How Effective is Fiscal Policy in Raising National Saving?

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Abstract

While fiscal adjustment is commonly viewed as the cornerstone of macroeconomic stabilization, the effectiveness of alternative fiscal instruments in raising national saving is still poorly understood. This paper enters the debate by estimating a private consumption function that allows for two types of agents, finite horizons and liquidity constraints, and nests three different consumption hypotheses. Using a large panel data set including both industrial and developing countries, we reject full Ricardian equivalence. We also find substantial differences between industrial and developing countries, regarding both the extent of Ricardian offsetting and the degree to which the government budget constraint is internalized.

KEYWORDS: Saving, Fiscal Policy, Ricardian Equivalence.

JEL classification: E21; E62.

1 Introduction

In recent years the world has followed a generalized trend towards fiscal orthodoxy. In industrial countries, the steady rise in fiscal deficits since the 1980s (IMF 1995) has been recently reversed both in the U.S., with the balanced-budget agreement of 1997, and in the European Union, under the fiscal constraints imposed by the Maastricht criteria. Developing countries have also joined the trend: since the late 1980s, many countries traditionally suffering high or even hyper-inflation have succeeded in radical stabilization based on fiscal orthodoxy (with Argentina perhaps as the clearest example), while most other developing countries have been able to strengthen their fiscal stance, with some of them showing consistent fiscal surpluses for a decade or more (Singapore, Chile).

While fiscal adjustment is commonly regarded as the cornerstone of macroeconomic stabilization,[1] the actual impact of lower public deficits on national saving and the current account balance remains both theoretically and empirically controversial. Yet this question is essential to assess the ability of fiscal policy to contribute to the economy's external equilibrium and reduce its vulnerability to external shocks, such as changes in terms of trade and capital inflows. Further, the relative effectiveness of alternative fiscal instruments (taxes, government consumption, transfers) is still poorly understood.

From the analytical perspective, alternative consumption theories offer very different predictions about the effects of fiscal policy on national saving. While under the simple Keynesian hypothesis only current levels of taxation matter for private consumption and saving decisions, under the permanent-income hypothesis future taxes - over an infinite horizon - matter as well. The latter notion is taken to its logical limit by the Ricardian equivalence proposition, that states that rational forward-looking consumers react only to permanent government spending, implying that how government expenditure is financed - taxation, inflation or debt - matters neither for private consumption nor for national saving (Barro 1974). In turn, the life-cycle approach with finite lives offers a different prediction: if inter-generational transfers are not fully operative, fiscal policy affects national saving as long as it shifts income across different cohorts.

In reality, however, consumption reacts more strongly to current income (net of taxes or government spending) than these forward-looking theories would predict (e.g., Deaton 1992). One plausible explanation for this fact are borrowing constraints faced by a significant share of consumers, which force them to a corner solution to their intertemporal optimization problem. As a result, they react strongly to higher current disposable income (and hence to lower current taxes) by raising their consumption significantly – just

[1] Monetary policy is a second cornerstone of stabilization. Even if fiscal adjustment is matched by lower private saving so that national saving is unchanged, the reduced pressure for monetizing government debt improves macroeconomic conditions.

as if they were Keynesian or myopic.

Distortionary taxation gives rise to further effects of fiscal policy on consumption and saving. Changes in the time profile of distorting taxes can affect the consumption plans of forward-looking agents, even when the present value of taxes is left unchanged. Finally, private consumers may also react to public consumption because their utility - not their budget constraints - is directly affected (Bailey 1971). If public consumption is perceived as a substitute (complement) for private consumption - like in the case of public education, for example - then an increase in the former will be accompanied by a decline (increase) in the latter.

In turn, the empirical literature has devoted considerable attention to the effects of fiscal policy on private consumption or saving during the last decade. Most studies belong to either of two types. The first category is based on the empirical implementation of private consumption functions derived from first principles (and therefore including a limited set of regressors) that are used to test for specific departures from Ricardian equivalence and/or for substitutability/complementarity between private and public consumption. The second group of studies is based on general reduced-form equations for private consumption or saving (including a broad number of regressors) used to measure directly the effect of fiscal variables, providing estimates of private-public saving offset coefficients. Estimations are typically based on time-series macroeconomic data for one or several industrial and developing countries.

What does this empirical literature find? As we document in more detail below, the results are very mixed. A majority of studies rejects strict Ricardian equivalence, but this rejection is far from unanimous. Estimated public-private saving offset coefficients are typically significantly different from both 1 and 0, but the range of empirical results is still very broad. In turn, estimates of public-private consumption substitution range from positive to negative in different countries and across different studies. Behind these large discrepancies in parameter estimates and policy inferences are large differences in specification, sample coverage and quality, and estimation techniques.

The purpose of this paper is to offer a fresh look at the world evidence on the saving impact of fiscal policy. In doing this we extend the preceding literature in four dimensions. First, we develop a consumption model that aggregates over two representative individuals and encompasses three consumption hypotheses. Second, we estimate the model on a large macroeconomic panel data set (derived from the World Bank Saving Project database) including 19 industrial and 22 developing countries, that offers significant advantages over previous studies in terms of data quality and coverage. Third, in contrast with all preceding work, that is based on individual country time-series estimations, we make use of panel estimation methods that allow us to correct for simultaneity and heterogeneity by using instrumental variable procedures based on "internal" instruments. Fourth, our large data set allows us to estimate the model separately on the industrial and developing-country samples, and hence makes it possible to identify any significant

differences between them. The paper is organized as follows. The next section reviews briefly the previous empirical literature. Section 3 presents the detailed derivation of the model. Next we discuss the data and econometric techniques. The estimation results are reported in section 5. Finally, section 6 concludes.

2 Overview of previous results

As stated above, the recent empirical literature on the effects of fiscal policy on private consumption and saving falls into one of two categories: narrow models derived from first principles or broad reduced-form specifications. We first summarize briefly the former group of studies, that are based on private consumption functions derived from intertemporal optimization and whose empirical implementation typically includes a limited number of regressors. These studies are aimed at testing for specific deviations of Ricardian equivalence and/or for substitutability/complementarity between private and public consumption.

Stringent assumptions are required for Ricardian equivalence to hold (for a detailed review see Seater 1993). Among the most important are the following: (i) full intergenerational caring (equivalent to assuming that the public and private sectors share the same discount rate or that the private sector has an infinite horizon), (ii) perfect capital markets (i.e. absence of borrowing constraints), (iii) far-sighted rational consumers that internalize the government's intertemporal budget constraint, (iv) absence of uncertainty (unless complete contingent/insurance markets exist that render ineffective any market-completing efforts of fiscal policy), and (v) non-distortionary taxes, subsidies and transfers. Empirical consumption studies testing Ricardian equivalence have concentrated mostly on the first and second assumptions.

To test the assumption of infinite horizons, most empirical studies follow Blanchard's (1985) model of overlapping generations with finite horizons, reflected by a survival probability (γ) smaller than 1. Some studies test separately for the existence of heterogeneous consumers, by introducing a parameter (λ) measuring the proportion of consumers that face binding borrowing constraints and therefore find themselves at a corner solution of their desired intertemporal consumption plan.

The Ricardian equivalence proposition has spawned a large industry of empirical studies -most on the U.S., some on industrial countries, and a few on developing countries- and a related cottage industry that surveys them. Among the latter surveys, Bernheim (1987), Leiderman and Blejer (1988), and Elmendorf and Mankiw (1998) tend to conclude that the empirical evidence rejects Ricardian equivalence. However "a small but prominent minority of economists, including Robert Barro, have argued that Ricardian equivalence does in fact describe the world, at least as a first approximation" (Elmendorf and Mankiw, 1998, p. 43) -a view also reflected in Seater's (1993) survey.

Since in this paper our interest is in multi-country studies, in Table 1 we present a brief summary of empirical results limited to a selected number of studies that include a sizable number of countries. As the table shows, the empirical literature almost invariably fails to reject the assumption of infinite horizons. Only in Khalid (1996) - and only in two out of 21 countries covered in that study - the annual survival probability γ is significantly lower than 1. Regarding borrowing constraints (as measured by λ), the opposite result obtains; this type of capital market imperfection is a frequent cause of rejection of Ricardian equivalence in empirical studies. However, the different studies are not unanimous about the extent of this rejection. They range from rejection for each of the 16 countries studied by Haque and Montiel (1989), and 5 out of the 6 countries studied in Campbell and Mankiw (1991) to rejection in only 8 out of 21 countries in Khalid (1996). In those countries where evidence is found of borrowing constraints, the estimated share of constrained consumers varies widely, from 18 percent to 100 percent[2].

In turn, a number of empirical studies have tested for private-public consumption substitution or complementarity – either as a self-standing issue or jointly with tests for Ricardian equivalence – following Bailey's (1971) model where public consumption enters as an argument in consumer utility. These studies typically parameterize the relationship between private and public consumption introducing a coefficient in the utility function (δ), and then test for private-public consumption substitutability ($\delta > 0$) or complementarity ($\delta < 0$).

While Bailey's specification - by far the most commonly used in empirical studies - has the appeal of empirical tractability (because it yields an estimable closed-form solution), it also poses a problem that might bias the results: the way public consumption is introduced in the utility function is very restrictive, as it only allows three extreme possibilities regarding the relation between public and private consumption: perfect substitutability, perfect complementarity, or independence.

Keeping this caveat in mind, the range of results on private-public consumption substitutability reported by the literature is very broad. In Karras (1994), public consumption is estimated to be a complement of private consumption (i.e., $\delta < 0$). However, Evans and Karras (1996) - who use a broader consumption specification - find that private and public consumption are independent (i.e., $\delta = 0$) in 41 countries, while in the remaining 13 countries the results vary in sign. Interestingly, the results reported in Evans and Karras yield an average δ of -1.2 for OECD countries and 1.3 in developing countries[3]. These results would suggest that public consumption is a complement for private consumption

[2]Strictly speaking λ is not the proportion of constrained consumers but the proportion of private consumption by constrained consumers.

[3]The average for the developing countries was computed discarding the African countries in the Evans-Karras study, to facilitate comparability with the results presented later

in industrial countries and a substitute in developing countries. In turn, Khalid (1996) - who uses the most general specification of the studies summarized in Table 1, a variant of the model applied to Israel by Leiderman and Razin (1988) - finds that public consumption is in general a poor substitute for private consumption; he reports δ=0 in 19 out of 21 economies, with significant substitution observed only in 2 countries.

The main empirical lesson from these structural models is that full Ricardian equivalence is typically rejected as a result of binding borrowing constraints affecting a large share of consumers in both developing and industrial economies. However, the infinite-horizon assumption is typically not rejected in those empirical studies based on Blanchard's finite-horizon model.[4] Finally, public consumption is generally found to be a poor substitute for private consumption, and in some cases the empirical relation turns out to be one of complementarity. The implication is that little, if any, direct crowding out of private consumption by public consumption should be expected, at least at the high levels of aggregation of agents and spending categories employed in these studies.

The second broad group of empirical studies uses a radically different approach, based on reduced-form private consumption or saving equations including a larger number of regressors. These studies aim at measuring directly the impact of fiscal variables, and yield estimates of private-public saving offset coefficients. Typical consumption or saving specifications include different regressors to test for Ricardian equivalence, like public deficits, household wealth, tax revenue, public debt, government transfers. Of course, the results from these studies are more vulnerable to the Lucas' critique than those of the structural models above.

Along these lines, many recent studies based on reduced-form private saving specifications, controlling for various consumption determinants, report private-public saving offset coefficients. Most are single-country time-series studies, and as before we confine our attention to a few selected panel studies with a sufficient cross-country dimension; their results are summarized in Table 2. The offset coefficients reported by the six studies in the table are in all cases significantly smaller than 1. But they are not zero either, and their range across studies is very large, from 0.23 (in Dayal-Ghulati and Thimann 1997) to 0.69 (in Loayza, Schmidt-Hebberl and Serven 2000). The qualitative policy implication of these results is straightforward: fiscal adjustment is an effective way to raise national saving - but the quantitative extent of this effect is much less clear: according to these estimates, the impact on national saving of an increase in public saving by one

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using our sample, that contains no African countries.

[4]In a sense, borrowing constraints play a role analogous to that of finite horizons, in that they tend to disconnect present consumers from their future economic selves; see Weil (1998) for further elaboration.

percentage point of GDP could lie anywhere between 0.77 and 0.35 points of GDP – a range of uncertainty broad enough to deserve further scrutiny.

3 The model

The objective of this model is to provide a framework to address the effects of fiscal policy on private saving and hence on national saving. In doing so, we allow for different mechanisms through which public expenditure and revenue decisions may affect private consumption and saving levels. We allow for heterogeneous consumer groups that differ in their reaction to fiscal policy, as considered previously in Haque and Montiel (1989), Campbell and Mankiw (1991), Corbo and Schmidt-Hebbel (1991), Evans and Karras (1996) and Khalid (1996). In these papers heterogeneity is introduced by allowing two types of consumers. Consumer 1 is unable to optimize intertemporally because of a binding borrowing constraint that forces her to consume all her disposable income. An alternative interpretation is that of a myopic agent with a utility function where only current consumption enters as an argument. Consumer 2 does not face borrowing constraints, and her consumption level is the result of an intertemporal optimization consistent with her intertemporal budget constraint. The horizon of such optimization, however, may be finite, as in Blanchard (1985). As noted in the previous section, an infinite horizon is equivalent to full inter-generational caring, whereas finite lives would give more weight in the utility function to present than to future generations. Our model extends previous work by allowing the optimizing consumer to forecast future taxes using information drawn from the observed evolution of both taxes and public consumption.

3.1 Individual Optimization

We next describe the individual's optimization problem, in an open economy with a constant domestic interest rate (assumed to equal the foreign interest rate). Formally, we assume that there are overlapping cohorts who do not face borrowing constraints. Each individual in the cohort faces a constant probability of dying per unit of time denoted $(1-\gamma)$. Hence, the probability of being alive at time $t+j$ for an individual born at t is

γ^j and life expectancy at birth is

$$\sum_{j=1}^{\infty} j\gamma^j = \gamma/(1-\gamma)^2.$$

When $\gamma = 1$ life expectancy would be infinite, and when $\gamma = .9$, say, life expectancy is 90 years. In each period a new cohort is born of size $(1-\gamma)$ (a normalization factor so that total population is 1). Each cohort is assumed to be large enough so that $(1-\gamma)$ is also the rate at which the cohort size decreases, and hence at time $t+j$ the size of a cohort born at t will be $(1-\gamma)\gamma^j$. When a new cohort is born, her initial wealth is zero. When an individual in the cohort dies, her wealth is distributed among the surviving members of her cohort.

If both domestic and foreign interest rates are denoted by r, the one period effective gross rate of return on private financial wealth will be given by $(1+r)/\gamma$.

Apart from the effective return on the stock of financial wealth at the end of period $t-1$, w^p_{t-1}, at time t individuals have labor income net of taxes and transfers x_t that does not depend on the age of the cohort. At time t individuals have knowledge of x_t but are uncertain about values of x dated $t+j$ $(j > 0)$.

Individuals consume c_t and accumulate domestic financial wealth w^{pd}_t and foreign financial wealth w^{pf}_t. Private financial wealth is therefore $w^p_t = w^{pd}_t + w^{pf}_t$.

Each cohort member solves an intertemporal problem for individual private consumption c_t. Expected lifetime happiness of the individuals is given by the following standard time-separable intertemporal utility function

$$E_t U = E_t \sum_{j=0}^{\infty} (\gamma/(1+\rho))^j u(c_{t+j}), \tag{1}$$

where $E_t(.)$ denotes the expectation conditional on information up to and including t.

Individuals maximize (1) subject to

$$x_t - c_t + (\gamma R)^{-1} w^p_{t-1} = w^p_t, \tag{2}$$

with

$$x_t = y_t - tt_t$$

and

$$E_t \lim_{T\to\infty} (\gamma R)^T w_T^p = 0. \tag{3}$$

where $R = (1+r)^{-1}$; $(1+\rho)^{-1}$ is the subjective discount factor; y_t is GDP plus private transfers from abroad, and tt_t is taxes net of public transfers. For analytical tractability we assume that the real interest rate r is fixed.

Equation (2) is the dynamic budget constraint of the individual and equation (3) is the standard transversality condition that prevents individuals from going infinitely into debt.[5] Observe that the intertemporal budget constraint of the individual is given by

$$\sum_{j=0}^{\infty} (\gamma R)^j E_t(c_{t+j}) = \sum_{j=0}^{\infty} (\gamma R)^j E_t(x_{t+j}) + (\gamma R)^{-1} w_{t-1}^p. \tag{4}$$

Equation (4) states that the present discounted value of private consumption equals the present discounted value of income net of taxes and transfer plus the effective gross return on financial wealth at $t-1$. In addition to lifetime uncertainty, consumers face uncertainty about all future income, tax, transfer, and consumption flows. Lifetime uncertainty implies a departure from Ricardian equivalence. However uncertainty about future flows does not imply a departure from Ricardian equivalence because complete financial/insurance markets for the borrowing-unconstrained individual are implicitly assumed in this model.

Individual preferences are given by the standard log utility function

$$U(c_t) = log(c_t).$$

[5]Note that the life expectancy parameter γ enters the individual's budget constraint, reflecting the assumption in Blanchard's (1985) model that wealth of individuals who die is distributed among surviving cohort members. This assumption is essential for tractability but obviously does not hold in practice, and therefore empirical estimates of γ may be difficult to interpret as reflecting exclusively expected lifetimes.

The Euler equation describing the optimal intertemporal allocation of private consumption is given by:

$$E_t(c_{t+1}) = ((1+r)/(1+\rho))c_t = sc_t,$$

where $s = ((1+r)/(1+\rho))$. Substituting in the intertemporal budget constraint (4) yields

$$\sum_{j=0}^{\infty}(\gamma Rs)^j c_t = \sum_{j=0}^{\infty}(\gamma R)^j E_t(x_{t+j}) + (\gamma R)^{-1} w_{t-1}^p.$$

or, provided that $\gamma Rs < 1$,

$$(1-\gamma Rs)^{-1} c_t = l_t + (\gamma R)^{-1} w_{t-1}^p,$$

where human wealth at time t is $l_t = \sum_{j=0}^{\infty}(\gamma R)^j E_t(x_{t+j})$. Finally, the solution for a given individual is

$$c_t = (1-\gamma Rs)(l_t + (\gamma R)^{-1} w_{t-1}^p).$$

3.2 Aggregation

Introducing the subindex i to denote an individual born at $t-i$, aggregate effective consumption C_t, private financial wealth (W_t^p) and human wealth L_t are

$$C_t = \sum_{i=0}^{\infty}(1-\gamma)\gamma^i c_{it}$$

$$W_t^p = \sum_{i=0}^{\infty}(1-\gamma)\gamma^i w_{it}^p$$

$$L_t = \sum_{i=0}^{\infty}(1-\gamma)\gamma^i l_{it}.$$

Observe that, since cohort i at time $t-1$ is of size $(1-\gamma)\gamma^{i-1}$, private aggregate wealth at $t-1$ is

$$W^p_{t-1} = \sum_{i=0}^{\infty}(1-\gamma)\gamma^{i-1}w^p_{it-1}.$$

Hence, aggregate consumption is given by

$$C_t = (1-\gamma Rs)((1+r)W^p_{t-1} + L_t). \tag{5}$$

As in Blanchard (1985), we assume that labor income does not depend on age[6] (i.e. x_{it}=x_t), which implies $L_t = l_{it} = l_t$.

The change in private aggregate financial wealth is given by

$$W^p_t - W^p_{t-1} = \sum_{i=0}^{\infty}(1-\gamma)\gamma^i(w^p_{it} - w^p_{it-1}/\gamma) = \sum_{i=0}^{\infty}(1-\gamma)\gamma^i(r\gamma^{-1}w^p_{it-1}) + (x_t - c_{it})),$$

or

$$W^p_t = R^{-1}W^p_{t-1} + X_t - C_t. \tag{6}$$

which is the law of motion of private financial wealth. Hence, even if individual wealth earns a gross rate of return of $(1+r)/\gamma$, aggregate wealth earns a return of $(1+r)$.

An important issue regards the possibility of borrowing constraints. Equation (5) is the reduced form of the consumption equation for individuals that are not constrained and hence can borrow against their future income. In practice, this may not be the case for all individuals in the economy and hence the representative-agent model outlined above may be a poor approximation to reality. We will assume that the economy consists of two groups of individuals: one group of borrowing-constrained individuals that consume all their income (net of taxes), and a second group that is unconstrained and whose consumption is given by (5).

In order to introduce this assumption we assume that the first group is a fixed share (λ_1) of total population and the unconstrained group is the complementary share (1-λ_1). Each group earns a fraction of aggregate incomeand pays a fraction of aggregate

[6]Although the assumption of labor income not depending on age may be strong, a model with the more appealing assumption of different earning profiles becomes untractable.

taxes equal to its share in total population. However, financial wealth is only held by unconstrained individuals. Aggregate consumption is given by the consumption of both groups. Therefore we have:

$$\begin{aligned} C_t &= C_t^u + C_t^c, \\ C_t^c &= \lambda_1(Y_t - tt_t), \\ C_t^u &= (1-\gamma Rs)(1+r)W_{t-1}^p + (1-\lambda_1)((1-\gamma Rs)L_t). \end{aligned} \tag{7}$$

Notice that the latter equations encompass different hypotheses on aggregate consumption behavior depending on the values of the relevant parameters:
(i) Keynesian: λ_1=1;
(ii) Permanent income: λ_1=0, $\gamma < 1$;
(iii) Ricardian Equivalence: λ_1=0, γ=1;

It is important to note that (7) involves optimizing agents' expectations of future variables. Of particular interest are individuals' anticipations of future taxes embedded in the above expression. As noted earlier, the Ricardian equivalence proposition is based on the view that forward-looking individuals internalize the government budget constraint when forming their expectations of future taxation. Taken literally, however, this theoretical view imposes formidable requirements on agents' ability to gather and process information. Thus, to accommodate also less-extreme forms of forward-looking behavior, we shall assume that a certain fraction of the unconstrained individuals (λ_2), fail to see through the "fiscal veil" and hence forecast future taxes using a more limited information set – specifically, the past trajectory of taxes alone. Hence their consumption behavior can be characterized by substituting these univariate tax forecasts into (7). In turn, the remaining fraction of unconstrained individuals, (1 - λ_2), do internalize the government budget constraint. To characterize their behavior, we need to describe the government sector.

3.3 The Government

The government spends cg_t on goods, collects lump-sum taxes (net of domestic transfers) tt_t and receives transfers from the rest of the world tr_t^g. The government issues domestic

debt which is held by the individuals in the economy (i.e. the domestic-currency financial assets of the government are $-w_t^{pd}$) and buys foreign bonds w_t^{gf}. As total population is constant over time and equal to 1, government financial wealth in per-capita terms is $w_t^g = -w_t^{pd} + w_t^{gf}$. Therefore the government's budget constraint is given by

$$tr_t^g + tt_t - cg_t + (1+r)w_{t-1}^g = w_t^g,$$

with

$$E_t \lim_{T\to\infty} R^T w_T^g = 0. \tag{8}$$

Notice also that the gross rate of return relevant for the government is $(1+r)$ rather than $(1+r)/\gamma$ relevant to individuals. Using the transversality condition (8), the intertemporal budget constraint of the government is given by

$$\sum_{j=0}^{\infty} R^j E_t(cg_{t+j}) = \sum_{j=0}^{\infty} R^j E_t(tr_{t+j}^g + tt_{t+j}) + R^{-1} w_{t-1}^g. \tag{9}$$

Equation (9) states that the present discounted value of public consumption equals the present discounted value of taxes (net of domestic transfers) and transfers from the rest of the world plus the government's initial financial wealth.

The consumption behavior of those unconstrained agents that internalize the government's intertemporal budget constraint can be characterized replacing the latter into equation (5), which yields

$$C_t = (1-\gamma Rs)((1+r)W_{t-1}^f + P_t) \tag{10}$$

where $W_t^f = W_t^{pf} + W_t^{gf}$ is the stock of foreign wealth of the whole economy and

$$P_t = \sum_{j=0}^{\infty} (\gamma R)^j E_t(y_{t+j} - tt_{t+j}) + \sum_{j=0}^{\infty} R^j E_t(tt_{t+j} + tr_{t+j}^g - cg_{t+j}). \tag{11}$$

Equation (10) expresses private consumption as a function of national external debt W^f and aggregate human wealth P adjusted for the discounted sum of current and future budget surpluses. Notice that in the limiting case of infinite horizons ($\gamma = 1$) taxes would cancel out from this expression and only the present value of government expenditure would matter for private consumption decisions, as stated by the Ricardian equivalence hypothesis: once the path of government spending is given, the time profile of taxes and domestic debt issue are irrelevant. Alternative ways of financing a given level of expenditure -taxation or debt- would affect neither private consumption nor national saving.

In the general case ($\gamma < 1$) equation (11) includes both the present value of future government consumption as well as the entire time path of future taxation. To render the equation operational, we need to specify how individuals form their anticipations of both taxes and public consumption. Obviously, such anticipations cannot be formed independently for the two variables, as their trajectories need to respect the government's intertemporal budget constraint. Since future public consumption enters (10) regardless of the value of γ, we adopt the following forecasting procedure. First consumers to which (10) applies form forecasts of public consumption on the basis of its own past. Through the government budget constraint, this in turn ties down the present value of anticipated taxes, but not their time profile, which is still relevant in the case of finite horizons. To resolve this, we assume that individuals anticipate tax smoothing by the government to finance the predicted path of public consumption. In fact this can be rigorously justified along the lines of Barro's (1979) model of optimal intertemporal taxation. Under this view, taxes follow a random walk, so that the best predictor of their future level is the

current one[7].

To sum up, consumption of unconstrained consumers is the aggregation of two components. The first one corresponds to the λ_2 share of consumers that do not internalize the government budget constraint; their consumption can be expressed as

$$C_t = (1 - \gamma Rs)((1 + r)W^p_{t-1} + L_t), \tag{12}$$

with

$$L_t = \sum_{j=0}^{\infty} (\gamma R)^j E_t(y^x_{t+j} - tt^x_{t+j})),$$

where the superscript x denotes the forecasts of future values of the variables constructed from their own past.

In turn, the remaining fraction $(1 - \lambda_2)$ of unconstrained consumers internalize the

[7]Barro (1979) assumes that public expenditure is exogenous and the government chooses the time pattern of distorting taxes to minimize distortions. The problem for the government is to minimize

$$E_t \sum_{j=0}^{\infty} (1 + \beta)^{-j} (tt_{t+j} + \alpha_1/2tt^2_{t+j}),$$

with $\beta > 0$, subject to (9). Under the assumption that the government subjective discount factor is equal to the real interest rate r, the solution for this problem is of the familiar form

$$E_t tt_{t+1} = tt_t.$$

Hence, given an expected stream of public consumption, taxes follow a random walk.

government budget constraint, and their consumption may be expressed as

$$C_t = (1 - \gamma Rs)((1 + r)W^f_{t-1} + P_t), \tag{13}$$

with

$$P_t = \sum_{j=0}^{\infty}(\gamma R)^j E_t(y^x_{t+j}) + \sum_{j=0}^{\infty} R^j E_t(tr^{gx}_{t+j} - cg^x_{t+j}) + ((1 - R)^{-1} - (1 - \gamma R)^{-1})tt_t.$$

Hence total consumption by unconstrained consumers is given by[8]

$$C_t = \lambda_2((1 - \gamma Rs)((1 + r)W^p_{t-1} + L_t)) + (1 - \lambda_2)((1 - \gamma Rs)((1 + r)W^f_{t-1} + P_t)). \tag{14}$$

Finally, aggregate private consumption combines the latter expression and consumption of borrowing-constrained individuals:

$$\begin{aligned} C_t &= C^u_t + C^c_t, \\ C^c_t &= \lambda_1(Y_t - tt_t), \\ C^u_t &= (1 - \gamma Rs)(R^{-1}(\lambda_2 W^p_{t-1} + (1 - \lambda_2)W^f_{t-1}) + (1 - \lambda_1)(\lambda_2 L_t + (1 - \lambda_2)P_t)). \end{aligned} \tag{15}$$

4 Empirical Implementation

As noted above, a preliminary step for the empirical estimation of the model is to replace the infinite discounted sums in the consumption equations of unconstrained individuals

[8]Notice that this specification is observationally equivalent to one in which a single group of unconstrained consumers form their forecasts of future taxation by combining two prediction schemes: one based only on past taxes, and another based on both past taxes and past public expenditure.

with observable variables. This refers to anticipated future taxes (for those consumers basing their forecasts only on the history of taxes), public consumption, foreign transfers, and real GDP. To do this, we use forecasts constructed from univariate time-series processes. These are simple representations of the reduced form of the data-generating process, they are very flexible, and their forecasts are in many cases superior to those obtained from more complex models. Both features, simplicity and flexibility, make them useful for the present analysis.

A natural candidate among univariate models is the Autoregressive Integrated (ARI) model[9]. Assuming that first-differencing is enough to achieve stationarity and that the order of the autoregression is also 1 (ARI(1,1)) for all flow variables in our setup, any variable variable z_t could be expressed as

$$\Delta z_t = \mu_z + \rho_z \Delta z_{t-1} + e_{zt}. \tag{16}$$

Equation (16) states that variable z_t follows an Integrated Autoregressive process ARI(1,1) with drift μ_z (i.e. the variable may trend up or down). This specification allows for growth (captured by the drift) and may generate cycles (the closer the value of ρ_z to 1, the longer the amplitude of the cycle). The error term e_{zt} is white noise and represents an idiosyncratic shock. Notice that if the data-generating process of z_t is like (16) and if agents know parameters ρ_z and μ_z, then they can infer the infinite sums involved in (15)

[9]As Deaton (1992, pg. 111) notes, if disposable income follows an ARI(1,1) process, innovations in income generate changes in consumption larger than the income innovations. This would run against conventional wisdom since consumption would be less smooth than income. Note, however, that even if $\gamma = 1$ and $\rho = r$ (the case analyzed in Deaton 1992), disposable income (i.e., GDP net of taxes) would follow an ARIMA(2,1,1) process in our setup.

as:

$$\sum_{j=0}^{\infty}(\gamma R)^j \Delta E_t z_{t+j} = \gamma R(1-\gamma R\rho_z)^{-1}\mu_z + (1-\gamma R\rho_z)^{-1}\Delta z_t. \tag{17}$$

Hence taking first differences in the aggregate consumption equation (14) and using (17) yields

$$\begin{aligned}
\Delta C_t &= \lambda_1(\Delta y_t - \Delta tt_t) \\
&+(1-\gamma Rs)((1+r)(\lambda_2 \Delta W^p_{t-1} + (1-\lambda_2)\Delta W^f_{t-1}) + (1-\lambda_1)((1-\gamma R\rho_y)^{-1}\Delta y_t \\
&-\lambda_2(1-\gamma R\rho_{tt})^{-1}\Delta tt_t + (1-\lambda_2)((1-R\rho_{trg})^{-1}\Delta tr^g_t - (1-R\rho_{cg})^{-1}\Delta cg_t))) \\
&+\mu + v_t,
\end{aligned} \tag{18}$$

where the error term v_t is serially uncorrelated but is correlated with the variables on the right hand side of (18). Parameter identification issues are discussed below.

Equation (18) reflects aggregate consumption as a weighted average of consumption expenditure by groups of Keynesian, PIH, and Ricardian consumers, after taking into account the time-series processes of expected future income, tax, and government consumption flows by the two latter groups. Notice that Ricardian equivalence would fail, even in the absence of liquidity constraints and finite horizons, if the government were to engage in the provision of insurance to private agents against future income shocks. However the paths of the fiscal variables that forward-looking agents use to forecast do not reflect any such risk-sharing arrangement.

We next consider the methodological issues involved in the estimation of the structural parameters using (18). In order to make the notation less tedious, re-write (18) as an econometric specification

$$\Delta C_{it} = f(\Delta X_{it}, \beta) + \mu_i + v_{it} \tag{19}$$

where the subscript t ($t = 1, ..., T$) continues to refer to time periods and the subscript i ($i = 1, ..., N$) now refers to cross-section unit (or country) i. C_{it} is private consumption at time t for unit i, X_{it} includes the variables of the right hand side of (18) at time t for

country i, μ_i is a country effect and v_{it} is a random term that it is uncorrelated over time and across countries. Finally, $f(.)$ is a non-linear function in

$$\beta = [\lambda_1, \lambda_2, \gamma, s, r],$$

but linear in ΔX_{it}.

Two econometric issues must be tackled. First, if the variables in X_{it} are endogenous, estimation of (19) using non-linear least squares will produce inconsistent results. Second, we also need to allow for the likely presence of unobserved country-specific effects. A possible solution to the latter problem is to difference (19) once to wipe out country effects, which yields

$$\Delta^2 C_{it} = f(\Delta^2 X_{it}, \beta) + \Delta v_{it}. \tag{20}$$

If the variables in X_{it} are endogenous in the sense that $E(\Delta X_{it} v_{is}) \neq 0$ for $s \square t$ then values of ΔX_{it} lagged two periods or more are valid instruments for (20). If instead the variables in X_{it} are predetermined in the sense that $E(\Delta X_{it} v_{is}) \neq 0$ for $s < t$ then values of ΔX_{it} lagged one period or more are valid instruments. Given our definition of X_{it}, we consider Δy_{it}, Δtr^g_{it}, Δg_{it}, Δcg_{it}, and Δtt_{it} as potentially endogenous, and ΔW^p_{it-1} and ΔW^f_{it-1} as predetermined. Also observe that values of the dependent variable ΔC_{it} lagged two periods or more are valid instruments as well.

Denoting by Z the $(TN \times p)$ matrix that contains p instruments and letting $\Delta v = (\Delta v_1', ..., \Delta v_N')'$, the GMM estimator $\hat{\beta}$ is given by

$$\hat{\beta} = argmin_\beta (\Delta v' Z A_N Z' \Delta v).$$

For arbitary A_N, a consistent estimate of the asymptotic variance of $\hat{\beta}$ is given by

$$Var(\hat{\beta}) = N(F'ZA_NZ'F)^{-1}F'ZA_N\hat{V}_NA_NZ'F(F'ZA_NZ'F)^{-1}$$

with $\hat{V}_N = N^{-1}\sum_{i=1}^N Z_i'\Delta\hat{v}_i\Delta\hat{v}_i'Z$, and $F = (\partial f(\Delta^2 X, \beta)/\partial\beta')$. Hansen (1982) shows that the optimal choice of A_N is $\hat{V}_N^{-1}$, and a consistent estimator is then obtained in two steps.

The first-step estimator may be obtained by setting $A_N = (Z'Z)^{-1}$. Once estimates of the residuals $\Delta\hat{v}_i$ are obtained, it is possible to construct $\hat{V}_N$ and hence the optimal second-step estimator.

A specification test available in this context is Sargan's test of over-identifying restrictions, given by

$$S = N\Delta\hat{v}'Z\hat{V}_N^{-1}Z'\Delta\hat{v}.$$

The test is used when the number of orthogonality conditions exceeds the number of parameters to be estimated (i.e. the model is overidentified), and allows to verify whether the sample moments $\Delta\hat{v}'Z$ are as close to zero as would be expected if the corresponding population moments were truly zero. Under the null that the restrictions are valid, the test statistic is asymptotically distributed as a $\chi^2(p-k)$, where p is the number of instruments and k is the number of estimated parameters.

Consistency of the GMM estimator above relies on the assumption that v_{it} is serially uncorrelated, which underlies the validity of lagged regressors as instruments. This hypothesis can be tested using Sargan's difference test (SDT) to discriminate between nested hypotheses concerning serial correlation (see Arellano and Bond (1991)). Consider for example a subset of the instrument matrix Z, denoted Z^*, such that the p^* ($p^* < p$) instruments in Z^* are admissible even in the presence of first-order serial correlation. Defining v^* and V_N^* as the residuals and covariance matrix obtained of using Z^* as instruments, then

$$S^* = N\Delta\hat{v}^{*\prime}Z^*(\hat{V}^*)_N^{-1}Z^{*\prime}\Delta\hat{v}^* \sim \chi^2(p^* - k),$$

if the errors are white noise or MA(1). In addition,

$$S - S^* \sim \chi^2(p - p^*)$$

if the errors are white noise. Moreover, $S - S^*$ is asymptotically independent of S^*.

In our empirical implementation, we estimated equation (20) in three stages. First, we obtained estimates of the autoregressive parameters $\rho = (\rho_y, \rho_{trg}, \rho_{tt}, \rho_{cg})$ using univariate models like (16). Once these parameters were estimated we substituted them in (20) and computed the GMM estimates using the two-step procedure described above. [10]

However, preliminary experiments along these lines revealed some numerical problems, which are not too surprising in view of the high non-linearity of the model. Specifically, unconstrained estimation of the model's parameters yielded some unrealistic results for γ and r, such as $\gamma > 1$ or $r < 0$. On these grounds, we opted for restricting γ to lie between 0 and 1, and experimented with r fixed at different values.[11] The estimates reported below were obtained imposing these restrictions.

5 Results

We use data for 41 countries spanning the years 1975-1992. Of these countries, 19 are industrial (OECD) countries and the remaining 22 are developing countries. For the OECD countries the public sector is defined as the General Government, whereas for the developing countries the public sector is defined as the Consolidated Central Government (that is, including the Social Security Agencies). Sources and definitions of variables as well as the country list are reported in the Data Appendix.

The instrument set we consider is

$$\begin{aligned} Z &= [\Delta C_{t-2}, \Delta C_{t-3}, \Delta y_{t-2}, \Delta y_{t-3}, \Delta tr^g_{t-2}, \Delta tr^g_{t-3}, \\ &\quad \Delta tt_{t-2}, \Delta tt_{t-3}, \Delta cg_{t-2}, \Delta cg_{t-3}, \Delta W^p_{t-2}, \Delta W^p_{t-3}, \Delta W^f_{t-2}, \Delta W^f_{t-3}]. \end{aligned}$$

Observe also that the restricted instrument set

$$Z^* = [\Delta C_{t-3}, \Delta y_{t-3}, \Delta tr^g_{t-3}, \Delta tt_{t-3}, \Delta cg_{t-3}, \Delta W^p_{t-3}, \Delta W^f_{t-3}],$$

[10] Thus, the standard errors from the second stage that we report below are conditional on the estimates of the autoregressive parameters obtained in the first stage.

[11] A general problem that may appear when imposing restrictions on the parameter γ is that $F_\gamma = \partial f(\Delta^2 X, \beta)/\partial\gamma$ may approach zero, in which case, $(F'ZA_NZ'F)$ would be nearly singular. Whenever this problem arose, the matrix $(F'ZA_NZ'F)$ was inverted by blocks. Notice that if $F_\gamma \to 0$ then $\hat{\gamma}$ may be viewed as uncorrelated with the remaining parameters.

will produce consistent results even in the presence of first-order serial correlation and therefore may be used as an auxiliary instrument set to evaluate the Sargan difference test.

Three different values of the exogenously-set real interest rate were considered, namely $r = (.03, .07, .1)$, although on the whole the estimation results seem fairly insensitive to the selected value. The model was estimated for the full sample containing all 41 countries, as well as for separate sub-samples of OECD and developing countries.[12]

Table 3 reports the estimates of the autoregressive parameters of the univariate processes followed by all exogenous flow variables. In general, all parameters are significant at standard levels. In particular, the only insignificant parameter is the one for tt in the developing-country sub-sample, which suggests that taxes net of domestic transfers in developing countries are well characterized by a random walk with drift. All other variables in all sub-samples follow an AR(1,1) process. In most cases, however, the estimates are considerably different across sub-samples, with the only exception of the estimates of the autoregressive parameter of government transfers, which are similar in OECD and developing countries.

Tables 4 to 6 report estimation results using the non-linear GMM estimator for equation (18). The tables report both the first-step (IV) and second-step (GMM) estimates, together with the test statistics for model misspecification. On the whole, the specification tests -Sargan test for overidentifying restrictions and Sargan difference test (SDT) for first order autocorrelation in the residuals- do not show evidence against the estimates obtained in the OECD and the developing-country sub-samples, but reveal some evidence of misspecification against the full-sample estimates. This likely reflects differences in the underlying parameter values between both country groups (more on this below).

Regarding the point estimates of the parameters, the first thing to notice is that $\hat{\gamma} = 1$ for every sample, rejecting the hypothesis of finite horizons for unconstrained individuals – a result in line with previous literature. In general, however, the estimates of γ carry very small standard errors, which might be considerably understated due to rounding problems that arise from restricting γ to lie between zero and one.

Judging from the full-sample point estimates, the proportion of constrained individuals is around 40 percent.[13] Of the unconstrained consumers, around 30 percent would

[12]Notice that estimation of the model with smaller country sub-samples would be problematic, as it would reduce the cross-section dimension of the sample below the time-series dimension, invalidating our estimation approach based on large N asymptotics (rather than large T asymptotics).

[13]As noted above, because the model assumes uncertainty about future incomes our empirical estimates might show departures from Ricardian equivalence reflecting the extent

look only at taxes when making their intertemporal consumption plan, while the rest internalize the government budget constraint and look at both taxes and public expenditure. Formally, the hypotheses that all unconstrained consumers look only at taxes (i.e. $\lambda_2 = 1$) or that all internalize the government budget constraint (i.e. $\lambda_2 = 0$) are both rejected.

Like in the case of the autoregressive parameters, there are also considerable differences between OECD and developing countries regarding the estimates of the structural parameters. In OECD countries the share of constrained individuals is similar to the one obtained in the full sample (around 40 percent); observe that the first-round estimate is not significantly different from 0, but the second-round is. It is also interesting to notice that we always obtain $\hat{\lambda}_2 = 0$ for the OECD group, so that all unconstrained consumers internalize the government budget constraint.

In turn, for the developing-country sub-sample we find a larger share of constrained individuals (larger than 60 percent), as one would expect in light of previous literature (e.g., Vaidyanathan 1993). Regarding unconstrained consumers, their composition is similar to that suggested by the full-sample estimates: around 30 percent look only at taxes, while the rest consider public consumption as well.

It is also interesting to note that the estimated value of the subjective discount parameter ρ[14] varies only slightly depending on the selected value of r. In general, the larger the value of r, the smaller the estimated value of ρ. Typically, $\hat{\rho}$ is smaller in the developing-country sub-sample (between .06 and .08) than in the OECD sub-sample (between .18 and .19). Thus, if one assumes the same interest rate for both country groups, say $r = .07$, the implied value of the subjective discount factor $(1+\rho)^{-1}$ would be around .83 for the OECD, as compared with .93 in the developing-country sample, which would imply a seemingly counter-intuitive higher degree of "impatience" in industrial countries.

In an extended version of this paper, [15] we examine the issue of private-public consumption substitution/complementarity using an extended model where government expenditure affects the marginal utility of private consumption *a la* Bailey (1971). Briefly,

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to which governments have actually engaged in an insurance provision role in the sample, even though the model does not explicitly consider such behavior.

[14] Observe that $s = (1+r)/(1+\rho)$ measures the slope of the intertemporal consumption path of unconstrained individuals.

[15] Available from the authors upon request.

the extended specification assumes that individuals obtain utility from effective consumption, c_t^* defined as

$$c_t^* = c_t + \delta cg_t,$$

where as above, cg_t is public consumption, c_t is private consumption as above, and δ is the weight attached to public consumption in the measure of effective consumption. When $\delta > 0$ an increase in government consumption reduces the marginal utility of private consumption; public consumption and private consumption are perfect substitutes, and increases of public consumption will be associated with reduced private consumption. Conversely, when $\delta < 0$ an increase in government consumption raises the marginal utility of private consumption, and public and private consumption are perfect complements (increases in public consumption will be associated with increases in private consumption). When $\delta = 0$, public consumption does not affect the marginal utility of private consumption and hence it does not affect intratemporal private consumption decisions.

The main results of the basic model reported above (i.e. a larger number of constrained individuals in the developing countries, larger proportion of unconstrained individuals internalizing the government budget constraint in OECD countries, infinite horizons in all samples) are maintained in the extended model. However, there is a significant difference in the two sub-samples when considering the effect of public consumption. In this regard, the results indicate that the estimated substitution parameter δ is always negative in the OECD sub-sample (δ=-2.04, s.e. .69) and positive in the developing-country sub-sample (δ=1.71, s.e. .25), suggesting that in the former countries government consumption is complementary with private consumption, whereas in the latter countries they are substitutes. While we find this contrast surprising, it echoes the results reported by Evans and Karras (1996), summarized earlier. In turn, in the full sample we also obtain a positive value for δ (δ=1.84, s.e. 1.49) although it is not significantly different from zero, reflecting the sharp contrast between the underlying industrial and developing-country estimates. Quantitatively, our estimates of δ for industrial and developing countries are fairly similar (although slightly larger in absolute value) than the comparable averages of country-specific values in Evans and Karras (1996). However, both sets of results are somewhat problematic regarding the implied magnitude of the impact of public consumption on private consumption.

To sum up, the above results suggest that full Ricardian equivalence can be rejected in all the samples, mostly due to the existence of constrained individuals – to an extent larger in developing than in industrial countries – rather than to finite horizons. In addition, the share of unconstrained individuals looking only at future taxes is generally smaller than that of consumers internalizing the government budget constraint – with the OECD sub-sample providing the limiting case, in which all optimizing consumers belong to the

latter group.

6 Conclusions

The impact of fiscal policy on private and national saving is an important question for both short-term macroeconomic stabilization and long-run growth prospects. However, it is also a question that remains theoretically and empirically controversial. Likewise, the effectiveness of alternative fiscal instruments in raising national saving is still poorly understood. In this paper we have developed a theoretical model that incorporates heterogeneous agents, takes into account intergenerational caring, and allows public consumption to affect private consumption through the standard budget-constraint channel. To the best of our knowledge, our model extends and generalizes the various analytical specifications used in previous research.

We have implemented the model empirically using a large panel data set which includes 41 countries and spans the years 1975-1992. In contrast with virtually all previous studies based on structural models, that use single-country time-series techniques, we estimate our model's parameters using nonlinear instrumental-variable panel methods that allow us to control for endogeneity of the regressors and country heterogeneity using only "internal" instruments. Further, our large sample size allows separate estimation of the model on the industrial and developing-country subsamples, which helps identify any systematic differences in private consumption behavior between both sets of countries.

On the whole, our estimation results are quite satisfactory, and reveal considerable differences between developing and industrial countries. The results suggest that private consumption can be explained by a combination of constrained (Keynesian) and unconstrained individuals, and the proportion of the former is larger in developing countries than in industrial countries. Likewise, we find that most unconstrained consumers internalize the government budget constraint when predicting future taxes, although the proportion of individuals doing so is considerably smaller in developing than in industrial countries. Like in most previous studies, we do not find evidence against the assumption of infinite horizons.

These results suggests four conclusions. First, there are considerable qualitative and quantitative differences between industrial and developing countries in the response of national saving to fiscal policy changes, as evidenced by the differences in the magnitudes of the estimated parameters. Second, the impact of a fiscal disturbance on national saving can also vary substantially depending on whether it is permanent (affecting all individuals) or temporary (affecting only constrained individuals)– a point already noted in the literature. Third, temporary expenditure cuts are more effective than temporary tax hikes to raise national saving, since neither constrained nor unconstrained consumers alter their saving behavior when facing temporary expenditure cuts. Fourth, and perhaps

more novel, the impact of fiscal disturbances on national saving depends also on the factors that govern the time path of private consumption as captured by the real interest rate relative to the rate of time preference.

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Data Appendix

The data used in the empirical implementation covers 41 countries spanning the years 1975 to 1992. Of this total, 19 are OECD countries and the remaining are developing countries. The countries in the sample are those for which all the variables were available during the period 1975-1992.

The sources for the variables are the following:

-Nominal GDP plus private foreign transfers from rest of the World. The source for GDP is "The Saving Project World Database (see Loayza et al. (1998)). Private net transfers from the rest of the world are "Non-Official Transfers from" BOP4 and BOP5 statistics of the International Monetary Fund (IMF).

-Nominal public foreign transfers from rest of the World. The source is BOP4 and BOP5 statistics of the IMF. Specifically, we have used "Offical Transfers", and hence it has been assumed that official transfers belong to the appropriate public sector definition.

-Nominal public consumption. For OECD countries the source is "The Saving Project World Database". For the remaining countries the source is Government Finance Statistics (GFS) of the IMF. Specifically we have use line (CIII.1) that includes consolidated central government expenditures on goods ad services, wages and salaries, employer contributions and other purchases of goods and services.

-Nominal private consumption. It is defined as total consumption (from the "The Saving Project World Database") minus public consumption.

-Nominal taxes net of domestic transfers. For OECD countries the source is United Nations National Accounts. Nominal taxes net of transfers (tt) is defined as *current receipts* minus *subsidies* minus *total transfers disbursed* plus *net transfers abroad*. For developing countries, the sources are GFS and BOP statistics. Nominal tt is defined as *current revenue* minus *subsidies and domestic transfers* plus *net transfers abroad* (from BOP4 and BOP5).

-Private domestic financial wealth. The source is "The Saving Project World Database".

-National foreign financial wealth. The source is "The Saving Project World Database".

The variables have been converted to real terms using the private consumption deflator. The exception is public consumption for which the public consumption deflator has been used. Both private and public consumption deflators are from "The Saving Project World Database".

The exceptions to the above sources are the following:

Morocco. 1990-94: tt and public consumption are extracted from IMF country reports.

Cyprus. 1970-94: consumption deflators are from United Nations National Accounts.

Netherlands: tt is from European Economy (1970-72) and from OECD National Accounts (1973-1976).

Norway: tt is from OECD National Accounts.

Pakistan: both tt and public consumption have been interpolated for 1987.

Spain: 1970-79 tt is from European Economy.

The countries in the sample are the following

OECD: Australia, Austria, Canada, Denmark, Finland, France, Former Federal Rep. of Germany, Greece, Iceland, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom, and United States

DEVELOPING: Chile, Costa Rica, Dominican Republic, Mexico, Paraguay, Peru, Uruguay, Venezuela, Republic of Korea, Malaysia, Singapore, Cyprus, Egypt, Israel, Morocco, Tunisia, Turkey, India, Pakistan, Sri Lanka, Thailand, and South Africa.

Table 1: Previous Results on Ricardian Equivalence and Private/Public Consumption Substitution

Study	Sample	Deviations from Ricardian Equivalence		Public-Private Consumption Substitution or Complementary
		Finite Horizon γ <1	Borrowing Constraints λ >0	
Haque(1988)	16 Develop.	No, γ=1	NA	NA
Haque and Montiel (1989)	16 Develop. 1960-1985	No, γ=1	.18 < λ < .71	NA
Campbell and Mankiw (1991)	6 Indust.	NA	5cs. .23 < λ < .97	NA
Corbo and Schmidt-Hebbel (1991)	13 Develop.	NA	9 cs. .23 < λ < .82 2 cs. $\lambda = 0$	NA
Karras (1994)	17 Indust. 13 Develop. 1950-1980s	NA	NA	18 cs. -4.9< δ <-.6 12 cs. δ=0
Evans and Karras (1996)	33 Indust. 32 Develop. 1950-1990	NA	40 cs. .24 < λ <1.1 14 cs. λ=0	8 cs. .8< δ <3.1 5 cs. -5.3< δ <-3.1 41 cs. δ=0
Khalid (1996)	21 Develop. 1960-1988	No, γ=1	8 cs. .34< λ <1.02 13 cs. λ=0	2 cs. .2< δ <1 19 cs. δ=0

This table reports values of γ=1, γ <1 when the point estimate is not significantly different from unity.
Reported values for λ and δ other than 0 or 1 are point estimates that differ significantly from 0 and 1.

Table 2: Previous Results on Private/Public Saving Offset Coefficients

Study	Sample	Estimated Offset Coefficient
Corbo and Schmidt-Hebbel (1991)	13 Developing 1980-1987	.47-.50 .23-.26
Masson, Bayoumi and Samei (1995)	21 Industrial 1971-1993	.40-.53
Edwards (1995)	11 Industrial 25 Developing 1970-1992	.36-.65
Dayal-Ghulati and Thimann (1997)	14 Developing 1970-1995	.23-.42
Bailliu and Reisen (1997)	7 Industrial 4 Developing 1982-1993	.46-.54
Loayza, Schmidt-Hebbel and Serven (2000)	69 Industrial and Developing 1966-1995	.29-.69

Table 3: Estimated Autoregressive Parameters of the Forecasting Equations

	Full	OECD	Developing
ρ_y	.44 (11.6)	.38 (6.63)	.52 (10.46)
ρ_{tt}	.26 (6.09)	.31 (4.95)	-.04 (-.67)
ρ_{cg}	.15 (3.75)	.29 (5.05)	-.27 (-4.74)
ρ_{trg}	.23 (5.69)	.24 (3.97)	.22 (4.04)
t-statistics in parentheses.			

Table 4: Estimated parameters of the model for r=.03

Sample	Full	OECD	Developing
Parameter	IV-ESTIMATES		
λ_1	.38 (2.09)	.29 (.85)	.60 (5.45)
λ_2	.32 (34.40)	.00 (.00)	.30 (11.17)
γ	1 (8.95)	1 (13.00)	1 (28.58)
ρ	.24 (2.80)	.21 (3.32)	.12 (1.03)
	GMM-ESTIMATES		
λ_1	.40 (9.00)	.40 (4.16)	.61 (28.88)
λ_2	.31 (15.36)	.00 (.00)	.29 (22.91)
γ	1 (35.72)	1 (999)	1 (999)
ρ	.27 (6.64)	.19 (10.28)	.08 (2.93)
SS	574	266	308
Sargan	15.93	12.73	10.13
p-val	.10	.24	.43
SDT	13.26	8.46	6.5
p-val	.06	.28	.47
F	60.13	37.04	35.90
p-val	0	0	0

t-statistics in parentheses.
"SS" is sample size.
"Sargan" is Sargan test of over-identifying restrictions.
"SDT" is Sargan difference test for autocorrelation.
"F" is a joint significance F-test.

λ_1 is the proportion of constrained consumers. $(1-\lambda_2)$ is the proportion of non-constrained consumers internalizing the government budget constraint. γ is the survival rate. $(1+\rho)^{-1}$ is the subjective discount factor. The instrument set consists of both explanatory and dependent variables lagged two and three periods. The restricted instrument set for SDT consists of both explanatory and dependent variables lagged three periods.

Table 5: Estimated parameters of the model for r=.07

Sample	Full	OECD	Developing
Parameter	IV-ESTIMATES		
λ_1	.39 (2.12)	.29 (.87)	.62 (6.13)
λ_2	.32 (35.54)	.00 (.00)	.30 (8.91)
γ	1 (999)	1 (13.34)	1 (33.96)
ρ	.24 (2.85)	.20 (3.36)	.10 (.94)
GMM-ESTIMATES			
λ_1	.41 (9.04)	.41 (4.28)	.63 (2.08)
λ_2	.31 (15.16)	.00 (.00)	.28 (17.15)
γ	1 (999)	1 (999)	1 (999)
ρ	.25 (6.35)	.18 (9.71)	.07 (2.61)
SS	574	266	308
Sargan	16.29	12.79	9.63
p-val	.09	.23	.47
SDT	13.52	8.53	6.09
p-val	.06	.28	.53
F	60.46	36.93	35.53
p-val	0	0	0

t-statistics in parentheses.
"SS" is sample size.
"Sargan" is Sargan test of over-identifying restrictions.
"SDT" is Sargan difference test for autocorrelation.
"F" is a joint significance F-test.

λ_1 is the proportion of constrained consumers. $(1-\lambda_2)$ is the proportion of non-constrained consumers internalizing the government budget constraint. γ is the survival rate. $(1+\rho)^{-1}$ is the subjective discount factor. The instrument set consists of both explanatory and dependent variables lagged two and three periods. The restricted instrument set for SDT consists of both explanatory and dependent variables lagged three periods.

Table 6: Estimated parameters of the model for r=.10

Sample	Full	OECD	Developing
Parameter	IV-ESTIMATES		
λ_1	.40 (2.13)	.30 (.89)	.63 (6.50)
λ_2	.32 (36.18)	.00 (.00)	.29 (7.41)
γ	1 (999)	1 (13.62)	1 (38.56)
ρ	.23 (2.79)	.19 (3.33)	.1 (.92)
GMM-ESTIMATES			
λ_1	.42 (9.08)	.42 (4.37)	.64 (30.71)
λ_2	.31 (15.06)	.00 (.00)	.28 (13.17)
γ	1 (999)	1 (999)	1 (999)
ρ	.25 (6.16)	.18 (9.31)	.06 (2.31)
SS	574	266	308
Sargan	16.49	12.82	9.38
p-val	.08	.23	.50
SDT	13.82	8.57	5.90
p-val	.06	.28	.55
F	60.52	36.53	35.26
p-val	0	0	0

t-statistics in parentheses.
"SS" is sample size.
"Sargan" is Sargan test of over-identifying restrictions.
"SDT" is Sargan difference test for autocorrelation.
"F" is a joint significance F-test.

λ_1 is the proportion of constrained consumers. $(1-\lambda_2)$ is the proportion of non-constrained consumers internalizing the government budget constraint. γ is the survival rate. $(1+\rho)^{-1}$ is the subjective discount factor. The instrument set consists of both explanatory and dependent variables lagged two and three periods. The restricted instrument set for SDT consists of both explanatory and dependent variables lagged three periods.