CONSUMPTION STRUCTURE, WELFARE GOODS AND RETIREMENT INCOME: LINKING THE AGEING PUZZLES

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Abstract
While the empirical evidence tends to support some predictions of the life-cycle theory, a number of puzzles remain: an ageing-consumption, an ageing-saving and a saving-capitalisation puzzles have been put forward in the literature. This paper analyses the links between these three puzzles and develops a model relating usual life-cycle variables, social transfers (public health care expenditures and the generosity of pension systems) to the level of savings. A reduced-form model using a panel of 18 OECD countries is tested, confirming the proposed explanations for the puzzles, together with other factors such as Ricardian equivalence and the population structure. We found that the relative generosity of welfare systems have a significant negative impact on household saving rate.

JEL Classification: C68, D91, G10, J11, J26
Key words: Ageing populations, longevity, consumption, saving

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1. Introduction

While the empirical evidence tends to support some main predictions of the life cycle theory, a number of puzzles remain. The literature has put forwards three types of puzzles: an ageing-consumption puzzle, an ageing-saving puzzle and a saving-capitalization puzzle.

First, in all OECD countries, the consumption decreases in old age, except for health goods. This seems to contradict the idea that households save in order to maintain their consumption level after retirement. Second, significant levels of savings are observed at old age. Another puzzling fact is that countries with generous PAYG system and health care system (welfare goods) have the highest private saving rate. In contrast, in countries where pension funds are well developed the private saving rate is much lower.

An extensive literature has put forward potential explanations for each of the individual puzzles and some of the main arguments are discussed below. To our knowledge, there has been no attempt to bring all these puzzles together in an integrated view. Accordingly, we argue in this paper that the three puzzles are linked together. The interaction between consumption and provision of welfare goods and the level of retirement income can explain a large part of these phenomena. In order to highlight the role of these determinants and their links, the paper compares the household saving behaviour, the health system and the retirement systems of two country groupings: those with PAYG systems and those with fully-funded systems. Of course, other traditional determinants of savings have also to put brought into the picture, in particular the role of a Ricardian compensation between private and public savings, as well as income.

The paper begins with a theoretical life cycle model where we consider the optimal welfare consumption, social transfers and the generosity of pension systems (section 2). We then review some empirical facts on consumption, pension and saving in section 3, discuss their links and present some explanations of the puzzles in section 4. In section 5, we present econometric estimates using a panel of OECD countries of the impact of age structure and welfare systems on household saving rates, together with a number of other controls often used in the empirical literature. A final section concludes.

2. Ageing, Consumption and Saving: theory

The most useful framework to study the link between ageing, consumption and saving is the life cycle model (Ando and Modigliani, 1963). In its simplest version, individuals live two periods. In the first period of which the person earns a wage from her labour supply and in the second one the person is retired. Individuals save from his wage income to provide for second period consumption with a constant rate of interest (i.e., the rate of interest does not vary with the level of saving). The main result obtained is that the consumption is smoothed: the individuals will save in order to transfer purchasing power to the period of the retirement.

In order to introduce other possible determinants of the saving rate, we use here a model inspired from Drouhin (2002). For generality, our model combines both a PAYG and funded pension systems. Each agent lives two periods and optimises her/his consumption and saving over the life-
cycle. In the first period, each agent splits her disposable wages into consumption \( (C_i) \) and saving \( (S_i) \):

\[
C_i + S_i = (1 - \alpha).w_i
\]  

(1)

The rate of social contributions being \( \alpha \). In the second period, we assume that only a welfare good consumption (e.g. health) is considered \( H_i \). To finance this consumption, the agent receives a PAYG pension with a replacement rate \( \beta \), the accumulated saving accrued by the return on capital \( r \) and a given amount of social transfers \( T \), such as:

\[
H_i = \beta.w_i + (1 + r) \cdot S_i + T_i
\]  

(2)

Note that this model is compatible, but does not necessarily implies, consumption smoothing (as \( C \) and \( H \) are not assumed to be equal). To simplify, we omitted the index corresponding to the time period. Using (2) and replacing into (1), we obtain the inter-temporal budget constraint:

\[
C_i + \frac{H_i}{1 + r} = (1 - \alpha).w_i + \frac{T}{1 + r} + \frac{\beta.w_i}{1 + r}
\]  

(3)

Maximising the utility of each agent under the budget constraint (3), we obtain:

\[
Max E[u(C_i, H_i)] = u(C_i) + p_i \cdot u(H_i)
\]  

s.t. \( C_i + \frac{H_i}{1 + r} \leq (1 - \alpha).w_i + \frac{T}{1 + r} + \frac{\beta.w_i}{1 + r} \)  

(4)

The variable \( p_i \) is the survival probability at the beginning of the second period. The first-order conditions imply that:

\[
u'(C_i) = \lambda_i p_i \cdot u'(H_i) = \frac{\lambda_i}{1 + r}
\]  

(5)

Where \( \lambda_i \) is the Lagrange multiplier associated with the budget constraint. Using these conditions we get the usual consumption smoothing over the life-cycle:

\[
\frac{u'(C_i)}{u'(H_i)} = p_i \cdot (1 + r)
\]  

(6)

Without loss of generality, we assume thereafter that the \( u(C) = \log(C) \) and idem for \( H \).\(^2\) We get then the following relation between \( C_i \) and \( H_i \):

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1. This assumption does not entail a loss of generality in the model, as we could have introduced a composite consumption good in the form \( \delta.C + (1 - \delta).H \), with the weight \( \delta \) changing from period 1 to period 2.

2. The main results of the model derive from the existence of the conditional life expectancy and from the budget constraint and not from the specific functional form for the utility.
\[ H_i = p_i \cdot (1 + r) \cdot C_i \]  
\( (7) \)

Now replacing (7) into the budget constraint:

\[ C_i + C_i \cdot p_i = (1 - \alpha) \cdot w_i + \frac{T}{1 + r} + \frac{\beta w_i}{1 + r} \]  
\( (8) \)

The optimal level of consumption in the two periods is therefore:

\[ C_i = \frac{1}{1 + p_i} \cdot \left[ (1 - \alpha) \cdot w_i + \frac{T}{1 + r} + \frac{\beta w_i}{1 + r} \right] \]
\[ H_i = \frac{p_i}{1 + p_i} \cdot \left[ (1 - \alpha) \cdot (1 + r) \cdot w_i + T + \beta w_i \right] \]  
\( (9) \)

It can be seen that, contrary to the first-period consumption, the optimal welfare consumption is increasing in the survival probability and the interest rate. It is also increasing in income level in the first and second period and the amount of social transfers. Conversely, we can use these expressions to derive the saving rate in the first period:

\[ \frac{S}{w_i} = (1 - \alpha) \cdot \frac{p_i}{1 + p_i} - \frac{1}{1 + p_i} \cdot \frac{1}{(1 + r)} \cdot \left[ \frac{T}{w_i} + \beta \right] \]  
\( (10) \)

Assuming that all individuals are identical in the first period, one can derive an aggregate saving ratio by multiplying, the individual saving rate by the share of the active people on total population. As the latter is equal to one minus the old-age dependency ratio:

\[ \frac{S}{Y} = \left[ (1 - \alpha) \cdot \frac{p_i}{1 + p_i} - \frac{1}{1 + p_i} \cdot \frac{1}{(1 + r)} \cdot \left[ \frac{T}{w_i} + \beta \right] \right] \cdot \left[ 1 - \frac{\text{Old population}}{\text{Total population}} \right] \]  
\( (11) \)

Where \( Y \) is aggregate Household income. Therefore, the aggregate saving rate is an increasing function of the survival probability and the interest rate. It is a decreasing function of welfare transfers to older people, the replacement ratio, the rate of social contributions (\( \alpha \)) and the old-age dependency ratio. In other words, the systems providing large transfers and generous retirement income (typically PAYG) are expected to have \textit{ceteris paribus} lower saving rates.

### 3. The Ageing-consumption-saving puzzles

Some empirical facts on consumption, pension and saving do not fit well with theory outlined above. A first puzzle concerns the link between ageing and consumption. A large body of literature has found that consumption falls significantly at retirement, a fact somewhat in contradiction with life-cycle consumption smoothing. This applies over a number of countries (e.g. US, UK and Italy), across different time periods and across different measures of spending. This stylized fact is displayed in Figure 3.1, relating levels of household consumption by age for the US and several European countries.
While household survey data suggest that total consumption displays a hump-shaped profile across age-groups, this is not equivalent to say that the consumption profile is hump-shaped over the life cycle mainly due to the existence of cohort and time effects. Nonetheless, they would suggest that the pure consumption-smoothing hypothesis is only partly supported by the micro data.

Several explanations of this puzzle have been put forward. Allowing for uncertainty, Banks, Blundell and Tanner (1998) suggest that unanticipated shocks that occur around the time of retirement could explain the fall in spending within the context of the life-cycle model. Bernheim, Skinner and Weinberg (2001) suggested that workers do not adequately foresee the decline in income associated with the retirement. Hurd and Rohwedder (2003) argue that the drop in spending can still be explained by an extended version of the life-cycle model, where certain work-related consumption expenditures stop at retirement and market-purchased goods & services are substituted by household home production. The latter could be the case of long-term care services, which often are provided informally within families. However, in a more recent paper, Hurd and Rohwedder (2006) argue, like others, that the reduction in consumption cannot be explained by the simple one-good life cycle model with forward-looking consumers. Many factors such as leisure or poor health could also explain the decline in spending. Along these lines, Smith (2007) argues that retirement is involuntary, largely reflecting ill health status and redundancy, and likely to be associated with a negative wealth shock.

The second puzzle is closely related to the previous one, although is not equivalent. With a certain stability of retirement incomes and a decline in consumption, positive saving at old ages could be observed (see Börsch-Supan et al., 2000). However, why individuals cannot anticipate this fact and continue to save at old age, in particular in countries with generous welfare goods (high pension replacement rates and health care coverage), as illustrated in Figure 3.2?

Bloom et al. (2003) and Sheshinski (2004) suggest that higher life expectancy may increase the need for additional precautionary savings, despite the effect of improved health care on the length of desired working life. Moore and Mitchell (1998) also conclude that Americans are not preparing adequately for retirement as a couple would need to save 20% of annual earnings between 1992 and the time of retirement (at 62) to have a replacement rate of 61%. A single woman would need to save around 32% of her income to have a replacement ratio of 54% at age of 62. They conclude, despite seemingly large accumulations of total retirement wealth, the majority of older households will not

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3. To be precise, the consumption profile is hump-shaped across households headed by individuals belonging to different age groups.

4. Due to the lack of data, it will be assumed that the snapshot picture of total consumption per household by age-groups approximates the life-time consumption profile of a cohort (e.g. static ageing as opposed to dynamic ageing). This approach takes an agnostic view on how a combination of various household characteristics in conjunction with institutional factors in each country affects the life-cycle consumption pattern. Fernandez-Villaverde and Krueger (2002) suggest that the bias induced by the use of age-groups instead of cohorts may not be very large for the estimation of the hump-shaped consumption profiles.

5. Attanasio (1999) provides an overview of competing theories of consumption behaviour over the life cycle. Note that when the age-income profile is more hump-shaped than consumption, the above observed age-consumption patterns are still compatible with some consumption smoothing over the life cycle.

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be able to maintain current levels of consumption into retirement without additional saving. Bernheim et al. (2001) argue their results are difficult to reconcile with the life-cycle model and that they are more likely to be the result of household behaviour not governed by rational, farsighted optimization. Khittrakun and Scholz (2004) note that tax incentives, like IRAs and 401(k) are not needed and may lead to excess savings. Finally, a largely evoked, but not well documented, reason for saving at older ages is the existence of bequest motives.

The *third puzzle* arises from the fact that countries with fully funded systems have the lowest private saving rates. In principle, the introduction of a fully-funded pension system should induce a decline in the replacement rate of PAYG systems and, according to our theoretical model, mechanically increase aggregate savings. Figure 3.3 shows that while saving rates have been decreasing steadily in all countries, the countries with PAYG systems have persistently higher household saving rates and the gap has widened over time.

![Figure 3.3 The Saving-Capitalisation puzzle](image)

In a seminal paper, Feldstein (1974) highlighted a negative link between PAYG pension systems and household savings. But, subsequent empirical tests on the impact of pension systems on household saving have produced mixed results (e.g. Edwards, 1996; Callen-Thimann, 1997; Corsetti-Schmidt-Hebbel, 1995) and Murphy and Musalem, 2004). Confirming earlier Feldstein’s results, Edwards (1996) found that the social security system has a negative impact on private saving using a sample of 32 countries (developed and developing countries). Baillu and Reisen (1997) also found a positive and statistically significant impact of pension funds on savings using a panel of 11 countries for the period 1982-93. In more recent study, Bosworth and Burtless (2004) did not find an econometrically significant impact on private saving for a set of 11 countries during the period 1971-2000. Murphy and Musalem (2004) considered 43 countries for the period 1960-2002 and found that mandatory contribution to funded pension systems increase national saving. It could be noted that it is quite difficult to compare these studies due to the heterogeneity of samples and estimation methods.

That the introduction of pension systems may decrease, increase or be neutral on savings has several potential explanations. Under defined benefits, if pension wealth can be seen as a substitute for private accumulation and therefore there could be a decrease of the household saving when a pension system is introduced. Moreover, pensions are usually paid in the form of annuities. Without pension annuities, the employee would be forced to accumulate more to finance their retirement period. Thus, by offering annuities, pension plans could reduce savings. Another explanation is related to earlier retirement decision, as individuals who retire earlier are forced to save more in order to finance a longer period of retirement. Imperfect capital markets can also prevent households from borrowing freely, thereby forcing them to save more than they otherwise would. In this case, insofar as mandatory private pension funds may increase financial deepening and reduce borrowing constraints they would decrease household savings.

4. Stylised facts on consumption structure, provision of welfare goods and retirement income

We argue in this paper that the three puzzles discussed above are linked together. The interaction among consumption structure, provision of welfare goods and the level of retirement income can explain part of the puzzles. The basic facts are as follows.
4.1 The consumption structure changes with age

The survey data allow an assessment of the age-group specific composition of consumption expenditure by broad categories of goods and services. Among the items covered by the data, the expenditure share on motor vehicles and related services falls with age, as older people tend to drive less. As could be expected, the elderly also tend to spend relatively less on entertainment and education. But the shares of housing, energy and health care spending increase steadily with age. The increase in the share of health care is particularly pronounced in the United States (Figure 4.1). The same profiles can be observed for other countries (cf. Oliveira Martins et al., 2005).

[Figure 4.1: Relationship between age and consumption by expenditure items]

It could be noted, nonetheless, that higher participation of old-age people in the labour force could also induce consumption patterns closer to those of prime-age workers. Also, with the development of information and communication technologies (ICT) some of the products that are less consumed by older people could become more old-age friendly.

4.2 Welfare goods are largely subsidised

While health care is one the few consumption items increasing with age, it is also heavily subsidised. The shares of publicly provided health services have decreased in some countries (e.g. France, Sweden, UK), but recently they still stay at around 70-80% of total health expenditures (Figure 4.2). In other countries, they have been increasing steadily (Portugal, Italy, US).

[Figure 4.2: Public shares in Total Health Expenditures]

Several studies have shown that age by itself is not a major driver of health care expenditures, but other factors such as the proximity to death or the effects of income and technological progress. In contrast, long-term care expenditures are mainly driven by the increase in the very-old dependent people in the population. Certain types of services demanded by older people, such as long-term care, are often seen as having low potential for productivity gains compared with manufactured goods. This could exacerbate spending pressures over the next decades.

4.3 Retirement incomes have increased in most countries

Average replacement rates have increased in most countries (Figure 4.3). For example, in France, Italy and Portugal they reached above 80%. In US, starting from a lower basis they reached close to 55% in the early 2000s. In Sweden they have declined following pension reform to around 55%. By 2003, average replacement rates in PAYG systems are around 58% compared with 44% in fully-funded systems. This pattern is expected to change in the future as many PAYG systems are currently unsustainable. This should induce a decline in replacement rates over time.

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6. The increase in housing expenditure is due to the fact that the imputed average market (rental) value of owned housing remains relatively high at the age of 75 years and above. As an aside, this reveals a strong potential for the development of reverse mortgage schemes (see Section 4).


8. Average replacement rates are defined here as the ratio between average pensions to average wages.
How the interrelations among these basic facts can explain the puzzles? The changing structure of consumption with age, together with a large subsidy for welfare goods and increasing replacement rates could provide an explanation for both the ageing-consumption and ageing-saving puzzles. If old-age consumers shift their consumption structure towards goods that are heavily subsidised and receive increased retirement income, this could both induce a decline of consumption and a surplus of saving at older ages.

Nonetheless, there is an explained fact related to the level differences in saving rates between the group of countries having PAYG and those with fully-funded systems. To see this point, we run a simple regression of saving rates on the rate of capitalisation (defined as the ratio of pension fund assets on GDP) for a set of 25 OECD countries for the period 1993-2005. We use both an OLS pooled regression and a fixed-effect model. To avoid a potential endogeneity problem, the capitalisation variable is lagged by one period. The results are as follows:

\[
\text{Sav}_i = 9.23 - 0.47 \cdot \text{Cap}_{i,t-1} + \varepsilon_{it} \\
\text{student} - t \quad (-4.72) \quad N = 193
\]

\[
\text{Sav}_i = 11.4 - 0.12 \cdot \text{Cap}_{i,t-1} + \text{Country}_\text{Fixed} \_\text{effects} + \varepsilon_{it} \\
\text{student} - t \quad (-4.40) \quad N = 193
\]

With these simple models, capitalisation appears negatively correlated with saving rates. This is the saving-capitalisation puzzle, i.e. PAYG systems tend to display higher saving rates, a fact already noted in Figure 3.3 above. As we will show below this could be related to a Ricardian equivalence effect, as illustrated in Figure 4.4. The countries with the largest budget deficits also display the largest saving rates. This relationship is particularly strong in countries dominated by PAYG systems.

[Figure 4.4: Public budget balances and Saving rates]

Now if we run the same regressions for a sub-set of OECD countries with fully-funded systems (Australia, Canada, Denmark, Netherlands, U.K. and US), we obtain the following estimates:

\[
\text{Sav}_i = 0.06 + 0.84 \cdot \text{Cap}_{i,t-1} + \varepsilon_{it} \\
\text{student} - t \quad (5.45) \quad N = 65
\]

\[
\text{Sav}_i = 12.9 - 0.12 \cdot \text{Cap}_{i,t-1} + \text{Country}_\text{Fixed} \_\text{effects} + \varepsilon_{it} \\
\text{student} - t \quad (-4.55) \quad N = 65
\]

In the case of an OLS pooled regression model we obtain a positive impact between capitalisation and saving ratios. Thus, the cross-section effect appears as expected. However, the introduction of fixed-effects changes the sign of the capitalisation coefficient, suggesting that within countries the increase in capitalisation is concomitant with a decrease in saving rates. The fact that introducing
fixed-effects changes the sign of the capitalisation coefficient suggests that, over time, the saving-capitalisation puzzle can be explained by increasing replacement rates. Despite the introduction of fully-funded systems, our model above would suggest that savings would then still decline.

5. Revisiting the ageing puzzles: an empirical test

Drawing from the above results, we are now in a position to test for a reduced-from model embodying both the long-term determinants of the saving rates suggested by the theoretical model, as well as other determinants (short-term, income effects and Ricardian equivalence). We adopt a reduced-form approach taking into account a variety of saving determinants identified in the literature (e.g. Edwards, 1996; Loayza, Schmidt, Hebbel and Serven, 2000; Musalem 2004). The focus here is on non-wealth determinants of savings. The list of determinants is as follows:

(i) Short-term and macroeconomic determinants:
- Public budget balance (in % GDP), in order to test the Barro-Ricardo equivalence hypothesis (Barro, 1974).
- GDP per capita (wealth effects)
- Long term real interest rate

(ii) Social security and welfare systems determinants:
- Public share on total health expenditures (proxy for the provision of welfare goods)
- Average replacement rate (in public and private pension systems)

(iii) Structure of the population:
- Shares of prime (25-59) and old-age (60+) population
- Life expectancy at 60 (proxy for the survival probability during the retirement period)

We also introduced interaction terms of the replacement rate with the population shares. We also considered the interaction between conditional life expectancy at 60 and the share of old-age people in the population. The estimates were carried out using country fixed-effects and a time trend captures an eventual spurious correlation among saving rates and explanatory variables (alternative specifications are also provided in Annex). The empirical test covers 19 OECD countries\(^9\) and the period 1970-2003. We also present separate regressions for a sub-set countries with mainly PAYG and fully-funded systems. Most estimated coefficients are significant and have the expected sign (Table 5.1). In contrast, the time-trend is not significant.

[Table 5.1 Econometric estimates of household saving rate]

The level of the public budget balance has a negative impact on savings, \(i.e.\) budget deficits tend to increase the saving rates. This result is in line with the Ricardian equivalence effect, although the size of the estimated coefficient is below one indicating that there is no full compensation between

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9. Australia, Austria, Belgium, Canada, Denmark, Germany, Finland, France, Italy, Japan, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, UK and the US.
public and private savings. This helps explaining the saving-capitalisation puzzle, as suggested above.

Both real interest rates and the level of GDP per capita impact positively saving rates, though the former not being significant in PAYG countries. In line with the life-cycle model, an increase in the share of old-age population (60-99 years) has a strong negative impact on the saving rate, while the share of prime-age population (25-59 years) is not significant.

In accordance to our theoretical framework, the generosity of pension systems and subsidisation of health goods impact negatively on saving rates. Both the Public share in total health expenditures and the average replacement rate have negative and significant coefficients for the overall sample.

Interestingly, the estimates also show that the interaction between replacement rates and the share of old-age population has a positive impact on savings. This result could explain the age-saving puzzle. With generous pension systems and subsidisation of welfare goods old-age households would continue to display excess savings.

The only opposite result to our theoretical a priori concerns the conditional life expectancy at 60. While this variable was expected to influence positively savings, the coefficient is only significant for PAYG systems and displays a negative sign. This could be seen as a sort of ‘saving-longevity puzzle’. Indeed, Bloom et al. (2003) argued that higher life expectancy should lead to an increase of precautionary savings. However, Bloom et al. (2006) have also shown that in the absence of strong saving retirement incentives, such as in PAYG systems, an increase in longevity does not induce higher savings. The latter argument is coherent with our results, but this would clearly require further research.

6. Concluding remarks

Some empirical facts on consumption, pension and saving do not fit well with theory. Three types of puzzles have emerged: an ageing-consumption puzzle, an ageing-saving puzzle and a saving-capitalisation puzzle. While most studies in the literature have analysed these puzzles separately, the originality of this paper is to integrate these three puzzles together. We first developed a simple theoretical model. Inspired from this model and a number of other determinants of savings analysed in the literature, we then estimated a reduced-form econometric model.

Our empirical results show that the three puzzles are linked together. The changing structure of consumption with age, together with a large subsidy for welfare goods and increasing replacement rates provides an explanation for both the ageing-consumption and ageing-saving puzzles. If old-age consumers shift their consumption structure towards goods that are heavily subsidised and receive increased retirement income, this induces a decline of consumption and a surplus of saving at older ages. Accordingly, higher replacement rates and larger shares of public provision of health care in total health consumption contribute negatively to the savings rate. Furthermore, in line with a Ricardian equivalence effect, the level of the public budget balance has a negative impact on savings. This explains the observed saving-capitalisation puzzle. Finally, in line with standard life-

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10. This is line with other empirical results in the literature (e.g. Serres and Pelgrin, 2003; de Mello, Kongsrud and Price, 2004).
cycle effects, we also showed that an increase in the share of the old-age population has a strong negative impact on the saving rate.

Finally, our econometric results raised an additional longevity-saving puzzle, as the impact of conditional life expectancy at 60 tends to be negative. Some explanations have been provided in the literature for this fact, but this would require additional analysis that will be left for further research.
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OECD, Institutional Investors, various years, OECD.


Figure 3.1 The Consumption-Saving Puzzle

United States

European countries

Source: Oliveira Martins et al. (2005)
Figure 3.2 The Ageing-Saving Puzzle


Figure 3.3 The Saving-Capitalisation Puzzle

Average Household Saving rate

Source: OECD ABD Database
Figure 4.1 Consumption structure and age, US Household Panel Expenditure Survey

Housing

Energy

Health

Entertainments

Education

Vehicles

Source: Oliveira Martins et al. (2005)
Figure 4.2 Public shares in Total Health Expenditures

Source: OECD Health Data.
Figure 4.3 Average Replacement rates in OECD countries

FRANCE

ITALY

SWEDEN

PORTUGAL

USA

Source: OECD ADB data base and authors’ calculations.
Legend: SAV: household saving rates (in % of Household income); nlgqa: Public budget balance (in % of GDP).
Source: OECD National Accounts and ABD database.
<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
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<tr>
<td></td>
<td>Total</td>
<td>PAYG systems</td>
<td>Fully-Funded systems</td>
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<tr>
<td>Public budget balance</td>
<td>-0.653***</td>
<td>-0.664***</td>
<td>-0.423**</td>
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<td></td>
<td>(-7.35)</td>
<td>(-7.04)</td>
<td>(-2.31)</td>
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<tr>
<td>Real interest rate</td>
<td>0.269***</td>
<td>0.124</td>
<td>0.340*</td>
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<td></td>
<td>(2.96)</td>
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<td>(1.91)</td>
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<td>GDP per capita</td>
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<td>0.000000769***</td>
<td>0.00000826</td>
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<tr>
<td></td>
<td>(3.40)</td>
<td>(3.55)</td>
<td>(1.02)</td>
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<tr>
<td>Share of pop 25-59</td>
<td>-0.963</td>
<td>0.449</td>
<td>-0.333</td>
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<tr>
<td></td>
<td>(-1.43)</td>
<td>(0.60)</td>
<td>(-0.18)</td>
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<tr>
<td>Share of pop 60-99</td>
<td>-3.399***</td>
<td>-1.947**</td>
<td>-3.103**</td>
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<td></td>
<td>(-4.82)</td>
<td>(-2.23)</td>
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<td>Share of public health exp.</td>
<td>-0.312***</td>
<td>-0.394***</td>
<td>-0.0723</td>
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<td></td>
<td>(-3.45)</td>
<td>(-3.57)</td>
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<tr>
<td>Replacement rate</td>
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<td>-0.763</td>
<td>-2.357</td>
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<td></td>
<td>(-2.28)</td>
<td>(-1.12)</td>
<td>(-1.41)</td>
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<tr>
<td>Replacement rate*Pop 25-59</td>
<td>0.0150</td>
<td>0.0125</td>
<td>0.00688</td>
</tr>
<tr>
<td></td>
<td>(1.15)</td>
<td>(0.95)</td>
<td>(0.19)</td>
</tr>
<tr>
<td>Replacement rate*Pop 60-99</td>
<td>0.0555***</td>
<td>0.0140</td>
<td>0.143***</td>
</tr>
<tr>
<td></td>
<td>(4.65)</td>
<td>(1.07)</td>
<td>(4.06)</td>
</tr>
<tr>
<td>Life expectancy at 60</td>
<td>-1.089</td>
<td>-2.318*</td>
<td>2.485</td>
</tr>
<tr>
<td></td>
<td>(-1.01)</td>
<td>(-1.69)</td>
<td>(1.06)</td>
</tr>
<tr>
<td>Life exp. at 60*Pop 60-99</td>
<td>-0.0239</td>
<td>0.00524</td>
<td>-0.0968***</td>
</tr>
<tr>
<td></td>
<td>(-1.57)</td>
<td>(0.34)</td>
<td>(-3.20)</td>
</tr>
<tr>
<td>Time trend</td>
<td>0.165</td>
<td>0.0321</td>
<td>-0.535</td>
</tr>
<tr>
<td></td>
<td>(0.95)</td>
<td>(0.15)</td>
<td>(-1.26)</td>
</tr>
<tr>
<td>Constant</td>
<td>155.5***</td>
<td>85.70*</td>
<td>85.51</td>
</tr>
<tr>
<td></td>
<td>(4.63)</td>
<td>(1.76)</td>
<td>(1.14)</td>
</tr>
<tr>
<td>Number of observations</td>
<td>245</td>
<td>134</td>
<td>111</td>
</tr>
<tr>
<td>Number of countries</td>
<td>18</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>R-squared (within)</td>
<td>0.51</td>
<td>0.59</td>
<td>0.62</td>
</tr>
<tr>
<td>F-Test</td>
<td>18.80</td>
<td>13.38</td>
<td>12.46</td>
</tr>
<tr>
<td>Hausman-test (p-value)</td>
<td>102.7</td>
<td>84.48</td>
<td>36.28</td>
</tr>
<tr>
<td></td>
<td>(0.0)</td>
<td>(0.0)</td>
<td>(0.0002)</td>
</tr>
</tbody>
</table>

(1) Defined as household saving on household income. All models include country Fixed-effects (not reported). T-statistics are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Hausman specification test of the fixed-effects vs. the random-effect model is also provided (p-values in parenthesis indicate the fixed-effect cannot be rejected at 95% confidence level).
Annex: Sensitivity Analysis with alternative econometric estimates

In order to test the sensitivity of the results to alternative specifications, we also carried out estimates using the random-effect model (Table A.1) and the dynamic panel estimator using the Arellano-Bond (1991) method (Table A.2).

In general, the estimated coefficients are robust. The long-term real interest rate, the GDP per capita (wealth effects) and public budget balance keep the same signs and roughly the same magnitudes. The share of old-age (60+) population also remains negative, as well as the share of public share on total health expenditures (the proxy for the provision of welfare goods). The replacement rate is less robust, as it becomes positive in the random-effect model, while negative in the dynamic panel estimate for the PAYG systems. Nonetheless, the interaction terms with the population share are in line with what could be expected. They are negative for the interaction with the prime-age population, indicating that generous pension systems are a disincentive for saving for this segment of the population, while the interaction with old-age population is positive in line with the excess saving argument.

The coefficient on the conditional life expectancy at 60 remains negative in the random-effect panel, but is positive for the dynamic model in funded systems. To sum, a fair conclusion is that our baseline results are not rejected by these alternative estimates.
TABLE A.1 Econometric estimates of household saving rate,
Random-effect model

<table>
<thead>
<tr>
<th></th>
<th>(1) Total</th>
<th>(2) PAYG systems</th>
<th>(3) Fully-Funded systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public budget balance</td>
<td>-0.592***</td>
<td>-0.688***</td>
<td>-0.271</td>
</tr>
<tr>
<td></td>
<td>(-6.60)</td>
<td>(-6.63)</td>
<td>(-1.51)</td>
</tr>
<tr>
<td>Real interest rate</td>
<td>0.210**</td>
<td>0.0317</td>
<td>0.222</td>
</tr>
<tr>
<td></td>
<td>(2.14)</td>
<td>(0.27)</td>
<td>(1.17)</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>0.00000324***</td>
<td>-8.56e-09</td>
<td>-0.0000811***</td>
</tr>
<tr>
<td></td>
<td>(4.64)</td>
<td>(-0.017)</td>
<td>(-6.41)</td>
</tr>
<tr>
<td>Share of pop 25-59</td>
<td>0.958*</td>
<td>2.256***</td>
<td>2.121</td>
</tr>
<tr>
<td></td>
<td>(1.88)</td>
<td>(5.10)</td>
<td>(1.30)</td>
</tr>
<tr>
<td>Share of pop 60-99</td>
<td>-2.546***</td>
<td>-0.336</td>
<td>-4.669***</td>
</tr>
<tr>
<td></td>
<td>(-5.02)</td>
<td>(-0.79)</td>
<td>(-4.74)</td>
</tr>
<tr>
<td>Share of public health exp.</td>
<td>-0.112**</td>
<td>-0.353***</td>
<td>0.0286</td>
</tr>
<tr>
<td></td>
<td>(-2.52)</td>
<td>(-5.16)</td>
<td>(1.13)</td>
</tr>
<tr>
<td>Replacement rate</td>
<td>-0.166</td>
<td>1.007***</td>
<td>-2.115</td>
</tr>
<tr>
<td></td>
<td>(-0.35)</td>
<td>(2.78)</td>
<td>(-1.57)</td>
</tr>
<tr>
<td>Replacement rate*Pop 25-59</td>
<td>-0.00186</td>
<td>-0.0214***</td>
<td>0.00926</td>
</tr>
<tr>
<td></td>
<td>(-0.18)</td>
<td>(-2.72)</td>
<td>(0.30)</td>
</tr>
<tr>
<td>Replacement rate*Pop 60-99</td>
<td>0.0172*</td>
<td>-0.00319</td>
<td>0.115***</td>
</tr>
<tr>
<td></td>
<td>(1.88)</td>
<td>(-0.44)</td>
<td>(4.51)</td>
</tr>
<tr>
<td>Life expectancy at 60</td>
<td>-3.839***</td>
<td>0.978</td>
<td>-1.396</td>
</tr>
<tr>
<td></td>
<td>(-5.45)</td>
<td>(1.22)</td>
<td>(-1.57)</td>
</tr>
<tr>
<td>Life exp. at 60*Pop 60-99</td>
<td>0.0360***</td>
<td>0.0166***</td>
<td>-0.00773</td>
</tr>
<tr>
<td></td>
<td>(6.07)</td>
<td>(4.22)</td>
<td>(-0.72)</td>
</tr>
<tr>
<td>Time trend</td>
<td>0.0414</td>
<td>-0.429***</td>
<td>-0.962***</td>
</tr>
<tr>
<td></td>
<td>(0.36)</td>
<td>(-3.69)</td>
<td>(-6.23)</td>
</tr>
<tr>
<td>Constant</td>
<td>61.94**</td>
<td>-85.82***</td>
<td>31.10</td>
</tr>
<tr>
<td></td>
<td>(2.19)</td>
<td>(-3.68)</td>
<td>(0.48)</td>
</tr>
<tr>
<td>Number of observations</td>
<td>245</td>
<td>134</td>
<td>111</td>
</tr>
<tr>
<td>Number of countries</td>
<td>18</td>
<td>11</td>
<td>7</td>
</tr>
</tbody>
</table>

(1) Defined as household saving on household income. The random-effect is estimated using the generalised least-square method. T-statistics are in parentheses, *** p<0.01, ** p<0.05, * p<0.1
TABLE A.2 Econometric estimates of household saving rate, Dynamic Panel estimates

<table>
<thead>
<tr>
<th></th>
<th>(1) Total</th>
<th>(2) PAYG systems</th>
<th>(3) Fully-Funded systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lagged dependent variable</td>
<td>0.550***</td>
<td>0.453***</td>
<td>0.533***</td>
</tr>
<tr>
<td></td>
<td>(12.2)</td>
<td>(6.58)</td>
<td>(7.40)</td>
</tr>
<tr>
<td>Public budget balance</td>
<td>-0.366***</td>
<td>-0.458***</td>
<td>-0.0999</td>
</tr>
<tr>
<td></td>
<td>(-5.17)</td>
<td>(-5.27)</td>
<td>(-0.63)</td>
</tr>
<tr>
<td>Real interest rate</td>
<td>0.233***</td>
<td>0.281***</td>
<td>0.0743</td>
</tr>
<tr>
<td></td>
<td>(3.34)</td>
<td>(3.49)</td>
<td>(0.52)</td>
</tr>
<tr>
<td>GDP p.c.</td>
<td>0.00000198</td>
<td><strong>0.00000466</strong></td>
<td>0.0000878</td>
</tr>
<tr>
<td></td>
<td>(1.26)</td>
<td>(2.36)</td>
<td>(1.42)</td>
</tr>
<tr>
<td>Share of pop 25-59</td>
<td>-1.085*</td>
<td>-1.086</td>
<td>0.886</td>
</tr>
<tr>
<td></td>
<td>(-1.90)</td>
<td>(-1.24)</td>
<td>(0.53)</td>
</tr>
<tr>
<td>Share of pop 60-99</td>
<td>-1.380**</td>
<td>-2.352***</td>
<td>-1.690</td>
</tr>
<tr>
<td></td>
<td>(-2.24)</td>
<td>(-2.69)</td>
<td>(-1.20)</td>
</tr>
<tr>
<td>Share of public health exp.</td>
<td>-0.208***</td>
<td>-0.232**</td>
<td>-0.0211</td>
</tr>
<tr>
<td></td>
<td>(-3.00)</td>
<td>(-2.03)</td>
<td>(-0.17)</td>
</tr>
<tr>
<td>Replacement rate</td>
<td>-0.805</td>
<td>-1.425*</td>
<td>-0.0324</td>
</tr>
<tr>
<td></td>
<td>(-1.38)</td>
<td>(-1.76)</td>
<td>(-0.021)</td>
</tr>
<tr>
<td>Replacement rate*Pop 25-59</td>
<td>0.00402</td>
<td>0.0164</td>
<td>-0.0367</td>
</tr>
<tr>
<td></td>
<td>(0.36)</td>
<td>(1.06)</td>
<td>(-1.07)</td>
</tr>
<tr>
<td>Replacement rate*Pop 60-99</td>
<td><strong>0.0423</strong>*</td>
<td><strong>0.0425</strong>*</td>
<td><strong>0.114</strong>*</td>
</tr>
<tr>
<td></td>
<td>(3.89)</td>
<td>(3.21)</td>
<td>(3.46)</td>
</tr>
<tr>
<td>Life expectancy at 60</td>
<td>1.004</td>
<td>-1.075</td>
<td><strong>3.886</strong></td>
</tr>
<tr>
<td></td>
<td>(1.25)</td>
<td>(-0.97)</td>
<td>(2.02)</td>
</tr>
<tr>
<td>Life exp. at 60*Pop 60-99</td>
<td>-0.0434***</td>
<td>-0.0213</td>
<td>-0.107***</td>
</tr>
<tr>
<td></td>
<td>(-3.69)</td>
<td>(-1.51)</td>
<td>(-3.74)</td>
</tr>
<tr>
<td>Time trend</td>
<td>0.224*</td>
<td><strong>0.328</strong>*</td>
<td>-0.322</td>
</tr>
<tr>
<td></td>
<td>(1.83)</td>
<td>(1.93)</td>
<td>(-0.99)</td>
</tr>
<tr>
<td>Constant</td>
<td>91.90***</td>
<td>136.7***</td>
<td>-18.62</td>
</tr>
<tr>
<td></td>
<td>(3.28)</td>
<td>(2.87)</td>
<td>(-0.28)</td>
</tr>
</tbody>
</table>

Number of observations: 215 116 99
Number of countries: 18 11 7

(1) Defined as household saving on household income. Regressions were carried out using the dynamic Arellano-Bond estimator. T-statistics are in parentheses, *** p<0.01, ** p<0.05, * p<0.1