

**THE DECLINE IN PRIVATE SAVING RATES IN THE 1990S
IN OECD COUNTRIES: HOW MUCH CAN BE EXPLAINED
BY NON-WEALTH DETERMINANTS?**

Alain de Serres and Florian Pelgrin

TABLE OF CONTENTS

Introduction	118
Stylised facts and determinants of saving rates in OECD countries	119
Development in international saving rates in the 1990s	119
The influence of revaluation effects and financial wealth on personal saving rates	119
Fundamental determinants of private saving rates: Looking beyond the wealth effect	124
Determinants of private saving: empirical strategy	128
Variable definition and data sources	128
Estimation method	129
Empirical results	133
Main findings	133
How these results compare with previous studies using panel data	137
Tests of robustness of the specification and out-of-sample simulation	140
Sensitivity to the inclusion of other potential determinants of private saving	142
Conclusions	147
Bibliography	152

Alain de Serres is a senior economist in the OECD Economics Department and Florian Pelgrin is a senior economist in the Department of Monetary and Financial Analysis at the Bank of Canada and was a consultant to the OECD Economics Department. The authors are grateful for helpful comments from Jørgen Elmeskov, Michael Feiner, Mike Kennedy, Ignazio Visco and Paul Swaim. They also thank Laure Meuro for statistical assistance and Veronica Humi for secretarial assistance.

INTRODUCTION

Private-sector saving rates have declined in the majority of OECD countries in the 1990s, in particular during the second half, with the decline being largely concentrated in the household or personal sector. In those countries where it has occurred, the sharp decline observed in household saving has been accompanied by a significant rise in private debt as a proportion of GDP and has coincided with a sharp increase in household's financial net worth. This was particularly the case in the United States, Germany, Italy and the United Kingdom for which data of financial net worth exist. To many, this was seen as evidence that the strong rise in equity and residential property prices during the late 1990s had been treated by households as a permanent increase in wealth, leading to an unsustainable drop in saving.

This raised concerns that a substantial fall in equity prices would leave households in poor financial health, prompting them to rebuild savings at a time when strong consumption would be needed to avoid a deep recession. Fears of a negative wealth effect have so far not materialised though it is possible that the continuing strength of property market has been a key factor cushioning the stock market blow. An alternative explanation is that the decline in private saving may have been more sustainable than suggested by the simple correlation with measures of household net financial wealth. In order to shed some light on this issue, this paper has used recent estimation techniques for systems of dynamic panel equations to analyse the contribution of a set of basic determinants of private saving rates for a pool of 15 OECD countries over the period 1970-2000.

In line with a recent study by Haque *et al.* (1999), the paper applies the pooled mean group estimation method (PMG) to estimate a dynamic specification that imposes homogeneity restrictions only on long-run coefficients and only when such restrictions are not statistically rejected. However, the paper goes one step further and uses the method to examine how accurately the evolution of private saving over time can be traced to the determinants as well as to assess the contribution of individual determinants in each country. More specifically, the empirical analysis indicates that private-sector saving rates in OECD countries have been significantly influenced by public-sector saving rates, the demographic structure of the population (as measured by the old-age dependency ratio), the growth rate of labour productivity, changes in the terms of trade and the real interest rate. Among these, the change in the public-sector saving rate has contributed the most to the evolution of

private saving between 1995 and 2000. Overall, even in countries where private saving rates have fallen to particularly low levels, the decline seems to be mostly accounted for by determinants that do not include measures of financial or housing wealth and that have themselves evolved in a sustainable way. In this respect, risks of a significant negative wealth effect seem remote. The flip side of the coin, however, is that a loosening of fiscal policy may have a limited impact on private consumption and end-up in higher private savings.

The rest of the paper is organised as follows: The next section provides an overview of international developments in saving rates in the 1990s and discusses a number of explanatory factors. The empirical strategy as well as the econometric methodology and dataset are introduced in the third section, followed by the key results from estimation and sensitivity analysis and, finally, the conclusions.

STYLISTED FACTS AND DETERMINANTS OF SAVING RATES IN OECD COUNTRIES

Development in international saving rates in the 1990s

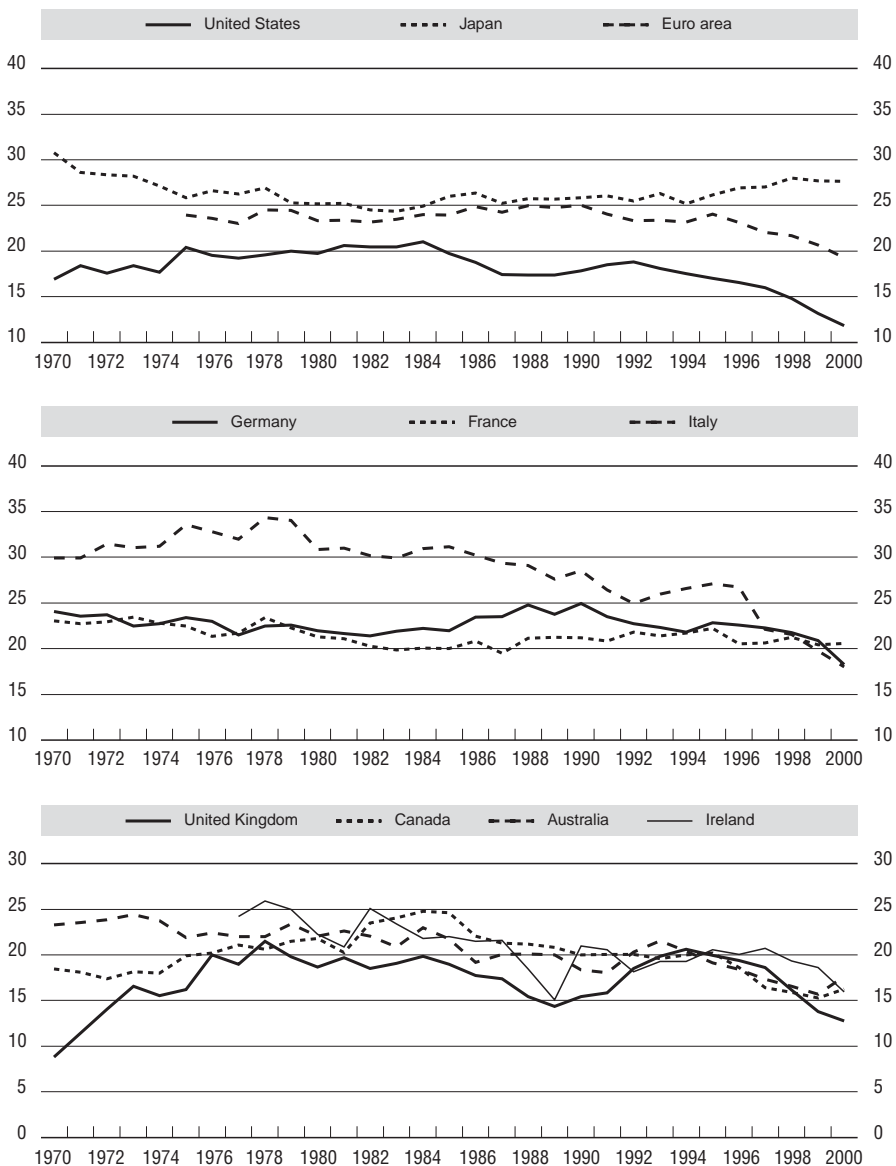
Gross private-sector saving rates have fallen substantially in a number of countries during the 1990s and although they have generally rebounded somewhat since 2000, they remain below longer-term average levels (Figure 1). In some countries, the decline of the 1990s probably reflected a cyclical adjustment following the sharp rise observed in the previous years (United Kingdom, Spain, Sweden and Finland). In other cases, however, private saving rates have been trending down since the mid-1980s and by year 2000, the decline had pushed those rates to low levels by historical standards in the United States, Italy, Canada and Australia.

The reduction in private saving has largely been concentrated in the household or personal sector, especially in the United States, Italy, Canada and Australia, where levels in per cent of GDP have been significantly lower on average in the 1990s than in the 1980s. In some cases, the decline in household saving has been partly offset by an increase in corporate saving, whose relative importance has risen considerably since the 1980s – notably in Canada, Australia and Finland – to the point of surpassing the size of household saving in the vast majority of countries.¹ In Japan, the drop in household saving was even more than offset by the rise in corporate saving, leading to a slight increase in private saving.

The influence of revaluation effects and financial wealth on personal saving rates

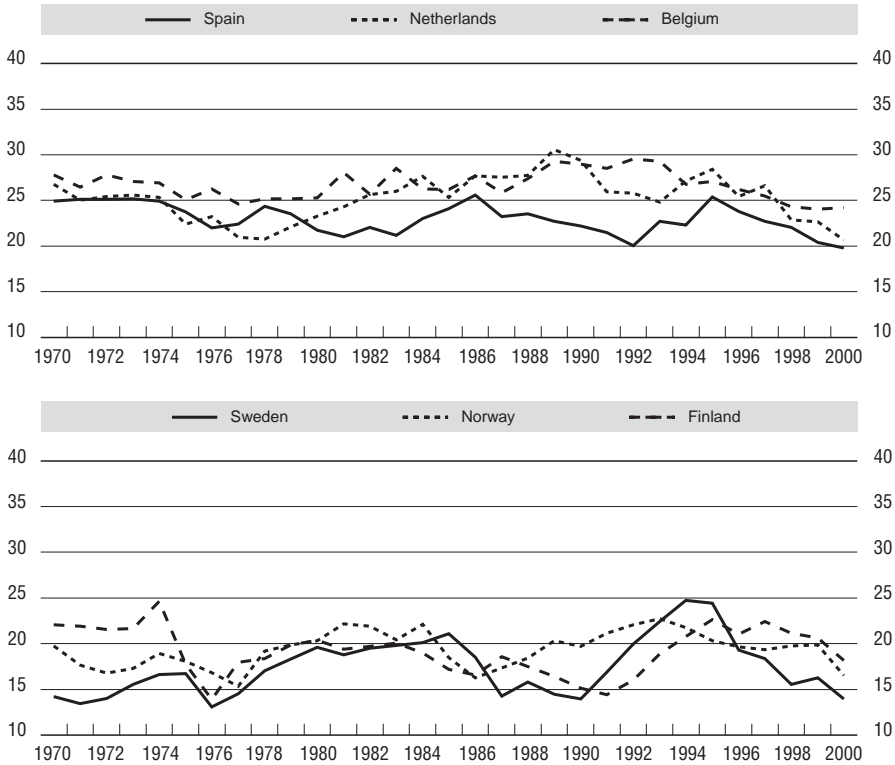
In those countries where it has occurred, the decline in personal saving rates has coincided with a sharp increase in households' financial net worth, as indicated by the strong negative correlation between the two series, at least in most

Figure 1. **Gross private saving rates**
In per cent of GDP



Source: OECD.

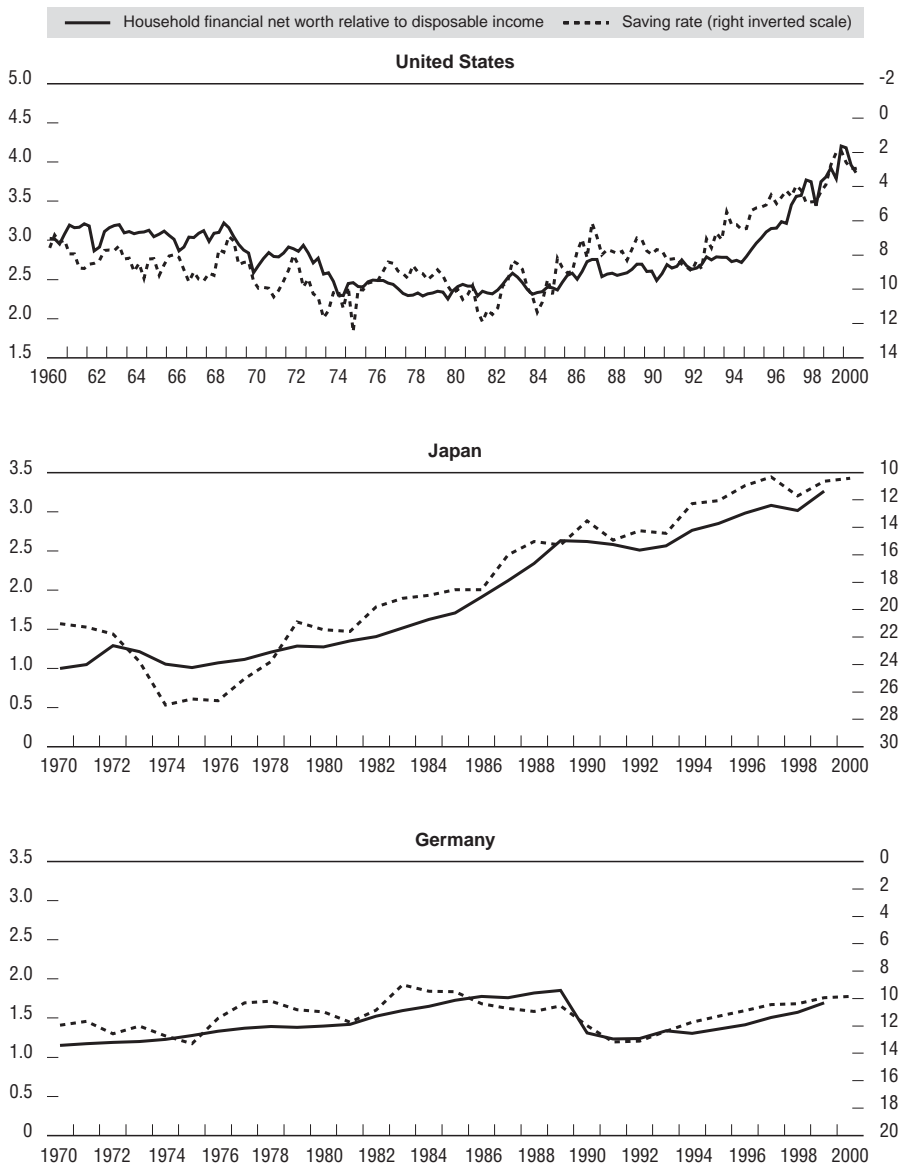
Figure 1. **Gross private saving rates (cont.)**
In per cent of GDP



Source: OECD.

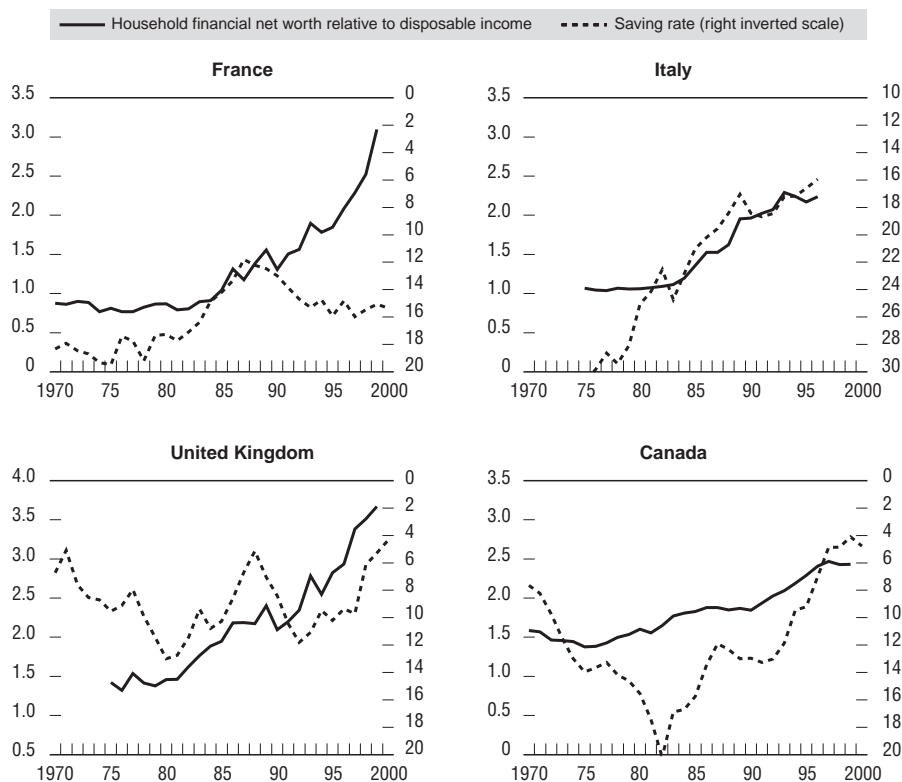
of the G-7 countries (Figure 2).² Several studies have indeed related the declines in private saving rates in the late 1990s to the substantial rise in financial wealth in particular in the United States.³ While this could be seen as evidence that the strong rise in equity prices during the late 1990s had been treated by households as a permanent increase in wealth – hence leading to an unsustainable drop in saving – several factors argue for a more cautious interpretation. First, given the divergence between the economic definitions of the two main variables entering the calculation of saving – income and consumption – and their respective treatment in the National Accounts, it may well be that the negative correlation between household saving and financial wealth is partly spurious. For instance,

Figure 2. **Household financial net worth and saving rates**
 In per cent of household disposable income



Source: National flow of funds or financial accounts statistics, OECD.

Figure 2. Household financial net worth and saving rates (cont.)
In per cent of household disposable income



Source: National flow of funds or financial accounts statistics, OECD.

while realised capital gains are not included in personal income in the National Accounts, taxes paid on them are fully deducted, implying a shift of income and, thereby, saving from the household to the public sector when substantial gains occur.⁴

Second, recent evidence from both household surveys and empirical analysis has shown that the sensitivity of consumption and/or saving to wealth can vary quite substantially depending on the source of capital gains (*e.g.* housing vs. stock-market)⁵ and whether such gains are realised or not.⁶ Third, the fears that a substantial stock market correction would impart a significant negative wealth effect in

the United States have to a large extent been proved unfounded by the resilience of private consumption, even as the economy went through a mild recession followed by an un-typically weak recovery. All this suggests that the concerns that households had gone too far in responding to the stock market boom of the late 1990s might have been misplaced. The latter interpretation is also consistent with recent empirical findings indicating that only *permanent* changes in wealth affect consumer spending and that a very large proportion of the post-war variation in household net worth is transitory (Lettau and Ludvigson, 2001).

Fundamental determinants of private saving rates: Looking beyond the wealth effect

A more systematic attempt to explain private saving patterns and assess their sustainability consists in looking beyond direct measures of wealth and to examine the extent to which recent trends can be accounted for by fundamental determinants which in many cases affect consumption *via* their impact on wealth. To do so, a panel of dynamic saving equations was estimated across a large number of OECD countries for which a reasonably complete set of reliable data could be assembled. Following previous empirical cross-country studies, the set of determinants includes variables aimed at capturing the influence of demographics, the level and growth rate of income or productivity, the inter-temporal relative price of consumption, uncertainty, the relative price of domestic vs. foreign goods and public finance. More specifically, the final system specification includes the public sector saving rate introduced to capture possible Ricardian effects, the old-age dependency ratio, the percentage change in terms-of-trade, the growth rate of labour productivity, the real interest rate and the inflation rate.

Direct measures of wealth are therefore intentionally left out of the basic specification for two reasons. One is to see whether the movement in saving can be tracked closely in an out-of-sample fashion by fundamental determinants less prone to sharp, unsustainable movements. The rationale is that in the event that wealth has had a significant effect over and above what is explained by fundamental determinants, the basic equation is likely to over-predict private saving rates in most countries where wealth has risen sharply in the post-1995 period. This question is examined below. The second reason is that while in principle measures of financial wealth could be introduced to see whether they have an impact independently from the effect captured by other determinants, relevant data on the stock of wealth are available only for a few countries.⁷

For most of these variables, the effect on private saving is theoretically ambiguous, especially as regards the long-run effect, since it often depends on the assumed consumption behaviour as well as on specific model characteristics such as the strength of inter-temporal substitution and the importance of general

equilibrium considerations. The following provides a brief overview of the main channels whereby these determinants can affect saving.

Productivity growth

In a life-cycle framework, an increase in the growth rate of income per capita is likely to benefit workers more than retirees. Given the higher saving rates of workers, this would generate an increase in aggregate saving provided that the saving rates per age remain unchanged (Modigliani, 1966). However, once the latter condition is relaxed, there is an alternative channel working in the opposite direction. For instance, assuming a significant proportion of private agents are able to shift consumption inter-temporally, a sustained increase in productivity growth may lead to a larger-than-proportional adjustment in consumption, as consumers attempt to spread over time the benefits of a higher and steeper expected income profile (Tobin, 1967). To the extent that future productivity gains are discounted into equity prices, the benefits from an anticipated acceleration in income per capita could be transmitted to current consumption and saving via their impact on financial wealth, as was the case in the United States in the late 1990s. In this context, a higher growth rate of productivity would lead to a decline in the saving rate.

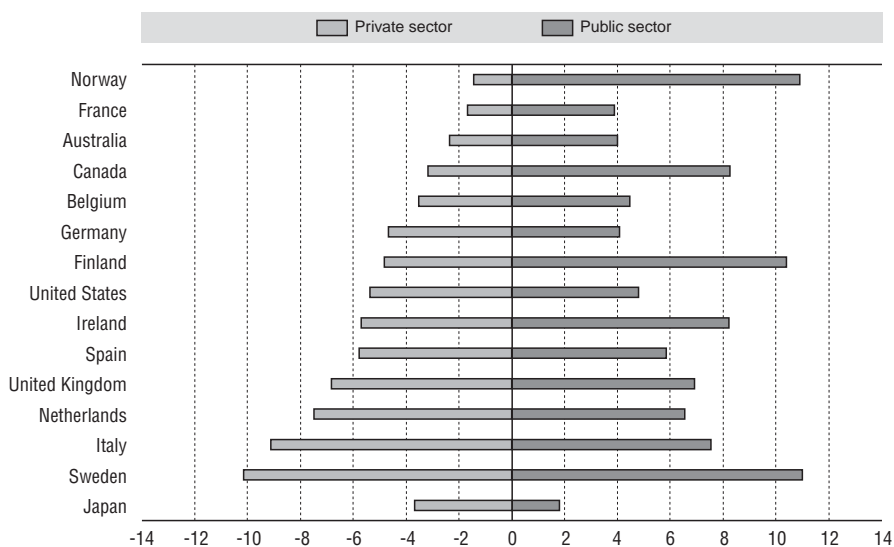
Demographics

Likewise, the impact of population ageing on aggregate saving depends largely on the importance of life-cycle effects on household behaviour. If consumers behave as predicted in simple life-cycle models, a significant decline in saving rates could result from the rise in old-age dependency ratios, as an increasing share of the population is drawing down financial assets to sustain consumption.⁸ However, household surveys reveal that people often continue to accumulate savings well after retirement and that in some cases, the saving rate is only marginally lower than that of prime-age worker categories (Borsch-Supan and Brugianni, 2001). The effect of ageing on private saving behaviour is also complicated by the nature of pension regimes in place, as well as by current and prospective levels of public debt and deficits. Considering in addition the high degree of heterogeneity over time and across countries in the composition of households, savings rate per age cohorts, the link between the aggregate saving rate and total dependency ratio is highly uncertain. Indeed, while the empirical evidence of the life-cycle effect tends to vary quite considerably across studies, the bulk of the more recent evidence, based on more sophisticated estimation techniques, points towards a relatively small, albeit significant, positive response of aggregate saving to different measures of dependency ratios (Turner *et al.*, 1998).

Public sector saving

The general decline in private saving rates in the second half of the 1990s coincided in most cases with a substantial improvement in government budget balances (Figure 3). Such opposite movement in public and private saving is consistent with the Ricardian equivalence hypothesis (REH) under which forward-looking private agents with altruistic motive *vis-à-vis* their descendants fully internalise the fact that government borrowing implies higher future debt service and, hence, deferred taxation. Given their desire to smooth consumption over time, private agents prefer to adjust their own saving behaviour so as to fully offset changes in government saving rather than temporarily adjusting consumption. In this respect, private agents do not regard their holdings of government bond as net wealth under the REH. Given that the proposition rests on very stringent conditions unlikely to be met in the real world, few really expect private saving to offset one-for-one changes in public debt, as predicted under strict Ricardian equivalence (Seater, 1993).⁹ Even though each of these conditions (except the altruism motive) taken in isolation may only be of second-order importance, a substantial departure from Ricardian equivalence might turn out if several of them

Figure 3. **Change in gross saving positions between 1995 and 2000**
In per cent of GDP



failed to be met, as is likely to be the case. In this regard, the extent of the private saving offset remains an empirical issue that cannot be easily resolved considering the multitude of factors simultaneously affecting the private saving behaviour.

Changes in the terms of trade

Earlier Keynesian models predicted that an adverse shift in the terms of trade will generate a decline in saving and a deterioration in the trade balance (the so-called Harberger-Laursen-Meltzler effect). This is because the decline in the relative value of exports corresponds to a fall in income which, in such flow models, is not matched by a drop in consumption given the less-than-unit marginal propensities to consume and save. This prediction was later challenged with the development of inter-temporal general equilibrium models of consumption and external balances (Obstfeld, 1982). According to inter-temporal models based on an infinitely-lived, representative agent, savings would adjust as predicted in the basic Keynesian analysis only if the terms-of-trade shocks were perceived as transitory. A permanent shock would have little effect on saving (as well as on the trade balance) as households would quickly adjust consumption to the lower level of income. In overlapping generation models, forward-looking households may adjust savings to smooth consumption even in the case of permanent shifts in terms-of-trade. However, the decline in saving in the short and medium run leads to a de-cumulation of financial wealth (Macklem, 1990). The adjustment to the lower stock of financial wealth requires, in the longer run, a net increase in the saving rate and the trade balance position as a ratio of income. In sum, most models would predict a positive relationship between the terms of trade and savings in the short run, but the long-run effect is theoretically ambiguous as it may depend on the perceived persistence of the shock and/or the importance of the wealth effect in consumption decisions.

Real interest rate

The direction and size of the impact of the real interest rate on saving in the short and long run depend on the offsetting influences of substitution, income and human wealth effects. A rise in the real interest rate raises the cost of current consumption relative to future consumption, providing an incentive to raise saving. The strength of this effect depends on both the elasticity of inter-temporal substitution and the proportion of households who face liquidity constraints. Re-enforcing this substitution effect, an increase in real interest rate reduces the present value of the future stream of labour income, causing a decline in human wealth. While a small change in the real interest rate can lead to a substantial change in human wealth and although the size of the latter is potentially much larger than non-human or financial wealth, the importance of this channel is difficult to assess,

not least owing to serious measurement difficulties. These impacts on saving can be offset by the income effect. Given that the private sector is typically a net creditor, a rise in interest rates raises income, consumption and lowers saving. Overall the net effect is ambiguous, but the larger the proportion of households who are liquidity constrained, the more the income effect is expected to prevail over the substitution and human wealth effect.

Inflation

There are several ways in which inflation can affect saving independently from its influence via the real interest rate. Given the high correlation between the level and variance of inflation, the latter may capture the effect of uncertainty on saving. In such a case a rise in inflation would be expected to raise savings for precautionary motives. Also, an unexpected rise in inflation may lead households to raise savings to compensate for the capital losses on a fixed-income imperfectly indexed asset. But even in absence of behavioural response to capital gains or losses, a spurious positive correlation between inflation and the private saving rate may be induced by the interaction of inflation, taxation and the omission of capital gains or losses from the National Accounts (Jump, 1980). For a given real return on assets fixed in nominal terms, higher inflation raises nominal interest receipts but also erodes their real value, leaving the level of wealth and consumption unchanged in real terms for the asset holders. However, given that the rise in nominal interest receipts is reflected in measured income (and is taxed accordingly) but not the capital loss on the assets, the personal (net lender) saving rate tends to rise artificially with inflation at the expense of both the government and corporate (net borrowers) saving rate. Regardless of the prevailing channel, a positive relation between inflation and saving is expected.

DETERMINANTS OF PRIVATE SAVING: EMPIRICAL STRATEGY

Variable definition and data sources

This section provides a description of the data and the methodology used to assess the contribution of fundamental determinants in the evolution of private saving rates over time and across countries. Two measures of gross national saving rates (expressed in terms of GDP) are used to derive residually the two measures of *gross private saving rates* used in the empirical analysis. One is taken directly from the OECD National Accounts database (SNA) and the other is constructed from the balance of payments statistics (BOP). In the latter case, the gross national saving rate is obtained by adding the total investment rate (including inventories) to the current account balance (as a ratio of GDP) from the BOP statistics. In both cases, a

gross private saving rate is then calculated residually by subtracting the *gross public sector saving rate* from the gross national saving rate. The gross public sector saving rate is measured as the sum of the general government financial balance (net lending as a per cent of GDP) and the gross public sector investment rate.

The *old-age dependency* ratio is calculated as the ratio of the population over 64 years to the population between the age of 20 and 64 years. The data on population per age categories are taken from the United Nations demographic database. *Labour productivity* is measured as the ratio of real GDP to total employment. The *terms-of-trade* are measured as the ratio of goods export to import prices (customs basis). The *real interest rate* is measured by subtracting a moving average of past inflation rates (based on the consumption price deflator) from a nominal long-term government bond rate. The *inflation rate* is measured by the percentage change in the level of the consumption deflator.

The sample is based on annual data spanning from 1970 to 2000 and includes 15 OECD countries: The United States, Japan, Germany, France, Italy, the United Kingdom, Canada, Australia, Belgium, Finland, Ireland, the Netherlands, Norway, Spain and Sweden.

Estimation method

The analysis of the determinants of private saving across time and countries has been the subject of several studies in the last few years (Table 1). Even though most of them pursue a similar objective of identifying the key determinants of private savings, the specific methodology used is, in some cases, quite different. Callen and Thimann (1997) study the household saving behaviour among 21 OECD countries over the period 1975-95. They use static fixed effect regressors and only a limited degree of dynamics or heterogeneity in some of their specifications. Masson *et al.* (1998) also examine the determinants of the private saving rate in a sample of 21 OECD countries over 1971-93. Edwards (1995) examines the determinants of the private saving rate in a sample of developed and industrial countries over the period 1970-92. In both papers, the modelling strategy relies on pooled OLS or static-fixed effect regressors. In contrast, Loayza *et al.* (2000) and Haque *et al.* (1999) focus on dynamic panel estimators. Loayza *et al.* (2000) use different generalised-method-of-moments (GMM) estimators. They consider a dynamic specification that allows them to discriminate between short- and long-run effects. They also take into account the possible presence of unobserved country-specific effects correlated with the regressors and for the possible joint endogeneity of explanatory variables.

However, even if they take dynamics into account, Loayza *et al.* assume that the slope coefficients as well as the short-run coefficients are homogenous.¹⁰ This may cause some problems of robustness when heterogeneity is neglected. In

Table 1. Selected empirical panel studies on saving rates in OECD countries

Authors	Sample	Method	Interest
Edwards (1995)	36 countries (including 12 OECD countries) (1970-1992)	Instrumental variables techniques	What are the determinants of private and public savings?
Callen and Thimann (1997)	21 OECD countries (1975-1995)	Cross-sections and Static Fixed Effects	Have public policies an impact on the household saving decisions?
Masson, Bayoumi and Samiei (1998)	21 OECD countries (1971-1993)	Cross-sections and Static Fixed Effects	What are the determinants of private savings to GDP?
Haque, Pesaran and Sharma (1999)	21 OECD countries (1971-1993)	Pooled Mean Group, Mean Group and Static Effects	How can neglected heterogeneity and neglected dynamics affect inference about the key determinants of savings behaviour?
Loayza, Schmidt-Hebbel and Serven (2000)	20 OECD countries (1966-1995)	GMM, Systems Estimators	What are the determinants of national and private savings?

addition, as pointed out by Haque *et al.* (1999), the use of lagged values or lagged first differences of the regressors as instruments might be problematic in the case of the saving process when one needs to include dynamics.¹¹ In effect, any lagged value of the regressors might be a factor explaining the short-run dynamics of the private saving rate.

Following the work of Haque *et al.* (1999), the empirical model used in this paper is specified in a panel error correction form and estimated with a technique developed by Pesaran, Shin and Smith (1999). The main advantage of this approach over more traditional alternatives based on time averaging is to give more freedom with respect to the choice of dynamics and the degree of heterogeneity across countries. More specifically, one feature of the approach is the possibility to treat the long-run determinants of private saving rates distinctly from the short-run adjustment, even though both long and short-run effects are jointly estimated from a general auto-regressive distributed-lag (henceforth ARDL) model.¹² In the estimation results reported below, one lag was chosen for the gross private saving rate, the real interest rate and the inflation rate and no lag for the other variables.¹³

General specification

Given the following unrestricted specification:

$$gps_{i,t} = \mu_i + \lambda_i gps_{i,t-1} + \delta_{1i}^t X_{i,t}^{(1)} + \delta_{2i}^t X_{i,t-1}^{(2)} + \varepsilon_{it} \quad (1)$$

where $X_{i,t}^{(1)}$ includes all explanatory variables and $X_{i,t-1}^{(2)}$ includes those (real interest rate and inflation rate) that enter the equation also with a lag. Equation (1) can be re-written in an error-correction form (ECM) as follows:

$$\Delta gps_{i,t} = \mu_i + \phi_i (gps_{i,t-1} - \theta_{1i} gprod_{i,t} - \theta_{2i} odr_{i,t} - \theta_{3i} gpub_{i,t} - \theta_{4i} rir_{i,t} - \theta_{5i} inf_{i,t} - \theta_{6i} pctl_{i,t}) + \delta_{4i} \Delta rir_{i,t} + \delta_{5i} \Delta inf_{i,t} + \varepsilon_{it} \quad (2)$$

where $gprod_{i,t}$, $odr_{i,t}$, $gpub_{i,t}$, $rir_{i,t}$, $inf_{i,t}$ and $pctl_{i,t}$ are the labour productivity growth rate, the old-age dependency ratio, the gross public saving rate, the real interest rate, the inflation rate and the change in the terms of trade, respectively.

$\theta_{j,i} = \frac{\delta_{j1,i}}{1 - \lambda_i}$ for $j = 1, 2, 3$ and 6 are the long run coefficients of the labour productivity growth rate, the old-age dependency ratio, the gross public saving rate and the change in terms of trade;

$\theta_{j,i} = \frac{\delta_{j1,i} + \delta_{j2,i}}{1 - \lambda_i}$ for $j = 4, 5$ are the long-run coefficients of the real interest rate and the inflation rate; $\phi_i = -(1 - \lambda_i)$ is the adjustment coefficient, and Δ is the first-order difference operator.

As in the case of error-correction specifications having only a time-series dimension, a number of conditions have to be met in order to obtain valid parameter estimates. The main requirements are that a long-run relationship among the variables of interest exist, that the regressors are strictly exogenous and that the residuals are not serially correlated.¹⁴ Strict exogeneity is required to ensure that the long-run relationship is unique.¹⁵ However, in contrast to error-correction models having only a time-series dimension, standard estimation and inference methods can be used regardless of whether the regressors are stationary or integrated of order one, as long as the model is stable, which implies that the adjustment parameter turns out negative (Pesaran *et al.*, 1999).

The goal consists of estimating both the long and short-run coefficients when the empirical sample is characterised by times-series (T) and cross-sections (N) dimensions that are both relatively large and comparable in size. Under these conditions, a variety of alternative methods can be applied allowing for different degrees of parameter heterogeneity across countries. More specifically, three approaches can be distinguished according to the restrictions imposed.

Polar cases: mean group and pooled estimators

At one extreme, the fully-heterogeneous coefficient model imposes no cross-country restrictions and can be estimated on a country-by-country basis, provided the time dimension is sufficiently large. In this case, the mean group estimator (henceforth MG) consists in estimating the N separate regressions based on equation (2) and then in calculating the coefficients as unweighted means of the estimated coefficients for the individual countries. At the other extreme, the fully-homogenous coefficient model assumes that all slope and intercept coefficients have to be the same across countries. This is the pooled estimator.

Between the extremes: dynamic fixed effect, static fixed effect and pooled mean group estimators

Between these two extremes, lie a number of estimators, which vary according to the number of homogeneity restrictions imposed. The dynamic fixed effect estimator (henceforth DFE) imposes the equality of all slope coefficients and errors variances, allowing only the intercepts to differ across countries. The specification is as follows:

$$\Delta gps_{i,t} = \mu_i + \phi(gps_{i,t-1} - \theta_1 gprod_{i,t} - \theta_2 odr_{i,t} - \theta_3 gpub_{i,t} - \theta_4 rir_{i,t} - \theta_5 inf_{i,t} - \theta_6 pctt_{i,t}) + \delta_{4i} \Delta rir_{i,t} + \delta_{5i} \Delta inf_{i,t} + \varepsilon_{i,t} \quad (3)$$

A special case of the dynamic fixed effect estimator is the static fixed effect (SFE) estimator, which as its name indicates, abstracts from all dynamic terms:

$$gps_{i,t} = \mu + \theta_1 gprod_{i,t} + \theta_2 odr_{i,t} + \theta_3 gpub_{i,t} + \theta_4 rir_{i,t} + \theta_5 inf_{i,t} + \theta_6 pctt_{i,t} + \varepsilon_{i,t} \quad (4)$$

Compared with the DFE estimator, the pooled mean group estimator (henceforth PMG) imposes the same long-run restrictions but allows the short-run coefficients to vary across countries. The rationale is that slope homogeneity has better chances to be valid in the long run than in the short run given that cross-country differences in adjustment costs and institutional characteristics are likely to have a larger influence on the short-term dynamics. Hence, the PMG estimator can be interpreted as an intermediate procedure between the DFE and the MG estimators since it involves a mixture of pooling and averaging. The specification is as follows:

$$\Delta gps_{i,t} = \mu_i + \phi_i(gps_{i,t-1} - \theta_1 gprod_{i,t} - \theta_2 odr_{i,t} - \theta_3 gpub_{i,t} - \theta_4 rir_{i,t} - \theta_5 inf_{i,t} - \theta_6 pctt_{i,t}) + \delta_{4i} \Delta rir_{i,t} + \delta_{5i} \Delta inf_{i,t} + \varepsilon_{i,t} \quad (5)$$

The choice among these estimators is a trade-off between consistency and efficiency. In effect, estimators that impose restrictions dominate the heterogeneous models in terms of efficiency, if the restrictions are valid. For instance, if long-run coefficients are indeed similar across countries, then the PMG estimates will be consistent and efficient, whereas the MG estimates will be consistent but not efficient. In contrast, if long-run restrictions are wrongly imposed, then PMG

estimates will be inconsistent, whereas MG estimates will provide consistent estimates of the mean of the long-run coefficients across countries. In addition, imposing non-valid parameter homogeneity in dynamic models typically leads to downward-biased estimates of the speed of adjustment (Robertson and Symons, 1992; Pesaran and Smith, 1995). However, the PMG approach is sufficiently flexible to allow for a subset of long-run homogeneity restrictions to be imposed. Furthermore, compared with the MG estimator, the PMG estimator is much less sensitive to the inclusion of outliers due to the weighted-averaging scheme. For these reasons it represents a good compromise in the search for consistency and efficiency among the class of estimators considered.

Final specification

In order to help select the appropriate set of restrictions, tests of homogeneity of long-run coefficients have been carried out using the Hausman's statistic.¹⁶ Based on the results, equality restrictions were imposed on the old-age dependency ratio, the public gross saving rate and the change of the terms of trade, but not on the other three determinants. The model estimated with the PMG estimator is thus specified as follows:

$$\Delta gpr_{i,t} = \mu_i + \phi_i(gpr_{i,t-1} - \theta_1 gproct_{i,t} - \theta_2 odr_{i,t} - \theta_3 gpub_{i,t} - \theta_4 rir_{i,t} - \theta_5 inf_{i,t} - \theta_6 pctt_{i,t}) + \delta_{4i} \Delta rir_{i,t} + \delta_{5i} \Delta inf_{i,t} + \varepsilon_{i,t} \quad (6)$$

The estimation procedure can be briefly described as follows. Assuming the normality of the disturbance terms, the likelihood of the panel data model can be written as the product of the likelihood for each group. A concentrated maximum likelihood procedure jointly estimates the long-run and adjustment coefficients across countries since these are the parameters of interest. Using the estimated long-run coefficients, the estimations of short-run coefficients as well as the country-specific error variances are then performed on a country-by-country basis through a maximum likelihood procedure.

EMPIRICAL RESULTS

Main findings

Long-run parameter estimates from pooled regressions are presented in Table 2 which shows the results for saving rates based on both the SNA and BOP measures. While the analysis focuses on the PMG results, those obtained from the SFE, DFE and MG estimators are also presented for comparison purposes. The main findings are the following:

- The PMG estimates show that five of the six determinants of gross private saving rate (SNA measure) come out with the expected sign and are

Table 2. **Results from dynamic panel regressions of private saving rates (1970-2000)¹**
 Mean group and pooled MG estimates

	Gross private savings (SNA measure)				Gross private savings (BOP measure)			
	Static fixed effects ²	Dynamic fixed effects ²	PMG estimates ²	MG estimates ²	Static fixed effects ²	Dynamic fixed effects ²	PMG estimates ²	MG estimates ²
Average error correction term		-0.334*	-0.489**	-0.559**		-0.388**	-0.480**	-0.550**
		(0.047)	(0.044)	(0.048)		(0.042)	(0.040)	(0.041)
Restricted long-run coefficients (common)								
Percentage change in terms of trade	0.063**	0.136**	0.132**	0.184**	0.057**	0.098**	0.132**	0.107**
	(0.014)	(0.029)	(0.017)	(0.046)	(0.011)	(0.028)	(0.019)	(0.026)
Old-age dependency ratio	-0.220**	-0.346	-0.638**	-0.692**	-0.192*	-0.260*	-0.585**	-0.618**
	(0.101)	(0.147)*	(0.086)	(0.146)	(0.093)	(0.132)	(0.085)	(0.182)
Gross public saving rate	-0.523**	-0.914**	-0.691**	-0.698**	-0.529**	-0.823**	-0.718**	-0.629**
	(0.065)	(0.102)	(0.041)	(0.186)	(0.062)	(0.089)	(0.085)	(0.130)
Unrestricted long-run coefficients (average)								
Per capita productivity growth rate	0.075	0.364**	0.401**	0.417**	0.142**	0.343**	0.416**	0.367**
	(0.069)	(0.129)	(0.111)	(0.132)	(0.058)	(0.098)	(0.110)	(0.107)
Real interest rate	-0.201**	-0.321**	-0.280*	-0.249	-0.156**	-0.273**	-0.224	-0.077
	(0.053)	(0.082)	(0.144)	(0.269)	(0.056)	(0.071)	(0.156)	(0.191)
Inflation rate	-0.059	-0.112	-0.192	-0.212	0.057	0.022	-0.082	-0.058
	(0.061)	(0.079)	(0.145)	(0.222)	(0.037)	(0.066)	(0.130)	(0.150)
<i>Memorandum Items</i>								
Hausman test								
h_test			1.47				2.16	
p-value			[0.69]				[0.54]	

1. The dependent variable is the gross private saving/GDP ratio (SNA and BOP basis). Regressions are estimated using 1970-99 data for 15 OECD countries, which are listed in the second part of this table. ** and * indicate significance at the 1 and 5 per cent level, respectively.

2. Heteroskedasticity-corrected standard errors are in parentheses.

3. PMG and MG estimates are based on an ARDL (1, 0, 0, 0, 1, 1, 0) specification, *i.e.* one lag was chosen for the gross private saving rate, the real interest rate and the inflation rate and no lag for other variables.

Source: OECD Secretariat estimates.

Table 2. Results from dynamic panel regressions of private saving rates (1970-2000)¹ (cont.)

For gross national saving rate (SNA basis): individual country results

	Average error correction term	Percentage changes terms of trade	Old-age dependency ratio	Gross public saving rate	Per capita productivity growth rate	Real interest rate	Inflation rate	$\overline{R^2}$
United States	-0.717** (0.145)	0.193** (0.065)	-1.260** (0.261)	-0.512** (0.102)	-0.087 (0.181)	0.114 (0.097)	0.301** (0.112)	0.71
Japan	-0.482** (0.121)	0.037 (0.034)	0.473* (0.247)	0.001 (0.150)	0.782** (0.301)	0.056 (0.3741)	0.398 (0.448)	0.74
Germany	-0.357* (0.197)	0.252 (0.191)	-0.975 (0.475)	-0.806 (0.451)	0.089 (0.158)	0.074 (0.903)	0.184 (0.401)	0.38
France	-0.788** (0.208)	0.180** (0.072)	0.076 (0.207)	-0.374** (0.159)	0.570* (0.295)	-0.638** (0.169)	-0.158 (0.099)	0.43
Italy	-0.611** (0.154)	0.061 (0.094)	-0.423** (0.181)	-0.900** (0.255)	0.405 (0.259)	-0.404** (0.168)	-0.060 (0.156)	0.58
United Kingdom	-0.495** (0.127)	0.239 (0.142)	-1.582 (1.160)	-1.028** (0.230)	0.722* (0.369)	0.402 (0.243)	0.287 (0.165)	0.69
Canada	-0.364** (0.104)	0.394** (0.159)	-0.522 (0.386)	-0.613** (0.215)	1.039 (0.657)	-0.023 (0.347)	0.689** (0.286)	0.57
Australia	-0.787** (0.139)	0.086** (0.030)	-0.990** (0.243)	-0.523** (0.151)	0.223 (0.211)	-0.196 (0.119)	-0.144 (0.122)	0.62
Belgium	-0.350** (0.125)	-0.092 (0.285)	-0.495 (0.847)	-2.044** (0.851)	0.880 (0.700)	-3.223* (1.403)	-2.674** (1.034)	0.42
Finland	-0.633** (0.175)	0.010 (0.096)	-0.154 (0.352)	-0.352 (0.164)	0.256 (0.318)	-0.286 (0.240)	-0.395 (0.347)	0.60
Ireland	-0.395* (0.198)	0.341 (0.607)	-0.863 (2.041)	0.947 (1.079)	-0.622 (0.509)	1.518 (1.908)	0.181 (0.298)	0.32
Netherlands	-0.288** (0.098)	0.630 (0.539)	-0.518 (1.699)	-2.017** (0.810)	1.433* (0.651)	-1.442 (1.115)	-1.403* (0.660)	0.48
Norway	-0.553** (0.138)	0.096* (0.042)	-1.510 (1.090)	-0.697** (0.225)	0.349 (0.275)	0.527 (0.519)	0.456 (0.264)	0.54
Spain	-0.707** (0.177)	0.117* (0.058)	-1.001** (0.316)	-0.907** (0.284)	-0.048 (0.248)	-0.410** (0.128)	-0.754** (0.211)	0.53
Sweden	-0.857** (0.122)	0.209** (0.083)	-0.635* (0.309)	-0.649** (0.072)	0.265 (0.269)	0.198 (0.234)	-0.086 (0.141)	0.75

1. The dependent variable is the gross private savings/GDP ratio (SNA and BOP basis). Regressions are estimated using 1970-99 data for 15 OECD countries, which are listed in the second part of this table. ** and * indicate significance at the 1 and 5 per cent level, respectively. Individual estimates are based on an ARDL (1, 0, 0, 0, 1, 1, 0) specification, i.e. one lag was chosen for the gross private saving rate, the real interest rate and the inflation rate and no lag for other variables.

Source: OECD Secretariat estimates.

Table 3. **Contributions to the changes in private saving rates between 1995 and 2000**
Percentage points

	United States	Japan	Germany	France	Italy	United Kingdom	Canada	
Change in: Gross private saving rate	-3.9	0.6	-4.8	-0.5	-8.3	-7.2	-3.8	
Contributions from:								
Old-age dependency rates	0.3	-2.8	-1.1	-0.9	-1.4	0.0	-0.5	
Gross public saving rate	-3.8	2.2	-3.0	-1.6	-5.2	-4.8	-5.8	
Percentage change of terms of trade	-0.4	-0.6	-1.0	0.3	-0.7	0.4	0.4	
Productivity growth rate	0.6	0.1	0.0	0.5	-1.1	-0.4	1.2	
Real interest rate	0.0	0.6	-0.4	1.0	1.1	-0.3	0.6	
Inflation rate	0.3	0.6	0.0	0.4	0.0	-0.1	0.3	
Total¹	-3.0	0.1	-5.4	-0.3	-7.3	-4.4	-3.9	
	Australia	Belgium	Finland	Ireland	Netherlands	Norway	Spain	Sweden
Change in: Gross private saving rate	-1.1	-3.8	-4.1	-0.7	-7.5	-3.8	-0.1	-10.6
Contributions from:								
Old-age dependency rates	-0.3	-1.3	-0.7	0.0	-0.4	0.8	-1.1	0.3
Gross public saving rate	-2.5	-2.9	-7.2	-1.1	-4.5	-8.4	-1.9	-7.8
Percentage change of terms of trade	0.3	-0.1	-1.7	-0.2	-0.1	3.5	0.5	-0.8
Productivity growth rate	0.1	0.2	0.7	1.3	2.0	0.2	-0.3	-0.3
Real interest rate	1.1	2.8	1.1	-1.3	-1.1	-0.3	0.7	-0.5
Inflation rate	0.0	-1.4	-1.0	0.2	-0.4	0.2	1.5	0.1
Total¹	-1.2	-2.7	-8.8	-1.2	-4.6	-4.1	-0.6	-9.1

1. May not exactly add up due to rounding.

Source: OECD Secretariat estimates.

significant at the 5 per cent level. Of these, four are significant at the 1 per cent level. The private saving rate is negatively related to the public saving rate, the old age dependency ratio and the real interest rate, and positively linked to a change in the terms-of-trade and productivity growth. The inflation rate is not found to have a significant independent effect on private savings. Similar results are obtained with the private saving rates based on BOP data, except that the real interest rate is only significant at the 10 per cent level.

- The results from the Hausman's test confirm that the assumption of homogeneity of long-run coefficients could not be rejected in the case of the terms of trade, old-age dependency ratio and gross public saving rate.
- The average estimated coefficient associated on the error-correction term is negative and significant, confirming the existence a long-run equilibrium relationship between the saving rate and the set of significant determinants. And, even though the size of the parameter indicates a fairly strong error-correction mechanism, the degree of persistence in private saving rates is sufficiently important to induce a bias in long-run parameter estimates if it is ignored.
- In all cases except the real interest rate, the short-run impact on private saving goes in the same direction as the long-run effect and is of smaller magnitude.¹⁷
- The relatively high precision of the grouped parameter estimates reflects in large part the efficiency gains of pooling observations across countries. Indeed, the results from the individual country regressions in Table 2 show that most of the explanatory variables are significant in only about one-third of the cases – the exception being public saving. Such a result is far from being unusual in pooled samples using a common set of determinants.¹⁸
- A simple calculation of contributions based on long-run parameter estimates show that in many countries, the net decline in private saving between 1995 and 2000 has been mainly driven by the rise in public saving, resulting from the significant fiscal consolidation efforts pursued during that period (Table 6). In some countries (Japan, Germany, Italy, Spain and Belgium), the old-age dependency ratio also had a non-negligible contribution to changes in private saving rates.

How these results compare with previous studies using panel data

The results indicate that while private-sector saving rates do respond to changes in those of the public-sector, the degree of offset is considerably less than unity (around 0.7), suggesting a significant departure from pure Ricardian equivalence.¹⁹ This finding is consistent with recent empirical studies that have

also generally found fairly strong evidence of partial offsetting private saving behaviour (larger than 0.5), although the degree of offset has varied across studies (Table 4). One exception is Loayza *et al.* (2000) who found a very small – albeit statistically significant – degree private saving offset.

The relatively strong effect of the old-age dependency ratio can not be directly compared with previous studies given that in most cases demographic changes are measured by the total dependency ratio, which usually comes out with a much smaller coefficient. One explanation is that even though the life-cycle model predicts that an increase in either the youth or the elderly dependency ratio will reduce aggregate saving, the effect appears to be empirically much weaker and hence harder to detect in the case of the young-age ratio. In fact, an analysis of the sensitivity of the results to the introduction of additional determinants reported below show that the negative coefficient on the old-age dependency ratio is not robust to the simultaneous introduction of the youth ratio (although it is not sensitive to the inclusion of other determinants).

In contrast to the findings of most studies reported in Table 4, the real interest rate has a significant negative impact on the private saving rate, suggesting that the income effects outweigh the sum of substitution and human-wealth effects. While such a long-run negative effect can be justified theoretically, the absence of a significant positive effect even in the short run is perhaps more difficult to rationalise. In any event, the real interest rate is the only variable that clearly lacks robustness among the determinants, which may reflect both a problem of identification – potentially more severe in the context of a reduced-form application – and the difficulties in constructing an *ex-ante* measure of the real rate. The identification problem could arise, for instance, if the process of financial liberalisation in OECD countries has resulted in an outward shift of the saving function that has not been matched by a similar shift in investment.²⁰ In addition, in the case of many countries, savings may have become more responsive to foreign rather than domestic interest rates given the closer linkages of international capital markets.

Both the percentage change in the terms of trade and the growth rate of labour productivity have a positive and significant effect on the private saving rate, largely in line with the findings of previous studies. In the former case, this provides support to the Harberger-Laursen-Metzler effect even in the long run, although the magnitude remains relatively small. In the case of productivity growth, the result suggests that the cohort effect dominates the consumption smoothing effect and thus a 1 percentage point increase in productivity growth would generate a 0.4 percentage point rise in the saving rate.

Table 4. Results from other studies on private savings using panel data

Variables	Masson, Bayoumi and Samiei (1998) ¹	Edwards (1995)	Callen and Thimann (1997)	Haque, Pesaran and Sharma (1999) ²	Loayza, Semidt-Hebell and Serven (2000) ³
	Fixed effect	Instrumental variables	Fixed effects	PMG	Systems estimator
Income					0.29**
Growth rate of GDP per capita		0.31* (1.8)			(2.0)
GDP growth	0.01 (0.3)		0.15*** (2.9)	0.03 (0.5)	
Percentage change in Terms of trade	0.04*** (4.7)			0.08** (2.4)	0.07*** (3.6)
Rates of return and uncertainty					
Real interest rate	0.11*** (2.7)	-0.05 (-0.5)	0.85* (1.7)	0.14* (1.7)	0.02 (0.3)
Inflation rate	0.08** (2.2)	-0.01 (-0.3)	-0.38 (-0.8)	0.10 (1.1)	0.16*** (3.0)
Fiscal policies					
Gross public saving		-0.54*** (-7.5)	-0.32*** (-4.7)		
Government net lending	-0.77*** (16.0)			-0.87*** (19.8)	-0.11*** (2.8)
Demographics					
Old-age dependency ratio			-0.22** (-2.4)		
Dependency ratio	-0.18*** (3.6)	-0.09*** (-2.6)		0.05 (0.39)	-0.22 (1.4)

Note: t-value in parentheses. ***, ** and * indicate significant at 1, 5 and 10 per cent level, respectively.

1. Masson *et al.* (1998) also use some additional variables: government current expenditures to GDP (-)*, wealth to GDP (+)*, per capita GDP relative to US (0) and per capita GDP squared (-)*.
2. Haque *et al.* (1999) use the same variables in Masson *et al.* (1998) and finds respectively statistically significant negative effect of the government current expenditures to GDP in each method, a significant positive effect of the wealth variable in the case of the fixed effects and dynamics fixed effects estimators, and no significant effect of both the per capita GDP relative to the United States and the per capita GDP squared.
3. Loayza *et al.* (2000) also use the following variables: real per capita GDPI (0), M2/GDP (0), urbanisation ratio (0150)* and private credit flows to GDPI (-)*.

Tests of robustness of the specification and out-of-sample simulation

*Tests of residual properties, functional form and parameter stability*²¹

As outlined in the third section, the consistency and efficiency of the PMG estimates depends on several conditions regarding the specification. In order to assess the robustness of the empirical model, the usual battery of statistical tests was applied to the individual country equations, including the Godfrey's test of residual serial correlation, the Ramsey's RESET test of functional form, the Jarque-Bera's test of normality of regressions residuals and the Breusch-Pagan Lagrange-multiplier test for homoskedasticity. The results indicate that except for some evidence of serial correlation in the United Kingdom and misspecification of the functional form in Finland and in Sweden, the equation residuals appear to have all the basic desirable properties.

Likewise, in order to assess the stability of the specification over time, the system of panel equations was re-estimated over the period 1970-1990 and parameters re-estimated after extending the sample by one year at a time. The results suggest that long-run parameter estimates are fairly stable over time except for the old-age dependency ratio, which jumps after 1992 and remains stable thereafter. In general, the coefficients become particularly stable for periods ending after 1995.

Out-of-sample tracking performance

Another way of assessing the stability of the relationship consists in re-estimating the equations over a sample ending in 1995 and to perform an out-of-sample dynamic simulation so as to evaluate the ability of the model to track the development in private saving in individual country since 1995. The choice of 1995 is motivated by the desire to have a sufficiently large number of post-sample years and also by the fact that it precedes the period of large stock-market led increase in financial wealth. The point is that in the event that wealth has had a significant effect over and above what is captured by the set of determinants included in the specification, the equation is likely to over-predict private saving rates in the post-1995 period marked by the sharp increase in financial wealth.

The specification used to perform the out-of-sample simulation is as follows:²²

$$\hat{y}_{i,1995+h} = \hat{\lambda} \hat{y}_{i,1995+h-1} + \hat{\mu}_i + \hat{\delta}'_1 X_{i,1995+h}^{(1)} + \hat{\delta}'_2 X_{i,1995+h}^{(2)} \quad \forall h = 1, \dots, 5$$

where $\hat{y}_{i,1995} = y_{i,1995}$

First, the results from re-estimating the equations reported in Table 5 show that the parameter estimates are not very sensitive to the re-estimation over a

Table 5. **Results from dynamic panel regressions of private saving rates (1970-1995)¹**
 Mean group and pooled MG estimates

	Gross private savings (SNA measure)				Gross private savings (BOP measure)			
	Static fixed effects ²	Dynamic fixed effects ²	PMG estimates ³	MG estimates ³	Static fixed effects ²	Dynamic fixed effects ²	PMG estimates ³	MG estimates ³
Average error correction term		-0.317** (0.046)	-0.480** (0.043)	-0.598** (0.069)		-0.392** (0.034)	-0.485** (0.041)	-0.606** (0.066)
Restricted long-run coefficients (common)								
Percentage changes in terms of trade	0.068** (0.017)	0.148** (0.031)	0.135** (0.020)	0.125** (0.056)	0.0597** (0.013)	0.095** (0.028)	0.129** (0.022)	0.066 (0.047)
Old-age dependency ratio	-0.216 (0.130)	-0.324 (0.202)	-0.555** (0.108)	-0.378 (0.198)	-0.171 (0.101)	-0.217 (0.151)	-0.428** (0.104)	-0.287 (0.181)
Gross public saving rate	-0.460** (0.074)	-0.855** (0.113)	-0.645** (0.050)	-0.661** (0.128)	-0.454** (0.067)	-0.722** (0.076)	-0.621** (0.045)	-0.562** (0.085)
Unrestricted long-run coefficients (average)								
Per capita productivity growth rate	0.086 (0.076)	0.381** (0.137)	0.401** (0.146)	0.442** (0.160)	0.166 (0.065)	0.348** (0.102)	0.492** (0.149)	0.381** (0.133)
Real interest rate	-0.163** (0.072)	-0.331** (0.122)	-0.429** (0.212)	-0.392 (0.214)	-0.126* (0.060)	-0.270** (0.092)	-0.325** (0.124)	-0.201 (0.131)
Inflation rate	-0.045 (0.085)	-0.185 (0.128)	-0.175 (0.171)	-0.192 (0.220)	0.056 (0.052)	-0.042 (0.097)	-0.111 (0.148)	-0.050 (0.162)
Memorandum Items								
Hausman test								
h-test			1.17				2.50	
p-value			[0.76]				[0.47]	

1. The dependent variable is the gross private savings/GDP ratio (SNA and BOP basis). Regressions are estimated using 1970–99 data for 15 OECD countries (** and *) indicates significance at the 1 and 5 per cent level.

2. Heteroskedasticity-corrected standard errors are in parentheses.

3. PMG and MG estimates are based on an ARDL (1, 0, 0, 0, 1, 1, 0) specification, *i.e.* one lag was chosen for the gross private saving rate, the real interest rate and the inflation rate and no lag for other variables.

Source: OECD Secretariat estimates.

shorter sample period, with the exception of the coefficient on the real interest rate which drops substantially and becomes less significant. Second, the results from out-of-sample dynamic simulations show that the declines in private saving rates during the second half of the 1990s are well captured by the equations in the United States, Italy, Canada, Australia, Sweden and, to a lesser extent, the United Kingdom, Germany and the Netherlands (Figure 4).²³ In the cases of Finland and Norway, the equations even predict a larger decline in private saving than the one actually observed. In contrast, the equations tend to over-predict the movement in saving after 1995 in France and Belgium. Finally, in the case of Japan, where the equation performs less well, the rise in private saving from around the mid-1990s cannot be completely accounted for by the set of determinants. Taken at face value, the implication from these simulations results is that private saving patterns in a number of countries, including in many where a substantial decline has been observed since 1995, appear to be reasonably well explained by a small set of determinants that does not include financial wealth.

Sensitivity to the inclusion of other potential determinants of private saving

The robustness of the basic results is also assessed by looking at the sensitivity of parameter estimates and equation properties to the introduction of alternative measures of the existing determinants or other potential determinants that have been used in previous studies. The changes in measures considered include using net rather than gross public saving²⁴ (with and without public investment added separately), using the growth rate of GDP per capita instead of labour productivity growth and adding the young-age dependency ratio to the old-age ratio so as to have a broader measure of demographics. As for the alternative determinants three proxies for possible wealth effects are considered: net public transfers, real housing prices and real equity prices, entered separately. Net public transfers are introduced to capture the effect of social security or pension wealth on private saving decision. To the extent that public pensions are perceived as a substitute for private saving a negative relationship between the two variables is expected.²⁵ Likewise, previous studies have found a significant effect of housing wealth on household saving, even though it is not clear to what extent capital gains on residential properties should be considered as net wealth *on aggregate*.²⁶ Finally, equity prices deflated by the consumption deflator are introduced to capture potential re-valuation effects on financial wealth.²⁷ All these changes are made sequentially and the results are reported in Table 6.

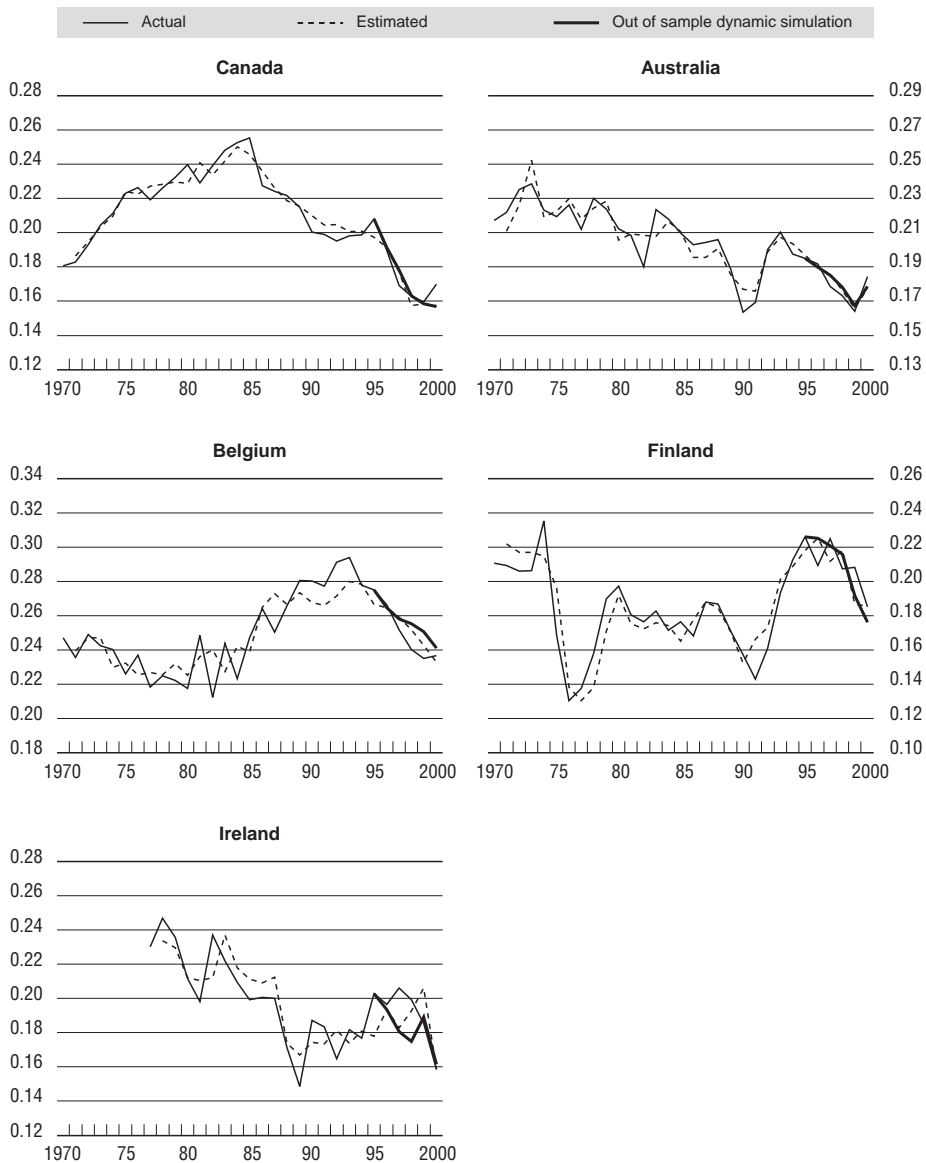
As mentioned earlier, the influence of the old-age dependency ratio is not very robust to the addition of the young-age ratio, which comes in significant but with the wrong sign (Column 1). On the other hand, overall parameter estimates are not very sensitive to the use of the net instead of gross government budget position (Columns 2 and 3). In particular, the estimated degree of offset (or Ricardian

Figure 4. **Gross private saving rates: actual and simulated**
Based on individual PMG estimates over the period 1970-95



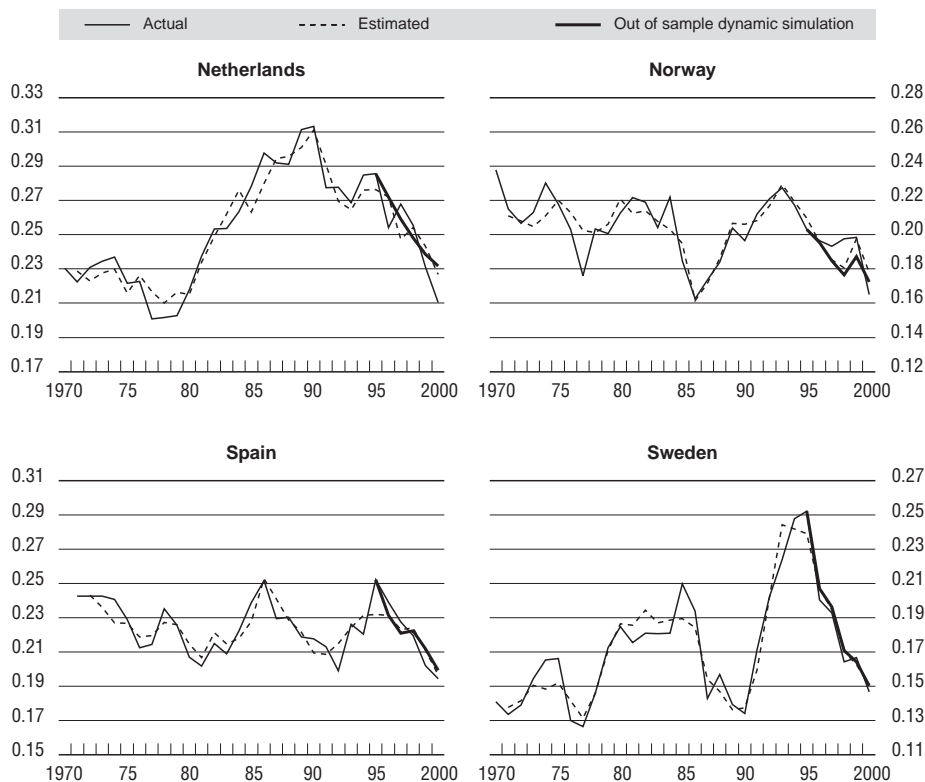
Source: OECD estimates.

Figure 4. **Gross private saving rates: actual and simulated (cont.)**
 Based on individual PMG estimates over the period 1970-95



Source: OECD estimates.

Figure 4. **Gross private saving rates: actual and simulated** (cont.)
Based on individual PMG estimates over the period 1970-95



Source: OECD estimates.

effect) is very similar in either case. Somewhat surprisingly, the results suggest that a rise in public investment has a significant net negative effect on private saving. Similar results are obtained also when income growth is measured by growth in GDP per capita instead of labour productivity (Column 4). In fact, both the real interest rate and inflation rates come in more significant than in the basic regressions. Moreover, the coefficients on the latter two variables are almost identical suggesting that the nominal, rather than the real, interest rate is the relevant determinant of private saving.

As regards the three variables used to capture possible wealth effects, only one of them, net transfers, is found to be significant with the predicted negative

Table 6. Sensitivity to other potential determinants

	Pooled Mean Group estimates							Memo: basic specification
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Average error correction term	-0.485*** (0.057)	-0.463*** (0.042)	-0.491*** (0.046)	-0.540*** (0.051)	-0.565*** (0.037)	-0.556*** (0.048)	-0.499*** (0.048)	-0.489*** (0.044)
Restricted long-run coefficients (common)								
Percentage change terms of trade	0.131*** (0.016)	0.143*** (0.018)	0.128*** (0.017)	0.123*** (0.015)	0.075*** (0.013)	0.119** (0.015)	0.143*** (0.021)	0.132*** (0.017)
Old-age dependency ratio	0.017 (0.109)	-0.503*** (0.044)	-0.673*** (0.091)	-0.552*** (0.071)	-0.255*** (0.074)	-0.399*** (0.093)	-0.446*** (0.123)	-0.638*** (0.086)
Young-age dependency ratio	0.186*** (0.033)							
Gross public savings rate	-0.699*** (0.039)			-0.680*** (0.036)	-0.686*** (0.048)	-0.727*** (0.046)	-0.813*** (0.061)	-0.691*** (0.041)
Net government position		-0.673*** (0.018)	-0.683*** (0.043)					
Public investment ratio			-0.932*** (0.204)					
Unrestricted long-run coefficients (average)								
Growth rate of labour productivity	0.366*** (0.127)	0.409*** (0.108)	0.397*** (0.113)		0.377*** (0.218)	0.378*** (0.102)	0.394*** (0.128)	0.401*** (0.111)
Growth rate of GDP per capita				0.242*** (0.038)				
Real interest rate	-0.042 (0.264)	-0.223 (0.140)	-0.278* (0.145)	-0.274** (0.135)	-0.153 (0.137)	-0.165 (0.156)	0.016 (0.176)	-0.280** (0.144)
Inflation rate	-0.153 (0.127)	-0.212 (0.143)	-0.174 (0.145)	-0.278* (0.133)	-0.066 (0.016)	-0.211 (0.140)	-0.004 (0.130)	-0.192 (0.145)
Net transfers					-0.499** (0.218)			
Residential prices						0.040 (0.027)		
Equity prices							0.015 (0.010)	
Memorandum items:								
Hausman's test	9.23	0.95	1.47	3.50	9.24	6.04	8.03	1.47
p-value	[0.06]	[0.81]	[0.83]	[0.32]	[0.03]	[0.11]	[0.05]	[0.69]

Note: Standard errors in parentheses.
 ***, ** and * indicate significant at 1, 5 and 10 per cent level, respectively.
 Source: OECD Secretariat estimates.

sign.²⁸ However, when the variable is introduced, the joint homogeneity restrictions on the terms-of-trade, old-age dependency and public saving rate are no longer accepted. And, when all homogeneity restrictions are relaxed (not shown), net transfers no longer have a significant effect on private saving. Both the housing and equity price variables are significant in the case of a few countries (not shown) but the average estimate is not significant. These results are consistent with earlier evidence based on out-of-sample simulations indicating only limited wealth effect at the margin, *i.e.* over and above the effect already captured by fundamentals.

CONCLUSIONS

This paper has applied the pooled mean group estimation method to a system of dynamic equations to analyse the contribution of a set of basic determinants of private saving rates for a panel of 15 OECD countries over the period 1970-2000. The empirical analysis indicates that private-sector saving rates in OECD countries have been significantly influenced by public-sector saving rates, the demographic structure of the population (as measured by the old-age dependency ratio), the growth rate of labour productivity, changes in the terms of trades and the real interest rates. For three of these determinants – public saving, dependency ratio and terms-of-trade – the hypothesis that the long-run effect is the same across countries could not be rejected.

Among the determinants, the change in the public-sector saving rate has generally contributed the most to the evolution of private saving between 1995 and 2000. Nevertheless, the results indicate that while private-sector saving rates do respond to changes in public-sector in a significant way, the degree of offset is considerably less than unity, suggesting a significant departure from complete Ricardian equivalence. Private savings are also negatively related to the old-age dependency ratio and the real interest rate, and are positively linked to a change in the terms of trade and productivity growth. Except for the negative coefficient on the real interest rate, these results are broadly in line with recent studies based on panel data.

A series of tests of specification and parameter stability indicate that the overall estimation results are fairly robust. In particular, results from an out-of-sample dynamic simulation have shown that the system of equations tracks remarkably well the change in private saving in most countries during the period 1995-2000. The implication is that private saving patterns in a number of countries, including in many where a substantial decline has been observed since 1995, appear to be reasonably well explained by a small set of determinants that does not include financial wealth. In this regard, fears that a negative wealth

effect imparted by the stock market collapse could compromise the recovery in the United States and elsewhere should not be exaggerated. However, given that, where they have occurred, the declines in private saving rates in the late 1990s were largely induced by the substantial rise in public-sector saving, fiscal stimulus may fail to boost consumption as households may respond by re-building their savings.

NOTES

1. See Figure 4 in de Serres and Pelgrin (2002). A strong negative relationship between the two main components of private saving should not be surprising given that households ultimately own businesses, either directly *via* shareholding or indirectly *via* mutual funds or pension fund participation. That said, given that business saving is calculated residually, this may also partly reflect a rise in measurement errors or statistical discrepancies.
2. The saving rate appears in Figure 2 with an inverted scale.
3. Based on a conservative estimate of the propensity to consume out of wealth (3 per cent), Lusardi *et al.*, (2001) indicated that the rise in the stock market value in real terms between 1988 and 2000 could account for 3.5 percentage points of the decline in the US personal saving rate over the same period. Moreover, using data disaggregated across income groups and education levels, Maki and Palumbo (2001) showed that the households which benefited the most from stock market gains were also the ones which accounted for most of the decline in the aggregate saving rate.
4. In countries where fully-funded pension regimes account for a large proportion of overall retirement benefits, the NA measure of personal saving rates may also be sensitive to significant capital gains or losses on invested funds, particularly in the case of regimes based on defined benefits. For a broader and more detailed discussion of the conceptual issues linked to the measurement of saving in national accounts see the Appendix in de Serres and Pelgrin (2002).
5. See Case *et al.* (2001) who find on the basis of a pooled sample of 14 countries that housing wealth has a more significant impact on consumption than equity wealth. However, their measure of wealth is based on prices. In contrast, Boone *et al.* (2001) use stock data on financial and housing wealth for six countries (G-7 minus Germany) and find a larger impact of housing wealth only in the cases of Japan and Canada.
6. See Edison and Sløk (2001) who have found that in the United States, the United Kingdom and Canada, capital gains on new economy shares (Telecommunication, Media and Information Technology) have had a lesser impact on consumption than those on old economy stocks, while they found the reverse to hold in the case of Continental Europe.
7. Alternative measures based on price data are nevertheless introduced as part of the sensitivity tests performed below.
8. This is assuming that the rise in the old-age dependency ratio comes more from a decline in fertility than from an increase in longevity. Under the life-cycle hypothesis, a rise in life expectancy leads individuals to save more during their working years in order to maintain consumption over a longer retirement period, generating a higher aggregate saving rate. In contrast, a decline in population growth due to lower fertility

leaves individual savings profiles unchanged, but leads to lower aggregate savings as the proportion of the elderly in the population rises.

9. The main conditions are the existence of bequests motivated by altruism, the absence of liquidity constraints and differential in borrowing rates between private consumers and governments, the absence of uncertainty regarding the future path of income and the presence of a non-distortionary tax system.
10. In fact, they consider different sub-samples within each of which, the coefficients are assumed to be the same.
11. Moreover, the number of instruments used becomes restricted when the number of time periods and countries included in the sample is large.
12. In addition, averaging the data induces a loss of information that can be exploited under a more flexible model and the choice of an averaging period may not always properly eliminate the cyclical component.
13. The lag orders were chosen using the Schwarz Bayesian criterion as well as the results of individual model specification.
14. Pesaran *et al.* (1999) make the following assumptions: The $\varepsilon_{i,t}$'s are independently distributed across i and t , with zero means, positive variances and finite fourth-order moments. They are also distributed independently from the regressors. In particular, in order to ensure that the residuals are distributed independently across groups, omitted common effects which impact all groups must be controlled for. When the long-run coefficients are identical across groups, the common time-period effect can be eliminated by a cross-sectional demeaning procedure. When they differ, the common effect can be reduced but not eliminated.
15. While the existence of a unique long-run relationship may be directly assessed through panel cointegration tests (Kao and Baltagi, 2001; Pedroni, 2000), strict exogeneity of the regressors can be controlled for by use specification tests or by augmenting the dynamic specification of the model.
16. An alternative procedure is to use classical tests, as for instance the likelihood ratio test. Based on such tests, homogeneity restrictions imposed simultaneously on error variances and/or slopes coefficients of all determinants are rejected at conventional levels. However, this feature may be discussed (Pesaran, Shin and Akiyam, 1998).
17. Short-run coefficients are not shown for space reasons. However, in the case of the variables which only enter the equation in levels (all except the real interest rate and the inflation rate), the impact coefficient is equal to the negative of the product of the long-run coefficient and the error-correction parameter. In the case of the real interest rate, the impact effect is negligible.
18. For instance, Haque *et al.* (1999) obtain similar results at the individual country level.
19. Based on a Wald test, the hypothesis that the long-run coefficient on public-sector saving is not statistically different from unity (pure Ricardian equivalence) was rejected at the 5 per cent level. However, this result should be interpreted with caution given that it represents an average outcome over time and across different types of changes in government saving. In fact, the degree of offset may vary depending on whether a given change in the level of public debt is expected or unexpected, perceived to be temporary or permanent, factors which can not be easily controlled for in reduced-form analysis (Bernheim, 1987).
20. This might be the case if financial deregulation generates better risk-adjusted returns.

21. The results from test of residual properties, functional form and parameter stability are not shown here for space considerations. However, they appear in Table 5 and Figure 6 of the Working Paper version (de Serres and Pelgrin, 2002).
22. The simulation is performed using the PMG estimates *i.e.* based on the specification that has common coefficients on the determinants where cross-country homogeneity is imposed and on individual coefficients obtained in each country equations on the other variables.
23. In the case of Germany, the large drop in private savings in 2000 partly reflects large payments made by telecom firms to the government for the purchase of UMTS licenses.
24. Net public saving is defined as gross saving less public investment and is therefore close to the SNA's net lending/borrowing.
25. For instance Rossi and Visco (1995) found that net government transfers have substantially contributed to the decline of the household saving rate in Italy until the early 1990s.
26. See Girouard and Blöndal (2001) for recent evidence.
27. Neither of the two price variables (housing and equity) provides an ideal substitute for stock-based measures of wealth. However, for many countries measures of housing and holdings of equities by households are not available.
28. Callen and Thimann (1997) obtained a similar result in their equation for private saving even though they used gross rather than net transfers.

BIBLIOGRAPHY

- BERNHEIM, B.D. (1987), "Ricardian Equivalence: An Evaluation of Theory and Evidence", *NBER Macroeconomics Annual* 1987.
- BOONE, L., N. GIROUARD and I. WANNER (2001), "Financial Market Liberalisation, Wealth and Consumption", *OECD Economics Department Working Paper*, No. 308.
- BORSCH-SUPAN, A. and A. BRUGIAVINI (2001), "Savings: The Policy Debate in Europe", *Oxford Review of Economic Policy*, Vol. 17, No. 1.
- CALLEN, T. and C. THIMANN (1997), "Empirical Determinants of Household Saving: Evidence From OECD Countries", *IMF Working Paper*, No. 97/181.
- CASE, K.E., J.M. QUIGLEY and R.J. SHILLER (2001), "Comparing Wealth Effects: The Stock Market Versus the Housing Market", *Cowles Foundation Discussion Paper*, No. 1335.
- DE SERRES, A. and F. PELGRIN (2002), "The Decline in Private Saving Rates in the 1990s in the OECD Countries: How Much Can Be Explained by Non-Wealth Determinants?", *OECD Economics Department Working Paper*, No. 344, December ([http://appli1.oecd.org/olis/2002doc.nsf/linkto/eco-wkp\(2002\)30/\\$FILE/JT00136211.PDF](http://appli1.oecd.org/olis/2002doc.nsf/linkto/eco-wkp(2002)30/$FILE/JT00136211.PDF)).
- EDISON, H. and T. SLØK (2001), "Wealth Effects and the New Economy", *IMF Working Paper*, No. 01/77.
- EDWARDS, S. (1995), "Why Are Saving Rates So Different Across Countries: An International Comparative Analysis", *NBER Working Paper*, No. 5097.
- HAQUE, M., H. PESARAN and S. SHARMA (1999), "Neglected Heterogeneity and Dynamics in Cross-Country Savings Regressions", *IMF Working Paper*, No. 99/128
- JUMP, G. (1980), "Interest Rates, Inflation Expectations and Spurious Elements in Measured Real Income and Saving", *American Economic Review*, Vol. 70, No. 3.
- KAO, C. and M.H. CHIANG (2000), "On the Estimation and Inference of a Co-integrated Regression in Panel Data", *Advances in Econometrics*, Vol. 15.
- LETTAU, L and S. LUDVIGSON (2001), "Understanding Trend and Cycle in Asset Values: Bulls, Bears and the Wealth Effect on Consumption", *CEPR Discussion Paper*, No. 3104.
- LOAYZA, N., K. SCHMIDT-HEBBEL and L. SERVEN (2000), "What Drives Private Saving Across the World?", *The Review of Economic and Statistics*, Vol. LXXXII, No. 2.
- LUSARDI, A., J. SKINNER and S. VENTI (2001), "Saving Puzzles and Saving Policies in the United States", *NBER Working Paper*, No. 8237.
- MACKLEM, R.T. (1990), "Terms-of-Trade Disturbances and Fiscal Policy in a Small Open Economy", *Bank of Canada Working Paper* 90-7.
- MAKI, D and M.G. PALUMBO (2001), "Disintegrating the Wealth Effect: A Cohort Analysis of Household Saving in the 1990s", Federal Reserve Board, Washington, *mimeo*.

- MASSON, P.R., T. BAYOUMI and H. SAMIEI (1998), "International Evidence on the Determinants of Private Saving" *The World Bank Economic Review*, Vol. 12, No. 3.
- MODIGLIANI, F. (1996), "The Life-Cycle Hypothesis of Saving, the Demand and Wealth and the Supply of Capital", *Social Research*, No. 33.
- OBTSFELD, M. (1982), "Aggregate Spending and the Terms of Trade: Is There a Laursen-Metzler Effect?", *The Quarterly Journal of Economics* 97.
- PEDRONI, P. (2000), "Testing for Convergence to Common Steady States in Nonstationary Heterogeneous Panels", *Working Paper in Economics*, Indiana University.
- PESARAN, M.H. and Y. SHIN (1999), "Pooled Mean Group Estimation of Dynamic Heterogeneous Panels", *Journal of the American Statistical Association*, Vol. 94.
- ROSSI, N. and I. VISCO (1995), "National Saving and Social Security in Italy", *Ricerche Economiche*, Vol. 49.
- SEATER, J.J. (1993), "Ricardian Equivalence", *Journal of Economic Literature*, Vol. XXXI, No. 1.
- TOBIN, J. (1967), "Life-Cycle Saving and Balanced Growth", in William Fellnes, ed. *Ten Economic Studies in the Tradition of Irving Fischer*.
- TURNER, D., C. GIORNO, A. DE SERRES, A. VOURECH and P. RICHARDSON (1998), "The Macroeconomic Implications of Ageing in a Global Context", *OECD Economics Department Working Paper*, No. 193.