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CURRENT ACCOUNT AND BUDGET DEFICITS IN AN INTERTEMPORAL MODEL OF CONSUMPTION AND TAXATION SMOOTHING. A SOLUTION TO THE "FELDSTEIN-HORIOKA PUZZLE"?

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ABSTRACT

This paper presents an infinite horizon model of consumption and taxation " smoothing" that implies a simple relation between current accounts, budget deficits, investment rates and transitory output shocks. It is argued that such a model could explain the "Feldstein-Horioka puzzle" of the apparent lack of international capital mobility. Traditional regressions of the savings rate on the investment rate, as performed in the literature, are shown to be incorrect tests of the hypothesis of capital mobility because they do not control for the independent role of budget deficits and temporary output shocks in the current account and savings equations. Empirical tests of the model for a sample of 18 OECD countries present good evidence that international capital markets are widely integrated and that the "Feldstein-Horioka puzzle" might be explained by the important role of fiscal deficits in the determination of the current account and the saving behavior.

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1. Introduction

The relation between the current account and budget deficits in open economies has been for a long time a central topic of open economy macroeconomics. The traditional "absorption approach" [1] to the current account determination was subject to criticism for the absence of intertemporal considerations that are central in the determination of the trade balance and the current account. The recognition of these dynamic aspects has led to a wide literature on "the intertemporal approach to the current account" that has significantly increased our understanding of the process of current account determination [2].

This intertemporal approach applies the "consumption smoothing" idea of Modigliani, Friedman and Hall (1978) to the optimal external borrowing problem of open economies and derives relations between the current account and temporary versus permanent economic disturbances. In particular, transitory shocks to public expenditures and the output level are shown to affect the current account while permanent disturbances are usually adjusted through movements in private consumption that leave the current account unaffected. From a normative point of view, this intertemporal approach suggests that countries should finance temporary shocks through external borrowing while they

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[1] For recent surveys of this approach see Kenen (1985) and Frenkel and Razin (1988).

[2] This approach, pioneered in the studies of optimal external borrowing by Bardhan (1969), Hamada (1969) and Bruno (1976), has been developed more recently by Svennson and Razin (1981, 1983), Sachs (1981, 1982), Buiter (1981), and extended by Lucas (1982), Persson and Svensson (1985), Frenkel and Razin (1986, 1988), Stockman and Svensson (1987) and Buiter (1988) among the others.

should adjust to permanent ones.

In spite of its theoretical appeal, systematic empirical tests of the intertemporal current account model have been very preliminary because hampered by the necessity to distinguish correctly between transitory and permanent components of spending and output. In fact, a standard formulation of these models expresses the current account as a function of temporary versus permanent components of government spending and output leaving open the complex econometric issue of distinguishing between these temporary and permanent components [3].

In coincidence with the development of the intertemporal approach to the current account, the idea of "smoothing" has been fruitfully applied to another optimization problem: the issue of the optimal choice of taxation and deficits in the presence of distortionary taxation. The so-called "equilibrium approach to fiscal policy", developed by Barro (1979, 1981, 1985, 1986) for a closed economy and recently summarized by Aschauer (1988), argues that actual tax rates and deficit policies are a reflection of an intertemporal optimization over a long horizon by the budgetary authorities, who choose their policies to reduce the excess burden of taxation for any given path of government expenditures. This "tax smoothing" hypothesis of government budgetary policy implies that budget deficits will be the optimal outcome of the government decision to smooth distortionary taxes in the

[3] Ahmed (1986, 1987) tests a version of the intertemporal theory of the current account for the United Kingdom by considering only the optimal "consumption smoothing" part of the problem. This leads him to the complex exercise of separating public expenditures in permanent and temporary components.

presence of temporary shocks to public expenditures and output [4]. Empirical tests of the "tax smoothing" hypothesis depend on the correct distinction between temporary and permanent components of public spending [5].

The "tax smoothing" model has been derived for the case of a closed economy and the open economy implications of the hypothesis have not been discussed. At the same time, the "consumption smoothing" model of the current account has taken as given exogenously the path of public spending and taxes without analyzing the optimal borrowing choices of a government faced with distortionary taxes.

The objective of this paper is to bridge the two approaches by presenting a model of an open economy where the current account is determined by the "consumption smoothing" objective of the social planner and the budget deficit is the result of the "tax smoothing" problem of the fiscal authority. It will be shown that the joint consideration of the two optimization problems leads to a very simple relation between the current account, the budget deficit and the investment rate that can be tested empirically without recourse to

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[4] For a critical empirical test of the tax smoothing hypothesis see Roubini and Sachs (1988 a, b).

[5] Barro (1981, 1982, 1985) and Sahasakul (1986) test the "tax smoothing" theory in a closed economy setting and have to distinguish between temporary and permanent components of spending. Some of the results of Sahasakul, however, leave the doubt that these two components might have not been correctly identified econometrically.

unobserved variables such as transitory expenditure shocks [6].

The approach taken in this paper might also shed some additional light on the paradox of the lack of international capital mobility first found by Feldstein and Horioka (1980) and Feldstein (1983) and then confirmed in numerous other studies of the issue [7] . These studies have systematically found a lack of correlation between the current account and the investment ratio for the OECD countries in a number of periods (or equivalently, a very high correlation between savings rates and investment rates) leading to the paradoxical suggestion that international capital mobility might be very low [8] . However, in all these studies, the independent (and exogenous) role of the budget

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[6] Razin and Svensson (1983) consider a consumption and taxation smoothing problem in a two period model and show the optimal response of the current account and the government debt to a permanent and temporary real disturbance (a productivity shock). Anderson and Young (1988) considers a similar problem in a finite horizon setting. Here, instead, we will stress the role of temporary versus permanent fiscal disturbances and derive a explicit relation between budget deficits and current accounts in an infinite horizon framework.

[7] See, among the others, Caprio and Howard (1984), Fieleke (1982), Frankel, Dooley and Mathieson (1987), Murphy (1984), Obstfeld (1986a, 1986b), Penati and Dooley (1984), Sachs (1981, 1983), Summers (1985). See also the comments of Tobin (1983) and Westphal (1983) to Feldstein (1983) and the critical observations of Harberger (1980) on the Feldstein-Horioka puzzle.

[8] As observed by Obstfeld (1986 a), among others, the substantial evidence in favor of the equalization of domestic and foreign (or on-shore and off-shore) interest rates for the industrial countries is also at odds with the idea of a large degree of capital immobility. Frankel (1985) and Frankel, Dooley and Mathieson (1986), however, argue that equalization of the returns on financial assets might not be equivalent with the integration of the markets for physical capital and interpret the high correlations between saving and investment rates as evidence of an "apparent isolation of national markets physical capital".

deficits, that we will derive in this paper, has been disregarded and regressions equations have estimated only the relation between the current account (or the savings rate) and the investment rate . The solution of the model presented in this paper suggests, however, that the traditional estimated current account equations might be misspecified because they do not control for the independent role of budget deficits (in addition to the investment rate) in determining the current account. Estimated savings equations present the same problem since they do not control for the effects of fiscal deficits on the level of national savings. The "Feldstein-Horioka paradox" might then be due to this misspecification of the equation determining the current account (and/or the savings behavior). This observation suggests that the hypothesis of international capital mobility can be tested by estimating the coefficients of the investment rate and the budget deficit in a current account equation. Alternatively, the hypothesis that savings are not correlated with investment rates can be tested only after controlling for the role of fiscal deficits.

The plan of the paper is the following. Section 2 presents the model of the intertemporal choice of the current account and the budget deficit. Section 3 introduces investment in the model. Section 4 tests empirically the theoretical implications of the model. Section 5 presents some conclusions.

2. The Model

Consider a small open economy producing one tradeable good and able to borrow in the international capital markets. It is convenient to begin the analysis from an accounting framework where the dynamic budget constraints of the private and public sector are described.

The change in the external indebtedness of the private sector ($D^p_t - D^p_{t-1}$) is given by:

$$D^p_t - D^p_{t-1} = I^p_t - (Q_t - T_t - C_t - r\ D^p_{t-1}) = I^p_t - S^p_t \qquad (1)$$

where I^p_t represents private investment, Q_t is GDP, T_t are taxes, C_t is private consumption, r is the exogenously given world real interest rate and ($Q_t - T_t - r\ D^p_{t-1} - C_t$) are private savings. The similar expression for the public sector budget constraint is [9] :

$$B_t - B_{t-1} = I^g_t + G_t + r\ B_{t-1} - T_t = I^g_t - (T_t - G_t - r\ B_{t-1}) =$$

$$= I^g_t - S^g_t \qquad (2)$$

[9] It is assumed for accounting simplicity that the government finances its budget deficits through external borrowing and does not issue domestic bonds. This simplification does not change any result of the model because in the consolidation of the budget constraint for the entire economy (equation (3) below) domestic bonds issued by the government and held by the private sector would cancel out leaving the budget constraint identical to expression (3). Including domestic bonds in the model would modify equations (1) and (2) in the following way:

$$D^p_t - D^p_{t-1} = I^p_t - (Q_t - T_t - C_t - r\ D^p_{t-1} - r\ B^f_{t-1}) + B^d_t - B^d_{t-1} \qquad (1')$$

$$(B^d_t - B^d_{t-1}) + (B^f_t - B^f_{t-1}) = I^g_t + G_t + r\ B_{t-1} - T_t = I^g_t - (T_t - G_t - r\ B_{t-1}) \qquad (2')$$

where ($B^d_t - B^d_{t-1}$) represents the domestic bond finance of the public sector deficit and ($B^f_t - B^f_{t-1}$) the foreign financing component.

Here S^g_t represents the current account savings of the public sector, G_t are exhaustive public expenditures on goods and services, and (I^g_t - S^g_t) gives the overall fiscal deficit (or surplus) of the public sector. Adding up (1) and (2) we get the change in the net external debt for the country that is equivalent to the current account deficit:

$$- CA_t = D_t - D_{t-1} = I^p_t - (Q_t - T_t - rD^p_{t-1} - C_t) + I^g_t - (T_t - rB_{t-1} - G_t) \tag{3}$$

In other terms the current account deficit, that is equivalent to the change in the net external indebtedness of the country, is equal to the excess of total (private and public) investment over savings:

$$- CA_t = D_t - D_{t-1} = I_t - (Q_t - T_t - rD_{t-1} - C_t) = I_t - S_t \tag{4}$$

Imposing the standard transversality (solvency) condition that insures that the country has the resources to service its debt and is not borrowing forever to pay the interest on it we get the budget constraint of the economy where the discounted value of its future consumption is less than or equal to its productive wealth minus initial external debt or:

$$\sum_{j=0}^{\infty} C_{t+j} (1+r)^{-j} \leq \sum_{j=0}^{\infty} (Q_{t+j} - I_{t+j} - G_{t+j})(1+r)^{-j} - (1+r) D_{t-1} \tag{5}$$

In order to concentrate on the role of the fiscal variables investment (both private and public) is disregarded for the moment and the time path of output is taken as exogenously given [10] .

Imposing a similar solvency condition on the public sector budget constraint (2) we get that the discounted value of public expenditure on goods and services must be equal to the present value of taxes minus the initial stock of public debt:

$$\sum_{j=0}^{\infty} G_{t+j} (1+r)^{-j} \leq \sum_{j=0}^{\infty} T_{t+j} (1+r)^{-j} - (1+r) B_{t-1} \qquad (6)$$

In this economy the social planner has to solve two maximization problems:

(a) Maximize an intertemporal social welfare function in the consumption level subject to the overall budget constraint of the economy ("consumption smoothing" problem).

(b) Choose an optimal path of taxes and public debt such that the distortionary effects of income taxation are minimized ("tax smoothing" problem.

The "consumption smoothing" problem is represented by [11]:

$$\max_{C_{t+j}} Z = E_t \sum_{j=0}^{\infty} (1+r)^{-j} U(C_{t+j}) \qquad (7)$$

subject to:

$$\sum_{j=0}^{\infty} C_{t+j} (1+r)^{-j} \leq \sum_{j=0}^{\infty} (Q_{t+j} - G_{t+j})(1+r)^{-j} - (1+r) D_{t-1} \qquad (5')$$

[10] Investment will be introduced in section 3.

[11] See Sachs (1982) for a presentation of this problem in the continuous time.

where Z is an intertemporal time separable social welfare function dependent on the level of consumption [12] and E_t is the expectational operator.

The second "tax smoothing" problem is given by [13] :

$$\underset{\tau_{t+j}}{\text{Min}} \quad Z = E_t \sum_{j=0}^{\infty} (1+r)^{-j} K(\tau_{t+j}) Q_{t+j} \tag{8}$$

subject to:

$$\sum_{j=0}^{\infty} G_{t+j} (1+r)^{-j} \leq \sum_{j=0}^{\infty} T_{t+j} (1+r)^{-j} - (1+r) B_{t-1} \tag{6}$$

where the function $K(\tau_{t+j})$ that represents the distortionary effects of income taxation is assumed to be a convex function of the tax rate. The first order conditions for the first problem are:

$$E_t \quad U'(C_{t+j}) = \mu \tag{9}$$

$$\sum_{j=0}^{\infty} C_{t+j} (1+r)^{-j} = \sum_{j=0}^{\infty} (Q_{t+j} - G_{t+j})(1+r)^{-j} - (1+r) D_{t-1} \tag{5'}$$

where μ is the Lagrange multiplier associated with the economy's budget constraint.

The first order conditions for the second problem are:

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[12] For simplicity, the private rate of time preference is assumed to be equal to the real interest rate.

[13] See Barro (1981, 1982) for a presentation of this "tax smoothing" problem in a closed economy.

$$E_t \quad K'(\tau_{t+j}) = \phi \tag{10}$$

$$\sum_{j=0}^{\infty} G_{t+j} (1+r)^{-j} = \sum_{j=0}^{\infty} T_{t+j} (1+r)^{-j} - (1+r) B_{t-1} \tag{6'}$$

where ϕ is the Lagrange multiplier associated with the public sector budget constraint.

The first order conditions (9) (10) are the classic martingale conditions for consumption and tax rates in these smoothing problems (see Hall (1978) and Barro (1979, 1986)). In order to get explicit solutions for our problem we assume particular functional forms for $U(C_{t+j})$ and $K(\tau_{t+j})$. In particular we assume that U is a logarithmic function of consumption and K is a quadratic function of the tax rate:

$$U(C_{t+j}) = \log C_{t+j} \tag{11}$$

$$K(\tau_{t+j}) = (\tau_{t+j})^2 \tag{12}$$

Given assumption (11) is straightforward to show that C_t will be equal to:

$$C_t = \frac{r}{1 + r} = W_t \tag{13}$$

where W_t or national wealth is equal to:

$$W_t = \sum_{j=0}^{\infty} (Q_{t+j} - G_{t+j})(1+r)^{-j} - (1+r) D_{t-1} \tag{14}$$

The implications of this model are clear:

(a) The consumption path is determined by the "smoothing principle" according to which external borrowing and lending should be used to smooth the marginal utility of consumption over time.

(b) Condition (5') implies that the private sector internalizes the government intertemporal budget constraint when choosing its consumption path. In this sense "Barro-Ricardian" equivalence holds: the optimal consumption path depends on the present value of government expenditures but not on the path of government taxes and borrowing.

The major normative implication of the model is that a country should finance transitory shocks through current account deficits (external borrowing) and adjust to permanent shocks.

To highlight the implications for the current account of this distinction between transitory and permanent shocks, it is convenient to define the permanent values of output (Q^P) and government expenditures (G^P):

$$\sum_{j=0}^{\infty} Q_{t+j} \; (1+r)^{-j} = \sum_{j=0}^{\infty} Q^P \; (1+r)^{-j} = Q^P \; \frac{1+r}{r} \qquad (15)$$

and:

$$\sum_{j=0}^{\infty} G_{t+j} \; (1+r)^{-j} = \sum_{j=0}^{\infty} G^P \; (1+r)^{-j} = G^P \; \frac{1+r}{r} \qquad (16)$$

Substituting (15) and (16) in (14) we get:

$$W_t = (Q^P - G^P) \frac{1 + r}{r} - (1+r)\, D_{t-1} \qquad (17)$$

By definition the current account is:

$$CA_t = Q_t - C_t - G_t - r\, D_{t-1} \qquad (18)$$

that can be rewritten as:

$$CA_t = (Q_t - Q^P) + (Q^P - G^P - C_t) - (G_t - G^P) - r\, D_{t-1} \qquad (18')$$

Substituting (17) in (13) and (13) in (18') we obtain:

$$CA_t = (Q_t - Q^P) - (G_t - G^P) \qquad (19)$$

Equation (19) is the basic equation of the intertemporal approach to the current account. According to this equation:

(1) If the output falls temporarily below its permanent level it is optimal to borrow abroad in order to maintain a smooth path of consumption; temporary negative (positive) shocks to output will therefore cause current account deficits (surpluses). Conversely, permanent changes in the level of output will have no effect on the current account.

(2) Given the output and optimal consumption path, transitory increases in public expenditures will cause a deterioration of the current account. Conversely permanent changes in government expenditures will lead corresponding and equivalent reductions in consumption (because of debt neutrality) with no effects on the current account. In other terms, the implication of the "Barro-Ricardian

equivalence" for the current account is that the current account will be invariant to the path of taxes, given the path of government expenditure.

Equation (19) show a link between the current account and the temporary components of public expenditure and output but it is not yet a relation between the current account and the budget deficit. In order to get such a relation we have to consider again the second leg of our "smoothing model", the smoothing of taxes.

Given the quadratic assumption (12) about the costs of distortionary taxation we can easily show that the tax rate will be equal to:

$$E_t \, \tau_{t+j} = \tau_t \qquad \text{for} \quad j = 0, 1, \ldots, \infty \qquad (10')$$

or:

$$E_t \, \tau_{t+1} = \tau_t \qquad \text{for} \quad j = 1 \qquad (10'')$$

In other terms the tax rate will follow a random walk without drift. Take now the government budget constraint (6) where total taxes are equal to the tax rate times output ($T_t = \tau_t \, Q_t$) :

$$E_t \left(\sum_{j=0}^{\infty} (\tau_{t+j} \quad Q_{t+j}) \; (1+r)^{-j} \quad = \quad \sum_{j=0}^{\infty} G_{t+j} \; (1+r)^{-j} + (1+r) \; B_{t-1} \right) \qquad (6')$$

From (10') the best forecast of future tax rates is equal to the current tax rate; then (6') becomes:

$$\tau_t \quad E_t \left(\sum_{j=0}^{\infty} Q_{t+j} \; (1+r)^{-j} \quad = \quad \sum_{j=0}^{\infty} G_{t+j} \; (1+r)^{-j} + (1+r) \; B_{t-1} \right) \qquad (6'')$$

We can then use our definitions of permanent income and permanent spending in (15) and (16) and substitute them in (6") to obtain:

$$\tau_t \frac{1 + r}{r} Q^P = \frac{1 + r}{r} G^P + (1 + r) B_{t-1} \qquad (20)$$

that implies:

$$\tau_t = \frac{G^P + r B_{t-1}}{Q^P} \qquad (21)$$

In other terms, smoothing of taxes will imply that the optimal tax rate is constant and equal to the permanent value of expenditures plus the interest payments on the debt divided by the permanent value of output (i.e. the constant tax rate is equal to the permanent spending to output ratio).

Then, given the government budget constraint:

$$DEF_t = (B_t - B_{t-1}) = G_t + r B_{t-1} - T_t \qquad (2')$$

and the definition of total taxes ($T_t = \tau_t Q_t$) we can substitute (21) in (2') to obtain:

$$DEF_t = (B_t - B_{t-1}) = (G_t - G^P) + \left(\frac{G^P + r B_{t-1}}{Q^P} \right) (Q^P - Q_t) \qquad (22)$$

where DEF_t is the real budget deficit (equal to the change in the stock of public debt held by the public). According to (22), temporary shocks to public expenditures will lead to budget deficits because the tax rate will be smoothed while permanent changes in expenditures will be adjusted with higher taxes and no deficits. Similarly, temporary negative shocks to output will result in budget deficits (because the fixed tax rates will lead to lower tax collections following an output fall) while permanent output shocks will leave the deficit unchanged.

We can finally combine the equilibrium solution for the current account (equation (19)) with the solution for the budget deficit (equation (22)) to obtain the following relation:

$$CA_t = - DEF_t + (Q_t - Q^P) \left(1 - \frac{G^P + r\, B_{t-1}}{Q^P}\right) \qquad (23)$$

or:

$$CA_t = - DEF_t + (Q_t - Q^P) (1 - \tau_t) \qquad (24)$$

Equation (24) is the crucial equation of the model and implies that, if "consumption smoothing" <u>and</u> "tax smoothing" are holding, there will be a simple one-to-one relation between current accounts and budget deficits. In particular:

(1) A budget deficit will lead to a corresponding and equivalent worsening of the current account because the same temporary spending

disturbance that leads to a budget deficit in (22) will worsen the current account as in (19).

(2) Temporary positive (negative) output shocks will lead to a current account surplus (deficit). In fact, according to (22) a temporary output shock, improves the budget balance by a fraction of the shock (τ_t) while it improves the current account by the full amount of the shock. On net the current account will improve by a share (1 - τ_t) of the output shock, for any given level of fiscal deficits.

In the particular case in which output follows a random walk , we obtain from the definition of permanent income (equation (15)) that permanent output will be equal to the current output ($Q^P = Q_t$) so that (24) simplifies to:

$$CA_t = - DEF_t \qquad (25)$$

i.e. if output follows a random walk, current account and budget deficit will have a perfect negative relation.

Equation (24) or (25) simplifies by a large degree the problem of testing the intertemporal theory of the current account. In the traditional formulation (equation (19)) the current account is expressed as a function of temporary versus permanent components of government spending leaving open the complex econometric issue of distinguishing between these temporary and permanent components; in particular, systematic tests of the intertemporal current account model have been very preliminary because hampered by the necessity to distinguish correctly between transitory and permanent component of spending [14]. Here, instead, the joint consideration of the two smoothing problems allows to derive a relation between current account and budget deficits that can be tested without any recourse to a distinction between permanent and temporary components of expenditure [15]; this because the underlying, and unobserved temporary shock to expenditures that leads to an observable budget deficit will also lead to a current account imbalance.

Econometric tests of equation (24) will then be joint tests of the intertemporal model of the current account and the equilibrium approach to fiscal policy. Rejection of equation (24) might be caused by the failure of either one of the two hypothesis [16].

3. Introducing investment

In order to simplify the analysis we disregarded the role of capital accumulation in the previous section. We now introduce investment in the model to see how the relation between the current account and the budget deficit is modified by the presence of capital

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[14] Ahmed (1986, 1987) tests a version of the intertemporal theory of the current account for the United Kingdom by considering only the optimal "consumption smoothing" part of the problem. This leads him to the complex exercise of separating public expenditures in permanent and temporary components. Similarly, Barro (1981, 1982, 1985) and Sahasakul (1986) test the "tax smoothing" theory in a closed economy setting and have to distinguish between temporary and permanent components of spending.

[15] However, the problem of distinguishing between permanent and transitory components of output remains in this approach.

[16] Roubini and Sachs (1988 a, b) find strong evidence against the "tax smoothing" model in the experience of the OECD countries.

formation [17].

In the presence of investment the consumption smoothing problem can rewritten as:

$$\underset{C_{t+j}}{\text{Max}} \quad Z = E_t \sum_{j=0}^{\infty} (1+r)^{-j} \quad U(C_{t+j}) \qquad (7)$$

subject to:

$$\sum_{j=0}^{\infty} C_{t+j} \ (1+r)^{-j} \leq \sum_{j=0}^{\infty} (Q_{t+j} - G_{t+j} - I_{t+j})(1+r)^{-j} - (1+r) \ D_{t-1} \qquad (5)$$

$$Q_t = F(K_t) \qquad (26)$$

$$K_{t+1} - K_t = I_t - \delta K_t \qquad (27)$$

where (26) represents the production function for the tradeable good produced in the country (labor supply is normalized to one); and (27) defines net capital accumulation as investment minus depreciation of capital (δ is the coefficient of geometric depreciation).

Then, the first order condition of this problem become:

$$E_t \ U'(C_{t+j}) = \mu \qquad (9)$$

$$F'(K_t) = r + \delta \qquad (28)$$

$$\sum_{j=0}^{\infty} C_{t+j} \ (1+r)^{-j} = \sum_{j=0}^{\infty} (Q_{t+j} - G_{t+j} - I_{t+j})(1+r)^{-j} - (1+r) \ D_{t-1} \qquad (5'')$$

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[17]In this section we lump together private and public capital formation.

(9) replicates the consumption smoothing rule seen in the previous section; (28) states that in each period investment should be undertaken so as to equate the marginal product of capital with the world cost of capital $(r+\delta)$.

These first order condition lead to the same consumption function as in (13) but now national wealth W_t in (14) must be redefined as :

$$W_t = \sum_{j=0}^{\infty} (Q_{t+j} - G_{t+j} - I_{t+j})(1+r)^{-j} - (1+r)\, D_{t-1} \qquad (14')$$

(14') can be rewritten in terms of permanent values of Q and G by observing that, given the optimal investment rule (28), present and future changes in investment do not change the present value of W_t as expressed in (14'). Then (14') can be rewritten as:

$$W_t = \sum_{j=0}^{\infty} \{ Q_{t+j}(\bar{K}_t) - G_{t+j} \} (1+r)^{-j} - (1+r)\, D_{t-1} \qquad (14'')$$

and (14'') can be expressed in terms of permanent output and spending as in (17).

The current account is now defined as:

$$CA_t = Q_t - C_t - I_t - G_t - r\, D_{t-1} \qquad (18')$$

Then, combining (13), (17), (18') we can write the final expression for current account as:

$$CA_t = (Q_t - Q^P) - (G_t - G^P) - I_t \qquad (19')$$

The main difference between (19') and the previous expression for the current account is the presence of investment in addition to the temporary shocks to output and spending. (19') implies that any change in investment will be fully financed through a current account deficit.

Combining this solution for the current account with the solution for the budget deficit derived from the "tax smoothing" problem (equation (22)) [18], we finally get:

$$CA_t = - DEF_t + (Q_t - Q^P) (1 - \tau_t) - I_t \qquad (29)$$

The main difference between equation (29) and (24) is the presence of the investment variable among the determinants of the current account. As in the case the budget deficit, the investment rate has a one-to-one negative effect on the current account, i.e. investment shocks are financed through capital inflows.

Equation (29) is important because it highlights the potential shortcomings of the empirical studies of the degree of international capital mobility following the seminal contributions of Feldstein and

[18] The tax smoothing problem is not modified in the presence of investment.

Horioka (1980) and Feldstein (1983). In all these studies [19], the independent role of the budget deficits has been disregarded and regressions equations have estimated only the relation between the current account (as a share of GDP) and the investment rate (as a share of GDP). These studies have systematically found a lack of correlation between the current account and the investment ratio for the OECD countries in a number of periods. Equation (29), however, suggest that the traditional specification of the estimated equation might be misspecified because it does not control for the independent role of budget deficits (in addition to the investment rate) in determining the current account. The "Feldstein-Horioka puzzle" might then due to this misspecification of the equation determining the current account. In fact, equation (29) suggest that the hypothesis of international capital mobility can be tested by estimating the coefficients of the investment rate <u>and</u> the budget deficit in a current account equation.

An alternative way to test the theory is to derive a saving equation and show that, in the presence of international capital mobility, saving rates are uncorrelated with the investment rate. This approach, rather than the estimation of a current account equation, has been preferred (starting from the contributions of Feldstein and Horioka) by most studies of the capital mobility puzzle [20]. However, the

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[19] See, among the others, Caprio and Howard (1984), Fieleke (1982), Frankel, Dooley and Mathieson (1987), Murphy (1984), Obstfeld (1985, 1986), Penati and Dooley (1984), Sachs (1981, 1983), Summers (1985).

[20] See, for example, Caprio and Howard (1984), Fieleke (1982), Frankel, Dooley and Mathieson (1987), Murphy (1984), Obstfeld (1985, 1986), Penati and Dooley (1984), Summers (1985).

model presented in this paper suggests that the standard savings equations used in these studies might be misspecified as well. To show this point, one can derive the savings equation implied by the model above. We know that national savings are equal to investment plus the current account:

$$S_t = I_t + CA_t \qquad (30)$$

Then, combining (29) with (30) we obtain that:

$$S_t = - DEF_t + (Q_t - Q^P) (1 - \tau_t) \qquad (31)$$

Equation (30) implies that total savings are a negative function of the budget deficit and a positive function of transitory shocks to output. In particular, budget deficits have a one-to-one negative effect on total savings or, in other terms, that private savings (S^P_t) are solely a function of transitory output shocks, i.e.:

$$S^P_t = (Q_t - Q^P) (1 - \tau_t) \qquad (32)$$

where private savings are by definition:

$$S^P_t = S_t + DEF_t \qquad (33)$$

It then follows that, the relation between national savings and investment should be zero only after we control for the effects on savings of budget deficits and temporary output shocks. Equation (31) then suggests that traditional test of the capital mobility hypothesis might be misspecified because they simply regress the savings rate on the investment rate only without controlling for the fiscal and cyclical determinants of the savings rate. The equation also suggests that an alternative test is to regress the savings rate on the budget deficit, the temporary components of output and the investment rate:

$$S_t = \alpha_0 \, DEF_t + \alpha_1 \, (Q_t - Q^P) + \alpha_2 \, I_t \qquad (34)$$

Then the null hypothesis of "smoothing" and capital mobility implies that:

$$\alpha_0 = -1 \qquad \alpha 1 = (1 - \tau_t) \qquad \alpha_2 = 0$$

i.e. the coefficient on the investment rate should be equal to zero only after having controlled for the effects of budget deficits and transitory output. Alternatively, the model might be tested, under the maintained assumption of tax smoothing, by regressing <u>private</u> savings on transitory output and investment:

$$S^P{}_t = \alpha_0 \, (Q_t - Q^P) + \alpha_1 \, I_t \; . \qquad (35)$$

Then the null hypothesis of "smoothing" and capital mobility implies that:

$$\alpha 0 = (1 - \tau_t) \qquad \alpha_1 = 0$$

i.e. private savings should not be affected by the investment rate.

4. Empirical Tests

In this section we will test the theoretical results obtained in the previous sections. We will first start with the estimation of current account equations like (29) and then move to the estimation of savings equations like (31).

As seen in the previous section, equation (29) suggests that one should regress current account equations on measures of budget deficits, investment rate and transitory output. In particular, the joint hypothesis of "consumption smoothing", "tax smoothing" and "international capital mobility" implies that the estimated coefficients of these two variables should be equal to minus one in the estimated equations.

To begin with, current account equations are regressed on the investment rate and the budget deficits disregarding the role of transitory shocks to output. Given the wide empirical evidence on the existence of unit roots in output and GNP [21], the estimation of equation (29) without a measure of transitory output is correct (under the random walk hypothesis output shock are all permanent and the transitory output term in equation (29) disappears).

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[21] See Nelson and Plosser (1982), Campbell and Mankiw (1987, 1988), Cochrane (1988), Mankiw and Shapiro (1985) for some tests of unit roots in GNP.

Table 1 present the results of regressions of the current account to GDP ratio on the budget deficit to GDP ratio and the investment to GDP ratio for 18 OECD countries in the 1960-1985 period. Some observations on the data used in the regressions are useful before the discussion of the results. First, as derived in the theoretical part of the paper, the correct measure of deficit to be used in the regressions is the real inflation adjusted budget deficit that is equivalent to the change in the net debt of the public sector. Data on net debt for the OECD countries have been obtained from the OECD for limited periods of time (for most of the 18 countries considered the data go back only to 1970 and are available since the early 1960s for only eight countries). The sample period of the regressions in table 1 is therefore limited by the availability of the figures for the public sector net debt. Second, the investment to GDP ratio used in the regressions includes the fixed capital formation and the change in inventories, i.e. inventories are considered a form of investment.

We can now discuss the results of the regressions presented in table 1. In 12 out of the 18 countries considered, the coefficient on the deficit variable has the right sign (negative) and is significant: budget deficits lead to a current account worsening. Also, the coefficient on the investment ratio has the right sign and is significant in 13 out of 18 countries : increases in investment ratios cause current account deficits. One can also observe that in 11 countries both variables are significant, i.e. the sample of 18 countries can be almost precisely divided between countries in which the model works better (both variables are significant) and countries in which the theory does not work at all (both variables are insignificant). However, even in the group of countries where the explanatory variables are significant, the estimates of the coefficients on the deficits and investment are almost always different from the theoretical value of minus one. The exceptions are Italy, Norway, Ireland, Greece and Spain where the coefficient on the investment ratio is not significantly different from minus one. In no country, however, the coefficient on the budget deficit variable gets close to the theoretical value of minus one.

If one compares these results with previous tests of "international capital mobility" for the OECD countries [22], one observes some striking differences. Table 2 summarizes the results of previous studies on the relation between the current account and the investment rate for the OECD countries. As the table shows Penati and Dooley (1984), Frankel, Dooley and Mathieson (1987) found no relation between current accounts and investment rates for the OECD countries while Sachs (1981, 1983) finds a weak and almost not significant relation. Our results in Table 1, instead show a strongly negative and significant relation for most of the countries in the sample and suggest that international capital mobility might be much higher than assumed on the basis of the previous studies of this issue.

How to reconcile the differences in results between table 1 and table 2 ? There are two main explanations:

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[22] See Feldstein and Horioka (1980), Feldstein (1983), Sachs (1981, 1983), Penati and Dooley (1984), Frankel, Dooley and Mathieson (1987) for example.

1) Many of the previous studies considered only cross-section regressions for a set of OECD countries while table 1 presents single country time series regressions [23] . This means that previous studies mixed in the same regressions countries for which the theory appears to work with countries in which the theory is not supported reducing therefore the fitness of the regressions. If one considers that countries might differ in their degree of capital mobility (either because of capital controls and/or other capital markets imperfections) cross-section studies will bias downward the degree of capital mobility for the entire sample. The time series approach followed in table 1, instead, allows to estimate for each country separately the degree of capital mobility.

2) All the previous studies have disregarded the separate and independent role of budget deficits in affecting the current account in addition to the investment rate. In this sense, previously estimated equations were misspecified in that the role of fiscal deficit was not considered. This might have been an independent cause of the weak relation between current account and investment rate. This explanation is supported by the results of table 3 where the current account is regressed on the investment rate <u>only</u> , the equation traditionally estimated in the literature. Compared to the results in table 1 where the investment variable was significant in 13 countries, in table 3 this variable is significant <u>only</u> in 5 countries. In other 8 countries

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[23] The main cross-section studies are those by Feldstein and Horioka (1980), Feldstein (1983), Fieleke (1982), Penati and Dooley (1984), Murphy (1984), Caprio and Howard (1985), Summers (1985) and Frankel Dooley and Mathieson (1986).

(U.S., Japan, Germany, France, Italy, Belgium, Sweden and Spain) the investment variable does not appear as significant in the simple bivariate (and incorrectly specified) regressions of table 3 while is significant in the table 1 regressions that include the fiscal deficit. This means that disregarding the role of budget deficits creates a serious specification error and significantly bias downward the estimates of capital mobility obtained through the exclusive consideration of investment rates .

The above results suggest that the lack of international capital mobility obtained in previous studies of the issue might be seriously biased by the cross-section technique used and the incorrect exclusion of the fiscal variable from the current account equation.

The results obtained here, while being consistent with the hypothesis of greater degree of capital mobility than previously thought do not, however, completely confirm the joint hypothesis of "consumption smoothing", "taxation smoothing" and "international capital mobility". In particular, the theory does not work for a number of countries and, even in the countries where both explanatory variables are significant, the estimated coefficients diverge from their theoretically expected values. Which one of the three components of the joint hypothesis is the source of these results ?

One might suspect that the "tax smoothing" hypothesis is the weak link in the model. Barro (1979, 1985, 1986) has found evidence in favor of the tax smoothing model for the United States and the United Kingdom but the tax smoothing model has been substantially rejected for most of the other OECD countries by Roubini and Sachs (1988 a, 1988 b). One can also observe that, while the investment variable is not significantly different from its theoretical value in a number of countries (Italy, Norway, Ireland, Greece and Spain) and very large in many others, only one country (Spain) shows a coefficient of the deficit variable close to the theoretical value of minus one.

We can now move to the estimates of the savings equation. As shown in the previous section, under the joint hypothesis of consumption and taxation smoothing and international capital mobility, national savings should be related only to the budget deficit and the transitory components of output with no additional effect of the investment rate (see equation (34)). Alternatively, and equivalently, private savings should be only a function of transitory shocks to output with no role of the investment rate (equation (35)). As discussed in the previous section, simple bivariate regressions of national savings on the investment rate, as usually performed in the literature, are not correct tests of the hypothesis of international capital mobility because they do not control for the effects on savings of fiscal deficits and temporary output shocks. In this sense the high and positive correlations between total savings and investment rates found in the literature do not provide evidence for the absence of capital mobility.

We will start the empirical test of the savings equation by regressing the <u>private</u> saving rate (as a share of GDP) on the investment rate (as a share of GDP) [24]. This is the specification suggested by equation (35) where the theoretical restriction of a minus one coefficient on the budget deficit in the saving equation (see equation (34)) is imposed [25]. Under the null hypothesis, we expect that investment rate is not correlated with the savings rate. Table 4 presents the results of the regressions of the private saving rate on the investment rate for 18 OECD countries. The results of the table strongly confirm the hypothesis of no correlation between private savings and investment rates: in 13 out of 18 countries the coefficient on the investments rate is not significant and/or has a negative sign. Only in 5 countries in the sample (Japan, Germany, France, Austria, Norway) there is a statistically significant positive correlation between private savings and investment. Moreover, even in the 5 countries where a statistically significant correlation is found the estimated coefficient on the investment rate is significantly below minus one (usually in the -0.30 to -0.40 range [26]), i.e. the estimated coefficient is much smaller (in absolute value) than the one found in the numerous studies on the degree of international capital immobility. These results suggest that the degree of international capital mobility might be much larger than the one implied by previous studies and that the "Feldstein-Horioka puzzle" might be the partial result of an

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[24] As explained above in the discussion of the current account equation, we disregard for the moment the role of transitory output shocks in the saving equation.

[25] We will test below whether this restriction is confirmed by the data.

[26] France is the only exception with a coefficient of -0.70.

incorrect specification of the savings equation. Once we control for the role of budget deficits, the correlation between savings and investment disappears in most of the OECD countries considered in our sample.

The regressions in table 4 have imposed the theoretical restriction of a minus one coefficient on the deficit variable in the savings equation instead of testing it . Is such a restriction warranted ? We can test this restriction by estimating directly equation (34) that relates total savings to the budget deficit rather than equation (35) that imposes a priori the above restriction.

The results of the regressions of total savings on the budget deficit are presented in table 5. As shown in the table, in 16 out of the 18 countries, the deficit variable has the correct negative sign and is significant (the only exceptions being the U.K. and Australia where the sign is correct but not statistically significant at the 5% confidence level). Also, in 10 out of the 16 countries with a significant coefficient, the estimated of the fiscal deficit coefficient is not statistically different from its theoretical value of minus one. In the other 6 countries, the estimate significantly differs from the one implied by the maintained hypothesis. These results then provide support for the restriction imposed in equation (35) and the saving equation tested in table 4 only for over half of countries in the sample.

The results in table 5 then suggests that we should estimate a saving function as in equation (34) where the restriction on the deficit variable is not imposed a priori and the assumed zero effect of investment is tested explicitly as well. Table 6 present the results of the regressions of the total savings rate on the budget deficit and the investment rate. The results in table 6 can be summarized as following:

(a) in 12 out of 18 countries the deficit variable is significant and has the correct negative sign; in the other 6 countries the sign is correct but statistically not significant at the 5% confidence level.

(b) In all the countries, with the exception of Spain, the coefficient on the deficit variable is statistically different from its theoretical value of minus one.

(c) The investment variable enters significantly in the savings in 11 countries out of 18 even after controlling for the effects of fiscal deficits.

(d) However, only in 5 countries (Italy, Norway, Ireland, Greece and Spain) the coefficient on the investment rate is close to positive one (the case of "capital immobility") [27]. In the other countries the coefficient is either insignificant (7 countries) or significant but much smaller than unity (6 countries) suggesting a large degree of capital mobility [28].

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[27] With the exception of Norway, these are also the OECD countries in the sample with the highest degree of capital controls.

[28] It should be remembered that studies in the Feldstein-Horioka tradition have usually found correlation coefficients between savings and investment rates above 0.80. See, for example, Caprio and Howard (1984), Frankel, Dooley and Mathieson (1987), Murphy (1984), Obstfeld (1985, 1986), Penati and Dooley (1984), Summers (1985).

The implications of the results in table 6 are twofold. On one side, they confirm the hypothesis of a large degree of capital mobility for most OECD countries and contrast with earlier results in the literature about a low degree of international mobility of capital. On the other side, the results are partially at odds with those found in table 4 where a much smaller number of countries showed a positive relation between the private savings rate and the investment rate (evidence of a very high degree of capital mobility) . Also, the large negative coefficients on the deficit variable found in table 4 are not replicated in table 6 where the number of countries with a deficit coefficient equal to the theoretical value of minus one is much smaller.

How to explain the persistent, even if modest, effect of investment rate on savings, residually found in table 6 ? One explanation, that substantially rejects the optimizing and Ricardian paradigm of the paper, is to suppose that investment rates are negatively correlated with budget deficits, i.e. budget deficits crowd-out investment. Under the Ricardian and tax smoothing assumption, temporary expenditure shocks that generate fiscal deficits should have no effect on the real interest rate and therefore on the investment rate.

Suppose now, instead, that budget deficits actually crowd-out investment. In this case, fiscal deficit would on one side generate directly a fall in national savings (public savings become negative) and would also cause a fall in the investment rate. We would then observe that, in correspondence with fiscal shocks, there will be a positive correlation between savings and investment rates even under the assumption of perfect capital mobility.

This explanation stresses again the important role of fiscal disturbances in explaining the capital mobility puzzle and allows to reconcile the results in table 4 with those in table 6. If budget deficits crowd-out investment estimates of the savings equation like (34) where savings are regressed on budget deficits <u>and</u> an endogenous investment rate will bias downward the estimates of the deficit coefficient and will show a positive correlation between investment and saving rates even under the hypothesis of perfect capital mobility.

How likely is such an hypothesis of a crowding-out ? While this study cannot answer specifically such a question, it is possible to test the hypothesis of a negative correlation between investment rate and budget deficits. Table 7 presents the results of simple bivariate regressions of the investment rate on the budget deficit for the 18 OECD countries in the sample. In 14 out of 18 countries table 7 shows a strong negative and significant relation between budget deficits and investment rates (the coefficients are usually above 0.50 (in absolute value) and in a number of countries close to negative one).

One interpretation of this strong result is, as suggested above, the crowding-out hypothesis. This hypothesis could explain the significant role of the investment rate in some of the results in table 6 and the weakening of the coefficient on the budget deficits in that table compared to the results of table 4. An alternative view could interpret the negative correlation between budget deficits and investment rates in terms of common underlying disturbances (such as negative real shocks) that lead simultaneously to budget deficits and falls in the investment rate. This alternative explanation would also be consistent with the hypothesis of capital mobility and interpret the correlation between savings and investment in terms of this common underlying disturbances.

5. Conclusions.

This paper presented an infinite horizon model of consumption and taxation smoothing that implies a simple relation between current accounts, budget deficits, investment rates and transitory output shocks. It was argued that such a model could explain the "Feldstein-Horioka puzzle" of the apparent lack of international capital mobility. Simple regressions of the savings rate on the investment rate were shown to be incorrect tests of the hypothesis of capital mobility because they do not control for the independent role of budget deficits and temporary output shocks in the current account and savings equations. Empirical tests of the model for a sample of 18 OECD countries present good evidence that international capital markets are widely integrated and that the "Feldstein-Horioka puzzle" might be explained by the important role of fiscal deficits in the determination of the current account and the saving behavior.

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Table 1.
Regressions Results.
Dependent Variable: Current Account to GDP Ratio.

Country	Sample Period	Independent Variables DEFY	INVY	R^2	D.W.
U.S	61-85	-0.61 (4.00)	-0.51 (3.06)	0.42	0.86
Japan	66-85	-0.36 (2.61)	-0.33 (3.23)	0.38	1.18
Germany	61-85	-0.44 (3.31)	-0.35 (3.70)	0.39	0.80
France	61-85	-0.65 (3.84)	-0.11 (1.31)	0.47	2.15
U.K.	61-85	-0.14 (2.19)	-0.57 (5.14)	0.54	0.92
Italy	61-85	-0.51 (5.83)	-1.00 (5.56)	0.71	1.62
Canada	66-85	-0.23 (4.33)	-0.57 (7.78)	0.78	1.71
Belgium	61-85	-0.51 (4.22)	-0.41 (2.10)	0.53	0.53
Austria	71-85	-0.37 (1.73)	-0.30 (2.04)	0.27	1.44
Denmark	71-85	-0.27 (1.43)	-0.28 (0.99)	0.21	1.75
Finland	71-85	-0.18 (0.91)	-0.62 (5.92)	0.77	1.54
Netherlands	71-85	-0.51 (1.23)	-0.54 (1.69)	0.19	0.43
Norway	71-85	-0.45 (5.19)	-0.97 (9.76)	0.96	1.71

Sweden	71-85	-0.49 (4.21)	-0.61 (2.71)	0.61	0.87
Ireland	71-85	-0.32 (2.63)	-0.91 (4.14)	0.69	1.42
Australia	71-85	-0.15 (0.30)	0.31 (0.005)	0.09	0.72
Greece	71-85	-0.25 (1.44)	0.90 (0.04)	0.36	1.65
Spain	71-85	-0.89 (2.07)	-0.86	0.37	0.62 (2.59)

Definitions:

DEFY = General Government Deficit as a Share of GDP = Change in the Net Debt of the General Government as a share of GDP.

INVY = Investment to GDP Ratio = Fixed Capital Formation plus Change in Inventories as a Share of GDP.

Data Source: OECD National Income Accounts.
OECD Data for Net Debt figures.

All equations include a constant term whose value is omitted.
t-statistics in parentheses.

Table 2.
Cross Section Studies of International Capital Mobility.
Dependent Variable: Current Account to GDP Ratio.

Number of OECD Countries	Source of the results	Sample Period	Coefficient on the Investment Variable	R^2
19	Penati and Dooley (1984)	(1949-1959)	-0.04 (0.30)	0.005
19	Penati and Dooley (1984)	(1971-1981)	-0.19 (1.66)	0.11
19	Penati and Dooley (1984)	(1974-81)	-0.24 (0.93)	0.12
19	Penati and Dooley (1984)	(1949-59)-(1971-81)	0.05 (0.46)	0.01
19	Penati and Dooley (1984)	(1949-59)-(1974-81)	-0.02 (0.19)	0.01
19	Penati and Dooley (1984)	(1960-74)	0.02 * (0.27)	0.01
15	Sachs (1983)	(1971-79)	-0.20 (1.89)	0.21
15	Sachs (1981)	(1968-73)-(1974-79)	-0.64 * (6.2)	0.72

Source: Data in Table 1 of Frankel, Dooley and Mathieson (1987).

* : This equation was estimated in first differences.

All equations include a constant term whose value is omitted.
t-statistics in parentheses.

Table 3.
Regressions Results.
Dependent Variable: Current Account to GDP Ratio.

Country	Sample Period	Independent Variable: INVY	R^2	D.W.
U.S	61-85	-0.08 (0.47)	0.01	0.31
Japan	66-85	-0.13 (1.69)	0.13	0.70
Germany	61-85	-0.11 (1.50)	0.09	0.84
France	61-85	-0.09 (1.20)	0.05	1.32
U.K.	61-85	-0.56 (4.67)	0.48	0.75
Italy	61-85	-0.46 (1.77)	0.14	0.42
Canada	66-85	-0.39 (4.58)	0.53	1.11
Belgium	61-85	0.28 (2.10)	0.15	0.53
Austria	71-85	-0.13 (1.12)	0.08	1.03
Denmark	71-85	0.10 (1.09)	0.08	2.03
Finland	71-85	-0.58 (6.32)	0.75	1.38
Netherlands	71-85	-0.23 (1.14)	0.09	0.54
Norway	71-85	-1.31 (10.1)	0.88	1.10

Sweden	71-85	0.15 (0.76)	0.04	1.23
Ireland	71-85	-0.98 (3.69)	0.51	0.70
Australia	71-85	0.07 (0.15)	0.001	0.72
Greece	71-85	0.26 (2.08)	0.25	1.37
Spain	71-85	-0.23 (1.52)	0.15	0.66

Definition:

INVY = Investment to GDP Ratio = Fixed Capital Formation plus Change in Inventories as a Share of GDP.

Data Source: OECD National Income Accounts.

All equations include a constant term whose value is omitted. t-statistics in parentheses.

Table 4.
Regressions Results.
Dependent Variable: Private Savings to GDP Ratio (PSAV).

Country	Sample Period	Independent Variable: INVY	R^2	D.W.
U.S	61-85	0.20 (1.40)	0.08	1.28
Japan	66-85	0.31 (3.06)	0.34	1.08
Germany	61-85	0.33 (4.29)	0.44	1.23
France	61-85	0.70 (9.49)	0.78	1.64
U.K.	61-85	0.36 (1.13)	0.05	1.07
Italy	61-85	-0.46 (1.77)	0.14	1.05
Canada	66-85	-0.18 (0.84)	0.04	0.51
Belgium	61-85	-0.09 (0.72)	0.02	0.57
Austria	71-85	0.42 (2.97)	0.40	1.46
Denmark	71-85	-0.26 (2.02)	0.23	0.99
Finland	71-85	0.16 (1.19)	0.10	1.62
Netherlands	71-85	0.16 (0.80)	0.05	0.63
Norway	71-85	0.42 (2.96)	0.40	1.78

Sweden	71-85	-0.40 (1.95)	0.22	0.81
Ireland	71-85	0.21 (0.53)	0.02	1.56
Australia	71-85	0.18 (0.32)	0.008	0.71
Greece	71-85	0.26 (1.46)	0.14	1.96
Spain	71-85	0.06 (0.47)	0.02	0.64

Definition:

PSAV = Private Savings to GDP Ratio = National Savings + Deficit of the General Government.

INVY = Investment to GDP Ratio = Fixed Capital Formation plus Change in Inventories as a Share of GDP.

Data Source: OECD National Income Accounts.
OECD Data for Change in Net Debt (General Government Deficit) figures.

All equations include a constant term whose value is omitted.
t-statistics in parentheses.

Table 5.
Regressions Results.
Dependent Variable: National Savings to GDP Ratio (SAVY).

Country	Sample Period	Independent Variable: DEFY	R^2	D.W.
U.S	61-85	-0.92 (7.08)	0.68	1.16
Japan	66-85	-1.00 (5.86)	0.65	0.72
Germany	61-85	-1.14 (7.99)	0.73	0.83
France	61-85	-1.60 (5.25)	0.54	0.42
U.K.	61-85	-0.15 (1.84)	0.13	0.66
Italy	61-85	-0.47 (7.31)	0.74	1.43
Canada	66-85	-0.39 (5.29)	0.60	0.83
Belgium	61-85	-0.80 (10.7)	0.83	0.59
Austria	71-85	-1.03 (3.79)	0.52	0.46
Denmark	71-85	-0.74 (9.62)	0.87	0.98
Finland	71-85	-0.53 (2.22)	0.27	1.69
Netherlands	71-85	-0.97 (3.56)	0.49	0.61
Norway	71-85	-0.44 (7.14)	0.79	1.65

Sweden	71-85	-0.65 (8.85)	0.85	0.77
Ireland	71-85	-0.31 (2.70)	0.36	1.37
Australia	71-85	-0.38 (0.83)	0.05	0.48
Greece	71-85	-0.94 (5.76)	0.71	1.72
Spain	71-85	-1.05 (6.23)	0.74	0.63

Definitions:

DEFY = General Government Deficit as a Share of GDP = Change in the Net Debt of the General Government as a share of GDP.

SAVY = National Savings to GDP Ratio.

Data Source: OECD National Income Accounts.
OECD Data for Net Debt figures.

Table 6.
Regressions Results.
Dependent Variable: National Savings to GDP Ratio (SAVY).

		Independent Variables			
Country	Sample Period	DEFY	INVY	R^2	D.W.
U.S	61-85	-0.67 (4.38)	0.43 (2.57)	0.75	0.94
Japan	66-85	-0.36 (2.61)	0.66 (6.37)	0.89	1.18
Germany	61-85	-0.47 (3.52)	0.62 (6.55)	0.91	0.80
France	61-85	-0.48 (2.91)	0.87 (10.5)	0.92	1.92
U.K.	61-85	-0.14 (2.16)	0.42 (3.81)	0.47	0.89
Italy	61-85	-0.45 (5.84)	0.10 (0.68)	0.75	1.61
Canada	66-85	-0.22 (3.93)	0.42 (5.47)	0.85	1.51
Belgium	61-85	-0.49 (4.18)	0.58 (3.06)	0.87	0.58
Austria	71-85	-0.36 (1.65)	0.70 (4.71)	0.83	1.42
Denmark	71-85	-0.24 (1.22)	0.76 (2.60)	0.92	1.75
Finland	71-85	-0.18 (0.93)	0.36 (3.52)	0.64	1.55
Netherlands	71-85	-0.51 (1.24)	0.45 (1.42)	0.56	0.42
Norway	71-85	-0.46 (5.39)	0.03 (0.30)	0.79	1.71

Sweden	71-85	-0.49 (4.22)	0.38 (1.72)	0.88	0.88
Ireland	71-85	-0.32 (2.63)	0.07 (0.35)	0.36	1.42
Australia	71-85	-0.16 (0.32)	0.59 (1.00)	0.12	0.37
Greece	71-85	-0.25 (1.42)	1.00 (4.77)	0.90	1.65
Spain	71-85	-0.87 (2.03)	0.15 (0.46)	0.75	0.63

Definitions:

DEFY = General Government Deficit as a Share of GDP = Change in the Net Debt of the General Government as a share of GDP.

INVY = Investment to GDP Ratio = Fixed Capital Formation plus Change in Inventories as a Share of GDP.

SAVY = National Savings (Private and Public) as a Share of GDP.

Data Source: OECD National Income Accounts.
OECD Data for Net Debt figures.

Table 7.
Regressions Results.
Dependent Variable: Investment to GDP Ratio (INVY).

Country	Sample Period	Independent Variable: DEFY	R^2	D.W.
U.S	61-85	-0.58 (4.04)	0.41	1.16
Japan	66-85	-0.97 (4.46)	0.52	0.44
Germany	61-85	-1.08 (5.79)	0.59	0.90
France	61-85	-1.27 (4.02)	0.41	0.47
U.K.	61-85	-0.03 (0.21)	0.002	0.65
Italy	61-85	-0.25 (2.52)	0.26	0.81
Canada	66-85	-0.41 (2.92)	0.32	0.64
Belgium	61-85	-0.52 (7.47)	0.70	0.71
Austria	71-85	-0.94 (3.04)	0.41	0.33
Denmark	71-85	-0.65 (10.6)	0.879	1.33
Finland	71-85	-0.94 (2.02)	0.24	1.39
Netherlands	71-85	-1.00 (4.40)	0.59	1.59
Norway	71-85	0.58 (3.15)	0.43	1.15

Sweden	71-85	-0.41 (4.91)	0.65	1.46
Ireland	71-85	0.06 (0.39)	0.01	0.92
Australia	71-85	-0.36 (1.69)	0.18	3.01
Greece	71-85	-0.68 (5.22)	0.67	1.56
Spain	71-85	-1.17 (8.09)	0.83	0.99

Definitions:

INVY = Investment to GDP Ratio = Fixed Capital Formation plus Change in Inventories as a Share of GDP.

DEFY = General Government Deficit as a Share of GDP = Change in the Net Debt of the General Government as a share of GDP.

Data Source: OECD National Income Accounts.
OECD Data for Net Debt figures.