easier approach could be followed. It should be noted that the errors in equation (29) follow a complicated autoregressive-moving average process. In linear terms equation (29) could be written as

$$(30) \quad C_t = \eta_0 C_{t-1} + \eta_1 C_{t-2} + \eta_2 (Y_{t-1} - T_{t-1}) + v_t$$

where $\eta_0 = \alpha^{-1} (s + \frac{1}{\gamma})$

$$\eta_1 = - \frac{s\alpha^{-2}}{\gamma}$$

$$\eta_2 = -(1 - \gamma)(1 - s) \frac{\alpha^{-1}}{\gamma}$$

and $(21) \quad v_t = \xi_1 e_t + \xi_2 e_{t-1} + u_t + \xi u_{t-1} + \xi_4 u_{t-2}$

Notice that (28) allows us to test for Ricardian equivalence using linear rather than nonlinear methods. If in a linear estimation that accounts for the autoregressive-moving average error process, the coefficient of lagged disposable income η_2, is insignificant, it can be inferred that the subjective probability of survival is one, and that the differences in the horizons between the government and the citizens cannot be regarded as a source of Ricardian equivalence. 1/

Another interesting feature of the model that can be seen from equation (28) is that if the Ricardian equivalence hypothesis is accepted (i.e., $\eta_2 = 0$ or $\gamma = 1$) then consumption will turn out to be a function of lagged consumption only. As mentioned earlier, Hall (1978) had proven that in a rational expectations framework, consumption would be a random walk, i.e., would differ from lagged consumption only by a random component. With $\gamma = 1$ equation (28) can be rewritten as

$$(32) \quad C_t = \theta C_{t-1} + {}_1 e_t + {}_2 u_{t-1}$$

1/ Note that as before if the probability of survival is equal to one, then the specification (28) reduces to the Hall hypothesis that consumption is a random walk.

which is similar to the Flavin (1981) re-specification of the Hall approach with the transitory components of income not equal to zero. Since $\theta = s\alpha^{-1}$, reasonable assumptions for the values of s and α would imply a value of θ close to one, which is similar to that implied by the Hall model.

IV. The Results

As discussed earlier, most of the empirical testing of the Ricardian Equivalence hypothesis has been done for the industrial countries in the context of a consumption function that was not derived from any optimizing approach. Here the equations that were derived in the last section using an optimizing approach are estimated for a sample of developing countries. The data were drawn from the World Bank's Economic and Social Database and approximately cover the period 1960-85. The exact length of the series used for each country is shown in Table 1. The sample consisted of the 16 countries: Algeria, Brazil, Cameroon, Colombia, Egypt, Indonesia, Korea, Malaysia, Mexico, Pakistan, Philippines, Peru, Sudan, Turkey, Tunisia, and Yugoslavia. Other than data considerations the choice of the sample was determined by the desire to maintain a geographical balance and to obtain a sample that is representative of various categories of developing countries. Thus, our sample contains five African countries, two European countries, four Latin American countries and five Asian countries. Classifying countries with per capita incomes in 1984 of $800 or less as low income countries, there are seven low income countries in our sample and nine middle income countries. 1/ The sample also contains seven oil exporters.

For each country the dependent variable used is real private consumption. For the independent variable, a measure of labor income and tax revenue is needed. Unfortunately, satisfactory estimates of both variables are not generally available for most of the countries in the sample. Gross revenues were not used because they were generally available only for a period of some ten years, and these figures could not be purged of nontax revenues, such as oil revenues. For these reasons it was decided to proxy disposable income by the gross national product divided by the consumer price index. 2/

For the estimation of the rational expectations specification (equation (30) above), generalized instrumental variables were used. The instruments are required because the estimating form involves both a lagged dependent variable and a fairly complicated auto-regressive-

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1/ See World Development Report, World Bank (1986).

2/ Since most of the countries under consideration have tax bases that are largely unresponsive to changes in income and since labor income is highly correlated with gross national product, the proxy used is likely to be fairly good.

Table 1. Generalized Instrumental Variable Estimation of the Consumption Function 1/

$$C_t = \eta_0 C_{t-1} + \eta_1 C_{t-2} + \eta_2 (Y_{t-1} - T_{t-1}) + v_t$$

Country	η_0	η_1	η_2	R^2	F	Sample Size
Algeria	1.324 (2.05)	-0.332 (-0.511)	0.015 (0.266)	0.97	104.291	1960-85
Brazil	1.409 (1.934)	-0.683 (-1.369)	0.192 (0.994)	0.989	266.953	1961-84
Cameroon	1.444 (1.96)	-0.434 (-0.605)	0.0001 (0.001)	0.851	12.643	1964-85
Colombia	1.939 (13.497)	-0.886 (-7.563)	-0.039 (-0.801)	0.991	362.08	1960-85
Egypt	1.199 (3.396)	-0.358 (-1.216)	0.113 (1.301)	0.922	38.045	1960-85
Indonesia	1.191 (0.936)	-0.178 (-0.177)	0.016 (0.057)	0.977	135.255	1960-85
Korea	1.4 (3.25)	-0.299 (-0.691)	-0.048 (-0.688)	0.994	520.08	1960-85
Malaysia	1.967 (1.384)	-0.921 (0)	-0.023 (-0.091)	0.982	174.2321	1960-85
Mexico	1.735 (5.906)	-0.506 (-1.39)	-0.152 (-2.527)	0.968	91.528	1961-84
Pakistan	0.783 (1.079)	-0.074 (-0.18)	0.248 (0.673)	0.962	75.434	1960-85
Peru	1.656 (7.056)	-0.705 (-4.373)	0.035 (0.432)	0.89	25.869	1963-85
Philippines	2.571 (2.831)	-1.544 (-1.879)	-0.026 (-0.275)	0.987	224.753	1960-85
Sudan	1.412 (5.42)	-0.533 (-2.057)	0.089 (0.655)	0.687	7.024	1960-85
Tunisia	1.563 (6.891)	-0.433 (-1.904)	-0.068 (-1.085)	0.987	211.2635	1960-85
Turkey	1.635 (3.482)	-0.506 (-1.028)	-0.084 (-0.752)	0.949	59.385	1960-85
Yugoslavia	1.104 (2.0356)	-0.026 (-0.47)	-0.018 (-0.132)	0.962	76.0331	1960-85

1/ t-ratios in parentheses.

moving average error process. As required by theory, the instruments were chosen such that they are uncorrelated with the residuals and correlated with the dependent variable--private consumption. The instruments that were used were lagged domestic credit to the government and lagged exports both deflated by the consume price index, and income lagged by one and two periods. The estimation technique first used ordinary least squares to derive estimates of the errors. These estimates were used to derive an estimate of the error covariance matrix which was then used to weight the residual sum of squares at the second stage. 1/

The results for the rational expectations model are presented in Table 1. In general, the fit appears to be reasonable while the coefficients have the signs that the model predicts. Lagged consumption is significantly different from zero at the 5 percent level and has a point estimate larger than one in most countries while the second lag of consumption though significant in fewer countries is negative. The most important result from the viewpoint of the paper is that the coefficient of lagged disposable income is insignificant in all countries, except Mexico. This tends to provide evidence for the Ricardian equivalence hypothesis. It appears, therefore, that in a rational expectations setting there is little support for the Blanchard hypothesis of differing discount rates for the private sector and the government.

As pointed out earlier, if $\gamma=1$ i.e., the equivalence proposition holds, the Hall specification of consumption being a random walk is suggested. The results in Table 1 tend to support this specification of a random walk. In most cases lagged consumption has a coefficient that is significantly different from zero but not from one while the other variables are insignificant. Only in four cases (Colombia, Mexico, Peru, and Tunisia) does the coefficient of lagged consumption differ from unity. In these cases however, the second lag of consumption tends to be close to one as predicted by the model. To see this, note that the estimating form (29) is just a differenced version of (28) with $\gamma=1$. In this differenced case the expectation is that the coefficient of lagged consumption be larger than one and the coefficient of the second lag be negative and close to one. The empirical results suggest that the Hall specification with $\gamma=1$ and coefficient of lagged consumption of $s\alpha^{-1}$ which is close to one appears to be the correct one. 2/ Thus the equivalence proposition is verified rather than the Blanchard model with finite-lived consumers.

1/ Although not required, the estimation process was iterative in that at each stage the error covariance matrix was re-estimated to achieve convergence of the weighted sum of squared residuals.

2/ The Hall specification (equation (21)) also yielded satisfactory results for the countries in our sample.

V. Conclusion

Considerable interest has recently been generated in the economic consequences of fiscal policy. The large and growing fiscal deficits of recent years in most countries have contributed to the fueling of this interest. In particular, the earlier Keynesian notion that an expansion of government expenditures financed by an increase in the stock of debt could have desirable countercyclical and growth effects has been challenged. It is hypothesized that rational economic agents would be able to see that the increase in current debt merely represents a shift in the timing of taxation from the current period to the future. To provide for this anticipated increase in taxation in the future these consumers will adjust their consumption today. In the extreme case the increase in government consumption may be fully offset by the private sector, thereby leaving aggregate consumption unchanged. The policy of pump-priming the economy by incurring current deficits would therefore not work.

This line of reasoning led to the revival of the Ricardian proposition that states that debt-financing and tax-financing of a given path of government expenditures have equivalent real consequences. If this proposition holds then domestic saving, a magnitude of considerable importance to a country's growth prospects, would remain unchanged when government saving increases or decreases given the offsetting behavior of the private sector.

In this paper the equivalence proposition has been tested for the first time for a number of developing countries. Unlike most other tests that have been carried out for the United States the approach used here was based on an explicit optimizing model of consumer behavior in a rational-expectation setting. The notion that a departure from Ricardian equivalence could occur if the planning horizons of the government and the private sector were different has recently received a great deal of attention in the theoretical litrature. 1/ The model developed here tests whether such differences in planning horizons could be a determinant of nonequivalence.

The results of the empirical tests, provide evidence that seems to be largely in favor of Ricardian equivalence. For 15 of the 16 countries in the sample the equivalence hypothesis is borne out and no difference between the planning horizon of the private sector and the government is indicated. For these countries, as one would expect when Ricardian equivalence holds, consumption appears to follow the random walk specification of Hall (1978).

It was noted above that a number of factors could lead to the observation of nonequivalence. Whereas our model was able to capture and test for one such factor, in future research it might be worthwhile

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1/ See Blanchard (1985), Buiter (1986), Frenkel and Razin (1986).

to investigate whether factors such as liquidity constraints that might arise from imperfections in capital markets, and a distortionary tax structure, could lead to a deviation from equivalence. In the course of this investigation it would be of obvious interest to also study if the result of this paper were in any manner influenced by the possibility of the simultaneous observation of factors that result in the observation of nonequivalence. A useful direction might be to incorporate liquidity constraints in the model proposed here to check whether such constraints hold along with finite individual planning horizons. If either or both liquidity constraints and finite planning horizons hold, Ricardian equivalence would not obtain.

Finally, the evidence provided here in support of the equivalence proposition in most developing countries has important implications for policy. First, assuming that private and public savings behavior are independent would lead to serious biases and perhaps inaccurate policy prescriptions. Second, the external financing constraint that most countries have faced since the shrinking of international capital markets has contributed to a slowdown in growth. For the regeneration of growth an increase in domestic saving would be required. To assume, as is often done, that an increase in public saving could achieve the necessary increase in domestic saving would not be correct if Ricardian equivalence holds as the evidence suggests. For a given path of government expenditures an increase in government saving would imply a reduction in future taxation and hence lead to an increase in current consumption. Consequently, while a decrease in fiscal deficits may be required because of the external financing constraint, the possibility that increased government saving might leave domestic saving unchanged and hence have no positive impact on growth should be recognized and taken into account in the framing of policy.

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