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The impact of the design of public pension programs on household saving rate: a cross-country panel analysis

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1 Introduction

"You can be young without money, but you can't be old without it" Tennessee Williams, Cat on a Hot Tin Roof (Act 1)

Since the 19th century, governments have provided financial aid for all those people who are in need. In particular, modern welfare states across the world have implemented acts and reforms to assure every worker a livelihood for their elderly, in order to avoid old-aged poverty which recently has become a widespread phenomenon.

The belief that individuals are shortsighted, in the sense that they pursue myopic behaviors, constitutes the primary justification for the State's intervention in the economy. All developed countries aim to reduce the risk that the lack of individuals' foresight leads them to save an inadequate amount of money during the working life for their retirement. Nowadays, public pension benefits constitute the primary form of financial support for the elders.

Nevertheless, the high level of generosity of public pension provisions and the current demographic changes seriously threaten the long-run sustainability of the public system. This pressing concern leads policymakers to wonder about the most effective maneuver to boost private savings. If individuals adhere to private pension funds, their level of future expected wealth will increase without jeopardizing the soundness of public finances. In order to reach this goal, scholars worldwide have started to investigate the relationship between public pension provisions and households' savings.

According to the Life Cycle model, an increase of 1% in the generosity of public pension claims offsets private savings for 1%. The seminal study of Feldstein [1974] on the matter shows that the introduction of Social Security has a "crowding-out" effect on private savings. From that moment on, economists

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have developed different versions of the Life Cycle model to fully capture the determinants of households' saving behavior. Both from a theoretical and empirical point of view, the results are ambiguous. Social Security has a different effect on households' saving behavior if they are allowed to choose when to retire, if they are credit constrained or if they weight their actions considering future generations (i.e., increasing their current level of savings to leave bequests to their heirs).

This analysis aims to tackle the relationship between the household saving rate and PAYG from a different perspective. Following the theoretical model developed by Lindbeck and Persson [2002], this thesis surveys how the *design* of public pension programs affects savings.

According to this setup, the crowding-out effect is more significant in an "actuarially fair" public pension system since it is perceived as a substitute for private savings. When the implicit rate of return associated with pension contributions closely replicates the trend of the capital market rate of return, an increase of the generosity of the public pension program depresses households' savings. Moreover, if the system is structured following an earning-related (Bismarck) approach, there is a stronger substitution effect. On the other hand, if the PAYG program departs from actuarially fair conditions, contributions are no more considered as a form of investment and are perceived just as a different kind of taxation.

With this in mind, whenever policymakers decide to implement pension reforms, they have to take into consideration the trade-off between making the PAYG more like a substitute for private saving retirement plans or like a tax system. In order to maximize total wealth, they have to find a balance between the welfare loss implied by the changes in the level of saving and employment. If household retirement savings are more "sensitive" to the structure of the program than labor supply, the loss is more significant. The answer to this

question cannot be forecasted a priori but necessitates an empirical investigation. Besides, to provide some policy recommendations in terms of pension reforms, it is necessary to understand how the household saving rate of a specific country varies when the structural parameters of the public pension scheme change.

The thesis is structured as follows: Section 2 briefly introduces the main features of the current public pension programs and summarizes the latest implemented reforms. Section 3 provides a general overview of the theoretical and empirical literature on the subject. Section 4 explains the theoretical model applied. Section 5 presents the empirical results of the analysis. Then, Section 6 performs a simulation of the possible policy reforms and their impact on households' behavior. Section 7 concludes.

2 Social Security

2.1 General Framework

Over recent years, pension reforms across the world have a shared goal: reduce the generosity of the pay-as-you-go (PAYG) and foster the growth of new pre-funded pillars based on voluntary or mandatory pension plans, which mostly rely on households' private saving. Despite their structural differences, modern economies generally guarantee a high and generous level of income after retirement that is no longer sustainable due to socio-demographic changes and the development of financial markets. Before going into depth with the possible implications of the reforms, it is useful to understand the main reasons for the introduction of Social Security in the first place.

First of all, Social Security has the function of overcoming market failures, as incomplete information and adverse selection that arises from insurance

contracts. Financial products are characterized by a high degree of complexity, which makes challenging their comprehension , especially for all people who not have a strong financial background. Thus, it creates situations of information asymmetry that can harm households.

Moreover, as Kaplow [2010] points out, the main reason for the existence of Social Security schemes relies on the belief that individuals suffer from "myopia." Individuals are more shortsighted than what it is assumed in the classical theory of savings: they underestimate the number of resources that they will need after retirement, reaching a sub-optimal level of saving. According to Kotlikoff [1987], "there seems to be an unstated belief that, left to their own devices, a sizeable fraction of households would inadequately save and insure." Many authors find different explanations for the existence of myopic behaviors, starting from Carroll and Summers [1991] who explains the presence of myopia as a consequence of the households' different rate of impatience and going to Thaler and Shefrin [1981], Rabin [1998] and Laibson [1998]who believe that individuals lack self-control and have time-inconsistent preferences, which lead them to be unable of behaving rationally over time.

As maintained by the majority of the academics, the inability of individuals to correctly foresee their future needs constitutes the primary reason behind the paternalistic approach followed by modern economies. In particular, Barr and Diamond [2006] argue that the presence of myopia is the principal market imperfection that justifies the government's interventions considering that in a dynamically efficient economy, Social Security does not provide any welfare increasing contribution.

Even if some current studies find evidence that individuals are less myopic than what should be expected for justifying the interventions of the State, the public pension scheme still has an important educational role. It teaches households to behave rationally and encourage them to participate in the saving retire-

ment system. As Bernheim [1995] and Lusardi [2001] underline, households usually lack financial competences and thus forcing them to participate in the public retirement saving system, increases their awareness of their future needs, leading them to undertake more rational behaviors.

In recent years a different specification of myopic behaviors has been developed. Even if households are aware of their future needs, they consider a lower discount rate for distant future consumption respect to the one used for current expenditures. They tend to postpone the moment when they will start to save for the future, discounting their expenditures at a "hyperbolic" or "quasi-exponential" rate.

Another important argument in favor of the existence of public securities is to prevent free-riding. The awareness of altruistic individuals' existence may induce agents to save less, relying on the fact that someone will provide them income for their elderly. This behavior reduces the overall society output.

One more advantage of Social Security concerns the lower administrative costs associated with such funds. However, it is not completely clear if this reduction arises only from the existence of economies of scale or also from the fact that individual pension plans provide a better set of investment options.

Furthermore, PAYG systems are based on an intergenerational agreement. The introduction of a public pension scheme constitutes a "gift" for the first cohorts and implicit tax for the futures. Given this, some authors, like Cooley and Soares [1999], survey the possible reason for which individuals might agree to those terms. They believe that workers of generations t fear to stop financing the retirees of generation $t-1$ since they would then expect generation $t+1$ to do the same to them in the future. Until each cohort continues to pay benefits for the previous one, the introduction of Social Security schemes creates only a distributional effect across generations. The decision of a generation not to fulfill its obligations anymore will generate an economic loss to all those

individuals who have already paid contributions for some years because the future cohorts will not repay them.The idea is that when the PAYG plans are established, each generation will accept its terms, fearing not to receive any compensation for their payments.

A different distributional argument in favor of PAYG schemes' existence, it is represented by the presence of altruistic behaviors. After the remarkable increase in living standards that working people experienced in the 20th century, they might want to compensate the older generation who have received less during their working life, letting them enjoy the current social and economic improvement.

Even if governments agreed to the rationale behind it, Social Security has been structured in different ways across countries. Pension programs can be divided into two main dimensions: funded vs. unfunded and defined contribution (DC) vs. defined benefit (DB). Defined benefit plans provide an income after retirement predetermined by a formula based on employee's pre-retirement earnings, the years worked for a company and individual's age but do not depend on the amount of the actual investment performance of the assets. In defined contribution plans, each employee has his/her savings account where the employer or the worker himself periodically deposit an amount of money. When he retires, he receives an annuity (or can decide to withdraw voluntarily) from his account, considering that its value varies according to accumulated investment returns and original contributions. The difference between funded or unfunded pension plans depends on the ability of the fund to have enough assets available or income to match its obligation. If the total assets are less than 90% of the existing debts, the fund is considered unfunded.

The last consideration of the different structures of pension schemes is related to their level of "actuarial fairness." Indeed, a system is considered actuarial fair if the level of benefits that an individual will receive is strictly related to

the level of contributions that he has paid. Many countries experience the existence of more than one system, but nowadays, the primary trend is to switch from unfunded DB to unfunded DC or a fusion between funded DC and unfunded DB. Sweden and Italy have recently changed their structure, moving from a PAYG (unfunded DB) to an unfunded DC. Each employee has her savings account where she accumulates money according to an implicit rate of interest. The payments are in the form of a "tax" paid by the employer or by the workers, and the final amount depends on a "notional" rate of interest, considering that there is no real investment. Therefore, these plans are also called "notional defined contribution plans."

In addition, the ideological framework followed by countries also influences the structure of the pensions scheme. Anglo-Saxon countries usually adopt a Beveridge approach, whereas continental ones follow a Bismarck approach. The latter was introduced in Germany by the Chancellor Otto von Bismarck, who instituted in 1833 the mandatory health insurance. This kind of system relies upon social insurance contributions, and the recipients are workers who have paid contributions based on their wages during their labor life.

On the other hand, the Beveridge system focuses on assuring a minimum level of living standard for all the population, regardless of their salaries or their contribution. It is mainly funded by the government budget, and it is financed with uniform, lump-sum contributions, which come in the form of a tax. Nowadays, there is no pure Bismarck of the Beveridge system but a mixture of the two.

Differences in the structure of pension plans across countries are influenced by many country-specific or ideological factors. Indeed, with the development of Social Security programs, there is a trade-off between protection and distortion that should be considered. The willingness to guarantee an income after retirement to avoid old-age poverty comes with the cost of a "tax", which

creates a deadweight loss, also changing the attitudes of current and future generations. According to the economic theory, the deadweight loss associated with the tax system increases with the square of the marginal tax rate. Thus, it is necessary to pay attention to the demographic changes as drivers for pension reforms. Worldwide, the structure of the population has changed due to a reduction in the fertility rate and an increase in life expectancy. The increment of longevity can be explained by health, technological progress, awareness of the advantages of following a healthy lifestyle, cutback in the participation to heavy works in favors of more sedentary ones, and general improvement in the level of people living conditions. The number of old-age people, meaning the ones aged 65 or over, is going to increase in the next years. At the beginning of 2018, there were 101.1 million old-aged people, approximately one-fifth of the total population, and it is forecasted that their number will grow up to 149.2 million in 2050, representing 28.5% of the population. This development path implies some economic challenges related to growth, labor supply, and government finances. In fact, when the number of old-age people versus to the number of working people increases, the number of working resources available will not be any more sufficient to maintain the elders. This will represent a financial burden for the government, not able anylonger to sustain the expenses for the existing pension system, and it is forced to change the retirement age or to provide less income as pensions.

Anyway, the actual demographic development has also some advantages considering that an increase in the number of older people creates demand for different services as health centers or transports and houses better fitting their needs. However, in the next fifty years, the old-age dependency ratio is expected to double. In Europe, it will reach 49.9% in 2050, meaning that for each retired person, there will be two working agents. In particular, in countries like Italy, Greece, and Portugal, it will be higher than 60%. Among OECD

countries, Japan has the highest life expectancy at birth, about 87 years, and an old-age dependency ratio which foreseen to reach 78% in 2050. Outliers of the old-age dependency ratio can be found in Australia and the US, where the working-age population will increase to 9% in 2050. Either way, in order to find a solution to this problem, Member States are shifting forward the statutory retirement age. This change has a twofold effect: it allows older people to increase their wealth and help governments to partially overcome the problems related to the increase of the old dependency ratio. Moreover, retirees will face fewer years as pensioners. Anyway, to apply these reforms, an adequate level of job supply and working environment and conditions which give the possibility to older people to perform the job should exist. Indeed, in 2018 more than half of the workers over 65 are occupied in part-time jobs. Governments are encouraging employers to make the working conditions suitable, giving the possibility for the elders to phase their retirements, slowly reducing the number of hours worked per week.

Across European countries, the statutory retirement age is not the same: in Greece, people can retire at 67 while in Austria at 60. On average, in Europe, 18.6% of workers go for early-retirement paths. This demographic path explains the interest of policymakers for pensions systems reforms. As Browning [1975] states, Social security programs were implemented according to the assumption that their existence creates concentrated benefits and diffuse costs. This implies that pensions provisions were meant for a small portion of the population, whereas the larger part is assumed to finance them paying taxes while working. With this demographic swing, governments have to implement different solutions going from the reduction of pensions generosity to the changing of retirement age criteria. The main issues are related to the public expenditure on pensions and its growth compared to GDP and the commitment to maintain them "adequate", in the sense that pensions schemes must

be structured without creating a situation of old-age poverty. The urgency of the question is also highlighted by the memories of the public finance's difficulties that occurred during the world financial crises. The public pensions expenditure was esteemed to be almost 11% of the GDP in 2018. European pensioners have increased since 2008, reaching the level of around one-quarter of the total population in 2016. However, the amount of pension expenditure varies a lot across European countries due to the different choices of the specific system' structure. Worth to be mentioned are the cases of Italy, Hungary, and the UK were the recent reforms enforced led to a contraction of the public expenditure, reducing the number of beneficiaries.

2.2   Pensions Reforms

Stated the reasons behind the existence of Social Security programs and the new challenges for the governments, the analysis provides a brief overview of the latest implemented reforms.

In order to harmonize the increase in life expectancy with the long-run sustainability of the pension systems, the first tool used by governments is to change the minimum statutory retirement age. Indeed, Belgium, Greece, Finland, the UK, and the Netherlands have increased the statutory retirement age in the last three years. The Finnish reform introduced in 2015 will raise the minimum pensionable age from 63 to 65 by 2027 and aims to directly link retirement age with life expectancy, making it grows by 1-2 months per cohort. However, some countries do not share this trend. For instance, Poland has lowered the minimum age, and Japan has maintained it fixed at 65. Moreover, some, instead of incrementing the statutory retirement age, raise the career-length requirements. On average, Belgium, France, Spain, the UK, want to increase it by five years in the next 15-20 years.

Others have tightened access to early retirement. Austria, Belgium, Denmark, Greece have introduced "penalties" for those who decide to leave the work earlier compared to what it was supposed to.

On the other hand, Romania, Italy, Finland, and Germany have enhanced the opposite trend, even if in some cases only for a specific group of workers. In Italy was introduced the APE pension (Anticipo finanziario a garanzia pensionistica) which facilitate the retirements for 'disadvantaged' workers. Finland's government allows for early retirement for the workers who are more than 60 and have been unemployed for five years. Japan's retirement rules allow individuals for both deferral and early retirement. When individuals decide to still work beyond the statutory retirement age, they get higher pension benefits. Considering the indexation rules and the additional contributors paid, their pensions increase of around 11,5%. On the other hand, the decision to early retire comes with the cost of an 8% of pension provisions reduction.

The other Member States, like Germany, Austria, Slovenia, and Finland, have also implemented some flexible retirement rule to smooth the transition into the pensions period. Finland has substituted the part-time pensions with the flexible partial old age (FPOA), which allows individuals to voluntary withdraw the 25% or 50% of their pension entitlements once they are at least 61. If workers adhere to this program, they took out permanently 0.4% of their pension provision per month until they reach the retirement age. The Dutch "flexible Pension Act" aims in 2017 to smooth the transition from work to pension. In Austria, the workers who have been unemployed for at least 780 weeks are allowed to reduce their working hours per week between 40% and 60% without leaving their previous pension entitlements unaffected.

Furthermore, some Member States reward the decision to postpone retirement. For example, in Austria, if people decide to work beyond their normal pensionable age, they would pay pension insurance contributions, which are cut by

half for three years. Another mechanism is to allow older workers to still work after the retirement age without any age limit, as in German, or to decrease the minimum age to shed contributions (i.e., Finland reduced it from 18 to 17 years old).

The other dimension on which governments can operate to make Social Security sustainable is to reduce the level of generosity of pension provisions. However, if the variation of the length of the working period is implemented according to the actual level of each country labor supply, this kind of maneuvers are carried out considering the need of assuring a minimum level of collateral during the retirement period. Thus, the choice of diminishing pension costs does not have to harm the poorest members of the population. For this reason, pension reforms, on one hand, reduce pension entitlements for the wealthy while on the other aim to guarantee a minimum level of income in order to reduce the risk of old-age poverty. For instance, Greece has cut down pension provisions by 40% for those who have an income higher than 1.300 euro per month and at the same time, has introduced a primary pension for those who are considered "at-risk poverty" equal to 384 euro per month for people who have paid contributions for at least 20 years. Moreover, it has established a means-tested social solidarity allowance corresponding to 360 euro per month for those old-aged people who were not insured. Italy has relaxed the minimum requirements for receiving the minimum pensions giving the possibility to 1.2 million Italians to obtain them. Austria increased the pension benefits from 883 to 1000 euro per month for those who have shed contributions for at least 30 years. On the other hand, Finland has normalized the accrual rate to 1.5% for all the working life, despite the age of the contributors.

Furthermore, several countries decided to index-linking pension claims to some macroeconomic variables, in order to maintain unchanged the real value of Social Security provisions. For instance, Latvia, Austria, and Belgium adapted

their pensions accrual rule to defend the value of pension annuities during periods of economic recession and introduced additional guarantees for retired people with long careers. In Japan, with the reform of 2004, pension provisions were linked to variation in the number of contributors and life expectancy, with some clauses. Until 2016 the macroeconomic indexation did not apply when the country experiences a period of negative inflation. Moreover, pension benefits vary also according to wage indexation, and pension contribution was increased up to 18,3% in 2017.

In addition, several reforms introduce incentives for boosting participation in occupational and voluntary pensions funds. For instance, Estonia allows employers to be entitled to choose the minimum age for bringing in from occupational funds. Germany, with the "Act on Strengthening Occupational Pensions", enforced in January 2018, switches its pension system from a DB to a DC. Moreover, it does not set a minimum mandatory interest rate and does not force companies to shed a preset amount of benefits in the fund, making in this way the level of pension provisions the result of a natural collective barraging process. Furthermore, the Dutch government introduced a new fiscal incentive for low-earners workers who join occupational schemes, allowing for a deduction of 30% from the taxes paid on salary to each additional transfer made to the fund. France aims to encourage participation in voluntary DC schemes, introducing tax relief for those employers who join them. Denmark sets the annual maximum contribution that can be paid into old-age savings without a reduction in the part of the national pension tested against other pension income at 670 euros for individuals with more than five years until pensionable age (which is of particular relevance to people with low income). The annual maximum contribution is set at 6.700 euro for individuals with less than five years to retirement, as well as for individuals already claiming a national old-age pension, so long as they have not already begun to draw

down their pension savings (previously the annual maximum contribution was 4.000 euro, independent of time to retirement).

Moreover, households fear that the recently implemented reforms will harm their pension provisions, making them inadequate for their subsistence. A survey conducted across the European household in 2016 reveals that, on average, on a scale from 1 (not worried) to 10 (extremely worried), their concern about future income is rated 5.8. The countries with the highest values were Greece (8.0) and Portugal and Latvia (7.0), whereas the lowest belonged to Denmark, Netherlands, and Sweden. An additional result that arose from the interviews is that older people are less worried than younger. Another survey conducted in 2001 shows that even if individuals are aware of the threat of lack of sustainability of the public pension funds, their preference is not to undertake any reforms.

In order to consider both the sustainability and adequacy of actual pension systems, governments mainly rely on the estimation of the replacement rate. It comes out as the ratio between pensions income and average earning built up during the all working life. Assuming that individuals' earnings grow in line with average earnings, lifetime average earnings are equal to the last earnings for full-career workers. The replacement rate is computed considering both private and public pensions schemes provisions and also means-tested social benefits and taxes. The gross replacement rate represents the gross pension allowance divided pre-pension average income, and its value has a considerable variation between the Member States. When it is estimated just taking into account public provisions, it corresponds to 97% in the Netherlands and 22% in the UK. In countries like Germany, Ireland, and Belgium, once the computation also considers the adhesions to voluntary pensions scheme, it increases on average by 26%.

Another useful instrument is the net replacement rate, which better represents

individual personal income after retirement, and it is a more trustworthy estimator of the adequacy across countries of the pensions systems being free of the different country-specific fiscal policy. Indeed, the comparison between the two indicators provides a measure of how the tax-system influences pensions adequacy. For example, considering that on average, all developed countries have a progressive tax system, the replacement rate of low-income individuals is, on average, 10% greater respect to the wealthy earners.

In addition to this, following a forward-looking approach, governments also estimate the theoretical replacement rate (TRR). It is constructed as the ratio between pension income in the first year of retirement divided by work income in the last year before retiring. The first variable considers all the benefits that might come from public pensions, private (both voluntary and mandatory), and also allows for a specification where it takes into account other kinds of social benefits, i.e., housing benefit. Concerning the denominator, it includes wage (and bonus), and it is adjusted considering one year of inflation, estimated at 2%.

Looking at the values of the TRR, it is possible to grasp the distributional effect of pension provisions across individuals who belong to the same cohorts. A comparison between average-earners, low-earners (defined as those individuals who receive at most 66% of the average wage), and high-earners shows that the TRR is higher for individuals with lower income. The magnitude of this effect varies across countries, e.g., Denmark recorded a gap of almost 50% between individuals with different earnings' profiles, whereas, on average, it is about 20%. Australian Age Pension safety net provides a replacement rate of 78% to low earners against the 69% guaranteed on average by the other OECD countries. However, there are some countries, as Italy and Sweden, who follow the opposite approach. Indeed, the TRR is higher for high-earners than for low-earners. These results might be explained by the structure of the

tax system and the presence of some extra benefit for all those individuals who are above a certain income threshold.

Moreover, the analysis of TRR confirms the concerns of policymakers about the long-run sustainability and adequacy of Social Security systems. This fact, as mentioned above, creates an incentive for the governments to ease the adhesion to complementary retirement saving vehicles. Anyway, the development of supplementary pensions depends on different factors, such as the level of completeness of financial markets, the individuals' willingness to save and invest, and the role of social partners in pension policies.

In addition to this, policymakers have a heterogeneous preference on how to boost retirement savings. Some Member States, instead of allowing for a tax deduction, provide direct subsidies for those who adhere to private saving vehicles. Governments can decide to grant them in the form of flat-rate subsidies or as a premium for those who have paid a certain number of contributions. In Germany, the introduction of the "Riester", which provides a flat-rate subsidy for those who take part in individual pension plans, had a positive effect in enhancing the participation of families with children and low-earners. Despite this encouraging result, policymakers are cautious about taking the provisions of subsidies as a straightforward solution, being aware of the well-known pitfalls of this fiscal policy tool. In particular, there is no guarantee that individuals do not decide to invest in private funds only the amount of money needed for being eligible for the subsidies. Thus, the introduction of subsidies does not really boost private savings, even if it increases the assets owned by private pension funds.

Others have tried to foster another participation in a personal saving plan, making them compulsory. When the enrolment is self-imposed, the employers propose to workers to participate in occupational plans, and they are considered enlisted unless they decide to opt-out. This decision is conditioned to

many elements as employers' income, the effectiveness of the communication, and the contribution rate. This approach, as the cases of Denmark and the Netherlands show, leads to an increase of 90% in the level of coverage and reduces the inequalities between employed and self-employed. However, it has some drawbacks like the fact that it is mainly based on a collective agreement, which in the currently ever-changing working environment constitutes a risk for employees. The introduction of financial incentives for employers and fairer and more transparent legislation on the matter, which enhances social dialogue, would help to overcome the problems of the collective bargaining process. In those countries with history of a high rate of unionization and dialogue between the industries, this practice has increased the level of coverage of 50% of the labor force. Moreover, social partner organizations play a key role, and their active participation in the process is crucial.

Furthermore, policymakers also have to enhance the transparency of these private plans, making them more understandable by individuals and assuring that they are perceived as "fair" compared to the other investment opportunities of the financial markets.

3 Literature Review

3.1 Savings

The relationship between Social Security and household savings has been studied both from a theoretical and empirical point of view by many economists. Before going into depth with the effect of the introduction of Social Security on the determinants of households' behavior, the analysis briefly tackles the outstanding issue in which extent the State should be involved in the economy. According to Hayek [1960] and Stiglitz [2000], Social Security should be

established only as a tool to ensure minimal benefits, considering that higher benefits would create significant economic inefficiencies. Indeed, the introduction of compulsory pensions scheme creates several distortions. PAYG systems provide a target replacement rate, which alters both individuals' decisions on saving and labor: it might disincentivize agents from working and leads to situations of over saving. Moreover, the existence of a mandatory savings plan might offset other forms of savings. In light of these reasons, the governments' decision to implement a social or a liberal pension scheme depends on their objective, e.g., reduction of old-age poverty, stable individual consumption, reduce the level of unemployment. If they opt for enhancing the role of funded pension plans, it is essential to understand the drivers of households' savings. The main rationale explaining why individuals save have been widely revised and updated since the beginning of the 20th century. Keynes [1936], in the ninth chapter of "General Theory of Employment, Interest, and Money," summarizes seven different reasons why people want to accumulate assets. Hitherto, academics have considered the willingness of the current generation to leave bequests for their beloved as the principal intent for saving. In his work, Keynes almost wholly confirms this view, listing five different reasons strictly linked with the bequests motive. However, he adds other two different explanations. He includes "precaution" intended as the desire "to build up a reserve against unforeseen contingencies" and "foresight" meant as "to provide for an anticipated future relation between the income and the needs of the individual or his family different from that which exists in the present, as, for example, concerning old age, family education, or the maintenance of dependents," showing for the first time a different explanation for saving related to individuals consideration of their future income's changes. After that, other economists, as Harrod [1948], begin to analyze the effect of "hump saving." Modigliani et al. [1954] studies the impact of transitory saving according to

the theory of consumer behaviors and the hypothesis of optimal allocation over time developed by Fisher [1930]. Following this approach, the planned individual's consumption path mirrors the allocation of resources to the consumption of the lifetime. Assuming the absence of bequests motive, individuals shift income over their life span to find a balance between periods when their level of accumulated wealth is above the average, and their consumption is below. This implies that agents save during their working life when they have resources in excess with respect to what they need. In this way, agents accumulate during their careers to dissaving eventually by the end of their life.

According to the Life Cycle Theory (LC), the main reason for individuals save is to smooth consumption over their life, saving while working anticipating their future needs. The model provides a simplified overview of the factors that affect households' attitude to save. A typical pattern is to save less or nothing until the thirties and then start to set aside money and assets for the elderly in the middle-age. Thus, when there are no Social Security provisions, the saving during the middle part of their life fully compensates for the dissaving that will occur during retirement. In the original framework, the LC model assumes that the utility of the households only relies upon their length of a lifetime and their consumption. In line with that, the introduction of PAYG schemes or an increase of their generosity would crowd-out investment by 100%, according to the assumption that individuals perceive net pensions benefits as part of their net expected wealth. However, from an aggregate perspective, the introduction of a public pension scheme does not affect it. The reduction in households' savings is wholly compensated by the lower amount of personal assets dissaved in their elderly. Further specifications of the model, which also consider the labor supply and the possibility that agents can freely choose to retire earlier, find different results. In particular, the reduction in the length of the working period increases households' preretirement savings

while taking into consideration the feature of the market labor weakens the substitution effect of pension provisions on savings.

An important specification of the model is the one considering bequests motive. By it, households consider a multi-generational time horizon, and to maximize their utility function, they take into account also the one of their family members. According to this setup, the introduction of a PAYG scheme has no impact on retirement savings. Individuals are aware that the presence of the PAYG system or an increase in the level of its generosity will constitute a tax burden for future cohorts. Assuming that individuals care about their children, they will save more to leave them bequests that will compensate them for the tax expenditures faced to maintain the public pensions. Modigliani and Brumberg [1980] included this rationale to the standard LC model finding that there are no significant changes in the outcomes of the analysis if the two following assumptions are satisfied. First, the share of the resources that a household earmarks, on the average, for bequests is a (non-decreasing) stable function of the size of its life resources relative to the average level of resources of its age cohort. Second, the frequency distribution of the ratio of life resources to mean life resources for each age group is also stable in time.

A different explanation for the lack of crowding-out effect of PAYG on savings relies on the existence of precautionary behaviors. Despite the presence of Social Security programs, the uncertainty associated with life induces individuals to save more to be able to afford unexpected expenditures, i.e., accidental medical care or an economic crisis. Even in the case where individuals are entitled to leave bequests, there is a milder offset on private retirement savings.

A further specification consists in allowing for capital market imperfections, as liquidity constraints. The idea is that the level of completeness of domestic financial markets affects households' decisions on smoothing consumptions over their lifetime. In the classical LC framework, liquidity constraints re-

duce the offset of private savings since households have fewer opportunities to borrow and thus shift current expenditures to accumulate wealth for their elderly. On the other hand, in the bequest's framework, capital market imperfections increase the crowding-out effect making the transfers of income to future generations more difficult.

In addition to this, all the previous specification of the LC model ground on the assumption that individuals have homogeneous preferences. Allowing for individuals' heterogeneity complicates the analysis making the crowding-out effect less linear. An example of that occurs considering that the savings propensity is not the same across generations. This hypothesis, called "vintage effect", is considered as the main reason for which the output of pensions reforms is unforeseeable a priori.

Also, the presence of income inequalities affects the relationship between PAYG and private savings. Before the introduction of Social Security schemes, low earners were not able to save enough for their retirement. However, the decision of the state to finance their pension have no effects on their willingness to save, both because they do not have assets to set aside and because in order to receive the primary pension they have to fulfill some requirements, which in most cases require individuals to have an income below a certain poverty thresholds. Thus, low earners are disincentivized to increase their level of savings even if they have the possibility because they will lose the state's subsidies. According to this argument, if individuals have different levels of income, the crowding-out effect on savings is less significant, because only the wealthy depress their savings.

The question has also been long studied also from an empirical point of view. With the seminal papers of Feldstein [1974] and Barro [1974], a significant debate on the displacement effect of PAYG schemes on private savings has started.

According to Feldstein, Social Security has a twofold effect on households' behavior: assets-substitution effect and induced retirement effect. If, from one hand, the presence of external forms of wealth reduces individuals' level of savings needed to afford future expenditures, on the other, creates an incentive for workers to retire early. Depending on what effect predominates, there are different results on crowding-out, and the only way to assess the real sensitivity of consumers saving to PAYG is through an empirical analysis. In particular, he estimates using a time series analysis, how total private household saving is influenced by the U.S. Social Security system during the period between 1929-1971, and he finds that they were almost cut in half by public pension provisions.

Barro considers an overlapping generation model with physical capital and individuals with a finite lifetime. He finds that, as long as there an efficient intergenerational transfer, reforms of Social Security do not have any effect on households' wealth. Indeed, individuals also consider the utility function of their heirs in their decision with respect to saving. Thus, the introduction of a public pension scheme leads households to increase their current level of saving to be able to leave bequests or gifts to the future generation. Individuals are aware that the rise of their wealth will constitute a cost for their heirs and, caring about them, modify their actions in order to compensate them for financing their pensions. The model assumes that, even if individuals live for a finite time, they maximize their utility considering an infinite time horizon. Further specifications of the model introduce transaction costs and inheritance taxes, showing that the latter does not change the output predicted by the classical model while the presence of transaction fees hurt households' wealth, tighten the liquidity constraints that individuals face in allocating their income over the lifetime.

Across economists, this debate is still going on, and due to the lack of comparability of the results and the different findings, they still have not found an unambiguous solution. The following paragraph provides a brief overview of the most relevant studies on the topic.

Kune [1981] performs a time series analysis in the Netherlands, following the LC approach and considering how savings can be affected by the generosity of public pensions considering the timeframe 1952-1978. According to his findings, there is no crowding-out effect between the household saving rate and the generosity of the system. Also, Von Furstenberg et al. [1979] find a similar result in Germany.

Markowski and Palmer [1980] show that in Sweden during the period between 1952-1975, the substitution effect between the household's savings and gross Social Security wealth was more than 30%. Feldstein and Pellechio [1980] show that there is one substitution between Social Security and saving considering a sample of U.S. households in 1963.

Kotlikoff [1979] analyzes the relationship between personal saving and pension's contribution finding no real impact on consumer's decisions on the level of accumulated assets. Hubbard and Judd [1987] find that an increase of one dollar of Social Security coverage decreases saving by 33 cents and that the effect is stronger for high-income individuals.

Rossi and Visco [1995] analyse the Italian reduction of the national saving rate in the period 1960-1990 and find that one-third of the measured offset could be imputed to public pensions provisions. Moreover, they finds that socio-demographic factors, like age, social status, income, and place of residence, influence the magnitude of the crowding-out effect. In addition, Engen and Gale [1997] carrie on their analysis in the U.S. and, like Rossi, allow their model for considering individuals' heterogeneity. Specifically, they show that educated agents face a more significant displacement effect (almost double) of

their savings compared to non-educated people. Furthermore, if a household does not use a personal retirement account, there is no influence of PAYG on savings.

Magnussen [1994] studies a precautionary saving model, also considering the presence of retirement pensions and exploits how their presence influences Norwegian households coming from different social classes. He estimates the consumption function of both workers and retirees and shows that there is no correlation between the generosity of Social Security and consumption, but there is a significant effect on the labor income. The relationship varies across social classes due to the different levels of income elasticity. Attanasio and Rohwedder [2003] consider the impact of pension reform in U.S. finding a significant crowding-out effect of pension provisions on retirement savings. Similarly, Kapteyn et al. [2005] show how the different level of saving across the cohorts depends on the level of generosity of Social Security.

Jappelli [1995] analyses the displacement effect of public pension entitlements to individuals' wealth using as dependent variables the result of the Italian Survey of Household Income and Wealth in the period 1989-1991. He considers in his analysis both the replacement rate and households' expectations of retirement age, and he finds out that an increase of one lira of pension benefits decreases individuals' wealth by 10 to 20%. These results are used to partially explain the reduction of the Italian private saving rate that happened between 1970 and 1980. Subsequently, Jappelli [1999] conducted a repeated cross-section study to evaluate the hypothesis of the LC model. He used the same data source of his previous work for the years between 1984 and 1993. He highlighted the importance of considering the differences across cohorts and found that, once they are added to the equations, individuals accumulate assets until their 70s, and after that, they start to dissave a rate of about 6%. Moreover, he deemed how the rate of wealth decumulation varies across an

individual with different levels of income, showing that the richer and more educated individuals decumulate fewer assets.

Other authors focus their attention on how specific reforms and changing in the structure of Social Security programs affects consumers' decision on savings. For instance, Attanasio and Brugiavini [2003] consider the relationship between the public and private wealth of Italian households after the pension reform of 1992. Following a difference-in-difference approach and allowing their model to consider individuals' heterogeneity, they find out that in general, when pension provisions drop out, the saving rate increases and that the crowding-out effect is stronger for individuals between 35 and 45 years. Kim [1992] shows that Social Security's reforms in Germany significantly displace private savings. Others, as Cigno and Rosati [1996] find similar results, but they attribute the offset of private saving to the variation of the fertility rate.

Buyse et al. [2017] study the impact of pensions reforms on households' savings in a model with heterogeneous individuals in an open economy. They consider four overlapping generations in the model, three of them are active and one generation composed by retirees. The model also allows for the difference in the ability to build human capital, and the analysis considers both flat-rate and earnings-related benefits, differently weighted for each category of individuals. This set-up makes it possible to understand the differences in the strength of the substitution effect induced by pensions reforms on the savings and welfare of households with different characteristics. According to their results, a PAYG system, with the benefits' structure built in relation to the earnings and with high weight associated with the wealthy individuals and low weight to the low-income earners, is better in terms of welfare compared to a fully-funded private system. Indeed, it generates a positive effect on labor productivity, human capital, and increases the level of welfare for current and future generations. On the other hand, if the PAYG system has a high

flat-rate and instead of providing a proportional replacement for the income gained during the working period aims to redistribute income and guarantee a sustainable lifestyle for the poorest, it creates huge welfare loss, affecting negatively the labor supply for low-ability agents and raising government taxes to compensate the higher level of public pensions expenditure. Much better is to maintain the close link between individual labor income and the pension also for low-ability individuals but to raise their replacement rate sharply.

Some authors consider the international comparison of the effects of disparate pension systems the only way to correctly assess the implications of PAYG schemes on private savings. Thus, in order to obtain reliable estimates of the causal relationship between the two variables, the only way is through a cross country analysis.

Feldstein [1979] performs a comparative analysis using a sample of 12 countries for the timeframe between 1969 and 1975, considering as dependent variables households' income and savings with the result of finding a displacement effect of 37 cents for each dollar of increase in pension provisions. Then, Kopits and Gotur [1980] develop a model, which takes into account life expectancy, old-dependency ratio, interest rates, the "age" of the Social Security system, and labor productivity and allows to distinguish between three kinds of Social Security: contributions, old-age benefits, and other transfers. They consider a pool of 14 OECD countries and 40 developing countries in the period 1969-1971 and found that public pensions positively affect savings. Moreover, they noticed that in those countries in which the Social Security system was established for a more extended period, the effect on savings was more significant. This result shows that the soundness of the program has consequences on consumers' decisions. Some authors criticized their findings, arguing that they did not choose a trustworthy unit of measure for the household saving rate and that, during the estimation, they have left out the possibility that other forms of contribu-

tions have displaced private savings. Barro and MacDonald [1979] considered 16 developed countries in the period 1951-1960, and they found that PAYG provisions and the level of households' consumption were significantly negative correlated, implying that an increase in pensions benefits fosters households' savings. When they added a specific country fixed effect, they noticed that the results are reversed. According to them, the problem is related to the tools used in the analysis. Indeed, if pensions provision increases over time, they negatively affect savings, while if the time is considered as fixed, a higher level of contributions implies a higher level of savings. Koskela and Viren [1983] perform a cross-country analysis between 16 OECD countries in the period 1960-1977, finding no substitution effect between Social Security benefits and private savings. Börsch-Supan and Lusardi [2003] exploit cross-national differences in saving rates across cohorts, finding a positive correlation between public pension schemes and savings, which reverses its sign when credit restrictions are considered. Hurd et al. [2012] take a sample of 12 countries and tackle the substitution effect of PAYG on savings using an international micro-dataset. They consider heterogeneous agents in terms of income and education, and differences in public pensions benefit in the progressivity or non-linearity of pensions formulas. They find, using a cross-country analysis of the level of generosity and progressivity of public pensions, that an increase of one dollar of pensions wealth decreases retirement savings by 23 to 44 cents and that an addition of ten thousand dollars in pensions wealth induces individuals to retire one month early. Hatzinikolaou and Tsoka [2016] exploit how some institutional changes, as perceived corruption and the debt-to-GDP ratio, affect the level of households' savings. They use a panel of 25 countries and asses a fixed-effect Euler equation for individual saving. Considering the uncertainty related to pensions benefits as a variable depending on the credibility and stability of the government, they find that when a country increases

its level of debt compared to GDP, the probability that Social Security system will provide pensions drops out and also the impact of PAYG plans on savings is reduced. Furthermore, for those countries where the quality of institutions is low when they marginally improve their quality and reliability, there is a more significant effect in displacing private savings.

3.2   Tax Incentives

Policymakers also wonder if it is possible to foster private savings through the use of tax incentives on private pension accounts. Even from a theoretical point of view, the effect of this kind of operation is ambiguous. Notwithstanding, they constitute a well-known public solution for boosting adhesion to private funds, their enforcement comes with the cost of tightening individuals' liquidity constraints, affecting the size of contributions paid and the eligibility funds' conditions. These implications risk to reduce the attractiveness of investments in private funds. Tax incentives generate both a substitution and income effect on total savings and also change the portfolio allocations, sometimes preventing its maximization. Another issue that must be considered is the fact that the marginal rate of return of investment is influenced by the progressivity of the tax system, such as individuals' age and income. In light of this, economists have started to survey the real effectiveness of tax-favored savings accounts (TFSAs).

Florentsen [1997] exploits how the introduction of lump-sum pension (KP) accounts have affected agent's saving decisions in Denmark. According to his results, the reform of 1987 increases the general level of awareness of the existing investment options and that the effect of the K.P. depends on households' income, age, and degree of liquidity constrained. He estimates that 60% of savings derive from income tax saving, and just 13% of the total contributions

of the KP are new saving. The value of the new saving is below the cost of the tax subsidy, leading to the conclusion that this kind of reform negatively affects national saving. Banks and Blundell [1994] analyse three different TFSAs in the U.K.: Tax-Exempt Special Savings Accounts (TESSAs), Personal Pension Plans (PPPs), and Personal Equity Plans (PEPs). All of them have been established between 1987 and 1991. PEPs and TESSAs grant for tax-exempt earnings on equity or savings for each individual, subject to the condition of respecting a minimum holding period (one or five years). PPPS instead, work as properly retirement funds, where U.K. households can decide to opt-in, rather than invest in public pensions, opening their own personal retirement accounts. The author finds that, on average, there is no significant positive effect on savings due to the introduction of these three plans. Indeed, TESSAs and PEPs only generate a portfolio substitution effect and, due to the tax expenditure needed to finance, they create an overall negative impact on national saving. Moreover, as reported by Disney [1996], inadequate capital regulation in the U.K. leads to "mis-selling scandals," which implies more severe difficulties for the development of private saving accounts. The problem was that some inappropriate financial product was sold to households, often by door-to-door salespersons, resulting in substantial financial losses to many families making the intervention of the government in the capital market needed.

On the other hand, Wise [2001] shows how the U.S. experience was different from this point of view. Indeed, the introduction of Individual Retirement Accounts (IRAs) and employer-sponsored retirement saving plans (401(k) plans) were successful. A possible explanation of this result is the level of efficiency of the capital markets and the adequate diffusion of financial information, which reduces investors' fears and uncertainty connected to this kind of saving tools, more than the effectiveness of the tax relief program. This hypothesis is confirmed by the finding of a Dutch survey conducted after the enforcement of

the pension reform in 2001, where individuals state that they attribute more weight to the structure of the capital market with respect to the possibility of tax relief, in their investment choices. In addition to this, Wise explains that the effect of tax incentives in the U.S. has been certified only for the wealthy, in particular for the individuals belonging to the upper two-third part of the income distribution. This result has generated a considerable debate across policymakers persuading them to wonder whether to make the adhesion to private pension accounts mandatory. The advantage of this reform consists of the possibility to guarantee coverage for all individuals, even for the poorest, and to avoid a situation of moral hazard while the disadvantage is related to the economic efficiency arguments against taxation. As Börsch-Supan et al. [2001] point out, individuals perceive PAYG contributions as taxes inducing a deadweight loss while private saving does not. On the other hand, making private saving plan compulsory would change their nature. Indeed, saving has no more the purpose of voluntary insurance and become a mandatory tax. Furthermore, also, the moral hazard must be added to the equation. If the government guarantees a minimum level of income like pensions, voluntary savings might be perceived by individuals as a waste of their resources. This argument creates an incentive for the government to introduce a mandatory character to private saving.

Even if the debate across economists has still not reached an agreement, workers across European countries seem to have a clear idea about what is best for them. Due to the presence of lack of self-control, the presence of myopic behavior, and the recent trend of increasing the level of guarantees provided by the government for funds constituted by mandatory saving (i.e., the possibility of bailout) individuals prefer that governments would make the adhesion to the private funds mandatory.

3.3   Problems of Empirical Studies

The variety of results across economists has its roots in the weaknesses of the econometric analyses performed. Auerbach et al. [1987] summarize the main difficulties for the estimation of substitution parameters both for the cross-sectional and time-series analysis carried out in the U.S. They conduct a simulation experiment, running several time-series with fake data changing the sample period around the date of introduction of PAYG plans or the level of generosity of the system. The results show that even slight modifications generate a significant variation in the outcome, related to the size, statistical significance, and the sign of the crowding-out effect. The theoretical explanation of these results is that econometric analysis can obtain significant results only when there is a significant change in the explanatory variables. The introduction of reform in the pension system will show its effect in the long run; indeed, the analysis relies on the behavioral changes of the individual through different cohorts. The problem is that in the long run, people's behavior could be influenced by other macroeconomic developments, which make it difficult to attribute the effect on PAYG evolution. Estimated parameters are characterized by structural instability since many factors affect their values i.e., fluctuations of interest rates and demographic changes in the contributions criterion after the reform.

Moreover, when the analysis is carried out a restricted sample period, it is impossible to capture the real variation of pension wealth. Another issue is related to the level of "changes" that a reform introduces. If there are just minor modifications in an already launched pension system, individuals are not able to fully understand them and tend to ignore them. For this reason, studies that consider mature PAYG plans find little effect while the ones covered by "new" pension systems find a huge displacement effect. The

same logic explains the differences found in studies related to a country with different levels of uncertainty of benefits provisions, showing that in the more reliable ones, the crowding-out effect is more significant.

Another issue is connected with the data. As Feldstein and Liebman [2002] points out, there are some theoretical difficulties of using macro aggregate time-series data to estimate the substitution effect. Thus, following the LC model with three different generations with the same cohort size, the total household saving would remain constant over time, making it challenging to observe the displacement effect induced by PAYG schemes at an aggregate level. This problem is added to the endogeneity issue just explained above, creating rooms for the better reliability of studies based on microdata. Even in this case, some considerations should be made. Microdata are not always available for a sufficient period, and often they are not comparable across countries.

Furthermore, country-specific factors also influence the size of the displacement effect. The variation in economic development, quality of institutions change the relative importance of bequests, precautionary reasons, and retirement decisions. For example, the average size and composition of the household, the aim for the introduction of public coverage, or the structure of the health care system and insurance vary across countries and influence consumers' perception of the future income they will need. Moreover, as mentioned above, the different structures of the capital market and the presence of stronger or weaker liquidity constraints also influence the size of the substitution effect. As well, measurement techniques of the variables create debates across authors. Expected pension wealth can be considered at gross or net of tax contributions as well as the current income. The estimation of the level of pension wealth takes into account also the expected length of an individual's life and present and future revenue and tax rates. When these variables are actualized, the in-

terest rate applied is composed of a risk-free component plus a risk factor that considers the soundness and the uncertainty of the specific pension system. King and Dicks-Mireaux [1981] showed that changes in the assumptions of real discount rates and inflation rates could substantially alter the size of estimated coefficients on (non-indexed) private pensions. This shall be illustrated through a simple example. Consider a stable economy without population growth. Furthermore, let us assume three generations equal in cohort size: (1) very young, non-working generation, (2) middle-aged working generation, and (3) elderly retired generation. The wage is constant over time. According to the LC hypothesis (Ando and Modigliani [1963]; Modigliani et al. [1954]), individual saving or dissaving is motivated by the desire to guarantee a constant level of consumption over the lifetime. The LC suggests that individuals save in the middle part of their life, when their earnings are relatively high, and dissave in retirement. Hence, in the absence of a PAYG social security scheme, the saving of the individuals in the middle part of their life is entirely compensated by the dissaving of individuals that are already retired. Total household saving is equal to zero in such a stable economy. The existence of a PAYG social security scheme would result in a lower savings rate of individuals in the middle part of their life. Total household savings, however, could remain constant because the already retired also dissave less. In other words, although the LC model predicts substitution effects between social security and saving, on an aggregate level, the observation of substitution effects is always challenging.

4   The Model

This section aims to address the question from a different perspective, taking into account, besides the generosity, the design of the PAYG system. As

mentioned in the second chapter, pensions schemes can be studied following three dimensions related to their structures, and in particular, this work aims to tackle the issue considering the different levels of "actuarial fairness" both from an intragenerational and intergenerational perspective.

Feldstein [1987] considers how the savings are differently affected by a means-tested pension plan that fosters some individuals not to save at all but requires a lower contribution rate and an earning-related scheme that needs higher contributions but boosts all households to decrease their level of savings. He finds that there is a substantial offset on private savings when a program is built following a Bismarck approach. After this first attempt, the subject has been studied again by Disney [2007], who assessed the impact of the structure of a PAYG system allowing for variation in both the internal rate of return of contributions and the degree of redistribution.

Following the theoretical framework developed by Lindbeck and Persson [2002], it is possible to forecast a priori the implications of the introduction of PAYG systems with different degrees of actuarial fairness. They use an overlapping generation model with two periods. The model takes into consideration economic transactions, in terms of labor and consumption, and income distribution across generations, which are critical variables in analyzing a pension plan. The introduction of the PAYG system corresponds as a gift for the first generation, whereas the effect for the future ones depends on the rate of return of their contributions. If the system is actuarially fair, the marginal and the average rate of return both equal to the growth rate of the tax bases, while in a non-actuarial system, the marginal rate is equal to zero.

According to the model, there are two generations living in two periods. Each individual is supposed to work in the first period and to retire in the second one. Without loss of generality, the model does not allow for the possibility to leave bequests, and there is no uncertainty related to life expectancy. Moreover, the

only source of wealth in the first period is composed by the labor income and in the second period by private savings and pension benefits. Moreover, there is no possibility that an individual has labor income in the second period, and the wealth of the first period is composed only by labor income. When the PAYG program is introduced, the individual budget constraint of generation t in the second period is the following:

$$c_t^2 = [y_t^1(1 - \tau) - c_t^1](1 + R) + b \tag{1}$$

The previous equation states that the individual's consumption in the second period is equal to the public pension benefits (b) plus his saving in the first period capitalized with the real rate of interest (R). The income of the first period is determined as the product between the wage rate (w) and labor supply (l), i.e.,$y = wl$. The variable τ is meant to represent the payroll tax proportional to the income in the first period for financing the PAYG system, and c^1 is the consumption of the first period. Besides, the model assumes that individuals cannot borrow using pensions entitlements as collateral. Thus equation (2) describes consumption in the first period.

$$c_t^1 \leq y_t(1 - \tau) \tag{2}$$

Household consumption in the first period has to be less or equal to their disposable labor income. Taking into account these liquidity constraints allows the analysis to consider also myopic individuals and free riders. The next equation describes the average rate of return of each individual's contributions (G).

$$1 + return = \frac{b_t}{\tau_t w_t l_t} \tag{3}$$

According to (3), the internal rate of return on contributions relies on the average flow of benefits provided by the public pension scheme, and the average total value of contributions paid by an individual. To sustain a PAYG plan, the

number of benefits received by the first generation must be equal to the total contributions paid by the next generation. The following equation determines the balanced pension budget, wherewith n is denoted the number of individuals in generation t.

$$n_t b_t = \tau_{t+1} n_{t+1} w_{t+1} l_{t+1} \tag{4}$$

Taking the value of b from equation (4) and plugging it in equation (3) leads to the following equivalence:

$$1 + return = \frac{\tau_{t+1} n_{t+1} w_{t+1} l_{t+1}}{\tau_t n_t w_t l_t} \tag{5}$$

Assuming that labor participation and contribution rate are constant across generations, it yields to the results derived by Samuelson [1958], who states that the long-run return on contribution G is equal to the growth of real wage and population. At this point, it needs to be considered the relationship between G and R. In a dynamically efficient economy, where capital stock is below the golden rule level, G is supposed to be less than R. In this case, the "gift" received by the first generation will constitute a cost for the future ones that comes in the form of an "implicit tax" to finance the PAYG system. On the other hand, if the capital level is the one associated to the golden rule, R would be equal to G and the gain of the first generation. Will not have any negative consequences on the second one. Last to be mentioned in the case where $G > R$ in which there is an economic advantage for both the generations. Considering that the last two cases constitute a benefit in terms of aggregate income, mostly welfare analysis of pension systems take the case where $R > G$. In particular, considering the balanced pension budget, it can be analytically shown that the losses of the future generations compensate for the gain of the present generation. Thus, until R is considered as an exogenous factor and the labor supply is inelastic, there is no variation in terms of the aggregate income of the society. The introduction of a PAYG

system creates a pure redistribution effect between generations, in agreement with the same results found by Feldstein and Liebman [2002]. Moreover, this conclusion is independent of the size of the difference between R and G. When R rises also the discount rate increases, leading to the result that the possible opportunity costs are compensated when the stream of future pension benefits is discounted.

In addition to this, many studies assume for simplicity that both τ and G are constant over time. However, once the structure of the PAYG plan is considered, it is still possible to develop the analysis considering their variation. If a system computes benefits as proportional to the wages earned during the working life, G_{t+1} is found estimating the growth rate of the previous period. On the other hand, if benefits do not vary over time, G will be defined by the growth rate of the working population in the previous period.

At this point in the analysis, the model takes into consideration both the possibility of intragenerational and intergenerational actuarial fairness. About the latter, households in an actuarially fair system will receive contributions equal to:

$$b_t = (1 + G)y_t\tau_t. \tag{6}$$

Applying this new formulation of benefits to the formula of individual consumption in the second period we obtain the following result:

$$c_t^2 = \left[y_t^1\left(1 - \tau\frac{(R - G)}{(1 + R)}\right) - c_t^1\right](1 + R) \tag{7}$$

On the other hand, if the system is fully non-actuarial, the contributions are equal to b, and individuals face a tax equal to τ. From this specification, it is trivial to see that the tax rate faced by individuals in an actuarially fair system is lower than the one in non-actuarial systems. Moreover, the interest rate generally associated with the capital market, R, is unaffected by the structure of the system. With regard to the estimation of the intragenerational actuarial

fairness, the model firstly assumes the more general case, where a country is not entirely Bismarck or Beveridge oriented, but the level of pension benefits depends on both the components. Taking into account this specification, the level of benefits is represented by:

$$b_t = \alpha(1+G)\tau y_t + (1-\alpha)\bar{b} \tag{8}$$

The first term of equation (8) represents the Bismarck component of the benefit (i.e., the part related to the earnings), whereas the second is a flat benefit computed according to the Beveridge approach (i.e., there is no correlation between contributions paid and b). The variable α represents the share of the Bismarck part of the system. Adding these features expressed in equation (8) to equation (7) leads to the following:

$$c_t^2 = y_t^1 \left[1 - \frac{(1+R) - \alpha(1+G)}{(1+R)}\tau - c_t^1 \right] (1+R) - (1-\alpha)\bar{b} \tag{9}$$

Given this, it is possible to consider three distinct cases:

1. $R = G$, $a = 1$:

   According to this set-up, the public pension provision perfectly matches the trend of private savings, becoming a perfect substitute for them. Thus, under the assumption that the level of mandatory contribution does not exceed the amount of saving an individual would undertake otherwise, an increase of 1% in the level of public pension's coverage will decrease private savings by 1%, leaving unchanged households' retirement choices.

2. $R = G, 0 < a < 1$:

   In this case, the pension system is still actuarial fair from an intergenerational point of view, but the replacement rate for an individual belonging to the same generations is no more constant. Thus, it implies that the

level of pension benefits is no longer only based on previous earnings, and contributors pay an implicit tax. Like any other tax, it generates distortions from an aggregate point of view, and the impact of savings is determined by how individuals with different incomes react to this policy. Equation (9) becomes:

$$c_t^2 = y_t^1[1 - (1 - \alpha)\tau - c_t^1](1 + R) - (1 - \alpha)\bar{b} \qquad (9.1)$$

3. $R \neq G, a = 1$:

This specification considers the possibility that a public pension plan is no more actuarially fair from an intergenerational perspective, meaning that the average returns of contributions are different for different generations. In this case, the previous equation becomes:

$$c_t^2 = y_t^1 \left[1 - \frac{(R - G)}{(1 + R)}\tau - c_t^1\right](1 + R) \qquad (9.2)$$

From a theoretical point of view, it can be forecasted that, when the different level of risks associated to investments is not taken into consideration, the more a system is actuarially fair in an intergenerational sense (i.e.,$R = G$) the more significant the offset of public pension benefits on households' savings. On the other hand, when the system departs from actuarial fairness in an intragenerational sense, the impact on household saving cannot be clearly determined a priori. When a program has a robust redistributive component between low and high earners, the latter are discouraged from saving because their contributions are not fully repaid by the benefits, whereas the low earners are better off. Poor people, being advantaged by the public pension system, will save more, but the ones of high earners compose the primary driver of total private saving. Following this reasoning, the higher the degree of redistribution imposed by a system, the lower would be the crowding-out effect on private savings.

To sum up, every existing public pension scheme has a component of unfairness inside, which creates a distortion on the ex-ante provision made by the LC model and, the substitution effect cannot be precisely forecasted a priori. For this reason, the next section will survey the extent of the crowding-out effect through an empirical analysis. However, some last comments must be made before moving to the analysis of the data. First of all, variation in the structure of the Social Security program does not affect only households' behavior with respect to saving but also alters their decision on retirement periods. Moreover, there is no proof that all private savings are for retirement. Some of them might be done for being ready to face unexpected expenditures, for example. This fact creates another difficulty for policymakers in choosing the "right" level of mandatory pension contributions because it might be the case that the contribution rate is too high, forcing individuals to save more than what they would have done without the program. These considerations explain why the relationship between public pension benefits and saving is lower respect to the one that could be forecasted a priori. The model also assumes that individuals can understand the general structure of the public pension scheme, meaning that they can get if the returns of their contributions are structured in way that will provide a basic income floor (as in Beveridge programs) or are related to their earnings (Bismarck style) and to estimate what they would receive after having paid all the contributions. Lastly, the estimation of the variables involved in the analysis does not follow an unambiguous path reducing the possibility of comparability across different studies.

5 Empirical Estimates

5.1 Data and Variables

Given the difficulties to asses a priori the real impact of the design of a PAYG system to private savings as explained above, the only way to evaluate it is through an empirical analysis. The analysis relies on a sample of 21 OECD for which data were available for the timeframe taken into account. To overcome some pitfalls of previous studies, the estimation is carried out with the use of a cross-country panel analysis referred to the years between 2005-2017. As described in the previous section, the thesis aims to investigate how the different degrees of actuarial fairness, both from an intergenerational and intragenerational perspective, influence households' private savings.

To reach this goal, the analysis examines two different scenarios. In the first, the evaluation of the crowding-out effect is performed without taking into account any specifications parameters which can reflect the design of PAYG schemes, and it is used to survey the existence and magnitude of the relationship predicted by the LC model. In the second evaluation, the impact on household saving behavior is assessed with the addition of the public pension structural parameters.

According to the literature, the data to estimate the *household saving rate* (*HSR*) as a percentage of GDP come from the OECD database. The variable estimate in this way has the clear drawback of being a weighted average of the level of saving of people belonging to all possible age groups. The reasons for proceeding in this way are twofold. First, from a practice perspective, there is no possibility to obtain age-specific data for each country. Second, as Jappelli and Modigliani [1998] proved from an empirical point of view, at the aggregate level, the impact of saving behaviors of people placed in the tails of the age-distribution is negligible. Indeed, the value is strongly dominated by

the saving's choices made by people in the late middle age, respect to whom the other parameters are estimated.

The data on the current *replacement rate* (RR) is taken as a measure of the generosity of the PAYG system. For the odd years from 2005 on, they were extrapolated by the Pension at Glance reports made by the OECD, whereas for the other years, they were directly taken by the OECD database [Whitehouse and Queisser, 2007]. The replacement rate provides the idea of how a public scheme effectively assures a retirement income to substitute working earnings, which are assumed as the primary source of income during the working period. It is usually built as the ratio between pension benefits and the last earnings received before the retirement period. Therefore, final earnings are equal to lifetime average earnings revalued in line with economy-wide earnings growth. Replacement rates expressed as a percentage of final earnings are thus identical to those expressed as a percentage of lifetime earnings.

The model grounds on the hypothesis that individuals are not entirely rational, in the sense that their behaviors are affected by myopia. According to this idea, they consider the actual replacement as a proxy of what they will receive in the future and adapt their saving attitudes with it. Current contributors believe that they will obtain the same pensions benefits of present-day retirees.

To capture the effect of the changes in the demographic path across countries, the analysis introduces the variable *support ratio* (SR). This variable is built with the data from the World Bank and represents the ratio between active workers aged between 20 and 64 and pensioners. For the latter, the study left out the possibility of retiring before 65. Moreover, it is not reasonable to assume that nowadays, old aged people rely only on public pensions provision as an income for their elderly, but, realistically, they have other forms of income, i.e., renting or private/occupational pension schemes. For this reason, the thesis considers only the men who are eligible for receiving pension provisions

instead of the actual beneficiaries of the pensions to consider the maximum proportion of participants to PAYG.

In order to estimate the *contribution rate* to public pension schemes (CR), the analysis does not rely on actual reported contributions rates, which are often notional and do not provide a reliable estimation of the effective tax rate faced by contributors. For example, in Australia, contributions for public pension programs are embedded in the general taxation and thus not constitute a detectable separate payment. In U.S., the estimated contribution rate is higher respect to the one needed to finance current pensions payments since assets are accumulated within the public pension scheme. On the other hand, its value is underestimated in all those countries, like Italy and Greece, that for years have financed their pensions programs through the use of directly budgetary transfers or with debt. Lastly, the UK contribution rate automatically adjusts its value in order to be able to sustain the pension system, while in other countries, this process of adjustment requires the intervention of the law. Due to the high strain of normative set up behind the computation of the actual contribution rate, it is difficult to compare countries over time basing on those values. Following this reasoning, the thesis estimates an effective contribution rate, esteemed with the use of equation (4). Plugging into the formula the replacement rate and dividing by the support ratio, the result is the effective contributions charged to finance current retirees considering the expected replacement rate and the demographic changes.

To avoid the risk of omitting some variables, the other two variables are added to the analysis. The first is the *GDP growth* $(GDPr)$ with data coming from the OECD database. The second, credit to the private sector (DCr), is used as a proxy of market imperfections, in particular, following the approach explained by Jappelli and Pagano [1994] it represents the level of liquidity constraints, implied by financial repression. That variation in the level of availabil-

ity of financial resources across time influences households' saving behavior.

In the second part of this study, variables representing PAYG's design must be added. As explained above, pension systems have different beliefs on the function of Social Security and thus different approach with respect to distributional issues. The variable *pension tax* (*Ptax*) has the aim to capture the variation of rates of return within the same generation, which derive from deviations in replacement rate across different households. It is a proxy of how much a system follows a Bismarck or Beveridge approach, providing a measure of the intragenerational actuarial fairness. The variable is constructed considering the variation of replacement rate of individuals who live in the same country, belonging to the same cohort but have a different income. If the replacement rate does not vary between households, the public pension program is fully earning-related, and there is no disparity across individuals belonging to the same generations. On the other hand, more considerable variation in replacement rates shows that the country pays attention to the redistributive role of Social Security. The variation found in this way is then multiplied for the average effective contribution rate, providing the variable pension tax used in the analysis.

Concerning intergenerational difference, the variable introduced to capture this variation is the *net pension wealth* (*Pwealth*). It represents the present value of the lifetime flow of all retirement incomes in mandatory pension schemes at retirement age, after deduction of social security contribution and taxes. It provides a proxy of the total net pension benefits that an individual will receive on average from a public mandatory pension scheme. The evaluation of contributions and taxes is carried on considering the mandatory pension benefits for which households are entitled at different levels of income. The computation also considers the possibility of fiscal relief. The pension wealth is expressed as a multiple of net annual individual net earnings for each country.

The value varies between men and women due to the fact that the latter has a longer life expectancy. The variation between countries is caused by the difference in net replacement rate, life expectancy, indexation rule, and the retirement period. For example, in Luxembourg, men receive 22,4 times annual individual net income, whereas, in Japan, it is just 7,6. Countries with a DB scheme, where there is almost no connection between replacement rate and expected duration of pensions entitlements, will face some difficulties in the long run to maintain the sustainability of the system. If pension provisions and pension age are kept constant, pension wealth follows the same path of life expectancy. If people live more, their pension wealth is greater.

On the other hand, in DC programs, the value of pension wealth is independent of individuals' longevity but depends on the number of assets accumulated during the working period. The variable pension wealth comes out as a combination of different quantities, and it is expressed in absolute value. To make it comparable across countries, it is adjusted by multiplying it for a coefficient that considers the differences in terms of life expectancy across countries. Indeed, for each country, the value of future pension provisions is actualized at a fixed interest rate and using country-specific life expectancy. The estimation procedure creates some difficulties in comparing the level of generosity across different countries and generations. If the life span faced by an individual is longer, the public pension program will afford a higher expense to assure him a sufficient retirement income. On the other hand, the governments of those countries characterized by a low life expectancy can raise the amount of monthly pensions provisions because they are due for a shorter timeframe. To overcome this issue, for each country and year, the difference between the statutory retirement age and the expected maximum age in which individuals will receive pensions has been computed. Among those values, the lowest has been selected. Then for each country the ratio between its own value and

the lowest value of the year has been estimated. These computations lead to an index that is always greater than 1 except for the country, which has the lowest value for that specific year, which of course, has the value of 1. In other words, considering an individual living in country X, he is allowed to retire at the age of 65 and has a life expectancy of 75 years, whereas an individual living in country Y can retire at 60, and he is expected to live until 80. The value of the coefficient for Y is 2 $[(80 - 60)/(75 - 65)]$, while for X is clearly 1 $[(75 - 65)/(75 - 65)]$. This procedure has been repeated for all the years belonging to the timeframe considered.

To survey the correlation among the variables and take over the factors of endogeneity of independent variables, the following correlations matrix has been analyzed.

Table 1: Correlation Matrix

	RR	CR	SR	Ptax	Pwealth
RR	1				
CR	0.8558	1			
	0.0000				
Ptax	0.2961	-0.3460	1		
	0.0000	0.0000			
Pwealth	-0.1461	-0.1384	0.0465	1	
	0.121	0.0176	0.4300		
SR	-0.0547	-0.4694	0.1497	-0.0132	1
	0.3497	0.0000	0.0107	0.8217	

The above correlation matrix shows a strong and positive correlation between the contribution rate and the replacement rate. According to this result, the generosity of a public pension system is strictly linked with the effective con-

tribution rate paid by the workers. As a matter of fact, considering the way in which effective contributions rate are estimated, the main variation in this variable depends on the changes in the value of replacement rates, and it is negatively affected by the evolution of demographic parameter (i.e., support ratio). The collinearity problem that arises from the correlation matrix leads the analysis not to consider at the same time both the contribution rate and the replacement rate. Moreover, as predicted by the theory, there is a negative and robust relationship between the pension tax and the contribution rate. This result proves that in those countries where there is a stronger redistributive approach, in other words, for those countries that follow a Beveridge orientation, the contribution rate is low. This is because the pension provisions are less related to the contribution paid and mainly financed by the State. Thus, the public pension scheme is less expensive for households belonging to those countries. Furthermore, as expected, the variable pension tax and pension wealth are not correlated between them, but both are related to the generosity of the system and the contributions paid.

As many other studies have highlighted, the generosity of public pension systems also affects the decisions on the period of retirement. According to the extended LC model, the introduction of Social Security influences both consumption and labor supply over the lifetime. Older people being aware that they will receive additional payments by the governments in the form of pension benefits are less incentivized to work. They can decide to alter the length of their working life and thus increase their savings. The two effects, one on saving and one on retirement decisions, are strictly linked, and it is meaningless studying one without considering the other. Indeed, the net effect of the introduction of Social Security programs on household savings depends on the relative strength of the two effects. For this reason, other variables related to working conditions and retirement periods are considered.

The *retirement test index* (RTI) takes into account the differences, from a normative point of view, in the possibility of deferring the period of retirement. The index can take the values 0,1 and 2 according to the following rule:

- 0 if there is no earnings limit, annual bonus or maximum deferral age.

- 1 if only one of earning limit, annual bonus and maximum deferral age is applied.

- 2 if there is a combination of earning limit, annual bonus and maximum deferral age.

The *earliest retirement index* (ERI) summarizes the different possibilities for early retirement. Some countries introduce penalties for workers who decide to retire earlier or impose a minimum age in which they can advocate their right or retire earlier, while others allow for a high degree of flexibility from this point of view. As the previous index, it takes values from 0 to 2.

- 0 if there are no constraints on retirement decision

- 1 if there is alternatively the penalty or the limit age

- 2 if there are both penalty and limit age

Moreover, the analysis considers other two OECD indicators, which reflect some features of the labor supply. The first is the *employment protection index* (EPL), which measures the procedures and costs involved in dismissing individuals or groups of workers and the procedures involved in hiring workers on fixed-term or temporary work agency contracts. It is compiled taking into account of the collective bargaining agreements, the statutory laws, and opinions from country experts.

The other variable is the *union density* (TU) considers the relation between the wages of the workers who are trade union members and the totality of wages

in the economy. It provides a measure of the association power of trade unions in different countries. Its value significantly varies across countries and sectors of the economy. For example, northern European countries tend to have a higher rate with respect to central members state, who has experienced a most considerable decline in union density since 1980. Furthermore, higher rates are recorded in the public sectors while in the private and manufacturing are lower. The main reason behind this is that public employees have better working conditions, which counterbalance the potential drawbacks of membership to workers.

Furthermore, the analysis considers the different ages at which individuals are allowed to retire and the statutory age of retirement. The variable $NEPA$, normalized earlies pension age, is a discrete variable that takes into account the level of flexibility of the system. The variable $NPAR$, normalized pension age of retirement, is built based on the statutory retirement age. It considers the mode of the retirement age, and it is clustered considering the difference between this value and the others, i.e., the mode is 65 years if a country allows for retirement at 67, the value of NPAR is +2. To consider both these estimates, the index $AGEF$ has been introduced.

As Table 2 shows, on average public pension entitlements guarantee to retirees an income equal to almost 60% of their previous earnings. However, outliers correspond to the replacement rate of the UK, which is the country with the most Beveridge pension system, and Luxembourg for which pension provisions cover more than 100% of the salary earned during the working period. The level of the support ratio has a low variation across countries and time, proving that almost everywhere, the demographic path is the same, despite the differences in terms of retirement rules. On the other hand, the household saving rate has a high standard deviation showing that individual attitudes respect to saving substantially differs across countries. The last consideration regards

the low value of the mean of the variable pension tax. The reason behind it is that usually, countries that follow a Beveridge approach, i.e., countries with a high value of $(1 - \alpha)$, are characterized by a low contribution rate. Considering that the pension tax is computed as the product between the Beveridge component and the contribution rate, it makes sense that it takes low values on average.

Table 2: Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
HSR	6.255132	6.675219	-13.02742	27.66744
RR	57.87917	18.2237	21.6	101.9
CR	16.74692	5.67362	5.20101	31.37276
SR	3.55775	0.6414	1.99826	5.60442
Ptax	3.01049	2.88904	-4.07392	11.34117
Pwealth	7.152547	2.307631	2.766904	15.09626
WGr	1.349583	2.397834	-10.5609	7.512655
GDPr	1.489956	2.87885	-9.132494	25.16253
DCr	1.530541	0.4812309	0	2.717315
RTI	1	0.7572178	0	3
ERI	1.095238	0	2	7.512655
AGEf	1.857143	2.277655	0	6
EPL	2.432852	6.080268	0.26	102.704
TU	29.11385	18.29576	7.9	81

5.2 Results

As mentioned in the previous section, the first part of the analysis aims to test the hypothesis of the traditional LC model. According to the theory, an increase in the replacement rate of 1% will crowds-out the saving of 1%. Thus, the analysis considers as indicators of the public pension program both the replacement rate and contributions rate, expecting that they would negatively affect the level of the household saving rate. Furthermore, the LC model, as theorized by Modigliani [1986], predicts that a higher support ratio implies a rise in the level of individuals' saving. In addition to this, the standard permanent income model forecasts that demand shocks and GDP growth will positively affect savings. According to the literature, financial repression, which is considered in the analysis allowing individuals to be liquidity constrained, depresses households' savings. The level of credit granted to the private sector is used as a proxy of the degree of credit market liberalization of a given country.

Table 3: LC results- Replacement Rate

HSR	Coefficient	Stand. Err.	z	$P > |z|$	Confidence Interval	
					Lower	Upper
RR	-0.16345	0.09248	-.1.77	0.077	-0.34471	0.01781
SR	1.68565	0.73877	2.28	0.023	0.23768	3.13362
GDPr	0.42238	0.07530	5.61	0.000	0.27479	0.56998
DCr	-3.88933	0.84577	-4.60	0.000	-5.54702	-2.23164

Table 4: LC results- Contribution Rate

HSR	Coefficient	Stand. Err.	z	$P > |z|$	Confidence Interval	
					Lower	Upper
CR	-0.67745	0.19256	-3.52	0.000	-1.05487	-0.30003
SR	-1.94417	1.09581	-1.77	0.076	-4.09193	0.20358
GDPr	0.54002	0.11299	4.78	0.000	0.31856	0.76148
DCr	-1.94061	0.93586	-2.07	0.038	-3.77487	-0.10634

The two previous tables suggest the existence of a significant substitution effect between private savings and the level of generosity of PAYG and effective contributions, as the LC theory predicts. Support ratio results to be strongly and significantly positively related to the level of private savings when the model with the replacement rate is considered and negatively in the case of the contribution rate. The GDP growth behaves as expected and fosters the level of savings, whereas the liquidity constraint results to reduce savings even if this relation is not significant in both the cases considered. Overall, the first part of the analysis finds results consistent with the LC model.

At this point, the thesis aims to prove that an individual's savings are not only affected by the generosity of the public pension system but also by the degree of actuarial fairness. In order to consider this specification, the analysis assumes that individuals can understand the general specification of the system and adapt their behaviors according to it. To get these effects, the model has to be slightly modified with respect to the previous one. First of all, instead of using as proxies the general level of generosity of pension provision, replacement rate, and contribution rate, the model relies on two variables that consider differences across individuals in terms of generations and wages. As explained in the previous section, these variables are the pension tax and pension wealth.

According to the theory, one should expect a positive impact of the pension tax on saving and a negative one of pension wealth. When $(1-\alpha)$ is low, the system is built according to a Bismarck approach, meaning that pension entitlements and private savings are close substitutes.

Secondly, to assess, the variation in terms of intergenerational actuarial fairness, the timeframe considered is not annual, but it is divided into lustrum. According to the literature, this division allows the analysis to take into account how pension reforms have changed the structure of public pension schemes. Even if in literature, authors usually consider the division in decades instead of lustrum, in this case, the use of a shorter time horizon is justified both by the fact that in the recent years there has been an increase in the frequency of pension reforms enforced and by the scarce availability of data for all the 21 OECD country. The latter is a common problem in all cross-country panel analysis of this topic. Moreover, the data show a significant variation in terms of pension wealth in the last twenty years.

The third and last issue considered in this specification of the model is the introduction of instrumental variables. Like many other macro and microeconomics studies, the possibility of endogeneity of the regressor constitutes a risk for the consistency of the parameters estimated. In policy analysis, regressors should estimate both causality and magnitude of the relations, while in the presence of endogenous variables, the outcomes of the regression consider only the magnitude. As Angrist and Krueger [2001] state, instrumental variables can be used to "counteract issues with measurement error in explanatory variables which result from a lack of accurate information available for analysis and to overcome the issue of omitted variables in order to make causal inference in observational studies". As other studies on the topic, individuals' behaviors are affected by other macroeconomic variables with respect to their choices concerning savings. The generosity and the structure of the PAYG system

are just an approximation of the complexity of factors taken into account by households. For this reason, many authors suggest to develop analyses on this topic relying on microdata, but for the purpose of this thesis, which aims to carry on a comparative analysis across different countries in different times, it is not possible to use these kinds of data. In light of this, to overcome the risk of leaving out some explanatory variables, the analysis introduces the variable "wage growth" as an instrument for the variable pension wealth, the EPL for the variable pension tax and the AGEf for the SR.

Table 5: Results of the Model with Structural Parameters

| HSR | Coefficient | Stand. Err. | z | $P > |z|$ | Confidence Interval | |
					Lower	Upper
SR	1.71329	1.03552	1.65	0.098	-0.31629	3.74289
Ptax	0.54934	0.25071	2.19	0.028	0.05795	1.04072
Pwealth	-1.81986	0.50513	-3.60	0.000	-2.80989	-0.82982
GDPr	0.69514	0.19085	3.64	0.000	0.32108	1.0692
DCr	-3.19374	1.20028	-2.66	0.008	-5.54626	-0.84123
TU	0.11306	0.02736	4.13	0.000	0.05942	0.16671
Lustrum	-0.35655	0.71626	-0.50	0.619	-1.76041	1.04731

As Table 5 shows, the introduction of structural parameters of PAYG in the analysis influences the household saving rate as expected in theory. When the pension tax is high, there is no crowding-out effect on private savings considering that in these kinds of schemes, public pension programs are not perceived by individuals as a substitute for personal savings. The introduction of structural parameters of PAYG in the analysis influences the household

saving rate as expected. When the variable pension tax takes a high value, there is no crowding-out effect on private savings considering that in these kinds of scheme, public pension programs are not perceived by individuals as a substitute for personal savings. The absence of a strong link between pension entitlements and contributions paid made the payment of pension more like a general tax than another form of investment. Thus, the existence of the PAYG scheme instead of reducing households' propensity to save, makes it increases. Furthermore, the awareness of changing in the level of actuarial fairness between generations, in the sense that pension provisions will decrease, incentivize people to save. The reasons behind this behavior might be explained both by the precautionary saving theory and by the possibility of leaving bequests. In both cases, individuals are aware that the government will guarantee them fewer benefits in the future and to avoid the risk of not being able to afford consumption expenditures in their elderly or caring about their family, which will receive less, boost their level of savings. As in the general model, the support ratio and GDP growth positively and significantly affect saving rates. In this setup, the level of liquidity constraints faced by individuals hurts households' savings. Across the variable added to model labor supply and conditions, only the level of trade union results to be positively and significantly related to the dependent variable. Also, the retirement age, both statutory and voluntary, does not have any significant effect. Lastly, the variable lustrum likewise is not significant. In order to understand the reason behind these results, the analysis has been reproduced in the following table to consider different combinations of the lustrum. Taking into consideration the existence of a collinearity issue between the three periods, the analysis first considers the Lustrum 1 and Lustrum 2 paired. The result shows that the first period is not collinear. Thus, the same analysis has been reproduced with Lustrum 2 and Lustrum 3.

Table 6: Results with the varible Lustrum splitted

HSR	Coefficient	Stand. Err.	z	$P > |z|$	Confidence Interval	
					Lower	Upper
SR	2.12654	1.16873	1.82	0.069	-0.16412	4.41721
Pwealth	-0.93203	0.49347	-1.89	0.059	-1.89923	0.03516
Ptax	0.41279	0.17552	2.35	0.019	0.06877	0.75681
GDPr	0.61035	0.12551	4.86	0.000	0.36435	0.85634
DCr	-1.65663	0.97134	-1.71	0.088	-3.56043	0.24717
TU	0.12961	0.03258	3.98	0.000	0.06573	0.19346
	-1.26896	0.73384	-1.73	0.084	-2.70727	0.16934
Lustrum*	-0.05111	1.00269	-0.05	0.083	-2.01637	1.91413
	-.05161	1.00155	-0.05	0.959	-9.75276	15.00749

Note: It summarizes the values of the variables Lustrum 1, Lustrum 2 and Lustrum 3.

Looking at Table 6, it can be inferred that the lack of significance of the variable depends on the third lustrum. It appears that the inconsistent estimation derives from the most recent period. The reason behind it might be related to the financial crises recently experienced by all countries included in the sample. The variations in households' behavior with respect to retirement savings do not appear immediately but need a more extensive period. Thus, the changes in households' attitudes concerning saving might be modified in the last years as a delayed reaction to the changes in macroeconomic factors.

6 Simulation

The estimates of the previous section provide a breeding ground for discussing policy implications. As the Melbourne Mercer Global Pension Index shows, governments across the world are struggling to deal with the sustainability issue related to the pension system. Even if before the 21th century, fostering private saving has been a primary concern only for the U.S, nowadays, across Europe, governments follow the trends of boosting the adhesion to the third pillar. In light of this, it is worthwhile to consider how pension reforms in terms of actuarial fairness would affect household saving rates. These sections aim to forecast the impact of variation in the structural parameters of the pension system. To obtain a reliable estimate, the simulation is performed considering all country-specific factors, rather than pensions structural parameter, which can have an effect on savings. Besides, the reforms tested are hypothesized in a realistic way, taking the values of the structural parameters from the other countries in the sample.

6.1 Residual Country Effect

First of all, the analysis focuses on the residual "country effects," controlling the effect of the independent regressor. The aim is to model how the specific characteristics of each country affects the level of savings. The introduction of a dummy for each country allows the analysis to consider the effect of the omitted country-specific factors. The result consists of different equations, one for each country, in which the constant is not still a weighted average of the differences across States. This approach allows to get an overview of how the fixed effects of each country influence the level of savings, despite its public pension program design.

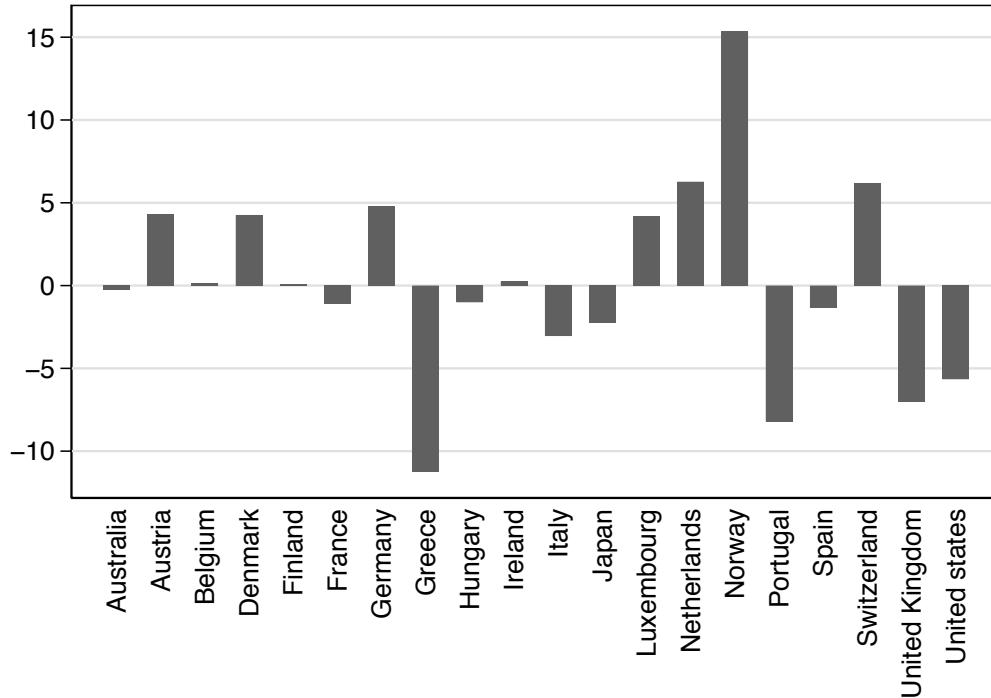Figure 1: Household saving rate: country effect

Figure 1 summarizes the effect of structural pension parameters in each country. As a common trend, "Anglo-Saxon" countries result to have a negative intercept, whereas European tend to have a saving rate, which is above average. Worth to be mentioned are the case of Italy and Greece that, despite their history of high saving rates, turn out to behave more like the Anglo-Saxon countries rather than the Mediterranean.

Once the analysis is reproduced considering the introduction of the structural parameter of the pension system, it is clear that in all those countries where the value of pension tax is low and the level of pension wealth is high, the savings contractions is stronger.

6.2 Sensitivity Analysis

In order to assess the effect of the public pension scheme on household savings, this part of the thesis carries on a sensitivity analysis. The idea is to take the regression and coefficients of a given country and modify them plugging the specific pension structural parameter of another country. In this way, the study can analyze the effect of specific reforms in a given country considering its characteristics fixed (e.g., financial market development, demographics...). To obtain reliable results, the analysis is performed on the country, appearing more "neutral" in terms of intragenerational and intergenerational actuarial fairness. In this specific case, the country having at the same time a mild redistributive approach, without being completely Beveridge or Bismarck oriented, and maintaining the pension provision more constant across generations is Denmark. Without loss of generality, it is possible to consider this country as a good proxy to analyze the different impacts of pension reforms, considering it as a "hybrid country". In particular, how households' savings react to reforms with different combinations of degrees of actuarial fairness is tested. In order not to make unrealistic assumptions, the values of maximum and minimum pension tax and pension wealth are taken from the data of other countries. The following table summarizes the possible combinations of pension reforms.

Table 7: Simulation results

		Pension Tax	
		↑	↓
Pension	↑	37%	59%
Wealth	↓	−56%	−42%

From the interpretation of table 7, it is possible to find some policy recommendations. As the theory predicts, when the structure of the system completely departs from actuarial fairness, there is no offset of savings, and instead, they increase by 59%. On the other hand, when within the same cohort pension provisions are strongly related to the level of previous earnings (Bismarck model), there is still no crowding-out effect on savings, but their value raises "just" for the 37%. This confirms the existence of a substitution effect with households' saving at least for the ones who belong in the same generations. Individuals can understand if pension contributions work as a different form of saving or if they are embedded in the general tax system.

If the reforms implemented "perfectly" replicate market interest conditions, there is a robust crowding-out effect of private savings, which decrease of 56%, as expected from a theoretical point of view. Last to be mentioned it is the possibility that a given reform maintains a high level of actuarial fairness between different cohorts but deviates in favor of a more redistributive system (Beveridge approach). In this scenario, private savings are still offset, but the strength of this effect is mitigated by the high level of the redistributive variable.

Considering these results, policymakers can modulate the impact of their pension reforms according to their belief on the optimal level of savings desired.

6.3 Policy Implications

With this in mind, what is left to discuss is the meaning of the *optimal level of saving*. From a macroeconomic perspective, it is by no means uncharted territory. However, the applicability of the economic forecasts on the optimal saving rate has long evaded the understanding of policymakers. Evidence of this can be found in the diversity of approaches worldwide. According

to U.S. economists, the saving rate should be boosted, considering that too low savings would harm capital accumulation and reduce economic growth. In turn, Continental Europe academics argue, according to the Keynesian Theory, that a high saving rate would dampen consumption and thus reduce economic growth. The divergence of perspective also depends on the country-specific experiences on the matter; European countries have always been characterized by high saving rates, whereas the U.S. has recorded meager savings, sometimes even negative. For this reason, it is not possible to set a priori target level of savings without considering each country's development and history.

According to neoclassical economic theory, if the natural growth rate of the labor force is higher than the rate of return to capital, there are too many savings, and there is a dynamically inefficient allocation of the resources in the economy. Abel et al. [1989] have attempted comparing natural growth rates with the appropriate rates of return, finding that, on average, it is more likely to have situations where savings are too low. Furthermore, demographic changes can affect the forecast of the optimal saving rate. When the ageing of the population affects the equilibrium between labor and output, leading to a situation where the number of workers per consumer will decrease over time. This will drive the remuneration of human capital up compared to the other factors of production, and, if the interest-elasticity of saving is positive, it will lower the incentive to save.

Some authors, like Börsch-Supan and Brugiavini [2001], argue that the path of population ageing can be used to predict the changes in saving behaviors of future cohorts. They use a multi country-general equilibrium model in which the demand and supply of private funds are equilibrated by the global rate of return, based on the Cass-Ramsey-Solow optimal growth model. According to their results, both consumption, saving, and investment will decline, due to the fact that an increase in the capital-labor ratio, implied by the population

ageing, will reduce the return to capital. This implies that the evolution of saving follows the path of labor force growth tightly. Saving rates have remained constant since 1990. In 2010 they started to decline by almost 2% points, and they will reach their minimum in 2035, ten years later than the labor force reaches its minimum level.

In addition, some authors as Bernheim et al. [2001] point out that if the actual level of saving comes out as the results of a rational farsighted optimization, its low level is just a reflection of households' preferences. Thus, the paternalistic argument behind the introduction of PAYG and the need to foster private savings lose validity. On the other hand, Strotz [1955] remarks on the fact that if individuals show time-inconsistent behaviors, constraining their decisions on smoothing consumption might be better in terms of welfare and increases the utility of those agents who are short-sighted and will regret their saving decisions. Indeed, according to Akerlof [1991], "hyperbolic model explains the uniform popularity of social security, which acts as a pre-commitment device to redistribute consumption from times when people would be tempted to overspend during their working lives to times when they would otherwise be spending too little in retirement. [..] Such a transfer is most likely to improve welfare significantly."

The estimation of the optimal level of saving has a remarkable political significance over and above the issue of capital accumulation and investment. If an economy is characterized by too high saving rate, public pension plans are preferable from a welfare perspective than private funded schemes. Given the expected demographic path and stated its implications on the sustainability of the existence PAYG system and the level of savings, nowadays, governments mostly share a common trend of fostering the adhesion to private pension plans. Nevertheless, some consideration of the implication of this shift should be done.

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From a theoretical point of view, Breyer [1989], analyzes the implication if a PAYG system is Pareto efficient from an intergenerational perspective, even when the internal rate of return of contributions is lower than the market interest rate for all the future generations. He proves that a transition from a PAYG scheme to a funded plan will create a loss for the first generation on pensioners that cannot be compensated. İmrohoroğlu et al. [2003] show, using an OLG model with time-inconsistent preferences and uncertainty, that the existence of PAYG schemes may lower or raise welfare depending on the strength of time inconsistency.

Besides, a shift from a public scheme to a funded plan does not constitute an "easy solution" to ensure income for retirement. The complex phenomenon of globalization and capital market liberalization experienced by all the main developed economies comes with the cost of increasing the financial risks associated with investments. Indeed, public retirement plans face both demographic and political risks, whereas private pension schemes deal with the same market risk of other forms of investment. It is difficult to assess a priori which hypothesis is riskless considering that political and demographic risks are exogenous while market risks can be reduced diversifying. On the other hand, the high mobility of capital, especially across Europe, creates a breeding ground for the transmission of financial crises. Moreover, PAYG systems are able to internalize the inflation risk, indexing pension claims with purchasing power and/or wages.

Another issue that should be taken into account is the level of development of the existing financial market. In order to satisfy the sheer volume and the seek for high returns of the capital invested for private pension claims, the capital market should be more efficient. Germany, Italy, and France, which represent the three major continental economies, have an undeveloped annuity market and a restricted number of pension funds. In turn, pension reform may

have side effects on capital markets by pushing up the share of funds that flow through institutional investors. Even in the U.S., where the private annuity market exists, the volume of contracts in these markets is inadequate. As Friedman and Warshawsky [1990] state, this phenomenon could be explained by the presence of adverse selection. In this framework, the role of public pension schemes might mitigate the loss in terms of welfare due to this market failure and substitute for missing private annuity markets. However, in the next future, the financial market is expected to grow and take a more predominant role worldwide, and thus the competition between public and private insurance will become stronger.

Nevertheless, in order to give private retirement plans a primary role, households have to be financially educated. They should be able to understand financial products and untwist themselves within complex financial information.

Worth to be mentioned is the fact that financial liberalization has lifted individuals' credit constraints. As discussed in the first section, it has an ambiguous effect on private savings, depending on their previous level, as argued by Chiuri and Jappelli [2010], if the saving rate is higher than what it should be, the introduction of new financial products will reduce it.

Besides, in order to have a sound private retirement system, financial regulation has to be strengthened, and the coordination across countries fostered. In particular, across Europe, there is a need to harmonize financial regulation and taxation. An example of this is the adoption of EET (exempt-exempt-taxed) by the majority of European countries to avoid the risk of double taxation.

Lastly, any variation of the level of actuarial fairness of the public pension systems does not affect only saving rates but also influences labor supply. In order to maximize the total wealth, policymakers have to find a balance between the welfare losses implied by the changes in the level of saving and employment.

If household retirement savings are more "sensitive" to the structure of the program than labor supply, the loss is more significant. The estimation of this sensitivity is an empirical issue, which is influenced by individuals' preferences and country-specific factors.

7 Conclusion

The thesis aims to understand how the design of public pension programs affects the household saving rate, though the use of a static panel analysis with instrumental variables and random effects on a sample of 21 OECD countries. Almost the totality of the previous literature on the topic considers the impact of PAYG schemes on household economic activity just focusing on the generic substitution effect between pension provisions and private savings, without going into depth with the implications of the structural parameters of the system. Even if some studies surveys how private savings varies when a specific reform of the pension system is enforced, they usually consider only the *introduction* of the reform, taking it as a structural break, without digging into the real contents of the changes carried by the reform. Moreover, these kinds of studies are country-specific, leaving out the possibility of drawing any conclusion in terms of worldwide policy recommendations.

According to Disney [2007], individuals do not adapt their behaviors relying on their considerations only on the assets that they will receive during the retirement period but take into account also the opportunity cost associated with the public pension scheme. If the implicit rate of return associated with public pensions follows the same trend of the one that an individual could obtain investing in the financial market, there is a perfect substitution effect between pension entitlements and savings. On the other hand, if the PAYG program departs from actuarially fair conditions, contributions are no more

considered as a different form of investment and are perceived just as a different kind of taxation. In the real world, there is no pure "actuarial-based" scheme, but, according to each country's belief on the role of the State in the economy, developed countries structure their public pension plans in different ways. The key assumption of the analysis consists in the fact that a representative agent is able to understand the general terms of the structure of his country pension system. Thus, the analysis provides different indicators of the design of the public pension scheme, measuring how far the rate of return associated with PAYG claims varies across and within generations. Employing these indicators, the empirical analysis proves that the offset of private saving is more significant in those countries having stronger actuarially fair parameters in their scheme.

After having found empirical evidence that the designing of public pension plans alters individual economic behaviors, the analysis attempts to draw some policy recommendations. Given that the main drivers considered by households in their savings decision are the structure of the system and its degree of actuarial fairness, it might be worthwhile to try to forecast the implications of reforms that alter them. Policymakers can operate through a twofold approach, varying the rate of return associated with savings "invested" in the public pension system of individuals belonging to the same or different cohort. The results of the sensitivity analysis show that the variation in the magnitude of the offset or the increase of private saving depends on the combination of the parameters chosen. Thus, for instance, if a country aims to double the level of private savings, the best option is to adopt a Beveridge approach with a low rate of returns across generations. However, policymakers should value the impact of their reforms carefully, taking into account both the economic objective and necessitate of their country and the actual and desired level of private savings. In addition, the decision to shift from a public retirement

scheme to a private funded program must take into account the actual level of development and soundness of the existing financial markets.

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Executive Summary

Since the 19th century, governments have provided financial aid for all those people who are in need. In particular, modern welfare states across the world have implemented acts and reforms to assure every worker a livelihood for their elderly, in order to avoid old-aged poverty which recently has become a widespread phenomenon.

The high level of generosity of public pension provisions and the current demographic changes seriously threaten the long-run sustainability of the public system. This pressing concern leads policymakers to wonder about the most effective maneuver to boost private savings. If individuals adhere to private pension funds, their level of future expected wealth will increase without jeopardizing the soundness of public finances. In order to reach this goal, scholars worldwide have started to investigate the relationship between public pension provisions and households' savings.

As first step, they explore the main reasons why Social Security has been introduced in the first place. As Samuelson [1975] points out, households do not always have the ability to estimate the right amount of income that they will need in the future, and for this reason, they might save less than what it would be necessary. The possibility of this myopic behavior considered together with the goal of avoiding poverty for the aged make necessary the presence of Social Security contributions, at least in the proportion in which they guarantee a basic income floor. Moreover, financial markets are still undeveloped for ensuring fair opportunity for everyone. In particular, continental European countries,

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as Italy and Germany, have a low percentage of enrolled in supplementary pension plans and, thus, are still forced to maintain a high level of generosity of public pension provisions. Given this, it is not plausible a complete shift from an unfunded scheme to an investment-based plan, but a new balance should be unavoidably found.

According to the Life Cycle model, an increase of 1% in the generosity of public pension claims offsets private savings for 1%. The seminal study of Feldstein [1974] on the matter shows that the introduction of Social Security has a "crowding-out" effect on private savings. From that moment on, economists have developed different versions of the Life Cycle model to fully grab the determinants of households' saving behavior. Both from a theoretical and empirical point of view, the results are ambiguous. Social Security has a different effect on households' saving behavior if they are allowed to choose when to retire, if they are credit constrained or if they weight their actions considering future generations (i.e., increasing their current level of savings to leave bequests to their heirs).

Disney [2007] considers the issue from a different point of view. Following the model developed by Lindbeck and Persson [2002], he surveys how the *design* of public pension programs affects savings. According to this setup, the crowding-out effect is more significant in an "actuarially fair" public pension system since it is perceived as a substitute for private savings. The idea is that when the implicit rate of return associated with pension contributions closely replicates the trend of the capital market rate of return, an increase of the generosity of the public pension program depresses households' savings. Moreover, if the system is structured following an earning-related (Bismarck) approach, there is a stronger substitution effect. On the other hand, if the PAYG program departs from actuarially fair conditions, contributions are no more considered as a form of investment and are perceived just as a different kind of taxation.

According to this framework, if Social Security plans are structured in a way that perfectly replicates interest capital market conditions and mainly based on contributions, individuals will perceive the payment of pension contributions just as a different form of investment. Thus, an increase in the generosity of the system will offset the level of private saving. With this in mind, systems with a lower internal rate of return of contributions and with a remarkable Beveridge orientation have higher savings rates. The integration between public and private pension funds would make the system sustainable in the long-run, reduce the risks associated with pension plans, have a financial educational effect, and it might guarantee higher future revenues at a lower rate of return of contributions.

This thesis constitutes an attempt to study with a static panel analysis with instrumental variables and random effects the alterations in individuals' saving behaviors in reaction to their perception of the degree of intragenerational and intergenerational actuarial fairness of the public pension systems. The sample is composed by 21 OECD countries considered in the timeframe between 2005-2017. The present study first surveys households' saving attitude according to the standard Life Cycle model. According to this approach, the level of contributions paid, and the generosity of the system affects the level of aggregate savings. In particular, the model assumes that higher replacement rate and contribution rate offset private savings. The results show a significant relationship between households' private savings and the level of generosity of the system, as the theory suggested.

In the second part of the analysis, variables that describe the structure of the PAYG system has been added. Pension systems have disparate beliefs on the function of Social Security and, thus, a different approach to redistribution issues. The variable *pension tax* has the aim to capture the variation of rates of return within the same generation, which derive from deviations in replacement

rate across different households. It is a proxy of how much a system follows a Bismarck or Beveridge approach, providing a measure of the intragenerational actuarial fairness. The variable is constructed considering the variation of replacement rate of individuals who live in the same country, in the same years but have a different income. If the replacement rate does not vary between different households, the public pension program is fully earning-related, and there is no disparity across individuals belonging to the same generations. On the other hand, more considerable variation in replacement rates shows that the country pays attention to the redistributive role of Social Security. The variation found in this way is then multiplied for the average effective contribution rate, providing the variable pension tax used in the analysis.

In order to model the intergenerational variation of actuarial fairness in the system, the thesis analyzes how the level of *pension wealth* of individuals belonging to different cohorts influences their savings. It represents the present value of the lifetime flow of all retirement incomes in mandatory pension schemes at retirement age, after deduction of social security contribution and taxes. It provides a proxy of the total net pension benefits that and individuals will receive on average from a public mandatory pension scheme. The evaluation of contributions and taxes is carried on considering the mandatory pension benefits for which households are entitled at different levels of income. The computation also considers the possibility of fiscal relief. The pension wealth is expressed as a multiple of net annual individual net earnings for each country. The value varies between men and women since the latter has a longer life expectancy. The variation between countries is caused by the difference in net replacement rate, life expectancy, indexation rule, and the retirement period. For example, in Luxembourg, men receive 22,4 times annual individual net income, whereas, in Japan, it is just 7,6. Countries with a DB scheme, where there is almost no connection between replacement rate and expected

duration of pensions entitlements, will face some difficulties in the long run to maintain the sustainability of the system. If pension provisions and pension age are kept constant, pension wealth follows the same path of life expectancy. If people live more, their pension wealth is greater. On the other hand, in DC programs, the value of pension wealth is independent of individuals' longevity but depends on the number of assets accumulated during the working period. The variable pension wealth comes out as a combination of different quantities, and it is expressed in absolute value. To make it comparable across countries, it is adjusted by multiplying it for a coefficient that considers the differences in terms of life expectancy across countries.

The introduction of structural parameters of PAYG in the analysis influences the household saving rate as expected. When the variable pension tax takes a high value, there is no crowding-out effect on private savings considering that in these kinds of schemes, public pension programs are not perceived by individuals as a substitute for personal savings. The absence of a strong link between pension entitlements and contributions paid made the payment of pension more like a general tax than another form of investment. Thus, the existence of the PAYG scheme instead of reducing households' propensity to save makes it increases. Furthermore, the awareness of changing in the level of actuarial fairness between generations, in the sense that pension provisions will decrease, incentivize people to save. Thus, the design of the public pension program in the twin sense of changing in across-cohort and within-cohort returns on contributions has an effect on private saving rates.

Whenever policymakers decide to implement pension reforms, they have to take into account the trade-off between making the PAYG more like a substitute for private saving retirement plans or like a tax system. In order to maximize total wealth, they have to find a balance between the welfare loss implied by the changes in the level of saving and employment. If household

retirement savings are more "sensitive" to the structure of the program than labor supply, the loss is more numerous.

To provide a guide for pension reforms, the thesis carries out a scenario analysis in which consider the effect of changing the level of actuarial fairness in a given country. Policymakers can operate through a twofold approach, varying the rate of return associated with savings "invested" in the public pension system of individuals belonging to the same or different cohort. The results of the sensitivity analysis show that the variation in the magnitude of the offset or the increase of private saving depends on the combination of the parameters chosen. Thus, for instance, if a country aims to double the level of private savings, the best option is to adopt a Beveridge approach with a low rate of return across generations. However, policymakers should value the impact of their reforms carefully, taking into account both the economic objective and necessitate of their country and the actual and desired level of private savings. In addition, the decision to shift from a public retirement scheme to a private funded program must take into account the actual level of development and soundness of the existing financial markets.