HOW RETIREMENT, HEALTH BENEFITS AND LONGEVITY AFFECT HOUSEHOLD SAVINGS?

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Abstract

This paper analyses the impact of welfare systems and longevity on savings. It develops a life-cycle model embodying social transfers (health care and pension expenditures) and changes in longevity to determine the level of household savings. We simulated an aggregate saving equation and derived a reduced-form model, together with other factors such as public deficits and the population structure. The model is estimated for a panel of 18 OECD countries. Our principal result is that both pension and health transfers may have a significant negative impact on the household saving. Therefore these interactions should be taken account when designing welfare reforms.

JEL Classification: C68, D91, G10, J11, J26
Key words: Ageing, Consumption, Health, Longevity, Pension systems, Saving

December 2010

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The authors thank Philippe Bernard, Johannes Clemens, Carlo Cottarelli and Christophe Hurlin for helpful comments and discussions. El-Mekkaoui de Freitas is grateful to the “Chaire Dauphine-Ensae Groupama” for their support. The views expressed are those of the authors and do not reflect those of the OECD or its Member countries.
1. Introduction

The life cycle hypothesis is the main framework used in economics to model the relations between age, consumption and saving behaviour. It has been largely used to understand households’ saving behaviour, design pension reforms and manage the effects of ageing. While the main predictions of life cycle theory tend to be supported by empirical evidence, some empirical facts have raised the need for further research. Those include the low or insignificant estimated impact of increased longevity on saving rates, the existence of significant savings at old-age and the observed fall of consumption after retirement.

This paper follows a similar line of research. Our main focus is to understand the impact of pension and public health systems on household saving behaviour. The originality of our theoretical framework is to combine the impact of pension replacement rates, provision of public health care and longevity on savings. We derive an aggregate saving equation and confront it with actual data for a number of OECD countries. Then we develop an identification strategy for econometric panel estimation.

Our approach relies on a number of previous papers, which aimed to reconcile observed saving behaviour facts with the life-cycle theory. Our starting point is the seminal paper by Feldstein (1974) who highlighted a negative link between Pay-As-You-Go (PAYG) pension systems and household savings. However, subsequent empirical tests on the impact of pension systems on household saving have produced mixed results (e.g. Edwards, 1996; Baillu and Reisen, 1997; Callen and Thimann, 1997; Corsetti, Schmidt-Hebbel, 1995, Bosworth and Burtless, 2004; and Murphy and Musalem, 2004). Sample heterogeneity has made these results difficult to compare.¹

Concerning the impact of longevity, Bloom et al. (2003) argued that higher life expectancy should lead to an increase of precautionary savings. Empirical work, however, has often found an opposite sign. Recently, Bloom et al. (2006) have shown that in the absence of strong saving retirement incentives, such as in PAYG systems, an increase in longevity does not induce higher savings.²

The fall in consumption after retirement is a stylized fact observed in most OECD countries (e.g. US, UK and Italy), across time periods and for different measures of household spending. This seems to contradict the hypothesis that marginal utility of consumption should be the same before and after retirement. A possible explanation would be to assume

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¹ 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. On the other hand, Bosworth and Burtless (2004) did not find any 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 only mandatory contribution to funded pension systems increase national saving.

² This of course only holds when the age of retirement is fixed and not linked to longevity, which is still the case in most social security systems in OECD countries.
that retirement may occur as the result of an anticipated shock. This uncertainty could generate a fall in consumption at retirement, but the estimated impact of this effect is small (see Blau, 2008). Thus, other explanations should be considered. Accordingly, some authors (e.g. Browning and Lusardi, 1996; Browning and Crossley, 2001) suggest that a deterioration of health status, a decrease of family size or increased mortality risk could reduce the marginal utility of consumption. Allowing for uncertainty, Banks, Blundell and Tanner (1998) argued that unanticipated shocks occurring around the date of retirement could explain the fall in spending within the context of the life-cycle model, while Bernheim, Skinner and Weinberg (2001) argued that workers do not adequately foresee the decline in income associated with the retirement or the risks associated with different retirement saving and pension schemes (Clark and Strauss, 2008).

According to Smith (2007), retirement is largely involuntary, reflecting ill health status and redundancy. Wakabayashi (2008) relate the decline in consumption to income and family size after retirement. For example, Battistin et al. (2009) found that the 9.8% drop in non-durable consumption after retirement of Italian households can be mainly accounted for the departure of grown children who previously lived with their parents. Aguiar and Hurst (2005, 2009) argued that when non-durable expenditures are disaggregated into detailed consumption categories, work-related expenditures account for most of the decrease in consumption.

Along these lines, Hurd and Rohwedder (2003) suggested that the drop in consumption spending cannot be explained by the simple one-good life cycle model, with forward-looking consumers. Certain work-related consumption expenditures stop at retirement and market-purchased goods and services are substituted by household home production. Notably, long-term care services are often provided informally within families. We follow this argument and consider in our model that different baskets of goods are consumed in active life and retirement.

Against this background, to our knowledge, there has been no attempt to integrate in the life-cycle approach the provision of public health care together with old-age pension and longevity. We argue in this paper that their interaction can explain part of the gaps between life-cycle theory and some empirical facts. The fact that the bundle of consumption at old-age could be twisted towards heavily subsidised goods, such as health care, might decrease savings. To model these less explored relationships among saving determinants, we develop a two-period optimal consumption model, with social welfare transfers and longevity. To highlight the role of different social welfare regimes, we allow both for PAYG and fully-funded systems. The reduced-form estimates also consider other traditional determinants of savings, such as the Ricardian compensation between private and public savings.

The next section motivates the research by describing key empirical facts on age, consumption and welfare goods. Section 3 presents the life-cycle model. In section 4, we carry numerical simulations in order to confront our theoretical saving equation with country data and discuss the identification strategy for the econometric estimates. Section 5 presents econometric panel estimates that combine both the relationships derived from the

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3. Often referred in the literature as a possible ‘retirement-consumption’ puzzle.
theoretical framework, other additional effects and controls often used in the empirical literature. A final section concludes.

2. Key empirical facts on age, consumption and welfare goods

It is well-known that total consumption displays a hump-shaped profile across age-groups. This stylized fact is shown in Figure 1. To be precise, the consumption profile is hump-shaped across households headed by individuals belonging to different age groups. This is not equivalent to say that the consumption profile is hump-shaped over the life cycle mainly due to the possible existence of cohort and time effects. Nonetheless, Fernandez-Villaverde and Krueger (2007) 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. Therefore, the snapshot picture of total consumption per household by age-groups can approximate 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. 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 (Attanasio, 1999).

Household surveys can be used to relate the levels of household consumption to age groups for the US and several European countries.

[Figure 1. Age Consumption profile]

Household survey data also allows investigating the age-group specific composition of consumption expenditure by broad categories of goods and services. Figure 2 shows the relative level of consumption for main items and age groups for the US. Most expenditure items display a hump-shaped profile, with consumption level per capita increasing steadily with age, peaking at middle-age then decreasing. Only health consumption increases with age. The same profiles can be observed for other countries (cf. Oliveira Martins et al., 2005).

[Figure 2. Relationship between age and consumption by expenditure items in the US]

While health care is one the few consumption items increasing with age, it is also heavily subsidised. The shares of publicly provided health services to household income increased steadily since the 1970s (e.g. in France, Sweden, UK and USA, see Figure 3). By 2003, the ratios of public health expenditures to Household income ranged from 5-7% in UK and US to 10-15% in France and Sweden.

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4. Note that age by itself is not a major driver of health care expenditures, but other factors such as the proximity to death, the effects of income and technological progress. In contrast, the expenditures of long-term care are mainly determined by the age profile (see Oliveira Martins and de la Maisonneuve, 2006 for a discussion).
At the same time, average replacement rates also increased in most countries (Figure 4). For example, in France, Italy and Portugal they had reached close or above 80% by 2003. In US, starting from a lower basis they reached nearly 55%. Only in Sweden they have declined to around 55%. following pension reforms

3. Saving, Consumption after retirement and Longevity: a simple model

The most widely used framework to study the link between ageing, consumption and saving is the life cycle model (Modigliani and Brumberg, 1954; Ando and Modigliani, 1963; Friedman, 1957). In its simplest version, individuals live two periods. In the first period each person earns a wage from his/her labour supply and, in the second period, the person retires. Individuals save from their wage income to provide for the 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 from this framework is that the consumption is smoothed in the sense of holding marginal utility constant during the life: the individuals will save in order to transfer purchasing power to the period of the retirement.

To guide our investigation of the ageing-related facts described above, we develop a simple life-cycle model. Following Bohn (1999) and Chakraborty (2004), we consider a two-period overlapping generation’s model (hereafter, OLG) with a survival probability. This provides a tractable framework to think about the different determinants of savings at the individual level. Our aim is to consider the institutional settings of the welfare system after retirement and how they impact saving behaviour. Thus, we specify a simple model combining Pay-as-You-Go (PAYG), funded pension retirement incomes and welfare transfers (e.g., public health insurance). Each agent optimises her/his consumption and saving over the two periods. In the first period, each agent splits disposable wages $w_i$ into a bundle of consumption goods ($C_i$) and saving ($S_i$):

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

Where $\alpha$ is the rate of social contributions.

Following Hurd and Rohwedder (2003), we consider two different bundles of goods in active and retirement. This captures the change in the structure of consumption. In the

5. Average replacement rates are defined here as the ratio between average pension benefits to gross average wages. They were computed using the data OECD Pension and ADB databases.

bundle of goods \( (H_2) \) consumed in the second period certain goods such as health and long-term care would have a much stronger weight and could be highly subsidised.

To finance consumption in the second period, 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 welfare transfers \( T \) subsidising consumption. Note that the amount of savings accumulated for the second period has to be scaled down by the survival probability \( p_i \) (assumed to be strictly positive) given that when the latter increases, the consumption has to be spread over a longer retirement period, as follows: \(^8\)

\[
H_i = \beta w_i + \frac{(1+r)}{p_i} \cdot S_i + T_i \quad \text{with} \quad p_i > 0
\]

Note that this introduces uncertainty not on the age of retirement, but on its duration. This enables to focus on longevity effects and is a departure from standard two-period OLG models. By definition, the income from the PAYG system and the welfare transfers are not affected by changes in the longevity (at least at the individual level). Also note that we did not introduce a pure time-preference parameter because, under uncertainty, the survival probability captures the effect of the discounting parameter (see Chakraborty, 2004). \(^9\) To simplify, we omitted the index corresponding to the time period.

Solving for \( S_i \) in (2) and replacing into (1), we obtain the inter-temporal budget constraint:

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

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

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

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

First-order conditions imply that:

\[
\begin{align*}
    u'(C_i) &= \lambda_i \\
    u'(H_i) &= \lambda_i / (1+r)
\end{align*}
\]

\(^7\) This assumption does not entail a loss of generality in the model, as we could have introduced a composite consumption good in the form \( \delta \cdot C + (1-\delta) \cdot H \), with the weight \( \delta \) changing from period 1 to period 2.

\(^8\) Using a survival probability is identical to modelling the length of life in the retirement period. Note that this probability is an indication of life expectancy. By normalising the duration of one period to one, life expectancy is by definition \( 1+p \). For example, if period 1 is equal to 60 years and total life expectancy is 84, the survival probability in this context is \( 24/60 = 0.4 \).

\(^9\) See Bohn (2001) and Jensen and Jørgensen (2008) for an alternative specification.
Where $\lambda_i$ is the Lagrange multiplier associated with the budget constraint. Using these conditions we obtain the usual consumption-smoothing rule:

$$\frac{u'(C_i)}{u'(H_i)} = (1 + r)$$

(6)

As in Bohn (1999) and Chakraborty (2004), we assume thereafter that the $u(C) = \log(C)$ and idem for $H$. We then get a simple relation between $C_i$ and $H_i$:

$$H_i = (1 + r) \cdot C_i$$

(7)

Now replacing (7) into the budget constraint:

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

(8)

The optimal level of consumption in each period can be derived:

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

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

(9)

By using the expression for the optimal consumption above and equation (1), we derive the optimal gross saving rate in the first period:

$$s_i = \frac{S_i}{w_i} = \frac{p_i}{1 + p_i} \cdot \left[ (1 - \alpha) \cdot \frac{\beta + T_i \cdot w_i}{(1 + r)} \right]$$

(10)

The derivative the optimal saving ratio ($s$) vis-à-vis the survival probability has interesting properties, depending from key parameters characterising the benefit level of the welfare system.

$$\frac{\partial s_i}{\partial p_i} = \left[ \frac{1}{1 + p_i} \right]^2 \cdot \left[ (1 - \alpha) - \frac{\beta + T_i \cdot w_i}{(1 + r)} \right] \geq 0 \text{ if } \beta \leq (1 + r) \cdot (1 - \alpha) - T_i / w_i$$

(11)

An increase of the survival probability increases the saving ratio for small values of the replacement rate ($\beta$). This is the expected result, i.e. when an individual experiences a higher longevity he/she has to save more in order to ensure an adequate consumption level in the second period. For larger values of this parameter, the sign of the derivative is

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10. A log-utility implies homothetic preferences. Nonetheless, the main results of the model used in this paper derive from the existence of the conditional life expectancy and from the intertemporal budget constraint.
reversed and an increase in the survival probability induces a decrease in the saving ratio. From (11), with an interest rate equal to 3%, a contribution rate of 20% and the welfare transfers equivalent to 10% of the wage income, the threshold for change in the sign of the derivative is a replacement rate around 72%. With higher replacement rates, consumption smoothing requires higher consumption and lower or even negative saving during active life.\(^\text{11}\)

To some extent, variation in the welfare transfer ratio \((T/w_i)\) also induces a change in the sign of \(\partial s_i/\partial p_i\), but this would happen only for very large values of \(\beta\). Under the still high replacement rates prevailing in many OECD countries, our model can therefore provide an explanation for weak or negative effects of longevity on household saving. In other words, the so-called ‘longevity puzzle’ is actually not in contradiction with life-cycle theory.

The derivatives of the saving ratio \((s)\) vis-à-vis the other key parameters in the model are defined in a non-ambiguous way, as follows:

\[
\frac{\partial s_i}{\partial \beta} \leq 0; \quad \frac{\partial s_i}{\partial T_i} \leq 0; \quad \frac{\partial s_i}{\partial \alpha} \leq 0; \quad \frac{\partial s_i}{\partial r} \geq 0 \quad \text{and} \quad \frac{\partial s_i}{\partial w_i} \geq 0 \quad \text{(12)}
\]

The saving rate is expected to be a decreasing function of the replacement ratio, welfare transfers to older people and the rate of social contributions \((\alpha)\). In other words, the systems providing large transfers and generous retirement income (typically PAYG) are expected to have \textit{ceteris paribus} lower individual saving rates. Conversely, the saving ratio depends positively from income and the interest rate.

Assuming that all individuals are identical in each period, the social budget constraint associated with the equilibrium of the social welfare system can be written as follows:

\[
\sum_{i=1}^{N_i} \alpha \cdot w_i = \sum_{i=1}^{N_{\alpha}} \left(\beta \cdot w_i + T_i\right) \quad \text{(13)}
\]

Where \(N_Y\) is the total number of young (active) population and \(N_O\) is the number of retired people. Total population is \(N=N_Y+N_O\). From (13) one can derive the endogenous parameters ensuring the equilibrium of the welfare system in each period. The contribution rate satisfying the social budget constraint \((\tilde{\alpha})\) is:

\[
\tilde{\alpha} = \left(\frac{N_O}{N_Y}\right) \left(\beta + \frac{T}{w}\right) \quad \text{assuming that} \quad w_i = w \quad \text{and} \quad T_i = T \quad \forall i \quad \text{(14)}
\]

As it could be expected, the rate increases with the old-age dependency ratio \((N_O/N_Y)\). Following pension reforms, the system can also be adjusted through the replacement rate:

\[
\tilde{\beta} = \frac{\alpha}{N_O/N_Y} - \frac{T}{w} \quad \text{(15)}
\]

\(^{11}\) In the case where there is no perfect consumption smoothing, an increase of the replacement income could actually induce excess savings in the second period.
The replacement rate respecting the social budget constraint ($\tilde{\beta}$) decreases as the old-age dependency ratio increases. Another adjustment variable could be the welfare transfer $T$ (subsidising health consumption). It is likely that in the long-run the sustainability of welfare systems would entail a combination of these adjustment factors ($\alpha, \beta$ or $T$).

In order to derive the aggregate saving rate respecting the social budget constraint, we have to sum individual savings and adopt a sustainability rule for the welfare system. If we assume that the system is balanced through the contribution rates, parameter ($\alpha$) in equation (10) should be replaced by ($\tilde{\alpha}$) from equation (14). Given that savings in the second period are by definition zero, after some algebra we obtain an aggregate gross saving ratio:

$$\frac{S}{W} = \frac{\sum_{i=1}^{N_i} S_i}{\sum_{i=1}^{N_i} w_i} \cdot \frac{p}{1+p} \left[ 1 - \left( \beta + \frac{T}{w} \right) \left( \frac{N_2}{N_y} + \frac{1}{1+r} \right) \right]$$

assuming that $p_i = p$ \forall $i$ (16)

As suggested by life-cycle theory, the aggregate saving ratio is expected to be negatively related to the old-age dependency ratio.

4. Confronting theory with observation and identification strategy

It is likely that equation (16) does not capture all the factors influencing savings. To check for how far it can go in explaining household saving ratios, we carried out numerical simulations. The variables and parameters entering in the equation are derived from different data sources, as follows:

1. $S/W$: the ratio of household saving to income is our dependent variable.\footnote{12} To be coherent with the equation (16), this ratio should only include the saving and revenues from active population. Given that these data are not available, we simulated a gross household saving ratio vis-à-vis both household income.\footnote{13} All these variables were extracted from the OECD ADB Database.

2. $p/(1+p)$: As noted above, in the context of our two-period life-cycle model, the survival probability can be defined as the ratio of the numbers of years in retirement (period 2) to the numbers of years in active life (period 1). If we take the age of retirement at 60, then the term $p/(1+p)$ is equal to ratio of life expectancy at 60

\footnote{12} Household saving is defined here as household disposable income less consumption. Household income consists primarily of the compensation of employees, self-employment income, and transfers. Property and other income - essentially dividends and interest - are evaluated in the light of business income and debt interest flows. The sum of these elements is adjusted for direct taxes and transfers paid to give household disposable income. Note that SNA93/ESA95 has changed the concept of disposable income for households (compared with SNA68/ESA79) so as to include private pension benefits and subtract private pension contributions.

\footnote{13} The ratio to household income is in principle the best measure, although a potential problem is that it also includes the PAYG income. We also calculated the ratio vis-à-vis GDP. The results are quite similar and are available upon request.
divided by the life expectancy at birth. These variables were derived from the OECD Population database.

3. \( \beta \): The average replacement rate was calculated as the ratio between the average pension revenues to average wages, derived both from the OECD ADB and Pension Databases. This proxy is the only available for a large sample of countries and years.\(^{14}\)

4. \( T/w \): was estimated by the ratio of Public health expenditures to GDP. The health expenditures were obtained from the OECD Health database.

5. \( N_{o}/N_{y} \): is the old-age dependency ratio computed as old-age (60+) population divided by the population aged (25-59). Population data are derived from national statistical offices gathered in the OECD Population database.

6. \( r \): is the long-term real (representative) interest rate derived from the OECD ADB database.

For a number of selected OECD countries, Figure 5 compares the simulated household saving ratio with the observed ratio (computed vis-à-vis Household Income). Despite the fact that the saving equation embodies only a limited number of determinants and do not contains calibrated behavioral parameters,\(^{15}\) the saving equation (16) is able to replicate closely the observed saving ratio for a number of countries and years. Those include the level and the trend of household savings in Canada, Japan and Germany. In the US, the trend decline is relatively well replicated but there is a level difference. According to the equation, the level of US household saving should be on average around 4 percentage points above the actual one. For the UK, Denmark and Sweden, the equation is not able to track particular episodes of financial market turbulence, such as early 1990s and 2000s, but in more stable periods the tracking record is acceptable.

In other countries, large gaps can emerge. In Australia and Finland, for example, the equation tends to overestimate household savings (Figure 5). These countries have reformed their pension systems, which should increase in principle individual incentives to save.

![Figure 5. Observed and simulated aggregate household saving ratios](image)

In contrast, for France, Italy and Spain, the observed savings are much larger than the simulated ones. This is puzzling as these countries provide pension to full-career workers on average earnings close or above 70% and also have large public health coverage. According to the theory developed above this would tend to reduce savings.

These gaps suggest that the empirical test will have to control for other determinants. An explanation suggested in the literature is the compensation between private and public savings or the, so-called, Ricardian equivalence (Barro, 1974). When government budgets are running on debt or public pension systems are not sustainable, households anticipate a

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14. If systematic data existed, a better proxy could eventually be the replacement rate of the retiring cohort in each year.

15. This is the case in applied general equilibrium models.
required increase in future taxes and/or lower transfers and adjust upwards their savings. For a large panel of OECD countries, we observe indeed that the level of household savings is inversely correlated with the level of public deficits (Figure 6). This effect will be introduced in the econometric specification discussed below.

[Figure 6. Public budget balances and Household saving rates]

Another determinant not captured in our simple theoretical model, is the possibility for households to have positive savings after retirement. As suggested in the literature reviewed above, this could be due to habit persistence and/or deterioration in health conditions, making elderly people less able to spend as much as they would like to do. These excess savings are particularly observed under welfare systems with high pension replacement rates and health care provision (cf. Börsch-Supan et al., 2000, 2003) and could partly explain the under-estimation of aggregate savings by equation (16) in the second group of countries.

Other explanations have been found in the literature using microdata. For American households, Scholz et al. (2004) note that tax incentives, as IRAs and 401(k), may lead to excess savings. A largely evoked reason for saving at older ages has been the existence of bequests, but excess savings due to these motives seem limited (Caroll, 2000). In a recent paper, De Nardi et al. (2010) show that the risk of living longer increases uncertainty related to expensive medical care and income effects are significant. Both explain why the elderly could save after retirement.

To consider these facts and allow for old-age replacement rates to have an impact on excess savings, we will include in the econometric specification two interaction terms: i) between the replacement rates and the share of old population; ii) between the replacement rates and public health expenditure ratio.

5. Econometric estimates integrating the different determinants of savings

We will now combine both the determinants of the structural model and the additional explanatory variables discussed above in a reduced-form equation. In order to be able to estimate the interaction between the replacement rate and the demographic structure, we consider the share of both young and old people in the population (instead of using only the old-age dependency ratio). Overall, our specification accounts for a variety of saving determinants identified in the literature (e.g. Edwards, 1996; Loayza, Schmidt-Hebbel and Serven, 2000; Börsch-Supan and Lusardi, 2003, Murphy and Musalem 2004). The empirical model is specified as follows:

\[
\frac{S_{i,t}}{Y_{i,t}} = \alpha_0 + \alpha_1 \cdot BAL_{i,t} + \alpha_2 \cdot r_{i,t} + \alpha_3 \cdot PopY_{i,t} + \alpha_4 \cdot PopO_{i,t} + \alpha_5 \cdot TH_{i,t} + \alpha_6 \cdot RR_{i,t} + \alpha_7 \cdot RR_{i,t} \cdot \frac{60_{i,t}}{60_{i,t}} + \alpha_8 \cdot LE_{i,t} \cdot 60_{i,t} + \epsilon_{i,t} \tag{17}
\]

Where variables are defined as:

- \( BAL \) : Public budget balance (in % GDP)
\( r \): real interest rate, as defined above

\( PopY \): share of population 25-59 in total population

\( PopO \): share of population 60-99 in total population

\( TH \): Ratio of Public health expenditures to GDP, as defined above

\( RR \): Average replacement rate (in public and private pension systems), as defined above

\( RR \_PopO \): interaction term between the replacement rate and share of old-age population

\( RR \_TH \): interaction term between the replacement rate and Ratio of Public health expenditures to GDP

\( LE60 \): Ratio of life expectancy at 60 to life expectancy at birth, as defined above

\( \varepsilon \): is a normally distributed error term

A time trend was also introduced as an additional control for an eventual drift in the household saving rates.

The model was estimated in a unbalanced panel of 18 OECD countries,\(^{16}\) for which the data were the most complete over the period 1970-2003. Annex 1 provides descriptive statistics on the different variables used in the regressions. The estimates were carried out using country fixed-effects. To test for the robustness of the coefficients, we first estimated the model without the interaction terms and then introduced them step by step. Furthermore, we also tested additional specifications using the random-effects and the dynamic panel estimator of Arellano-Bond (1991).

The signs of estimated coefficients appear robust, basically confirming the results from the baseline specification (equation 17). Most estimated coefficients are significant and have the expected sign (Table 1). 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 compatible with the Ricardian equivalence, although the size of the estimated coefficient is below one indicating that there is no full compensation between public and private savings.\(^{17}\)

\textbf{[Table 1. Econometric estimates of household saving rate]}

In line with the life-cycle model, an increase in the share of old-age population (60-99 years) has a negative impact on the saving rate. Also in line with the theoretical model, the subsidisation of health goods impact negatively saving rates. Without the interaction terms (column 1, Table 1), the sign of the replacement rate is positive and significant. This could capture the fact that in our sample many PAYG countries display both high replacement and higher household savings, than countries with less generous pension systems. However, after the introduction of the interaction terms, the initial intuition is

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16. Australia, Austria, Belgium, Canada, Denmark, Germany, Finland, France, Italy, Japan, Netherlands, Norway, Poland, Portugal, Spain, Sweden, UK and the US.

17. This is line with other results in the empirical literature (e.g. Serres and Pelgrin, 2003; de Mello, Kongsrud and Price, 2004).
confirmed, i.e. the individual effect of the replacement rate on savings is negative and significant whereas the interaction with public health expenditure and the share of old-age population is positive. This suggests that the combination of high replacement rates, large shares of public health spending and old-age population could generate excess savings after retirement. If old-age consumers shift their consumption structure towards goods that are heavily subsidised and receive substantial retirement income, both a decline in consumption expenditures and a surplus of saving at older ages could indeed be observed.

The size effect of public health expenditures is large. An increase of one percentage point of public health spending to GDP induces on average almost a one-to-one decrease (0.95 percentage points) in the household saving rate.\textsuperscript{18} The combined marginal effect of the replacement rate is relatively smaller and actually slightly positive (0.15). These results point towards the importance of considering both the pension and health systems among the determinants of savings. As health care provision could have a significant impact on household savings, it should be taken into account when designing health care reforms.

The sign of the life expectancy ratio is negative and significant. This result is compatible with equation (16) above, as the sign of the survival probability on savings may be negative depending on the values of the other parameters defining the welfare system. Nonetheless, our reduced form model does not allow for a complete test of this effect, which would require further empirical investigation.

6. Concluding remarks

The main novelty of this paper is to integrate health system among the determinants of aggregate savings, together with pension replacement rates and longevity. Given that the consumption bundle of old-age individuals tends to be twisted towards health good and services, systems that provide a large subsidization of these goods tend to decrease household savings. This issue has been somewhat overlooked in the literature.

We developed a life-cycle theoretical model combining Pay-as-You-Go (PAYG), funded pension retirement incomes and welfare transfers (e.g. public health insurance) and derived an aggregate household saving equation. This equation was simulated numerically for a number of OECD countries. In many countries and years it provides a reliable benchmark (as it replicates closely the observed saving ratio), but it also suggests that other determinants of savings should be considered, such as public deficits and old-age excess savings. On this basis, we derive an identification strategy to specify a reduced-form econometric model.

Our results are significant and have the expected sign. They provide evidence that the changing structure of consumption with age, together with a large subsidy for health goods and increasing replacement rates can explain observed patterns of household savings. Taken alone, high replacement rates and large public provision of health care contribute

\textsuperscript{18}. These marginal effects were calculated using the baseline model (column 3, Table 1) and the average values for the replacement rate, public health expenditure ratio and share of old-age population given in Annex Table 1.
negatively to aggregate household savings. However, if old-age consumers shift their consumption structure towards goods that are heavily subsidised and receive substantial retirement income, this could induce both an observed decline of consumption and a surplus of saving at old ages. Confirming a Ricardian equivalence effect, we also found that public budget deficits (surplus) tend to increase (decrease) household savings.

The theoretical model developed in this paper provides an intuition why an increase in longevity may not led to increased saving incentives, but empirically this effect could not be disentangled from the other variables and is left for further research.

Our analysis highlights that both pension and health systems must be taken into account among the determinants of savings. As health care provision could have a significant impact on household savings, it should be taken into account when designing health and long-term care reforms.
References


Drouhin, Nicolas, 2000, « Statique Comparative du modèle de choix intertemporel avec durée de vie incertaine : le cas discret », Notes de Recherche du GRID, No. 00-20.


Figure 1. The Consumption-Saving profile

United States

European countries

Figure 2. Relationship between age and consumption by expenditure items in the US

NB: Consumption levels per capita in each age group are normalized at 100 to the under 25 years age group.
Figure 3. Ratio of Public Health Expenditures to Household income

Source: OECD Health and ADB databases.
Figure 4. Average Replacement rates (in %) in selected OECD countries

Source: OECD ADB data base and authors’ calculations.
Figure 5. Observed and simulated aggregate household saving ratios (in household income) for selected OECD countries
Figure 5. Observed and simulated aggregate household saving ratios (in household income) for selected OECD countries (cont’d)
Figure 6. Public budget balances and Household Saving rates

Legend: SAV: household saving rates (in % of Household income); BAL: Public budget balance (in % of GDP).
Source: OECD National Accounts and ADB database.

(1) The sample corresponds to 23 OECD countries for the period 1970-2003 (depending on the availability of data).
### TABLE 1. Econometric estimates of household saving rate\(^1\) (1970-2003, 18 OECD countries)

<table>
<thead>
<tr>
<th></th>
<th>Fixed-effects (1)</th>
<th>Fixed-effects (2)</th>
<th>Fixed-effects (3)</th>
<th>Random-effects (4)</th>
<th>Dynamic GMM (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lagged saving ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.527***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(11.78)</td>
</tr>
<tr>
<td>Public budget balance</td>
<td>-0.686*** (-7.684)</td>
<td>-0.621*** (-7.171)</td>
<td>-0.610*** (-7.161)</td>
<td>-0.638*** (-7.352)</td>
<td>-0.250*** (-3.798)</td>
</tr>
<tr>
<td>Real interest rate</td>
<td>0.174* (1.859)</td>
<td>0.122 (1.351)</td>
<td>0.200* (2.154)</td>
<td>0.159* (1.691)</td>
<td>0.198*** (2.843)</td>
</tr>
<tr>
<td>Share of pop 25-59</td>
<td>0.161 (0.508)</td>
<td>0.308 (1.013)</td>
<td>-0.0271 (-0.0845)</td>
<td>0.591** (2.192)</td>
<td>-0.0986</td>
</tr>
<tr>
<td>Share of pop 60-99</td>
<td>-0.748*** (-3.422)</td>
<td>-0.668*** (-3.186)</td>
<td>-2.581*** (-3.767)</td>
<td>-1.443** (-2.432)</td>
<td>-1.417** (-2.427)</td>
</tr>
<tr>
<td>Public health exp. ratio</td>
<td>-1.461*** (-3.130)</td>
<td>-7.261*** (-5.427)</td>
<td>-5.273*** (-3.563)</td>
<td>-6.092*** (-4.216)</td>
<td>-4.565*** (-4.093)</td>
</tr>
<tr>
<td>Replacement rate</td>
<td>0.144*** (2.999)</td>
<td>-0.547*** (-3.479)</td>
<td>-0.889*** (-4.588)</td>
<td>-0.783*** (-4.110)</td>
<td>-0.790*** (-4.464)</td>
</tr>
<tr>
<td>Replacement rate* Public health exp. ratio</td>
<td>--</td>
<td>0.122*** (4.599)</td>
<td>0.0821*** (2.797)</td>
<td>0.0960*** (3.385)</td>
<td>0.0887*** (4.017)</td>
</tr>
<tr>
<td>Replacement rate*Share of pop 60-99</td>
<td>--</td>
<td>--</td>
<td>0.0349*** (2.927)</td>
<td>0.0216** (2.065)</td>
<td>0.0212** (2.113)</td>
</tr>
<tr>
<td>Ratio Life exp. 60/Life exp. birth</td>
<td>-249.8*** (-2.755)</td>
<td>-168.5* (-1.903)</td>
<td>-170.2* (-1.955)</td>
<td>-154.3** (-2.085)</td>
<td>-8.651 (-0.140)</td>
</tr>
<tr>
<td>Time trend</td>
<td>0.185 (1.220)</td>
<td>0.0452 (0.305)</td>
<td>0.148 (0.989)</td>
<td>-0.0542 (-0.427)</td>
<td>0.0210</td>
</tr>
<tr>
<td>Constant</td>
<td>76.34** (2.546)</td>
<td>82.08*** (2.858)</td>
<td>115.4*** (3.792)</td>
<td>74.31*** (2.784)</td>
<td>54.95** (2.493)</td>
</tr>
</tbody>
</table>

| Observations | 245 | 245 | 245 | 245 | 215 |
| R-squared (within) | 0.426 | 0.477 | 0.497 |
| Number of countries | 18 | 18 | 18 | 18 | 18 |
| F-test | 20.3 | 22.1 | 21.4 | -- | -- |
| Wald-test | -- | -- | -- | 194.9 | 616.9 |
| Hausman test | 36.7 | (0.0) |

---

(1) Defined as household saving on household income. 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-value in parenthesis indicate the fixed-effect cannot be rejected at 95% confidence level).
### Annex 1: Descriptive statistics of the variables used in the econometric estimates

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs.</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household saving ratio</td>
<td>612</td>
<td>10.08</td>
<td>6.26</td>
<td>-12.82</td>
<td>30.23</td>
</tr>
<tr>
<td>Public budget balance</td>
<td>529</td>
<td>-2.78</td>
<td>3.45</td>
<td>-16.38</td>
<td>7.84</td>
</tr>
<tr>
<td>Real interest rate</td>
<td>599</td>
<td>3.05</td>
<td>3.64</td>
<td>-17.82</td>
<td>14.25</td>
</tr>
<tr>
<td>Share of pop 25-59</td>
<td>507</td>
<td>46.08</td>
<td>2.89</td>
<td>37.44</td>
<td>51.79</td>
</tr>
<tr>
<td>Share of pop 60-99</td>
<td>522</td>
<td>16.76</td>
<td>3.10</td>
<td>10.53</td>
<td>24.85</td>
</tr>
<tr>
<td>Public health exp. Ratio</td>
<td>608</td>
<td>5.53</td>
<td>1.26</td>
<td>1.51</td>
<td>8.77</td>
</tr>
<tr>
<td>Replacement rate</td>
<td>392</td>
<td>52.61</td>
<td>13.78</td>
<td>28.78</td>
<td>89.87</td>
</tr>
<tr>
<td>Replacement rate*Pop 60-99</td>
<td>355</td>
<td>929.74</td>
<td>347.44</td>
<td>369.78</td>
<td>2007.54</td>
</tr>
<tr>
<td>Replacement rate* Public health exp. ratio</td>
<td>356</td>
<td>307.63</td>
<td>101.83</td>
<td>87.50</td>
<td>591.19</td>
</tr>
<tr>
<td>Ratio Life exp. 60/Life exp. birth</td>
<td>681</td>
<td>0.26</td>
<td>0.01</td>
<td>0.23</td>
<td>0.30</td>
</tr>
</tbody>
</table>