The Impact of Later Retirement Ages on Aggregate Household Savings and Saving Rates: An Analysis of OECD Countries

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THE IMPACT OF LATER RETIREMENT AGES ON AGGREGATE HOUSEHOLD SAVINGS AND SAVING RATES: AN ANALYSIS OF OECD COUNTRIES

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Abstract

As a result of population aging, governments of many OECD countries have begun to implement policies to increase average retirement ages in an attempt to alleviate some of the financial strain in supporting retirees. This paper explores the effect that later retirement ages have on aggregate household saving rates, both on a theoretical and empirical level. Using a two-wave panel of OECD countries, the results show that later retirement ages have the effect of decreasing aggregate household saving rates. We show that it is likely that this corresponds to a decrease in household saving. In addition, it appears that it is increases in female retirement ages that is driving this result.

JEL Classification: E21, J26

Keywords: retirement age, saving, life-cycle model

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1 Introduction

In recent years, governments of many developed countries have gradually started implementing policies to increase the average age of retirement in an attempt to combat the economic problems associated with population aging. Population aging is a result of an increase in life expectancy coupled with a decrease in the fertility rate, causing the median age of the population to rise. With a considerable increase in the proportion of the retired population relative to the working population, governments are becoming increasingly concerned as to how they will be able to support future retirees. This concern is exacerbated by the retiring baby boomers, who will now put extra strain on public pension systems. One policy to increase the average retirement age is for the government to increase the Normal Retirement Age (NRA)[1]. As such, the trend of rising NRAs in developed countries seen thus far is set to continue well into the future, with many countries across the world expected to follow in the same direction. The most recent announcements to raise the Normal Retirement Age have come from France, Greece and Spain, where such announcements have been met by much opposition by citizens.

An important consequence of increasing retirement ages that has been overlooked both theoretically and empirically is how it affects a country's aggregate household savings. In essence, aggregate savings reflect the ability of a country to accumulate capital and are, therefore, a critical determinant of economic growth. The impact of an increase in the retirement age on aggregate household savings has two opposing effects, namely the compositional effect and the behavioral effect. The compositional effect is based on the age structure of the population which is measured using a dependency ratio (a ratio of the non-working to the working population)[2]. It follows that, for a given life expectancy, a rise in the retirement age will decrease the proportion of the non-working population to the working population, thus increasing the ratio of those individuals who save relative to those who dissave, causing aggregate savings to rise. On the other hand, with an increase in the retirement age, individuals will have a longer working life. Since there will be less years spent in retirement, the behavioral effect suggests that younger individuals will not need to save as much for their future retirement years. The implication would be a decrease in aggregate household savings.

The purpose of this paper, therefore, is to provide a novel investigation into the relative strengths of the two effects, thereby contributing to the literature, both theoret-

[1] This is the age at which individuals are eligible to receive full social security retirement benefits.

[2] For example, the dependency ratio for a retirement age of 65 is defined as:

$$\frac{\text{(people aged 0 to 14)+(people aged 65+)}}{\text{(people aged 15 to 64)}}$$

ically and empirically, on the impact that later retirement ages have on both aggregate household savings and saving *rates*. Over the last thirty years, aggregate savings have been decreasing in many developed countries. Various studies have surfaced that have tried to link changes in aggregate savings to changes in the fertility rate and longevity (cf., e.g., Kelley and Schmidt, 1996; Sheshinski, 2006a, 2006b; Lee, Mason and Miller, 2000). None of these studies, however, have dealt with the effect that the fairly recent increase in retirement dates could have on this trend in aggregate savings.

To deal with the potential endogeneity problem that may exist between average retirement dates and savings, the average retirement age is instrumented with the NRA since it is exogenously set by the government. The investigation is based on a short, two-wave panel of OECD countries. Since NRAs do not change much from year to year, the first 1990 wave and second 2006 wave are chosen in order to exploit some time variation in the retirement age.

The rest of this paper is structured as follows. Section two provides an overview of the trend in retirement ages in OECD countries. Section three provides an overview of the relevant life-cycle literature. In section four we develop a simple theoretical model of the effect of the retirement age on aggregate savings and saving rates. Section five provides a discussion of the data. This is followed by regression analysis in section six, while section seven concludes the paper.

2 Trends in Retirement Ages

Labor force participation rates of older individuals in many OECD countries have been increasing since the late 1990's. This comes after a decrease in such rates for men through most of the 20th century[3]. Blau and Goodstein (2010) suggest that increasing labor force participation rates of older individuals is a result of changes in the composition of the older male population, away from high school dropouts and toward college graduates. Other factors cited by authors as influencing the increasing labor force participation of older individuals include the movement away from defined-benefit pension plans, which tend to incentivize early retirement, to defined contribution plans which are more age neutral. Schirle (2008) found that about one quarter of the increase in older male participation could be accounted for by the growth in the participation of older wives, since to a large extent working husbands and wives tend to retire at the same time. Most importantly, however, in an attempt to keep their public pension systems solvent, governments have instituted policies to increase average retirement ages. One such policy

[3]The participation rate for older women did not follow such a downward trend through this time, since overall participation rates for women were increasing.

is to increase the Normal Retirement Age (NRA). The Normal Retirement Age is defined as the age at which a person is eligible to receive full pension benefits without facing early retirement penalties. Many OECD countries have announced their intention to, or have already, increased their NRAs since the mid 1990s. Hungary, Italy, and the United States are just a few examples of countries where the NRA has already increased. Some countries, such as Australia, Portugal and Switzerland, have raised only the female NRA, leaving the NRA for males unchanged. Although these trends are still relatively new, many countries are set to see even more significant changes in the future. Starting from April 2010, the NRA for women in the UK started increasing from age 60, and is set to reach age 65 by 2018, at which point it will be in line with that of men. At that point both the male and female NRA will start increasing further, reaching age 68 by 2046. Starting from 2024, Austria plans to raise the NRA for women from 60 to 65 by 2033. By 2027 and 2029, Denmark and Germany, respectively, intend on increasing the retirement age for both men and women from the current age of 65 to 67. These changes are set to start in 2024 and 2012, for the two countries respectively. In 2013, South Korea's current NRA of 60 will rise to 61, thereafter increasing by one year every five years until it reaches age 65. The most recent announcements have come from France, Greece and Spain, where the announcement to raise the Normal Retirement Age from 65 to 67 has been met with much opposition, culminating in violent protests.

3 The Life-Cycle Theory of Consumption and Saving: The Behavioral versus the Compositional Effect

To fully comprehend the effect of the trend in retirement ages on aggregate savings it is necessary to understand the saving behavior of individuals over their lifetime. Harrod's (1948) 'hump-savings' model formed an important basis for the two most fundamental life-cycle models of saving. Proposed by Modigliani and Brumberg (1954) and Friedman (1957), the essence of these two models is that rational individuals dislike volatility and thus attempt to smooth their consumption over their lifetime when faced with predictable variations in their expected lifetime income. Based on the assumption of perfect capital markets, individuals borrow during the early years of their lives, when their permanent income is lowest, followed by a period of higher earnings to pay off any accrued debt and to save for retirement. Individuals then retire and live off their accumulated savings. In this way individuals have a hump-shaped saving profile that is dependent on age, whereby they dissave in their early and retirement years and save during their productive working years.

Furthermore, since the standard life-cycle model does not make any allowances for bequests, and since individuals are assumed to have perfect knowledge about the future, the model predicts that wealth will be exhausted by the end of the life-cycle. This has important implications for aggregate savings in that, absent income and population growth, the savings of the working citizens together with the dissavings of the non-working citizens of a country will be zero. The model thus predicts that aggregate savings can become negative (positive) if the proportion of the non-working population is greater (less) than the working population (cf., Ando and Modigliani, 1963). As mentioned earlier, the proportion of the non-working to the working population is measured via the dependency ratio. Consequently, any changes to this ratio will have an impact on aggregate savings. More specifically, an increase (decrease) in the dependency rate will result in a decrease (increase) in aggregate savings due to a higher (lower) number of individuals in the population that dissave. Three factors influence the dependency ratio, namely: fertility, longevity and retirement ages. While the effect of changes in fertility and longevity on aggregate savings has already been analyzed in various papers, the effect of changes in the retirement age has not, as yet.

In light of the population aging problem that many countries— particularly developed countries— have been experiencing, a significant amount of research has surfaced regarding the impact of rising longevity and falling fertility rates on the dependency ratio and, hence, aggregate savings. Ceteris paribus, an increase in life expectancy will increase the number of dependents aged 65 and above, causing the dependency ratio to rise, while a decrease in the fertility rate will lower the number of dependent individuals aged 0-14, causing the ratio to fall at first. However, a continued decline in population growth resulting from falling fertility will eventually filter through, causing the proportion of individuals aged 65 and above to rise. The overall impact is an increase in the dependency ratio as the rising dependent population above age 65 outweighs the falling population aged 0-14. In general, fertility rates and longevity do not change at the same time (An and Jeon, 2006), therefore, the rate at which a country's dependency ratio changes will depend on how far along the population is in the aging process. On the whole, however, the future sees ever increasing dependency ratios for most regions of the world (IMF, 2004).

Possibly the most influential empirical work regarding the effect of the dependency ratio on aggregate savings is that by Leff (1969). In his study he keeps longevity constant, focusing instead on how a decline in the fertility rate affects the dependency ratio and, hence, aggregate savings. Based on a cross-section of 74 countries, Leff finds a statistically significant negative relationship between the dependency ratio and aggregate savings. This result is intuitive as a rise in the dependency ratio means that there is an increase in the number of dissavers in the population relative to the savers, thus resulting in a decrease in aggregate saving.

Leff's results were heavily criticized at first, particularly regarding his methodology (cf., Goldberger, 1973; Gupta, 1971; Ram, 1982). In replies to his critics, Leff (1971, 1973, 1984) provided conclusive reasoning and evidence to support the results of his original paper. Subsequent research has come to the same conclusions as Leff, supporting the notion that increases in the dependency ratio, due to falling fertility rates, are significantly and negatively related to aggregate savings (cf., e.g., Fry and Mason, 1982; Kelley and Schmidt, 1996; Williamson and Higgins, 1997)

Studies that keep the fertility rate constant, focusing instead on the effect of longevity on aggregate savings, identify two opposing effects, namely the behavioral effect and the compositional effect. The compositional effect simply implies that increases in longevity will result in a higher proportion of individuals aged 65 and above in the population. This will cause the dependency ratio to rise, thus decreasing aggregate savings. On the other hand, the behavioral, or life-cycle, effect means that more years will be spent in retirement due to a higher life expectancy. Since individuals are rational, it is reasonable to assume that they will adjust their lifetime consumption-saving decisions to account for these extra years of life. In this instance, the standard life-cycle model predicts that individuals will reduce consumption in all periods, thereby increasing personal as well as aggregate savings. The net impact on aggregate saving thus depends on which effect is dominant. Several empirical studies have shown that the behavioral effect is dominant, (see, for example, Bloom et al. (2003); Lee et al. (2000); Tsai et al (2000); Kinugasa and Mason, (2007)). However, Li et al. (2007) find that the behavioral effect is almost the same as the compositional effect resulting in a possible net effect of zero.

However, as spoken about in the previous section, this increase in longevity has been accompanied— in many countries— by an increase in average retirement ages. The contribution of this paper, both theoretical and empirical, is to study the effects of changes in the retirement age on aggregate household savings and saving rates. As in the context of longevity, we find it fitting to identify both a behavioral effect and a compositional effect when regarding the effect of changes in retirement dates. The compositional effect refers to the fact that with an increase in the retirement age, the proportion of the non-working to the working population will decrease causing the dependency ratio to fall, thus resulting in a rise in aggregate household savings. The opposing life-cycle (or behavioral) effect, on the other hand, suggests that an increase in the retirement age leads to an increase in the number of years spent working. Since there will be less years spent in retirement, individuals will not need to save as much for their future years of dissaving, thereby lowering aggregate household savings. In addition, in the case of increasing retirement ages, there is also likely to be a non-trivial effect on aggregate household income, rendering the effect on aggregate savings and saving *rates* different. The purpose of this paper is to disentangle these effects, both on a theoretical and empirical level.

4 A Simple Theoretical Model of Aggregate Savings and Saving Rates

4.1 Microeconomic Foundation

We consider a deterministic model in which we have a rational representative agent whose aim is to maximize lifetime utility. We assume that the agent lives till (and including) period T. Within this period he will spend a certain amount of time working full time and the rest of the time in retirement, during which time he will live off savings accumulated during his working years and social security (and/or private pension) income. We assume that in order to maintain his lifestyle post retirement, savings are necessary to supplement social security/pension income. A further assumption is that the agent does not face any liquidity constraints in that he is able to borrow against future income.

The agent's aim at any time t is to maximize utility as follows:

$$\max_{(c_t \dots c_T)} \sum_{k=t}^{T} \beta^{k-t}(u(c_k)) \tag{1}$$

where, c_k is consumption in time period k, $u(c_k)$ is the instantaneous utility function in time period k, and β is the discount factor $= \frac{1}{1+\rho}$, where ρ is the rate of time preference.

The dynamic budget constraint at any time t is given by:

$$\begin{aligned} x_t &= (x_{t-1} - c_{t-1}) \cdot R + y_t \\ &= a_t \cdot R + y_t \end{aligned} \tag{2}$$

where x_t is "cash on hand"; R is the fixed gross return on assets, a_t, and is equal to $(1 + r)$, where r is the interest rate common to borrowing and lending; and y_t is non-capital income. We assume, further, that

$$y_t = \begin{cases} I_t \text{ if } t < t_{\mathrm{Ret}} \\ i_t \text{ if } t \geqslant t_{\mathrm{Ret}} \end{cases} \tag{3}$$

where I_t is labor income, and i_t is social security/pension income. We assume $I_t > i_t$.[4]

Human capital wealth, h_t, is the sum of discounted non-capital income and is given by

$$
\begin{aligned}
h_t &= \sum_{k=t+1}^{T} y_k \cdot R^{-(k-t)} = \frac{h_{t+1} + y_{t+1}}{R} \\
&= \sum_{k=t+1}^{t_{\mathrm{Re}\,t}-1} I \cdot R^{-(k-t)} + \sum_{k=t_{\mathrm{Re}\,t}}^{T} i \cdot R^{-(k-t)} \qquad (4)
\end{aligned}
$$

Finally,

$$w_t = x_t + h_t \qquad (5)$$

where w_t is total worth at time t, and evolves according to the following equation:

$$w_t = (w_{t-1} - c_{t-1}) \cdot R \qquad (6)$$

We also have

$$\sum_{k=t}^{T} \frac{c_k}{R^{k-t}} = w_t \qquad (7)$$

with terminal condition

$$w_{T+1} = 0 \qquad (8)$$

That is, the present value of all future consumption must equal total wealth, and further, the binding constraint in equation 7 and terminal condition given by equation 8 imply that all wealth must be consumed by the time the agent dies[5].

The utility maximization problem, from the perspective of any time period, t, subject to the proceeding budget constraint, can be written as the following standard dynamic programming problem

$$J(a_t, I, i,\ t_{ret}) = \max_{(c_t \dots c_T)} \sum_{k=t}^{T} \beta^{k-t}(u(c_k)) \qquad (9)$$

where $J(a_t, I, i, t_{ret})$ is the value function, which depends on assets, a_t, pre retirement income, I, post retirement social security/pension income, i, and the date of retirement.

In Romm, 2012, we show that the solution to the above maximization problem is given by

[4] This assumption is certainly valid in the context of most OECD countries where the old age pension is earnings related, i.e., the old age pension replaces a *percentage* of pre-retirement income.

[5] For the purpose of this model, we abstract from the bequest motive.

$$c_t = \left(\frac{R^{T-t}}{\sum_{j=0}^{T-t} (\beta R)^{\frac{j}{\theta}} \cdot R^{T-t-j}} \right) \cdot w_t \tag{10}$$

with the marginal propensity to consume out of total worth equal to $\left(\frac{R^{T-t}}{\sum_{j=0}^{T-t} (\beta R)^{\frac{j}{\theta}} \cdot R^{T-t-j}} \right)$.

4.2 Effect of an Increase in the Retirement Age

4.2.1 Short Term effect

Behavioral Effect on Household Saving The actual increase in the retirement age is usually preceded by the expectation of such. A government will announce a policy that will result in retirement ages increasing, starting from a specified date in the future. At the point of the announcement there is likely to be a behavioral effect on the part of younger individuals who will be affected by this change.

Proposition 1 *Suppose at time t_0, a policy is announced, to take effect from time period t_5, that will result in average retirement dates increasing from that point. Suppose this causes the representative agent, i, to increase his expected retirement age at time t_0 from age^1_{ret} to age^2_{ret}. The Behavioral effect of this anticipated increase at time t_0 can be expressed as* [6]

$$\frac{\Delta s_{it_0}}{\Delta age_{ret}} < 0 \qquad \forall\ i \text{ where } age_{it_0} \leq age^1_{ret} - 5 \tag{11}$$

Proof. ■

From equation 10

$$c_{it_0} = \left(\frac{R^{T-t_0}}{\sum_{j=0}^{T-t_0} (\beta R)^{\frac{j}{\theta}} \cdot R^{T-t-j}} \right) \cdot w_{it_0} \tag{12}$$

Now,

$$\frac{\Delta w_{it_0}}{\Delta age_{ret}} > 0 \qquad \forall\ i \text{ where } age_{it_0} \leq age^1_{ret} - 5 \tag{13}$$

so that

$$\frac{\Delta c_{it_0}}{\Delta age_{ret}} > 0 \qquad \forall\ i \text{ where } age_{it_0} \leq age^1_{ret} - 5 \tag{14}$$

[6] We use the Δ notation instead of the derivative notation since we assume discreet values for age_{ret}.

Now,

$$s_{it_0} = y_{it_0} - c_{it_0} \tag{15}$$

where y_{it_0} is current income (i.e. income of individual i in period t_0)
Thus, for a given y_{it_0}, an increase in c_{it_0} implies a decrease in s_{it_0}.

■

Now aggregate savings at time t_0, can be defined as:

$$AS_{t_0} = \sum_{i=1}^{z} s_{it_0} \tag{16}$$

for z individuals in the population.
The behavioral effect implies

$$\frac{\Delta AS_{t_0}}{\Delta age_{ret}} < 0 \tag{17}$$

since

$$\frac{\Delta AS_{t_0}}{\Delta age_{ret}} = \sum \left(\frac{\triangle s_{it_0}}{\Delta age_{ret}} \right) \forall\ i \text{ where } age_{it_0} \leq age^1_{ret} - 5 \tag{18}$$

Effect on the Aggregate Household Saving Rate The aggregate household saving rate at any time t_0, $ASrate_{t_0}$, can be expressed as

$$\frac{AS_{t_0}}{\sum_{i=1}^{z} y_{it}} \tag{19}$$

Since there is no change in $\sum_{i=1}^{z} y_{it_0}$, we have the following proposition:

Proposition 2 *The implication of the behavioral effect on the aggregate household saving rate at time t_0 an be expressed as*

$$\frac{\Delta ASrate_{t_0}}{\Delta age_{ret}} < 0 \tag{20}$$

4.2.2 Medium Term Effect

We assume the new retirement age is instituted at time t_5. At this point, in addition to the behavioral effect, the compositional effect comes into play.

Effect on Household Saving

Proposition 3 *The compositional effect of an increase in the retirement age from age^1_{ret} to age^2_{ret}, at time period t_5, can be expressed as follows:*

$$\frac{\Delta s_{it_5}}{\Delta age_{ret}} > 0 \qquad \forall\ i \text{ where } age^1_{ret} \leq age_{it_5} < age^2_{ret} \tag{21}$$

Proof. ■

$$\frac{\Delta y_{it_5}}{\Delta age_{ret}} = (I - i) > 0 \qquad \forall\ i \text{ where } age^1_{ret} \leq age_{it_5} < age^2_{ret} \tag{22}$$

Now,

$$\frac{\Delta s_{it5}}{\Delta age_{ret}} = \frac{\Delta y_{it_5}}{\Delta age_{ret}} - \frac{\Delta c_{it_5}}{\Delta age_{ret}}\ \forall\ i \text{ where } age^1_{ret} \leq age_{it_5} < age^2_{ret} \tag{23}$$

where, due to consumption smoothing behavior

$$\frac{\Delta y_{it_5}}{\Delta age_{ret}} > \frac{\Delta c_{it_5}}{\Delta age_{ret}} \tag{24}$$

We thus have a positive effect on savings at time t_5 for this age group. ■

Remark 1 *The behavioral effect at t_5 remains for individuals whose $age_{it_5} < age^1_{ret}$.*

The overall net effect of an increase in the retirement age on AS_{t_5} can be expressed as:

$$\frac{\Delta AS_{t_5}}{\Delta age_{ret}} = \sum \left(\frac{\Delta s_{it_5}}{\Delta age_{ret}} \right) \forall\ i \text{ where } age_{it_5} < age^2_{ret} \tag{25}$$

and will thus depend on whether the behavioral or compositional effect is dominant.

Effect on the Aggregate Household Saving Rate While we have already noted that the effect of an increase in age_{ret} on AS_{t_5} is theoretically ambiguous, we know from the proceeding discussion that the effect of this increase will certainly result in an increase in $\sum_{i=1}^{z} y_{it_5}$.

Proposition 4 *The medium term effect of an increase in the retirement age on the aggregate household saving rate, is negative when the behavioral effect dominates, and ambiguous when the compositional effect dominates. When the compositional effect dominates, the effect on the aggregate household saving rate depends on the relative magnitudes of the increases in AS_{t_5} and $\sum_{i=1}^{z} y_{it_5}$.*

More specifically, an increase in the aggregate household saving rate would require a very strong compositional effect.

4.2.3 Long Term Effect

As time goes on, the cohort of individuals affected by the later retirement date and hence greater lifetime incomes start entering retirement. The behavioral effect is now present both in younger generations still anticipating retirement, and in older generations.

Proposition 5 *The behavioral effect at time $t_{(5+h)}$ of an increase in the retirement age instituted at t_5 can be expressed as*

$$\frac{\Delta c_{it_{(5+h)}}}{\Delta age_{ret}} > 0 \qquad \forall\ i \text{ where } age_{it_{(5+h)}} \leq age_{ret}^2 + h \text{ , for } h = (1, ..., T - age_{ret}^2) \tag{26}$$

such that

$$\frac{\Delta s_{it_{(5+h)}}}{\Delta age_{ret}} < 0 \qquad \forall\ i \text{ where } age_{it_{(5+h)}} \leq age_{ret}^2 + h \text{ , for } h = (1, ..., T - age_{ret}^2) \tag{27}$$

Thus as time goes on and $h \to T - age_{ret}^2$, the behavioral effect extends to a greater portion of the population, and thus becomes stronger. In the end, as the effect of the later retirement date has worked its way through an entire life-cycle, and now affects all age groups in the population, it is very likely that the behavioral effect outstrips the compositional effect. At this point we would expect both aggregate household savings, and the aggregate household saving rate to decrease as a result of the increase in the retirement age.

5 Data

5.1 Overview

The dataset used to investigate the impact that later retirement ages have on aggregate saving rates is comprised of a short, two-wave, balanced panel of 28 OECD countries (Luxembourg and Turkey are excluded due to missing data).

Because a potential endogeneity problem may exist between aggregate savings and the average retirement age (an issue that will be discussed in more detail in the next section), the NRA will be used as an instrument for the average retirement age. In light of the fact that the NRA in countries changes very gradually– if at all—, two waves are chosen in such a way so as to allow for some observable change in both average and normal retirement ages. As such, the first 1990, and second, 2006, waves are selected to capture this time variation, in addition to any cross-sectional variation.

The dependent variable in our analysis is the aggregate household saving rate. Due to data limitations we only have information on the saving *rate*, not aggregate household saving (in absolute terms). Since we cannot directly observe household saving, we study household saving *rates* (which is of interest in its own right), and from here, proceed to make some inferences about household saving. The data is obtained from two major sources, namely the OECD statistics database and the World Bank's World Development Indicators. Where data is unavailable, we refer to the relevant country's national statistics database.

5.2 Trends in Average and Normal Retirement Ages

Of the 28 OECD countries in the dataset, 19 countries showed an increase in their average retirement age[7] between 1990 and 2006.

In terms of the instrument, ten countries have increased their NRAs between 1990 and 2006 (These are: Australia, Belgium, Czech Republic, Hungary, Italy, New Zealand, Portugal, Slovak Republic, Switzerland and the United States). Of these countries, Australia, Belgium, Portugal and Switzerland increased only the NRA of females, leaving the male NRA unchanged, while the rest changed both their male and female NRAs. Denmark and Ireland are the only two countries that have decreased their NRAs over the same period. While Denmark has already announced its intention to increase its NRA between 2024 and 2027, nothing has been mentioned by Ireland's government as yet. While the NRA of all other countries remained unchanged during this period, as discussed earlier, many will experience increases in the future.

Further, of the ten countries that have increased their NRAs between 1990 and 2006, seven have also had increases in their average retirement ages. Thus, while the NRA is likely to influence when individuals actually retire, i.e., the average retirement date, it is far from the only determinant, making it a likely candidate to act as an instrument for the average retirement age.

Since the changes in the retirement ages considered are those that have already come into practice (i.e., are not just expected to be instituted at some future date), the time frame considered in this analysis is not the short-run. While cross-sectional variation might reflect a long-term effect, the variation in retirement dates within countries between 1990 and 2006 are more likely to reflect a medium to long-term effect, with the changes having occurred closer to 2006 than to 1990. Thus, individuals being affected by the new retirement age would have spent at most a few years in retirement, with the change not yet having filtered through the entire life-cycle.

[7] Combined male and female average retirement age.

5.3 Descriptive Statistics

Table 1 and Figure 1 show the relationship between the average (ARA) and normal retirement ages (NRA) for males and females. Both quite clearly illustrate that higher NRAs are generally associated with higher average retirement ages.

The data suggests that a possible negative relationship exists between later retirement ages and the aggregate household saving rate. Figure 2 illustrates graphically. The average retirement age in this case is taken as the average of the male and female average retirement ages in each country, and is plotted against the aggregate household saving rate. While graphically there appears to be a weak negative association between the two variables, regression analysis is necessary to confirm any causal relationship.

We have already discussed theoretically how the average retirement age would affect the household saving rate. However, an endogeneity problem may exist in that an individual's optimal retirement age depends on a range of factors, one of which is his level of savings. In this way, the aggregate household saving rate depends on the average retirement age, and the average retirement age, in turn, depends on the aggregate household saving rate. In order to alleviate the potential endogeneity problem and extract any causal effect, we use the Instrumental Variable technique, instrumenting the average retirement age with the NRA. Since the NRA is exogenously set by governments when considering the solvency of their old age pension, it is unlikely to be determined by household savings. We will speak more about the Instrumental Variable technique, and the appropriateness of the instrument in section 6.2.

Figure 3 plots the aggregate household saving rate (AS_{rate}) against the NRA (an average of the male and female NRA). Here we see a distinct negative relationship. Table 2 shows this relationship further.

6 Regression Analysis: Methodology and Results

6.1 OLS Regression

The first regression model to be tested is specified below. It is a simple pooled OLS model that serves as a basis of comparison for other models.

$$y_i = a_0+a_1x_{1i}+a_2x_{2i}+a_3x_{3i}+a_4x_{4i}+a_5x_{5i}+a_6x_{6i}+a_7x_{7i}+a_8x_{8i}+a_9x_{9i}+a_{10}x_{10i}+a_{11}x_{11i}+\varepsilon_i \quad (28)$$

Where,

$i = 1, 2, \ldots, 56$

y = net aggregate household saving rate (household savings as a percentage of disposable household income)

x_1 = average retirement age (males)

x_2 = average retirement age (females)

x_3 = fertility rate

x_4 = percentage of population above age 65

x_5 = life expectancy

x_6 = log of real GDP per capita

x_7 = 3-month Treasury bill rate

x_8 =Public Pension Replacement Rate

x_9 =Private Pension Coverage

x_{10} =Gini coefficient

x_{11} = 2006 time dummy (base category: 1990)

ε = error term

It is evident from the literature that aggregate savings are affected by the dependency ratio and expected longevity. For this reason, the fertility rate, the percentage of the population that is aged 65 and above, and life expectancy are all included. All of these demographic variables influence the dependency ratio, while life expectancy serves, additionally, as an indicator of expected longevity. Real GDP and the Treasury bill rate are the macro-economic variables that need to be controlled for. The 3-month Treasury bill rate is used as the interest rate control because it provides a risk-free rate of return on investments and is linked to the real interest rate, thereby serving as an important indicator for savers. The public-pension replacement rate is included in the regression model to provide an indication of the generosity of a country's old-age pension system. This ratio shows the percentage of pre-retirement income that the public pension system replaces. The Private Pension Coverage variable is calculated as the benefit expenditure of private pension schemes as a percentage of GDP. We also include the Gini coefficient as an inequality measure.

As discussed earlier, it can be expected that the fertility rate is negatively related to the household saving rate, that life expectancy is positively related to the household saving rate, while the coefficient on the variable relating to the percentage of the population above age 65 should be negative. While we may expect a positive coefficient on the Treasury bill rate, the relationship between GDP per capita and savings is ambiguous. The literature finds the direction of causality running both ways. The general consensus is that higher savings leads to greater GDP, through it's effect on capital accumulation. At the same time higher income has an effect on savings, with the sign of the effect being debatable. To the extent that we are looking at the saving *rate*, and that a higher GDP implies greater household income, we will have an increase in the denominator—apart from any change in the numerator— which will most likely render the net effect in this direction negative. A priori, the greater the generosity of a country's old-age pension system, the less is the amount that individuals will need to save for their retirement years. Thus, a negative coefficient can be expected on the pension replacement rate variable. For similar reasons we would expect a negative effect holding for greater private pension coverage. We would expect a lower saving rate with higher inequality, and thus expect a negative coefficient on the Gini coefficient variable.

The pooled OLS (POLS) regression results are reported in Table 3. The first regression that is presented, POLS(1), is the simple OLS regression that is specified in equation 28 above. POLS(2) looks at the combined average retirement age of males and females. Although statistically insignificant, the results of POLS(2) suggest a negative relationship between the average retirement age and household savings.

6.2 Instrumental Variables (IV) Regression

If endogeneity is present in the regression model above, this implies that the average retirement age is correlated with the unobservable error term in equation 28. Our main concern in this instance would be that while the average retirement age influences the net aggregate household saving rate, at the same time we would expect the net aggregate household saving rate to influence the average retirement age. That is, the wealthier individuals are, the younger we would expect them to retire. If this is the case then the size of the coefficient of the average retirement age may be biased. In an attempt to correct for this endogeneity the average retirement age is instrumented with the normal retirement age. Note that both the average and normal retirement ages are combined averages of males and females, since it is only in the combined case that the NRA is a good instrument.

For the NRA to be a valid instrument two conditions have to be satisfied. Firstly, the NRA (z_i) must be correlated with the average retirement age (x_{1i}), i.e. $Cov(z_i, x_{1i}) \neq 0$. This condition is satisfied by the significance of the NRA in the first stage of the IV regression. Secondly, the NRA must be exogenous, i.e. $Cov(z_i, \varepsilon_i) = 0$, meaning that the NRA must exogenously influence the net aggregate household saving rate only through its effect on the average retirement age. While the NRA is exogenously set and altered by government, and to a large extent is based on historical trends shaped by cultural preferences, such as that for leisure, as well as changing social norms in terms of equality between men and women, there are certain economic issues that may come into governments' decision when setting, or altering the NRA. We postulate that the main issues that may be considered by government when setting the NRA, and that would simultaneously affect the saving rate, would be the old age dependency ratio (most importantly), and then perhaps, inequality in the economy, and private pension coverage. To this end, we have controlled for such factors, and are confident that most remaining variation in the NRA would be exogenous to household saving.

While the NRA remains our best candidate as an instrument, there is a last kind of endogeneity which may still be present. More specifically, while the normal retirement age affects average retirement ages, it may also have a direct effect on aggregate savings. By setting higher NRAs, governments are forcing individuals to retire at later ages if they hope to receive their full retirement benefits. Therefore, those individuals that do not intend on changing their retirement plans even with higher NRAs will receive smaller pension benefits due to early retirement penalties. Since pension benefits are smaller, it is expected that such individuals will save more for their retirement, thereby increasing aggregate household saving rates. Thus, if present, this second type of endogeneity would cause an upward bias on the coefficient of the average retirement age. It should be noted that, to the extent that the direction of the potential bias is known, i.e. that it is upwards, it is certain that if a negative coefficient appears in the instrumented case, the effect of later retirement ages on the aggregate household saving rate is most certainly negative.

The results of the instrumental variables regression are shown in the IV OLS column of Table 3[8]. The first row of Table 3 reports the coefficient of the NRA variable in the first stage regression. It can be seen that a statistically significant positive relationship exists between the average and normal retirement age. More specifically, a one year increase in the NRA leads to the average retirement age increasing by approximately six months. The findings of the instrumental variable regression show that a statistically significant negative relationship exists between the average retirement age and the aggregate household saving rate.

6.3 Fixed Effects (FE) Regression

Since there may be some unobserved country fixed effect/s that influences saving behavior, a fixed effects regression is performed to correct for this. The OLS results report a fixed intercept estimate, without differentiating across countries, whereas the fixed effects regression results report different intercepts for different countries. Thus, to control for any country specific effects, such as a savings culture, that may influence the aggregate household saving rate, a fixed effects regression model is tested.

The columns labelled FE(1) and FE(2) in Table 3 present the results of the fixed

[8] This regression is estimated using the IVREG command in stata.

effects regressions. In FE(1) the coefficients of the average retirement age of males and females are presented separately, while in FE(2) the combined average retirement age coefficient is shown. FE(2) shows a statistically significant negative relationship between the combined average retirement age and the aggregate household saving rate.

It is interesting to note that the female average retirement age coefficient in FE(1) is negative, and almost equal in magnitude to that of the ara coefficient in FE(2), while the male average retirement age is insignificant, and small and positive in magnitude. This seems to indicate that the net aggregate household saving rate responds more to changes in the average retirement age of females than to that of males. It is, thus, likely that it is the female retirement age driving the average result.

The F test statistic for each fixed effects regression is presented at the bottom of Table 3. The formal test is:

$H0$: the intercept coefficient is equal across all countries in the sample (OLS is valid)

$H1$: the intercept coefficient is not equal across all countries in the sample (fixed effects is valid)

Both regressions report a p-value of 0.0001 for the F statistic. This implies that the Fixed Effects estimation method is more appropriate than the pooled OLS method.

A fixed effects regression with the NRA as an instrument is also performed to compare results. The results are presented in the last column of Table 3, IV FE. The first row reports the results of the first stage of the IV regression. The coefficient on the "average retirement age" is negative and significant, with the magnitude being considerably higher than in the other regressions.

6.4 Summary of Results

It seems that the preferred method of estimation is one that controls for fixed effects, which confirms that there is some unobservable country effect (probably a cultural issue) that is nontrivial in explaining saving behavior. Therefore, the IV FE, FE(1) and FE(2) regressions are of greatest interest.

The most important result is that the average retirement age coefficient is negative and significant in the FE(2) and IV FE regressions, with the magnitude in FE(2) being approximately equal to that of the female average retirement age in FE(1). It has already been mentioned that an upward bias may be present due to an increase in the NRA directly increasing the net aggregate household saving rate. Therefore, the fact that this coefficient is negative, even with a potential upward bias, provides support that a strong negative effect on the aggregate household saving rate is present.

We know from our theoretical exposition that a negative coefficient on the aggregate household saving rate could be as a result, either of household savings (AS) decreasing, or household income ($\sum_{i=1}^{z} y_i$) increasing, or both. To the extent that GDP (which is a proxy for household income) has been controlled for in the regressions, it is unlikely that this negative effect is due simply to an increase in household income. It is most likely due to household saving decreasing, i.e. the behavioral effect dominating the compositional effect.

7 Conclusion

Population aging puts strain on the ability of social security systems to support retirees, and is a problem that governments of many developed countries are currently experiencing, or will be experiencing in the not so distant future. In the wake of such a situation, governments have been following policies aimed at raising the age at which individuals retire. While this may seem desirable, and in many respects is, the results of this study confirm that later retirement ages have a significant negative effect on aggregate household saving rates. In an attempt to alleviate economic problems associated with population aging, governments are unintentionally lowering aggregate household saving rates, thereby potentially harming economic growth. More so, in this analysis, we have only observed the beginnings of the long-term effect of increasing retirement dates. As time goes on, and an increasing number of cohorts at any one time are affected by such changes, we can expect even larger decreases in aggregate household saving rates.

Furthermore, it seems that increasing the female retirement age is more detrimental to the household saving rate than increasing the male retirement age. This may suggest that women change their saving behavior to a larger extent than do men in response to a change in retirement date expectations. In light of the fact that female retirement rates are increasing at a greater rate than that of men (in the most part for good reason), the adverse effect on household saving rates is justifiably a point of concern.

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NRA_m	Mean ARA_m	Median ARA_m	N
60	63.2	62.1	9
65	63.6	62.8	38
67	66	64.2	5
NRA_f	Mean ARA_f	Median ARA_f	N
60	60.8	60.4	16
65	63.5	62.6	22
67	64.1	63.2	5

Table 1: The Relationship between Average and Normal Retirement Ages

NRA	Mean AS_{rate}	Median AS_{rate}	N
60	9.46	9.2	5
62.5	5.62	6.5	11
65	5.45	5.1	22
67	0.78	0.1	5

Table 2: The Relationship between the Aggregate Household Saving Rate and the Normal Retirement Age

Variable	POLS(1)	POLS(2)	IV OLS	FE(1)	FE(2)	IV FE
NRA (first stage)			0.51** (0.19)			0.23* (0.13)
Average Retirement Age (males)	−0.55 (0.73)			0.34 (1.18)		
Average Retirement Age (females)	0.26 (0.60)			−1.19 (0.78)		
Average Retirement Age (combined)		−0.21 (0.26)	−1.54* (0.90)		−1.18** (0.48)	−4.82* (2.85)
Controls:						
Fertility	−6.02** (2..50)	−5.78** (2.53)	−7.67** (2.98)	0.27 (2.38)	0.92 (2.14)	7.21 (8.33)
% of Population Above Age 65	−0.53 (0.46)	−0.55 (0.44)	−1.63* (0.89)	−1.81*** (0.63)	−2.06*** (0.54)	−1.53* (0.82)
Life Expectancy	−0.21 (0.72)	−0.24 (0.74)	0.19 (0.92)	−0.38 (1.00)	−0.20 (1.05)	0.35 (2.10)
Public Pension Replacement Rate	−0.08 (0.06)	−0.06 (0.05)	−0.11* (0.06)	−0.07 (0.07)	−0.09* (0.05)	−0.15 (0.12)
Private Pension Coverage	0.83 (0.62)	0.82 (0.61)	0.63 (0.64)	0.67 (1.25)	1.19 (1.03)	−0.09 (2.44)
Gini Coefficient	0.83 (27.00)	11.95 (22.55)	−1.02 (31.15)	32.94 (26.63)	28.34 (23.52)	−34.26 (84.16)
Log of Real GDP per Capita	0.52 (2.65)	0.96 (2.70)	3.52 (3.76)	−15.78* (8.17)	−14.03* (8.33)	−17.69 (13.59)
3-Month Treasury Bill Rate	−0.03 (0.22)	−0.05 (0.22)	0.21 (0.34)	−0.26* (0.14)	−0.23 (0.14)	−0.06 (0.34)
Time Dummy (Base category=1990)	−7.02** (3.04)	−7.31** (2.79)	−5.34 (3.68)	0.77 (3.19)	0.09 (3.68)	4.72 (9.45)
Intercept	60.26 (51.55)	48.50 (43.19)	96.51 (61.76)	255.60*** (72.73)	253.28*** (79.01)	484.65* (293.53)
F test statistic				5.40 [0.00]	5.68 [0.00]	2.05 [0.06]
No of observations	56	56	56	56	56	56
Robust standard errors in parenthesis ().						
*** significance at 1% level; ** significance at 5% level; * significance at 10% level						
[] p-value						

Table 3: Regression Results

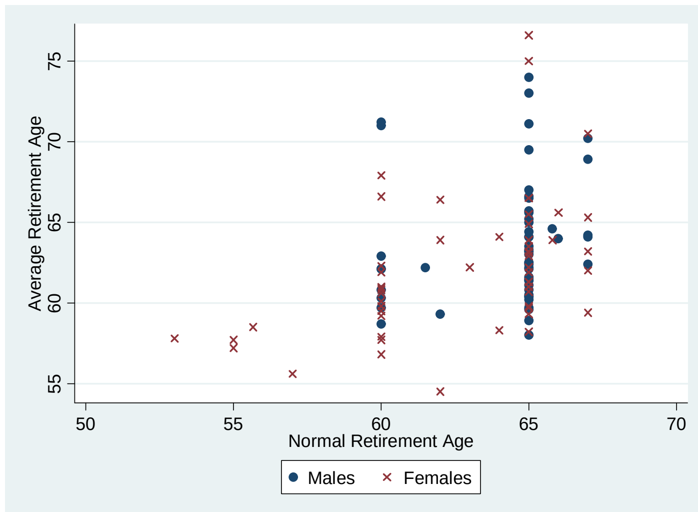

Figure 1: The Relationship between the Average and Normal Retirement Ages

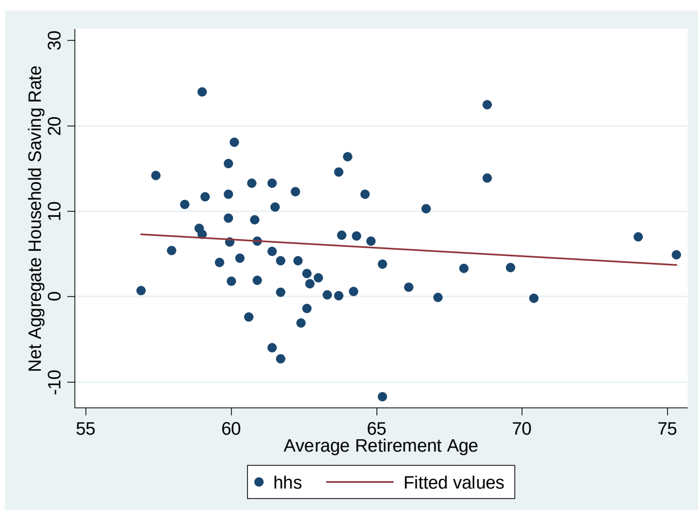

Figure 2: The Relationship Between the Household Saving Rate and the Average Retirement Age

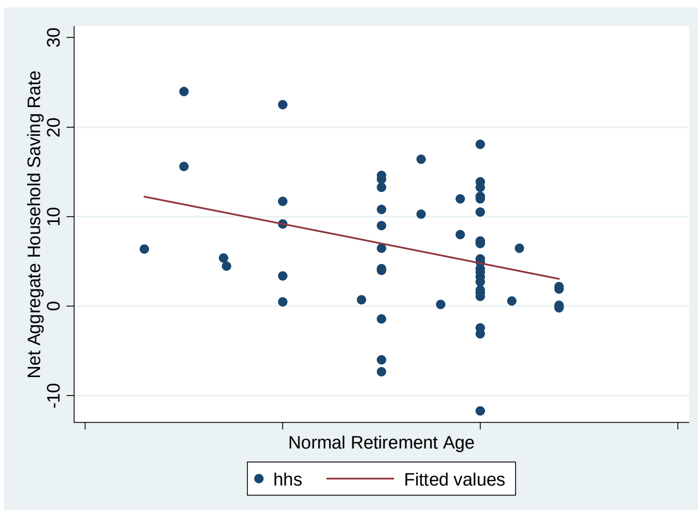

Figure 3: The Relationship between the Household Saving Rate and The Normal Retirement Age