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TAXES, CREDIT MARKET 'IMPERFECTIONS' AND INTER-COUNTRY DIFFERENCES IN THE HOUSEHOLD SAVING RATIO***

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ABSTRACT

This paper analyzes aggregate household saving under the capital market imperfection, which is characterized by the wedge between the borrowing rate and the lending rate. Under these circumstances the assumption of a representative household is unlikely to hold and consumers are distributed into savers, liquidity-constrained consumers and borrowers depending on the exogenous future labour income. An interest rate wedge is shown to affect saving positively; as for tax rate, while there are some conflicting tendencies, it will likely affect saving negatively mainly via affecting the post-tax interest rate wedge. Moreover, though the within regime behavioural functions were linear in terms of incomes, the aggregate marginal propensity to save out of current income is increasing so that e.g. a fall in the income inequality will tend to decrease saving. In the second part of the paper a large international data sample from 26 countries in the 1980s is used to test for the role of tax and interest rate wedge factors in addition to the usual life cycle variables. On the whole, results, while quite preliminary, are encouraging; coefficient estimates are rather precise and of 'correct' sign. The growth effect is significant, but - in sharp contrast to earlier findings - negative. Finally, tax and wedge variables help to improve the performance of household saving ratio equation indicating that both a rise in the tax rates and better access to credit market - measured by the ratio fo currency to GDP and to M2 respectively - will tend to decrease household saving, ceteris paribus. The income distribution variable is also of 'correct' sign, but not very precisely estimated.

CONTENTS

1 INTRODUCTION

After Modigliani and Brumberg had provided, in early 1950s, seminal formulations of what has come to be known as the life cycle hypothesis of saving (LCH), it has been pursued by a number of authors, both at the theoretical level and for the analysis of empirical data (see Modigliani (1986) for a recent review of the approach). Early applications dealt with aggregate time series data, and later on it was argued that LCH is equally fruitful for an understanding of huge observed inter-country differences in the average household (and private) saving ratios. The studies by Houthakker (1960) and Modigliani (1970) was extended by Feldstein (1977) to account for social security and endogenous retirement age. According to the Houthakker-Modigliani-Feldstein hypothesis, the aggregate household (and private) saving ratio depends on the growth rate of income, various demographic variables, social security benefit variable and the labour force participation rate of the aged.

The early tests of LCH to account for inter-country differences in the average private saving - the sum of household saving and corporate saving - ratios were successful. Modigliani (1970) concluded his study with a sample of 36 countries from the 1950s by saying that ".. all the evidence supports both qualitatively and quantitatively the role of the two principal variables suggested by the life cycle model, productivity growth of income, and the age structure of the adult population" (Modigliani (1970), p. 219). According to LCH with endogenous retirement social security will have an a priori ambiguous effect on private saving due to offsetting 'asset substitution' and 'induced retirement' effects. Using a sample of 15 countries from the 1950s Feldstein (1977) introduced social security benefit and labour force participation rate of the aged - variables into the inter-country private savings ratio specification proposed by Modigliani. Feldstein's results provided support to this extended LCH.

Attempts to understand inter-country differences in saving ratios by using more recent data have been less successful. Using a sample of 12 countries from early 1970s Feldstein (1980) kept sticking to the 'social security depresses private saving' hypothesis by saying that ".. the new estimates support ..the conclusions ..that indicate ..the negative impact of social security benefits on private saving" (Feldstein (1980), p. 238). This claim, however, turned out to be very fragile to the specification details of the private saving ratio equation as indicated in Koskela and Virén (1983). Hence, the social security benefit variable's role in understanding international differences of the private saving ratios in the 1970s remains moot. Recently, Graham (1987) has looked at the ability of LCH to explain the observed variations in the household saving ratios of 17 OECD nations during the 1970s. According to Graham's regressions the standard version of LCH is totally unable to account for intercountry differences in the household saving ratios. The results can be considerably improved, however, by weighting observations by population and by introducing the labour force participation rate of the working age female population as an additional explanatory variable into the household saving ratio equation. But Graham's "..rather strong evidence that higher female participation is associated with lower household saving rates" (Graham (1987), p. 1523) is robust neither to data sample nor to time period (see Koskela and Virén (1989) for details). Moreover, Graham's additional variable can be critisized on theoretical grounds.

Concludingly, LCH appears to be on a rather shaky empirical ground in accounting for inter-country differences in household saving ratios with more recent data.[1)] A notable feature of the formulations of LCH referred above is neglect of the capital market 'imperfections' and the tax rates; the saving ratio equations do not incorporate variables reflecting either capital market 'imperfections' or/and tax rates, though they vary widely across countries and may affect incentives to borrow and save. In fact, there is some theoretical and empirical evidence for the importance of capital market 'imperfections' and its relation to household saving behaviour.

In the context of less-developed countries McKinnon (1973) has argued that in the lack of extensive and well-developed financial

intermediation money serves as a conduit through which accumulation takes place so that the demand for money rises pari passu with the productivity of physical capital. The relation of saving to financial intermediation is not necessarily unambiguous; thin financial markets can stimulate saving via the 'forced saving' effect,[2] but saving can also be discouraged due to the lack of suitable saving instruments.[3]

In the case of developed industrial countries one might be tempted to argue against the importance of capital market 'imperfections'. But the existence of well-developed financial markets with flexible interest rates does not necessarily imply perfect capital markets, where agents can borrow and lend at the same interest rate whatever amount they want. In fact, it has been recently shown rigorously, how various kinds of capital market 'imperfections' can arise as a market's response to asymmetric or imperfect information. These capital market 'imperfections' include non-linear interest rate schedule as a function of the amount of borrowing (see e.g. Keeton (1979)), endogenously determined wedge between borrowing and lending rate (see King (1986)) and credit rationing in the form of quantitative limits on the amount of borrowing at the equilibrium interest rate (see e.g. Stiglitz and Weiss (1981) and for an empirical evaluation, see Kugler (1987)). On the other hand, Jappelli and Pagano (1988) have produced some empirical evidence suggesting that imperfect capital markets have an important effect on consumption and saving behaviour of households.[4]

As mentioned above, inter-country saving ratio equations have not incorporated the marginal tax rates into the specifications. It is well-known that they vary widely across countries and may affect saving via post-tax income, post-tax income profile, post-tax return on saving and post-tax cost of borrowing.[5]

The purpose of this paper is to derive the aggregate saving function under the capital market imperfection, which is characterized by the wedge between the borrowing rate and the lending rate. Under these circumstances the assumption of a representative consumer is unlikely to hold and consumers are distributed into savers, liquidity-constrained consumers and borrowers depending on their future

(exogenous) labour income. After developing some qualitative properties of this three-class economy, particularly with respect to interest rate wedge and the tax rate on labour income as well in terms of the behaviour of the marginal propensity to save out of current income, we turn to consider estimation results based on a cross section of 26 countries. The data was chosen so that the maximum number of countries could be included and the variables usually represent five-year averages over the period 1981 - 1985. The data are also the most recent one, which are available for international comparisons.

Theoretical considerations are presented in section 2, while section 3 is devoted to the presentation of empirical results. Finally, there is a brief conclusion.

2 AGGREGATE HOUSEHOLD SAVING: THEORETICAL CONSIDERATIONS

In this section we first show how consumers of one generation are divided into savers, liquidity-constrained ones and borrowers respectively in the presence of interest rate wedge on the capital market. Then we develop the comparative statics of the aggregate saving in this three class economy with respect to the interest rate wedge, the tax rate and in terms of how the marginal proponsity to save out of current income behaves. The latter part of section is devoted to consider implications on saving of across generational factors as well as introducing some other potentially important explanatory variables.

2.1 Aggregate Saving, Interest Rate Wedge and Taxes: Cohort Effects

Consumers are assumed to have a preference ordering over the present and future consumption c_1 and c_2, which is represented by an intertemporally additive, twice differentiable utility function

$$(1) \qquad U = u(c_1) + \beta u(c_2)$$

where $\beta^{-1} = (1+\rho)$ refers to the rate of time preference factor. In what follows the partial derivatives are denoted by primes for functions with one argument and by subscripts for functions with many arguments. For convenience, u is assumed to be an increasing and strictly concave, quadratic function of consumption c_i

$$(2) \qquad u(c_i) = ac_i + (b/2)c_i^2 \qquad i = 1, 2$$

For u to be increasing in c_i, $a + bc_i > 0$ and for strict concavity $b < 0$. Earnings in the two periods are assumed to be exogenous, and are denoted by y_1 and y_2 (y_1 also includes possible first-period wealth). In the model with no uncertainty there is no need for more complicated notation for y_2. The (permanent) tax rate is denoted by τ so that the post-tax incomes are $y_1\theta$ and $y_2\theta$, where $\theta = 1-\tau$. Hence, we do not distinguish between the current and future tax rates τ_1 and τ_2 respectively.

We begin by analyzing the optimal consumption and saving plan of a consumer facing the (pre-tax) borrowing and lending rates, rz and r, respectively, where $z > 1$ so that there is a wedge between the borrowing and lending rate on the capital market.[6] The budget constraint facing consumers is now non-linear and can be expressed in terms of future consumption as follows

$$(3) \qquad c_2 = \begin{cases} y_2\theta + R(y_1\theta - c_1) & \text{as } c_1 < y_1\theta \\ y_2\theta + R^*(y_1\theta - c_1) & \text{as } c_1 > y_1\theta \end{cases}$$

where $R = 1 + r$ and $R^* = 1 + rz$. With this budget constraint there are three regimes in which a consumer may be located. These are: (a) an interior solution at which $c_1^s < y_1\theta$; the consumer saves. (b) a corner solution at which $c_1^n = y_1\theta$; the consumer neither saves nor borrows and (c) an interior solution at which $c_1^b > y_1\theta$; the consumer borrows.[7]

In this contest one might wonder whether there exists a possibility for tax arbitrage; a good example of such a procedure would be borrowing to purchase tax exempt bonds and deduct interest payment in

taxation. Denoting borrowing by B, and tax exempt bonds by S (= saving) gives the following flow-of-funds equations with a possibility of tax arbitrage $c_1 = y_1\theta + B - S$ and $c_2 = (y_2 - rzB)\theta + S(1 + r) - B$. Combining the flow-of-funds equations gives the intertemporal budget constraint $c_2 = (y_2 - rzB)\theta - Br + R(y_1\theta - c_1)$ and differentiating this with respect to tax arbitrage borrowing yields $\partial c_2/\partial B = -r(z\theta + 1) \gtrless 0$ as $\tau \gtrless 1 - z^{-1}$. Thus, with linear taxation there is no unique solution and we can distinguish between three cases: (1) if $\tau > 1-z^{-1}$, then the consumers can increase their consumption without bound by borrowing at the interest rate rz, investing it at the lending rate r and deducting borrowing expenses rzB from taxable income. (2) if $\tau = 1 - z^{-1}$, then consumers are indifferent as for the tax arbitrage. In this case the intertemporal budget constraint becomes after substitution $c_2 = y_2\theta + R(y_1\theta - c_1)$ so that the intertemporal budget constraint is linear even in the presence of the pre-tax interest rate wedge. (3) finally, if $\tau < 1-z^{-1}$, then there is no arbitrage and the non-linear budget constraint (3) remains valid. In what follows we proceed by assuming that $\tau < 1-z^{-1}$ holds.

Maximizing the intertemporally additive, quadratic utility function subject to the non-linear budget constraint (3) gives the following condition at an interior solution

$$a + bc_1 = \beta\hat{R}[a + bc_2] \tag{4}$$

where $\hat{R} = R$ for savers and $\hat{R} = R^*$ for borrowers. In appendix 1 it is shown that consumers will be located among the regimes according the their second-period earnings in the following way:

$$\begin{cases} \text{(i)} & y_2 < \lambda_1 \equiv R^{-1}[y_1\beta^{-1} - (b\theta)^{-1}a(R - \beta^{-1})] \text{ for savers} \\ \text{(ii)} & y_2 > \lambda_2 \equiv R^{*-1}[y_1\beta^{-1} - (b\theta)^{-1}a(R^* - \beta^{-1})] \text{ for borrowers} \\ \text{(iii)} & \lambda_1 < y_2 < \lambda_2 \text{ for "liquidity-constrained" consumers.} \end{cases} \tag{5}$$

It is easy to show that the saving functions of the respective groups can be written as

$$(6) \qquad s^x = \left[1 + \beta\hat{R}^2 \right]^{-1}\{b^{-1}a(1-\beta\hat{R}) + \theta(y_1-\beta\hat{R}y_2)\}$$

where $s^s > 0$ and $\hat{R} = R$ as $x = s$ and $s^b < 0$ and $\hat{R} = R^*$ as $x = b$. The former holds as $y_2 < \lambda_1$, while the latter holds as $y_2 > \lambda_2$. In the case of "liquidity-constrained" consumers we have $s^n = 0$, which holds the domain $\lambda_1 < y_2 < \lambda_2$.

The allocation of consumers to various regimes of the capital market depends upon their earnings in the second period; as the earnings increase consumers move through the regimes s^s, s^n, s^b. Notice that along the interval $\lambda_1 < y_2 < \lambda_2$ consumers behave as if they were liquidity-constrained; they would like to borrow at the lending rate r and to lend at the borrowing rate rz so that their saving is zero. For a given interest rate wedge - which may be affected by the tax system - the number of consumers in each regimes is determined by the distribution of second-period earnings in the population. In what follows we denote this distribution by a continuos frequency function with support [A, B], $f(\lambda)$, when $\lambda = y_2$. The aggregate saving by consumers of a generation can now be written as

$$(7) \qquad S = \int_A^{\lambda_1} s^s(\cdot)f(\lambda)d\lambda + \int_{\lambda_2}^{B} s^b(\cdot)f(\lambda)d\lambda$$

where $s^s(.)$, $s^b(.)$, λ_1 and λ_2 have been defined in equations (6) and (5) respectively.

Let us next turn to develop some comparative statics of the aggregate saving function (7). Here we have to notice that exogenous variables may affect total saving both within regimes and by changing the boundaries of regimes. A change in the pre-tax interest rate wedge z on the aggregate saving can be decomposed as

$$(8) \qquad S_z = \underbrace{\int_{\lambda_2}^{B} s_z^b f(\lambda)d\lambda}_{+} \underbrace{- \lambda_{2z}\, s^b(\lambda_2)f(\lambda_2)}_{-} > 0$$

where $s^b_z = \partial s^b/\partial z$, $\lambda_{2z} = \partial\lambda_2/\partial z$ and $s^b(\lambda_2) < 0$. It can be shown, utilizing the expressions (6) and (5ii), that

$$(9)\quad \begin{cases} \text{(i)} & s^b_z = -[b(1+\beta R^{*2})]^{-1}\beta r[(a+bc_2) + bR^* s^b] > 0 \\ & \text{and} \\ \text{(ii)} & \lambda_{2z} = -r(\beta b\theta)^{-1}[a + b\theta y_1] > 0 \end{cases}$$

due to the first-order conditions for utility maximization $a + bc_1 > 0$ and $a + bc_2 > 0$ and due to the fact that $c^b_1 > y_1\theta$. Notice that $s^s_z = \lambda_{1z} = 0$ (see Novshek and Sonnenschein (1979) for a similar analysis in a different context).

According to the expression (8) the pre-tax interest rate wedge z will have a positive affect on aggregate saving. On the one hand, a rise in the wedge will decrease the consumption of borrowing consumers, when the substitution and income effects reinforce each other (the term $\int_{\lambda_2}^{B} s^b_z f(\lambda)d\lambda$). On the other hand, a rise in the wedge will shift some consumers from the borrowing status to the liquidity-constrained situation, which also tends to decrease consumption (the term $-\lambda_{2z}s^b(\lambda_2)f(\lambda_2)$).

As for the comparative statics of the tax rate, consider first the case where the tax rate τ changes permanently both in the current and future period and affects aggregate saving solely via current and future earnings. The comparative statics in the absence of profitable tax arbitrage can be decomposed as

$$(10)\quad S_\tau = \int_A^{\lambda_1} s^s_\tau f(\lambda)d\lambda + \underbrace{\lambda_{1\tau}s^s(\lambda_1)f(\lambda_1)}_{+} + \int_{\lambda_2}^{B} s^b_\tau f(\lambda)d\lambda - \underbrace{\lambda_{2\tau}s^b(\lambda_2)f(\lambda_2)}_{-}$$

where $s^s(\lambda_1) > 0$ and $s^b(\lambda_2) < 0$. Utilizing the marginal propensity to save out of current income-expressions $s^s_{y1} = (1+\beta R^2)^{-1}\theta > 0$ and $s^b_{y1} = (1+\beta R^{*2})^{-1}\theta > 0$ the saving responses to the permanent tax rate within the regimes can be written as

$$(11) \qquad s^x_\tau = -s^x_{y_1}\theta^{-1}\left[\, y_1 - \beta\hat{R}y_2 \,\right] \lessgtr 0 \quad \text{as } y_1 \lessgtr \beta\hat{R}y_2 \text{ for } x = s,\ b$$

where subscripts refer to partial derivatives, e.g. $s^x_\tau = \partial s^x/\partial\tau$ etc. and where $\hat{R} = R$ for $x = s$ and $\hat{R} = R^*$ for $x = b$.

The response of the regime boundaries λ_1 and λ_2 for $x = s, b$ to the permanent tax rate can be written as follows

$$(12) \qquad \begin{cases} \text{(i)} \quad \lambda_{1\tau} = -a(b\theta^2 R)^{-1}(R - \beta^{-1}) \lessgtr 0 & \text{as } r \lessgtr \rho \\ \text{(ii)} \quad \lambda_{2\tau} = -a(b\theta^2 R^*)^{-1}(R^* - \beta^{-1}) \lessgtr 0 & \text{as } rz \lessgtr \rho \end{cases}$$

The income effects of a permanent change in the tax rate within regimes remain a priori ambiguous; on the one hand, a rise in the tax rate decreases saving via the current income effect, but on the other hand saving is increased via the future income effect. What happens to the regime boundaries as a response to a change in the tax rate depends on the relationship between the lending rate and the rate of time preference on the one hand and between the borrowing rate and the rate of time preference on the other hand. It is instructive to look at some special cases. First, if the lending rate is equal to the rate of time preference ($r = \rho$) and the income profile is not decreasing ($y_1 < y_2$), then $s^s_\tau > 0$, $\lambda_{1\tau} = 0$, $s^b_\tau > 0$ and $\lambda_{2\tau} > 0$. Under these circumstances e.g. a permanent rise in the tax rate will have a positive effect on aggregate saving; the saving within the saving regime will either remain constant ($y_1 = y_2$) or increase ($y_1 < y_2$) and the consumption within the borrowing regime will decrease. Finally, some consumers will shift from the borrowing status to the liquidity-constrained situation (the term $-\lambda_{2\tau}s^b(\lambda_2)f(\lambda_2) > 0$). Second, if the lending rate is equal to the rate of time preference ($r = \rho$) and the income profile is decreasing ($y_1 > y_2$), then $s^s_\tau < 0$, $\lambda_{1\tau} = 0$, $s^b_\tau = ?$ and $\lambda_{2\tau} > 0$. Under these circumstances the tax rate will have an a priori ambiguous, but quite likely negative effect on aggregate saving; the saving within the saving regime will go down, and some of the borrowers shift from the borrowing status to the liquidity - constrained situation. But the borrowing response within the borrowing

regime will remain a priori ambiguous and depends on the relationship between the pre-tax interest rate wedge and the shape of the income profile.

Earlier we abstracted from the interest rate wedge effect of the tax rate. What happens to the post-tax interest rate wedge, when the tax rate will change, depends naturally on the details of the tax code. If the interest income from saving are tax free, while borrowing expenses are deductible in income taxation, then the only change in the non-linear budget constraint (3), which is needed, is to redefine the post tax wedge as $z^0 = z\theta$. Now in the absence of profitable tax arbitrage the wedge effect of the tax rate can be expressed $S^0_\tau = -(z/\theta)S_z < 0$. A rise in the tax rate will decrease the post-tax wedge, which tends to decrease aggregate saving, ceteris paribus.[8] Hence, the total effect of a permanent change in the tax rate on aggregate saving can be decomposed into the a priori ambiguous income effect S_τ and the negative tax wedge effect $-(z/\theta)S_z$, so that we have $S^0_\tau = S_\tau - (z/\theta)S_z$.

2.2 Aggregate Saving, Income Distribution and Progressive Income Taxes

As the equation (6) indicates, the saving functions within the regimes are linear in terms of incomes under the assumption of homothetic preferences (here quadratic utility) so that $s^s_{y_1y_1} = s^b_{y_1y_1} = s^s_{y_2y_2} = 0$. This does not imply, however, that the aggregate marginal propensity to consume out of current income is constant. It is shown in appendix 2 that under a mild additional assumption the response of the aggregate marginal propensity to save to a change in current income can be written as

$$(13) \qquad S_{y_1y_1} = 2f(\lambda^0)(\beta R^*)^{-1}\{\underbrace{s^s_{y_1}R^{-1}r(z-1)}_{+} + \underbrace{(s^s_{y_1} - s^b_{y_1})}_{+}\} > 0$$

where $f(\lambda^0) = f(\lambda_1) = f(\lambda_2)$.

Hence, despite the linear saving functions within the regimes, the aggregate marginal propensity to save out of current income is increasing. This is due to the regime shift effects in the presence of the non-linear intertemporal budget constraint; as current income increases, consumers move from the liquidity-constrained situation to savers on the one hand and from the borrowing status to the liquidity-constrained situation on the other hand. In the former case the marginal propensity to save increases ($s^s_{y_1} > s^n_{y_1} = 0$) and in the latter case vice versa happens ($s^b_{y_1} > s^n_{y_1} = 0$) in such a way that the former effect dominates. This means that even with homothetic preferences the income distribution matters for the aggregate saving; the more unequal is the income distribution, the higher is the aggregate saving and vice versa.

Thus far we have assumed the constant marginal tax rate. By accounting for the changing marginal tax rate will modify some of the results. Introduce an income tax such that a gross taxable income y yields a net disposable income $\psi(y)$, where the marginal tax rate are assumed to be less than 100 per cent, i.e. $\psi'(y) > 0$ and increasing i.e. $\psi''(y) < 0$. With quadratic utility the saving functions of various consumer categories can now be written as

$$(14) \qquad s^x = [1 + \beta\hat{R}^2]^{-1}\{b^{-1}a(1 - \beta\hat{R}) + [\psi(y_1) - \beta\hat{R}\psi(y_2)]\}$$

where $s^s > 0$ and $\hat{R} = R$ as $x = s$ and $s^b < 0$ and $\hat{R} = R^*$ as $x = b$. The within regime saving functions are still linear in terms of net disposable incomes $\psi(y_1)$ and $\psi(y_2)$, but not in terms of gross taxable incomes y_1 and y_2. In particular, $s^x_{y_1y_1} = [1 + \beta\hat{R}^2]^{-1}\psi''(y_1) < 0$ under increasing marginal tax rate, which runs counter to the hypothesis that the aggregate marginal propensity to save out of current pre-tax income is positive. This suggests that the more steeply the marginal tax rate rises - i.e. the lower is $\psi''(y)$ - the lower is saving ceteris paribus. Thus, with rising marginal tax rates saving tends to decrease both by equalizing the current post-tax distribution of income and by making the within regime saving functions decreasing in terms of gross taxable income. With constant marginal tax rates these two effects do not exist.[9)]

Later on in empirical part we use not the household saving, but the ratio of household saving to aggregate disposable income as the dependent variable. Hence, it is important to look at the implications of exogenous variables to $S/\theta Y$, where θY refers to the aggregate disposable income. A change in the interest rate wedge z will increase the saving ratio because $(S/\theta Y)_z > 0$. The response of the saving ratio to a change in the tax rate can in turn be expressed as $(S/\theta Y)_\tau = Y^{-1}(S_\tau + \theta^{-1}S)$ which is a priori ambiguous; the tax rate will affect aggregate saving on the one hand (the term $Y^{-1}S_\tau$) and it will also affect the saving ratio via the denominator of the saving ratio (the term $(Y\theta)^{-1}S$).

Finally, how is the result that in the presence of interest rate wedge the aggregate marginal propensity to save out of current income is increasing should appear in the household saving ratio equation? A way to account for nonlinearity is to postulate the aggregate saving function, which is nonlinear in terms of post-tax income so that $S = \alpha Y\theta + (1/2)\beta(Y\theta)^2$, where $\beta > 0$. The response of the saving ratio to the pre-tax income is $(S/\theta Y)_Y = (1/2)\beta\theta > 0$ because $S_{Y\theta} > (S/Y\theta)$. The response of the marginal propensity to save out of current (pre-tax) income can in turn be expressed as $S_{YY} = \beta\theta^2 > 0$. Hence, a rising marginal propensity to save and a rising saving ratio in terms of current (pre-tax) income are closely related.

2.3 On Saving Effects of Aggregation Across Cohorts

After considering the aggregate saving behaviour within a single cohort, we turn to discuss briefly the implications of aggregation across cohorts for saving behaviour. The steady state implications of aggregation across cohorts were first analyzed in Modigliani and Brumberg in early 1950s (published in (1986)). Assuming that saving is done by yourger cohorts, Modigliani and Brumberg established that income growth would lead to a positive saving ratio; in steady state the saving ratio would be constant and an increasing function of the rate of growth, whether due to population or productivity growth. The saving of the younger cohorts would exceed the rate of dissaving of cohorts currently retired.

But the basic premise of the standard LCH, according to which saving is done by younger cohorts, is sensitive both to the expectations formation concerning future income and the shape of income profile. If earnings are sufficiently skewed towards older ages and consumers do not fail to foresee the increase in future earnings, then in quite contrast to the usual textbook picture of hump saving, younger cohorts borrow and saving is done primarily by older cohorts. Under these circumstances there might be a negative relationship between saving ratio and income growth, as was noticed by Farrell (1970). If a fraction of younger cohorts save and a fraction borrows, then there might be no relationship between the household saving ratio and the income growth. Finally quantitative constraints on borrowing might prevent the negative relation between saving ratio and income growth (see Russell (1977) for a preliminary analysis). Hence, there is no a priori unbiquous relationship between the saving ratio and the income growth (for a further analysis, see also Seoka and Hoshikawa (1989)).

If the population is not under balanced growth the demographic structure matters for saving behaviour. In particular, it can be argued that the saving should depend negatively on the ratio of retired persons to total population as well as on the ratio of portion of population which has not yet reached working age to population (see Modigliani (1970)). Finally, a longer expected lifetime should increase saving.

2.4 Towards an Empirical Specification

According to the considerations presented in equations (6) and (7) the aggregate household saving ratio is assumed to depend on various explanatory variables as follows

$$(15) \qquad HSR = a_0 + a_1 G + a_2 D + a_3 Z + a_4 TAX + a_5 V,$$

where HSR denotes the household savings ratio, G the growth rate of households' real disposable income (i.e. $y_2/y_1 - 1$), D the (set of) demographic variable(s), Z the post-tax interest rate wedge variable,

TAX the marginal income tax rate and V nonlinearities and income distribution variables.

While HSR, G and D can be measured with the accuracy provided by SNA and Demographic statistics,[10] the measurement of Z and TAX create real problems with our cross-section data. First, there is the question of how taxes affect the interest rate wedge. Second, it is not possible with our data to calculate the precise average marginal tax rates, but the average direct tax rate can be obtained and it is used as one basic alternative. We also experiment with the squared average tax rate to better account for the marginal income tax rate. Finally, we apply the approach suggested by Blinder (1981) to develop a proxy for the marginal income tax rate. The aggregate marginal tax rate is created from the average tax rate by first postulating a frequency distribution of pre-tax income and a functional form for the tax function and then perturbing the pre-tax frequency distribution of income so as to produce the aggregate marginal tax rate, MRT, and the aggregate average tax rate, ART. In order to obtain closed form expressions for MRT and ART we followed Blinder (1981) and adopted the following functional forms for the tax function, T(Y), and the pre-tax frequency distribution of income, f(Y): $T(Y) = aY^b$ and $f(Y) = ge^{-gY}$, where $a > 0$, $b > 1$ and $g > 0$. Under these assumptions the ratio of the aggregate marginal tax rate to the aggregate average tax rate is $MRT/ART = (b+1)/2$. The tax parameter b was estimated from the time-series data for each individual country covering the period 1970 - 1985, and the aggregate marginal income tax rate was then computed from the aggregate average tax rate.

Turning to the measurement of Z, unfortunately very little reliable data on (post-tax) interest rate wedges exists. In some cases the official IFS-data suggested implausibly that $rz < r$.[11] Thus we decided not to try to measure Z directly, but developed two alternative proxy variables to it. Thus, we assume that Z can be simply expressed as $Z = \alpha_0 + \alpha_1 CUR$, where CUR stands as a proxy for the interest rate wedge. In what follows we measure CUR ('degree of development' of credit market facilities) by the fraction of currency (notes and coin) to GDP and M2 respectively.

After these considerations we specify the household saving ratio equation to be estimated

$$(16) \qquad HSR = b_0 + b_1G + b_2YPC + b_3RET + b_4DEP + b_5MLE + b_6TAX + b_7CUR + b_8DIS + u,$$

where YPC = GDP per capita in U.S. dollars and DIS = a measure of income distribution describing the fraction of household pre-tax income obtained by the highest decile. RET = population aged 65 and over in relation to total population, DEP = population aged 0 - 14 in relation to total population, MLE = expectation of life at birth, TAX = the income tax rate variable and u = the error term. The variables YPC and DIS are included to control for the possible non-linearity and income distribution in the household saving ratio (see the expression (13)). One may assume that $b_5, b_7, b_8 > 0$ and $b_3, b_4, b_6 < 0$, while the signs of b_1 and b_2 are ambiquous.[12)]

3 ESTIMATION RESULTS

Before turning to estimation results, some further comments about data. The data consist of a cross-section of 26 countries so that, as a rule, the variables represent five-year averages for 1981 - 1985. The definition of data and data sources, as well as a printout of the data are presented in the data appendices. The data sample was chosen so that a maximum number of countries could be included. Only in the case of Botswana this principle was not followed because we found the data too dubious. Only the household savings ratio is used here because the measurement of the after-tax interest rate wedge for the whole private sector is far too difficult (moreover, the existing evidence suggests that household and corporate savings are not perfect subsitutes, cf. e.g. Koskela and Virén (1986)).

OLS estimates are reported in Table 1, OLS estimates with weighted data in Table 2 and various robust regression estimates in Table 3 respectively. Initial estimations of equation (16) brought out a couple of clear outliers in the data, namely Malta and Italy.[13)] With

Malta, the explanation lies in the CUR-variable being the outlier (see the printout of data), while in the case of Italy the household saving ratio behaves for some reason in the way which cannot simply be accounted for by the explanatory variables specified in equation (16). Hence we introduced two dummy variables to account for these countries and were not able to detect any clear outliers after this procedure. Nevertheless, we tested for the presence of outliers by estimating all equations with two alternative robust estimation methods, i.e. using the least absolute deviations estimator (LAD) and Huber's M-estimator (ROB) (see Snyder (1978) and Huber (1981) for details).

The OLS estimation results of Table 1 with unweighted data can be briefly summarized as follows: First, the estimating equation(s) fit the data reasonably well and the individual coefficients are rather precisely estimated. The only marginal exception seems to be the income level variable YPC, which is sensitive to which proxy variable for CUR is used. Second, the demopraphic variables - RET, DEP as well as MLE - are of 'correct' sign from the point of view of LCH. The significance of demographic variables lies in contradiction with the intergenerational altruism view by Barro according to which demographic factors should not matter. Third, the growth effect seems to be significantly negative. This lies in sharp contrast with the strong positive growth effect detected from inter-country data of the 1950s as well as with somewhat weaker growth effect detected from inter-country data of the 1970s. Hence, the growth effect on saving ratio seems to have moved during the decades from positive to negative. Without further examination it is not possible to say precisely what has been the major force behind this apparently changed relationship between the growth rate and the saving ratio. On the basis of discussion in section 2.3 one may conjecture, however, that the improved access to capital market and/or more skewed earnings profile towards older cohorts (due to a rise in the level of education) among others may be underlying reasons. Finally, and perhaps most importantly, the TAX- and CUR-variables - serving as proxies for post-tax interest rate wedge components - are of 'correct sign' and of reasonable magnitude from the point of view of our hypothesis.

Table 1. OLS Estimation Results of Equation (15) without the DIS variable

	G	YPC	RET	DEP	MLE	TAX	CUR	SEE/F	R2
(1)	-.907	.030	-1.539	-.871	.259	-.202	1.044	2.78	.788
	(1.99)	(0.12)	(3.69)	(4.20)	(2.23)	(1.18)	(2.97)	(5.74)	
	[3.37]	[0.13]	[5.71]	[4.36]	[3.20]	[1.76]	[4.76]		
(2)	-.878	.029	-1.543	-.821	.257	-.493	1.049	2.67	.803
	(2.11)	(0.12)	(4.01)	(4.43)	(2.30)	(1.67)	(3.12)	(6.84)	
	[3.50]	[0.13]	[6.12]	[5.01]	[3.37]	[2.17]	[5.23]		
(3)	-1.034	.007	-1.587	-.950	.260	-.202	1.001	2.54	.822
	(2.52)	(0.03)	(4.47)	(4.95)	(2.45)	(2.19)	(3.11)	(8.40)	
	[4.14]	[0.04]	[5.93]	[4.78]	[3.03]	[3.64]	[5.00]		
(4)	-1.034		-1.583	-.951	.261	-.201	.994	2.47	.822
	(2.59)		(4.76)	(5.25)	(2.64)	(2.26)	(4.22)	(15.60)	
	[4.13]		[5.69]	[5.05]	[3.09]	[3.71]	[5.73]		
(5)	-.946	-.397	-1.273	-1.168	.280	-.249	.288	3.14	.728
	(1.88)	(1.70)	(2.79)	(5.13)	(2.12)	(1.30)	(1.85)	(2.74)	
	[2.87]	[1.85]	[3.48]	[5.78]	[2.82]	[1.64]	[2.76]		
(6)	-.907	-.389	-1.272	-1.121	.283	-.629	.321	2.98	.756
	(1.95)	(1.83)	(3.06)	(5.49)	(2.25)	(1.92)	(2.17)	(3.95)	
	[3.01]	[1.99]	[3.60]	[6.87]	[3.07]	[2.32]	[3.56]		
(7)	-1.066	-.420	-1.360	-1.223	.280	-.218	.263	2.94	.762
	(2.24)	(2.05)	(3.42)	(5.72)	(2.26)	(2.05)	(1.79)	(4.27)	
	[3.61]	[2.33]	[3.70]	[6.29]	[2.75]	[2.19]	[2.61]		
(8)	-1.165		-1.469	-1.225	.186	-.274	.302	3.21	.699
	(2.25)		(3.41)	(5.25)	(1.48)	(2.44)	(1.91)	(5.77)	
	[3.41]		[3.81]	[6.39]	[1.40]	[2.73]	[2.69]		

t-ratios are in parentheses, below them are White's heteroskedasticity adjusted t-ratios. SEE is the standard error of the estimate, F denotes a F(2,16) test statistic for the parameter restriction $b_6 = b_7 = 0$. The dependent variable is HSR. All equations also include a constant term and two dummy variables for Italy and Malta. With equations (1) - (4) CUR = (currency/GDP) and with equations (5) - (8) CUR = (currency/M2). The average income tax rate is used for TAX in equations (1) and (5), the corresponding squared term (divided by 100) in equations (2) and (6) and, finally, the aggregate marginal income tax rate in remaining equations. The number of observations is 26. Thus, the critical value of the t-statistic at the 5 per cent level of significance is 2.12. The corresponding critical value for F is 3.63 (however, for equations (4) and (8) it is 3.59).

Moreover, their significance is reasonally good. This is particularly true in the case of aggregate marginal income tax rate (which is the the best TAX variable on a priori grounds) and currency/GDP ratio. Only, if the average income tax rate (which may not be a good proxy for the TAX variable) and currency/M2 ratio are used one cannot reject the joint hypothesis that the coefficients of these variables are equal to zero. This combination of variables is, however, the only one which produces this negative finding. Hence, there are reasonable grounds to conclude that both a rise in tax rates and better access to credit markets - measured by the ratio of currency to GDP and to M2 respectively - will tend to decrease household saving ratio, ceteris paribus.

In order to evaluate the robustness of results a bit further, we carried out a number of further experiments. First, even though we had serious doubts about the quality of the interest rate wedge data collected from the IMF International Financial Statistics (see footnote 10), we estimated the equation (16) without the DIS-variable so that CUR was replaced by z (= the interest rate differential between the borrowing and the deposit rate). The following OLS coefficient estimates - which correspond to the equation (1) of Table 1 - were obtained: .286(.85) without country dummies and .240(.70) with country dummies for Colombia, Sri Lanka and Paraquay. Hence the coefficient of interest rate differential - though imprecise - were of 'correct sign'.[14] Second, estimation was also carried out so that the observations were weighted by population or, alternatively, by the square root of population. In these cases, the following results, presented in Table 2, emerged.[15]

First, the effect of weighting observations by population seems to be a deterioration in the significance of the growth rate and the life expectancy variables, while an improvement in the significance of the income level variable. Second, the TAX-and CUR-variables are still of 'correct' sign, while their significance is now slightly less than in the case of the unweighted OLS estimation. Third, the income distribution variable DIS is also of 'correct' sign in terms of our hypothesis, but its coefficient estimate is not very precise and it seems to be plagued by lack of robustness, particularly in terms of

Table 2. Weighted OLS Estimation Results of Equation (15) with and without the DIS-variable

	G	YPC	RET	DEP	MLE	TAX	CUR	DIS	R2	W
(1)	.815	-.344	-.907	-.776	.081	-.064	.852		.99	N
	(1.45)	(2.15)	(2.32)	(3.11)	(0.97)	(0.55)	(1.78)			
(2)	-.197	-.296	-1.278	-1.005	.173	-.148	.516		.93	√N
	(0.34)	(1.77)	(2.99)	(4.10)	(1.50)	(1.31)	(1.60)			
(3)	-.246	-.316	-1.273	-.968	.196	-.512	.456		.93	√N
	(0.42)	(1.96)	(2.99)	(4.23)	(1.66)	(1.34)	(1.44)			
(4)	.043	-.340	-1.186	-.901	.164	-.099	.440		.92	√N
	(0.07)	(1.96)	(2.66)	(3.46)	(1.35)	(0.48)	(1.33)			
(5)	-1.054	.013	-1.763	-1.139	.325	-.236	1.051	.108	.75	UW
	(2.15)	(0.04)	(3.52)	(3.57)	(2.34)	(1.29)	(2.68)	(0.64)		
(6)	-1.206	-.006	-1.861	-1.253	.333	-.227	1.011	.118	.80	UW
	(2.76)	(0.06)	(4.44)	(4.43)	(2.71)	(2.40)	(2.93)	(0.80)		
(7)	-.312	-.112	-1.661	-1.389	.136	-.246	1.124	.147	.93	√N
	(0.54)	(0.54)	(3.36)	(3.80)	(1.13)	(2.03)	(2.49)	(0.98)		
(8)	.354	-.125	-1.607	-1.662	-.201	-.307	1.419	.291	.99	N
	(0.61)	(0.65)	(3.40)	(4.19)	(0.24)	(2.17)	(2.83)	(2.37)		

t-ratios are in parentheses. The dependent variable is HSR and currency/GDP is used for CUR. N (√N) indicates that the data are weighted by population (square root of population), UW indicates that unweighted data are used. The average tax rate is used for TAX in equations (4) and (5), the average marginal tax rate in (1), (2) and (6) - (8) and the squared average tax rate in equation (3). Equations (1) - (4) also include a constant term and a dummy variable for Italy (the dummy for Malta was completely insignificant and thus it was dropped). Equations (5) - (8) only include a constant term because neither Italy nor Malta is included in the data sample (n = 22).

weighting by population. Thus, the role of income distribution remains somewhat moot.

Finally, we used robust estimation techniques to try to account for possibly remaining outliers in the data. The results are presented in Table 3. They are perfectly in line with those presented in Table 1 in terms of signs of explanatory variables and almost perfectly in line in terms of the significance of explanatory variables. There does seem to remain some ambiquity, however, in terms of accuracy of estimated coefficients; the standard deviations computed in OLS estimation, White's heteroscedasticity correction, LAD- and ROB-estimations, all differ from each other, though they clearly follow the same overall pattern.[16] Obviously, we should have more data points to nail down standard errors more precisely.[17]

4 CONCLUDING REMARKS

In this paper we have derived aggregate household saving under capital market imperfection, which is characterized by the wedge between the borrowing and lending rate. Under these circumstances the assumption of a representative consumer is unlikely to hold, and consumers are distributed into savers, liquidity-constrained consumers and borrowers depending on their exogenous future labour income. An interest rate wedge is shown to affect saving positively; as for the tax rate, while there are some conflicting tendencies, it will quite likely affect saving negatively mainly via affecting the post-tax interest rate wedge.

In the second part of the paper we use a large international data sample from 26 countries in the 1980s to test for the role of tax and interest rate wedge factors in addition to the usual life cycle variables to see whether they are useful in understanding inter-country differences in household saving ratios during the 1980s. On the whole, results are encouraging; the estimating equations fit the data reasonably well and coefficient estimates are rather precisely estimated. Demographic variables are of 'correct' sign and

Table 3. Robust Estimation Results of Equation (15) without the DIS-variable

	G	YPC	RET	DEP	MLE	TAX	CUR	R2/DC	method
(1)	-1.270	.058	-1.788	-.941	.314	-.187	1.038	.776	LAD
	(2.36)	(0.18)	(3.53)	(3.75)	(2.23)	(0.90)	(2.44)	(.847)	
(2)	-1.291	.034	-1.738	-.970	.366	-.184	1.075	.806	LAD
	(4.10)	(0.19)	(6.39)	(6.59)	(4.49)	(2.59)	(4.36)	(.860)	
(3)	-1.527	-.545	-1.537	-1.426	.380	-.305	.194	.745	LAD
	(3.70)	(3.07)	(4.45)	(7.69)	(2.54)	(3.31)	(1.52)	(.833)	
(4)	-.919	.049	-1.464	-.775	.281	-.171	1.132	.783	ROB
	(1.95)	(0.18)	(3.31)	(3.53)	(2.29)	(0.95)	(3.06)	(.834)	
(5)	-1.042	.022	-1.609	-.914	.291	-.186	1.065	.820	ROB
	(2.66)	(0.10)	(4.76)	(5.00)	(2.87)	(2.12)	(3.48)	(.848)	
(6)	-1.232	-.461	-1.437	-1.327	.315	-.267	.255	.759	ROB
	(2.19)	(1.91)	(3.06)	(5.25)	(2.16)	(2.13)	(1.48)	(.821)	

Asymptotic t-ratios are in parentheses, DC is the Least Absolute Deviations analogon of R2 in the OLS regression. The dependent variable is HSR. All equations also include a constant term and two dummy variables for Italy and Malta. With equations (1), (2), (4) and (5) CUR = (currency/GDP) and with equations (3) and (6) CUR = (currency/M2). The average income tax rate is used for TAX in equations (1) and (4), otherwise the marginal tax rate is used. LAD corresponds to the Least Absolute Deviations estimator and ROB Huber's robust M-estimator. The LAD estimates are computed using the algorithm of Snyder (1978), Huber's (1981) M-estimator uses the tuning constant 1.345 (for further details see Sonnberger et al (1986)).

significant. Also the growth effect is significant, but in sharp contrast to earlier findings it is negative. Improved access to credit markets and/or more skewed earning towards older cohorts and/or changes in expectations may be underlying reasons for this. Finally, our evidence suggests that tax and wedge variables help to improve the performance of the household savings ratio equation, are of 'correct' sign from the point of view of our hypothesis and their significance is reasonably good. According to estimation results, both a rise in tax rates and better access to credit market - measured by the ratio of currency to GDP and M2 respectively - will tend to decrease household saving, ceteris paribus.

We regard current estimates quite preliminary. More research is needed to provide more accurate data for tax rates and interest rate wedge to get more refined models and more precise estimates. We are reasonably confident that these sort of variables can eventually explain the intercountry differences in the household (and private) saving ratios.

FOOTNOTES

1) This is also a conclusion by Hayashi (1987) in his attempt to explain, why the saving ratio in Japan is so much higher than the one in the U.S.

2) This effect is emphasized in Hayashi and Ito and Slemrod (1988) in the (mainly simulation) analysis of the interaction between household saving and housing purchase decisions. Households on the imprefect capital markets are induced to save more early in the life cycle in order to meet the higher down-payment requirement.

3) For a large collection of data on the 'degree of development' of financial markets, see Goldsmith (1969). For an attempt to measure the private savings response to the 'degree of development' of financial markets, see Koskela and Virén (1983).

4) Jappelli and Pagano (1988) estimated the so-called Euler equations for consumption by using annual time series data from 7 OECD nations. They found that the degree of excess sensitivity of consumption to current disposable income varied across countries and was larger in the countries with more imperfect capital markets.

5) Usually, examining the effects of taxes on saving with perfect capital markets has necessitated to address the following issues: (i) what is the effective marginal tax rate on income from saving? and (ii) what is the (post-tax) interest rate elasticity of saving? In the presence of capital market 'imperfections' the effects of taxes on the interest rate wedge and 'liquidity' become important.

6) Here wedge is exogenous. King (1986) has presented a model with asymmetric information between borrowers and bankers, where the equilibrium on the capital market is characterized by the endogenous interest rate wedge.

7) By allowing for future income uncertainty it is possible for consumers to default. This complicates the analysis slightly, see King (1986) for details in the quadratic utility case.

8) In the case where capital income from saving is not exempted from taxation, the analysis is a bit more complicated. Even then, however, the negative tax wedge effect tends to hold.

9) Allowing for a possibility of tax arbitrage in non-linear taxation yields the following intertemporal budget constraint

(1) $$c_2 = \psi(y_2 - rzB) + Br + R(\psi(y_1) - c_1)$$

where $\psi(.)$ describes the net disposable income function with $\psi'(.) > 0$ and $\psi''(.) < 0$. The most profitable tax arbitrage borrowing is now characterized by

(2) $$1 - z\psi'(y_2 - rzB) = 0$$

at the interior solution. Thus there is no arbitrage borrowing if $y_2 < y_2^* = \psi'^{-1}(z^{-1})$, while if $y_2 > y_2^*$ the arbitrage borrowing is positive and it is defined by

(3) $$B = (rz)^{-1}[y_2 - \psi'^{-1}(z^{-1})]$$

If there are no limitations to tax arbitrage, then it can be shown that accounting for tax arbitrage under non-linear taxation will make the effective tax system linear with positive intercept term. This suggests that while the tax arbitrage may eliminate non-linearities from the tax system, it will not completely eliminate the redistributive aspects of taxation.

10) This is not to say that the SNA-data is completely free from various conceptual and measurement issues. See Boskin (1988) for a recent and comprehensive discussion of the issues involved.

11) The standard measures of lending and borrowing rates, published for instance in the IMF International Financial Statistics, and OECD Financial Statistics Monthly are very deficient in the sense that the maturities cannot be matched, various restriction in terms of deposits (minimum amounts, withdrawal conditions etc.) cannot be compared and so on. Some idea of data can be obtained srutinizing the following interest differentials between the borrowing and deposit rates from the International Financial Statistics: Australia 3.64, Austria 2.96, Belgium 8.05, Canada 2.12, Colombia -10.60, Ecuador 3.00, Finland 1.06, France 11.37, Germany 5.09, Greece 5.78, Italy 6.46, Japan 3.26, Korea 2.20, Malta 3.00, Netherlands 5.57, Norway 8.73, Paraquay .., Philippines 5.68, South Africa 4.72, Spain 3.47, Sri Lanka -2.84, Sweden 5.02, Switzerland 0.87, Thailand 5.78, United Kingdom 3.13 and U.S.A. 2.14. See also King (1986) for analysis of the U.K. and U.S. interest rate wedge, and Jappelli and Pagano (1988) for the problems of finding the interest rate wedge data with matched maturities.

12) In the light of the equation (13) the pre-tax distribution of income should matter for saving behaviour, which is why we decided to check whether this distribution effect can be captured by introducing a separate additional income distribution proxy into the saving ratio specification. It is, however, far from clear how to account for potential income distribution variable (see e.g. Kakwani (1980) for a discussion of some of the issues involved). Partly because of the data problems we used the highest pre-tax income decile as the proxy for income distribution.

13) The role of outliers were scrutinized using the procedure proposed by Cook and Eisberg (1982) which is included in the IAS-System 3.6 software package (see Sonnberger et. al. (1986)).

14) In addition, equation (15) was estimated by representing the demographic variables with one principal component and by using the ridge regression technique. No qualitative change in results (in terms of the TAX- and CUR-variables) could be detected, however.

15) Weighting country observations effectively increases the weight of population of rich countries. E.g. in our data sample the ratio of Japan and U.S. population to total population is .38.

16) The equation (16) was also estimated by defining Y as households' total current receipts in the tax schedule $T = aY^b$, where T denotes direct transfers and other current transfers from households to general government. Naturally this alternative procedure tended to give smaller values to the average marginal tax rates, but the estimation results turned out to be very similar to those presented in Tables 1 - 3. Hence, they are not reported. A complete set of results is available from the authors upon request.

17) In this context we also tested Slemrod's (1988) hypothesis that the fear of nuclear war affects household (or private) saving negatively. Thus, we included the Gallup Poll variable WAR (which measures the perceived likelihood of nuclear Wold War) into the final estimating equation (15) without the DIS-variable. Due to lack of data the sample now consists of 22 countries. The following OLS results emerged (the estimated constant term is not displayed)

WAR	G	RET	DEP	MLE	MTAX	CUR1	R2
-.094							.04
(0.90)							
.062	-1.818	-2.014	-1.293	.365	-.241	1.017	.78
(0.71)	(2.32)	(4.61)	(4.15)	(2.65)	(2.17)	(3.08)	
-.151							.68
(2.28)							
-.004	-1.024	-1.716	-1.115	.358	-.260	1.487	.88
(0.05)	(0.86)	(2.46)	(2.28)	(2.13)	(1.59)	(2.92)	

where unweighted data is used in two first equations and weighted data (weighted by the square root of population) in the two remaining equations: for other details, see the footnote of Table 1. Clearly, Slemrod's hypothesis does not seem to lie in conformity with data. In contrast to what he himself argues the WAR-variable seems to be very sensitive both in terms of data sample, estimating equation and weighting the data.

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APPENDIX 1

It is shown how consumers will be located among regimes depending on their second-period earnings. Substituting the savers' budget constraint for c_2 in the first-order condition for utility maximization yields the following condition for regime (a):

$$(1) \qquad a + bc_1 = \beta Ra + b\beta R\theta(y_2 + Ry_1 - Rc_1\theta^{-1})$$

which can be written as

$$(1') \qquad c_1(1 + \beta R^2) = -ab^{-1}(1 - \beta R) + \beta R\theta(y_2 + Ry_1)$$

Regime (a) holds only where $c_1 \leq y_1\theta$. Hence in this regime

$$(2) \qquad y_2 \leq \lambda_1 \equiv R^{-1}[y_1\beta^{-1} - (b\theta)^{-1}a(R - \beta^{-1})] \quad \text{as } c_1 \leq y_1\theta$$

Similarly, the condition for the regime (c) to hold can be written

$$(4) \qquad c_1(1 + \beta R^{*2}) = -ab^{-1}(1 - \beta R^*) + \beta R^*\theta(y_2 + R^*y_1)$$

where $R^* = R + r(z - 1)$, z = the interest rate wedge. Regime (c) holds only where $c_1 > y_1\theta$, which implies

$$(5) \qquad y_2 > \lambda_2 \equiv R^{*-1}[y_1\beta^{-1} - (b\theta)^{-1}a(R^* - \beta^{-1})] \quad \text{as } c_1 > y_1\theta$$

Finally, regime (b) holds, and consumers are liquidity-constrained, when the second period income lies between the boundaries defined by the equations (2) and (5), i.e. when $\lambda_1 < y_2 < \lambda_2$.

APPENDIX 2

This appendix shows how the linear saving functions within the regimes - see the equation (6) in the text - and the non-linear budget constraint (3) imply that the aggregate marginal propensity to save out of current income is increasing. Differentiating the equation (7) with respect to y_1 implies

$$(1) \qquad S_{y_1} = \int_A^{\lambda_1} s^s_{y_1} f(\lambda)d\lambda + \lambda_{1y_1} \cdot s^s(\lambda_1)f(\lambda_1) + \int_{\lambda_2}^{B} s^b_{y_1} f(\lambda)d\lambda - \lambda_{2y_1} \cdot s^b(\lambda_2)f(\lambda_2)$$

where $\lambda_{1y_1} = (\beta R)^{-1} > 0$, $\lambda_{2y_1} = (\beta R^*)^{-1} > 0$, $s^s_{y_1} > 0$, $s^b_{y_1} > 0$, $s^s(\lambda_1) > 0$ and $s^b(\lambda_2) < 0$. Differentiating (2) with respect to y_1 gives

$$(2) \qquad S_{y_1y_1} = \int_A^{\lambda_1} s^s_{y_1y_1} f(\lambda)d\lambda + 2\lambda_{1y_1} \cdot s^s_{y_1}(\lambda_1)f(\lambda_1) + \int_{\lambda_2}^{B} s^b_{y_1y_1} f(\lambda)d\lambda - 2\lambda_{2y_1} \cdot s^b_{y_1}(\lambda_2)f(\lambda_2)$$

where $s^s_{y_1y_1} = s^b_{y_1y_1} = 0$. Now assuming that $f(\lambda_1) = f(\lambda_2) = f(\lambda^0)$ and rearranging the terms we end up with the expression (13) of the text, where

$$(3) \qquad s^s_{y_1} - s^b_{y_1} = [(1 + \beta R^2)(1 + \beta R^{*2})]^{-1}\theta\beta(R^{*2} - R^2) > 0$$

with positive interest rate wedge ($z > 1$).

DATA APPENDIX

Definition of data and data sources

HSR — Household savings ratio, %. Households' net saving in relation to households' disposable income, %. A five-year average for 1981 - 1985. From: United Nations National Accounts Statistics: Main Aggregates and Detailed Tables, 1985, United Nations, New York 1987. Table 1.6.

G — Growth rate of households' real disposable income. Households' disposable income has been deflated by the implicit price deflator of private consumption expenditure, %. A five-year average for 1981 - 1985. From United Nations National Accounts Statistics, Tables 1.1 and 1.6.

YPC — Gross Domestic Product per capita in U.S. dollars. A five-year average for 1981 - 1985. From National Accounts Statistics: Analysis of Main Aggregates, 1985, United Nations, New York, 1987. Table 1.

TAX — Households' average income tax rate. Direct transfers and other current transfers from households to general government in relation to households' total current receipts, %. A five-year average for 1981 - 1985. From United National National Accounts Statistics, Table 1.6.

MTAX — Household's marginal income tax rate, %. Equals TAX(1+b)/2, where b corresponds the slope parameter in the tax schedule $T = aY^b$; T denotes direct transfers and other current transfers from households to general government and Y households' total current receipts minus current transfers. The tax schedule was estimated from time series data covering (with some exceptions) the period 1970 - 1985. Both T and Y were deflated by the consumer price index CPI. From United Nations National Accounts Statistics, Table 1.6 (for T and Y) and International Financial Statistics, International Monetary Fund, Washington D.C., line 64 (for CPI).

DEP — Population aged 0 - 14 in relation to total population, %. For 1977 - 1986. From United Nations Demographic Yearbook 38, United Nations, New York, 1988, Table 7.

RET — Population aged 65 and over in relation to total population, %. For 1977 - 1986. From United Nations Demographic Yearbook 38. Table 7.

MLE — Expectation of life at birth, years. Unweighted average of male and female population. For 1980 - 1985. From United Nations Demographic Yearbook 38. Table 4.

CUR1 Currency outside deposit money banks in relation to GDP, %. From IMF International Financial Statistics, International Monetary Fund, Washington D.C., lines 14 a and 99 b.

CUR2 Currency outside deposit money banks in relation to money plus quasi-money, %. From IMF International Financial Statistics. Lines 14 a, 34 and 35.

DIS Measure of income distribution describing the fraction of all household pre-tax income obtained by the 10 per cent of households with highest income, %. From United Nations National Accounts Statistics: Compendium of Income Distribution Statistics, United Nations, New York 1985. The data for Columbia, Ecuador and Greece are, however, partly derived from Kakwani (1980).

POP Estimate of mid-year population at 1985 (in millions). From United Nations Demographic Yearbook 38, Table 4.

WAR Fraction of Gallup Poll respondents saying in 1986 that the change of world war within ten years is 50 per cent or greater, %. From Slemrod (1988).

PRINTOUT OF DATA

Country	HSR	G	YPC	TAX	MTAX	RET	DEP	MLE	CUR1	CUR2	DIS	POP	WAR
AUS	4.7	3.17	11.33	17.0	22.2	10.0	24.4	75.4	3.8	9.1	23.2	15.4	38.0
AUT	9.3	1.57	7.05	27.6	33.6	14.5	17.9	73.9	6.7	8.2	28.7	7.6	20.0
BEL	15.3	0.10	9.31	28.2	32.7	13.8	19.4	73.4	9.5	20.8	23.2	9.9	24.0
CAN	15.1	2.39	12.88	19.5	20.4	10.6	21.3	75.4	3.0	6.5	25.0	25.6	34.0
COL	10.6	2.24	1.37	4.8	4.5	3.9	36.1	63.7	5.3	25.2	44.9	27.8	42.0
ECU	9.7	-0.00	1.49	4.4	3.7	3.7	42.1	74.3	4.5	21.3	42.6	9.1	45.0
FIN	4.8	2.57	10.43	31.0	38.9	12.5	19.4	73.0	2.0	4.5	23.4	4.9	17.0
FRA	11.0	1.29	9.65	25.9	29.9	11.3	21.1	74.6	4.7	9.8	34.5	55.3	24.0
GER	8.7	-0.00	11.14	29.6	39.7	14.8	15.1	74.3	5.6	10.2	24.0	61.0	18.0
GRE	18.4	0.02	3.60	15.2	15.7	13.3	21.6	74.4	11.6	18.7	24.1	9.8	18.0
ITA	19.8	0.52	6.32	23.5	27.7	12.8	19.9	77.7	6.3	9.1	-	57.0	22.0
JPN	16.7	2.27	1.00	16.6	20.5	10.3	21.5	65.9	7.3	7.9	22.7	121.0	15.0
KOR	12.2	3.25	1.82	4.6	5.0	4.3	29.8	73.4	4.7	13.2	24.5	41.6	19.0
MAL	11.9	3.02	2.87	15.2	18.5	9.7	24.2	76.3	58.3	45.8	-	0.3	-
NET	14.2	0.24	9.22	31.1	37.0	12.1	19.5	76.2	6.7	9.0	23.9	14.5	14.0
NOR	3.6	2.43	13.69	29.4	25.7	15.6	20.2	76.2	5.5	9.9	23.7	4.1	21.0
PAR	6.0	2.92	1.68	2.3	2.0	4.3	40.8	61.2	4.5	20.8	-	3.0	-
PHI	4.3	0.00	0.69	2.8	3.2	3.1	39.0	53.5	4.1	18.7	40.9	53.2	27.0
SAF	3.7	0.18	2.37	10.0	11.2	8.1	37.7	75.6	3.1	8.4	-	25.0	41.0
SPA	8.3	-0.00	4.71	19.3	28.0	12.2	22.9	69.7	7.7	10.0	24.5	38.8	22.0
SRL	8.8	6.69	0.33	3.2	4.0	4.3	35.3	76.7	5.8	18.9	35.2	15.8	-
SWE	1.4	-0.00	11.99	36.4	47.7	18.1	17.4	76.8	5.9	10.7	24.6	8.4	15.0
SWI	12.4	1.73	14.69	23.8	28.0	14.6	16.9	60.6	12.8	10.7	27.0	6.5	18.0
THA	13.2	2.66	0.78	2.1	2.3	3.3	36.4	74.3	6.3	13.4	42.8	51.3	-
UK	7.9	1.09	8.24	20.2	16.6	15.3	19.0	74.7	3.9	9.8	24.8	56.6	20.0
USA	8.3	2.74	14.53	19.7	22.9	12.1	21.6	74.7	4.3	7.3	28.2	241.1	49.0

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