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Master Thesis

BOOSTING ASSET ALLOCATION IN PENSION FUNDS: AN EXPERIMENT ON MYOPIC LOSS AVERSION

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Chapter 1

Introduction

Since the 1990s, the Italian public pension system has experienced profound changes. The progressive increase in average life expectancy, which has led to a lengthening of the period over which pensions are paid, and the slowdown in economic growth, have led to a review of the structure of the compulsory system, so as to ensure the sustainability of public finances. These changes have led, over time, to a decrease in the amount of new pensions in relation to the last salary received. Supplementary pensions were thus born as an efficient tool to build greater economic security for the future, and in recent years millions of Italian workers have joined them.

In these forms of savings designed to protect old age, the individual holds the responsibility for choosing the investment line in which to allocate the contributions made, and he can choose from sub-funds that offer different combinations of financial securities. This decision is probably the most important financial choice that enrolled individuals will make in their lives, but how is it made? When Nobel laureate in economics Harry Markowitz, the theorist of mean-variance analysis, was asked how he invested his retirement savings, he replied, "I should have calculated the historical covariances of the asset classes and drawn an efficient frontier. Instead, ... I split my contributions fifty-fifty between bonds and stocks." (p.6 Benartzi and Thaler, 2007) .

If even the founder of modern portfolio theory demonstrates such a lack of diligence, then it is well worth investigating the behavior of all individuals. Often the regulator's attention is focused on how individuals may not understand the risks involved in their investment choices, and therefore they may tend to protect them from excessive exposure to securities with very volatile returns, but underinvestment in equities is a risk too. The resources accumulated over the course of one's working career, especially by individuals with a low to medium income, may be insufficient if not properly invested.

Observing the Italian data published by COVIP (2021) , on average less than 10% of the members of a complementary pension fund invest in the equity sub-fund, while more than half of the members invest in bond or guaranteed lines. Observing only the component of equities in the portfolios, it can be seen that only for young individuals (<25 years of age) the allocation in equities is close to 40%, while for other subjects it is on average 30% up to the age of 50 and then falls to 10%. These percentages, far from the 50-50 cited by Markowitz, highlight a clear problem of underinvestment in the stock market.

Starting from these data, we conducted an experiment to study the effect of different representations of returns in investment in risky securities. In fact, according to the evidence presented in the literature, the ways in which the individual learns the distribution of returns can affect not only the allocative choice, but also the ability to understand the properties of the distribution itself. The experiment we conducted did not record a significant effect of the proposed treatments, but it can nevertheless provide insights to pursue this analysis in the specific field of Italian pension funds. We believe that the main purpose to be pursued is to design useful tools to support individuals in their investment choice, so that they can consciously choose the best asset allocation consistent with their preferences, without falling into the traps of decision bias.

This thesis is organized as follows. In Chapter 2, the main characteristics of the Italian pension system are presented; first, the historical evolution of the public system and the main mechanisms governing an NDC model are presented, highlighting the specifics with which this model has been applied to Italy. An analysis is then conducted on the trend of the main demographic and economic variables that can condition the stability of the pension budget. The focus then shifts to forms of complementary pensions, presenting the general functioning of the second pillar with a focus on data regarding enrolment rates, average contribution and investment decisions.

In Chapter 3, a brief analysis was conducted of the evidence in the literature in the field of savings and investment choices. Initially, we concentrated on the classic models of the Life-Cycle and Mean-Variance analysis, and then we highlighted the limits identified in their ability to explain a phenomenon observed in reality, that is, the equity premium puzzle. Next, one of the explanations identified by behavioral finance was proposed, namely the Myopic Loss Aversion, and the different experiments that have been conducted on the basis of this explanation. Particular attention was paid to the different types of interventions that can be informed by behavioral economics, and the importance of making individuals more competent in the domain of financial decisions.

Chapter 4 describes the experiment we conducted, with the experimental hypotheses and main features, and the results that were obtained, discussing them. Finally, Chapter 5 presents the conclusions of this work, proposing a possible future direction with which to increase participants awareness of their investment choices, allowing the to better understand the relationship between the allocation to risky securities and subsequent returns in the medium and long term, without run into the errors generated by myopic loss aversion.

Chapter 2

The Italian pension system

The Italian pension system is founded on three pillars: the first pillar is the public, compulsory, pension scheme, the second and the third are private, voluntary, systems based on collective or individual subscription. (Paci et al., 2010).Nowadays the public system is designed as an unfunded pay-as-you-go scheme, where pension benefit depends on the total contribution paid during working years. For years the compulsory system has guaranteed high replacement rates, as a result the public expenditure for pensions have risen to unsustainable levels and reforms were needed to re-balance the public budget (Franco and Sartor, 2006).

The reforms introduced from the mid 90s followed two main directions: an increasing in the required age to reach retirement and the shifting from a calculation method based on salaries to a method based on contributions (Franco and Sartor, 2006). These reforms lead to lower replacement rates, especially for some categories of workers like self employed workers, young subordinate employees and temporary or precarious workers (Paci et al., 2010). Consequently, the second and third pillars gain importance for an important part of the population, since the public pension will not guarantee the level of income needed to maintain a desirable, or sometimes even decent, lifestyle.

This chapter is organized as follow: the first section describes the historical origins of the public pension system, its general functioning and, by presenting different data, it presents the main issues related to the long term stability of the system. Section two describes the general functioning of complementary pension funds with a focus on the data regarding enrollment rates, average contribution and investment decisions.

2.1 The public pension system

2.1.1 Historical overview

The political discussion on a public pension system started in Italy right after the unification of the country, but it was not considered as a priority in the first decades of government due to the lack of resources and the rule of the liberal thinking in the Italian political system. In the last years of the 19th century the social problems arising from the phenomena of industrialization and urbanization accentuated the need to encourage savings among workers (Ferrera et al., 2012).

The first pension scheme was introduced in Italy in 1898, with the "Cassa nazionale di previdenza per l'invalidità e la vecchiaia degli operai", which was instituted with the Law No. 350/1898. Inspired by liberal principals, workers could choose to register to the fund freely, also the contribution level was left to the free choice of individuals, and there was a state contribution deriving from a share of the profits made by the Post Office Saving Banks (Morselli, 2018). The project of entrusting the protection of old age to free private insurance, subsidised by public authorities, proved to be very weak: on the eve of the First World War enrolment reached only half a million people. After the war the country was experiencing different social emergencies, and a substantial consensus over the introduction of compulsory pensions emerged within political parties (Ferrera et al., 2012). In 1919, the legislative Decree of the King's Lieutenant No.603 established the old age insurance compulsory for all private workers, and appointed the existing Cassa Nazionale, already quoted, to collect and manage the contributions (Morselli, 2018).

The pension scheme was designed as a capitalization system, where a fixed amount of the salary was transferred to the fund and invested. In order to obtain the pension, some requirements must be respected: a minimum age of 65 and a minimum tenure of 12 years (Ferrera et al., 2012).The capitalization system was chosen for being simpler and less expensive than the pay-as-you-go scheme. Indeed it foresaw a surplus in the first years given by the first contributions and then a balance between the positive assets,contributions and returns from investments, and the liabilities, pensions and administration costs (Morselli, 2018). This system worked until the great financial crisis of the 30s, the economic depression broke irreparably the monetary stability, which was a condition needed to maintain the capital-funded scheme. Due to inflation, which grew further during World War II, the real value of the reserves dropped, and so the value of pensions: the average value of old age pension shifted from 25.440 lire in 1934 to 2.850 lire in 1944 (Morselli, 2018).

After the war, in a context doomed the by monetary and economic crisis, Italian governments decided to gradually overcome the capitalization scheme, adopting a pay-as-you-go scheme. The strength of this scheme was its immunity to inflation: no more reserves were needed since the revenues from current contribution were used to paid current pensions. The transition from one system to the other was made gradually, as a result pensions might be paid immediately, and also adjusted at the present cost of living, thanks to the new contributions and the residues of the previous system (Morselli, 2018). The progressive shift ended the 1st may 1970. The choice of the pay-as-you-go scheme determined the end of the private insurance view of the welfare, and introduced the modern principle of a social assistance based on individual needs where the government takes on some of the economic burden (Ferrera et al, 2012).

In this context, the eligibility requirements were lowered: the minimum age was set at 55 for women and 60 for men. In 1968-1969 another major change was introduced: the earning-based method of calculation. This method linked the pension benefits with final salaries, and it was aimed to reach a replacement rate of 80% with 40 years of work. With the law No.153/1969 it was introduced a *social pension* directed to all the citizens with more than 65 years old that were in need. This final change complete the transformation of the Italian pension system from the original bismarckian pension system to a universalistic one where not only workers, but also poor elderly are protected(Ferrera et al, 2012).

Before the reforms carried in the 90s, the main characteristics of the Italian pension system were:

- The system was funded with a payroll tax shared between the employer (2/3 of the contribution) and the employee (1/3 of the contribution).
- Eligibility requirements were 55 years form women and 60 for men, and a minimum tenure of 15 years was required. However, it was possible to retire after 35 years of contribution in the private sector (20 in the public sector) without paying any extra cost.
- Benefits were computed in this way: each year worked entitled a 2% of the average final salary, after 40 years the benefit would be the 80% of the pensionable earnings. A minimum benefit was granted.

In the early 1990s, it became clear that the pension system needed to be reformed. Three factors of instability can be identified in the system (Franco and Sartor, 2006). First, pension spending was largely contributing to the imbalance of the italian budget, its value grew from 5.0 percent of GDP in 1960 to 14.9 percent

in 1992, and forecasts predicted an increase to 25 percent in 2030. Second, the possibility to leave the labor market after 35 years of contribution tended to foster early retirement and then undeclared work to avoid paying contributions. Due to this facilitation, the employment rates for older men and women were very low. Finally, the rate of return on contribution resulting from the earning-based method was extremely unfair, it worked in favor of those whit higher salaries at the end of their careers.

The first reform occurred in 1992, with the Legislative Decree No. 503/1992, in the urgent need to stop the undisputed growth of the deficit. The main changes introduced by the reforms are related to the retirement age, which was raised to 60 for women and 65 for men, and the reference period for calculating pensionable earnings, that shifted from the last five to the last ten years of working. Furthermore, the minimum tenure required was raised from 15 to 20. This reform reduced the net pension liabilities of a quarter: from the 387 percent to the 278 percent of the GDP (Franco and Sartor, 2006). Despite this huge reduction, further measures were necessary to balance the public spending in Italy.

The law No.8/1995, following the direction taken three years before, changed the Italian pension system significantly with the adoption of a notional defined contribution scheme, that introduced a strong link between contributions and benefits. Workers could choose to retire between 57 and 65 years old, as long as the pension was at least 1.2 times higher than the welfare benefit for elderly people. The minimum tenure required was reduced to five years, but also the guaranteed minimum pension level was abolished. The introduction of the notional defined contribution scheme was aimed at making the system fairer, by removing the advantages granted to workers with growing careers. These new rules were gradually introduced, workers with more than 18 years of contributions before 1995 would have continued to benefit from the earning-based scheme (Franco and Sartor, 2006).

Several small changes were made in the early 2000s, but the current pension system in Italy derives primarily from the Monti-Fornero reform of 2011. The Law Decree No. 201/2011 established the extension, from that moment, of the contribution based system to all workers, even the ones that were excluded by the Dini reform, and accelerated two important projects: the adjustment of age requirements to life expectancy and the harmonization of different treatments for workers in the private and public sectors, as well as workers of different sexes.

2.1.2 The design of the current system

As already mentioned, the Italian pension system has adopted a contribution based-scheme. The scheme is based on personal virtual accounts where contributions are deposited during the working life, and then withdrawn as pension annuities. NDCs schemes pursue the following goals (Gronchi et al., 2019):

1. Fairness: the value of the expected pension annuities must be equal to the value of contributions gross of interests matured. This must hold for every career patterns and retirement age.

2. Sustainability: equivalence over time between pension expenditures and revenues, which depends on the contribution rate established by the policy maker.

3. Flexibility: freedom to choose the retirement age preferred from an interval set by the policy maker, given the respect of some fixed requirements and the link of benefits to life expectations.

Gronchi et al. note that the first goal implies the exclusion of any redistributive flows, besides those coming from the resources transferred from individuals who live less than their life expectancy to individuals who live longer. Another important issue is that the effective ability to reach these goals depends on different political decisions: the contribution rate, the way in which interest rate is determined, the forecasting of life expectancy and how often it is updated.

The Italian pension system, inspired by the NDC model, presents specificities deriving from the political decisions taken. The following section summarizes the main features.

Retirement rules. In 2022 the minimum age for old-age retirement (pensione di vecchiaia) is 67 years of age, equal for all men and women in the private and public sectors or for self-employed. In addition to the age requirement, workers must have paid contributions for at least 20 years. Moreover, the value of the pension benefits must be greater than 1.5 times the value of the social allowance, which in 2022 corresponds to 6,809.79 euros per year If these targets are not met together, workers cannot be eligible for pension benefits, but the constrain expires when individuals reach an age of 71 years if they have at least 5 years of contributions. All workers can also access to earlier retirement (pensione di anzianità) if they have at least 42 years and 10 months of contribution for men, and 41 years and 10 months of contribution for women. This requirement is independent of age and is adjusted over time to changes in life expectancy. Finally, the Italian government introduced in 2019 an experimental measure, called "Quota 100," which allows people to retire

at 62 years of age with 38 contributions. In 2022, "Quota 100" was superseded by "Quota 102," which allows workers to retire with at least 64 years of age and at least 38 years of contributions.

Contributions. For employed workers, the rate allocated to the pension fund is the 33%, of which 27% is charged to the employee and 73% to the employer. There is a salary limit above which no extra contributions are due.The ceiling is revalued annually on the basis of the price index, and for 2022 it is 105,014 euros. For self-employed workers the rate equals 24% of the business income for artisans and retailers and 25,98% for the VAT number holders.

Rate of return. The amount of contributions paid is revalued each year on the basis of the capitalization rate resulting from the average five-year change in GDP, computed by ISTAT. Inflation is also considered, but full indexation is valid only for the lowest pensions, while it is partial for pensions of medium-high amount. Among the last twenty years conflicting indexation measures have been taken with the aim to produce savings, and in certain years pensions did not receive any equalization, consequently producing a structural reduction in their value.

Calculation methods. According to Law No. 335/95 pension computation is based on three methods: earnings-based, contribution-based and mixed (Paci et al., 2010).

- Workers that had at least 18 years of contribution at the end of 1995, and that retired before 2012, have their pension calculated with the earnings-based method. Pensionable earnings are defined as the average salary for the 10 years prior to retirement. These pensionable earnings are multiplied to a yield rate, equal to the 2% of salary for each year of contribution. For example, for an individual with 37 years of contribution and a 2% yield rate, the amount of his pension would be equal to the 74% of the pensionable salary.

- Workers with less than 18 years of contribution, or that did not retire before 2012, have their pension calculated with a mixed pro-rata scheme. Pension benefits are obtained considering two components: the first computed with the earnings-based method for the years worked before 1995, and the second computed with the contribution-based method for the remaining years.

- For individuals who entered the workforce after 1995, the contribution-based scheme is in force. According to this scheme, when workers retire, a transformation coefficient, increasing with age, is applied to the total amount of contributions, revalued with a rate linked to the GDP five-year trend. For example, an individual with a contribution amount of €200,000 who retires

at age 67 will have a gross annual pension of €200,000 multiplied by the respective coefficient (5,575% for the for the biennium 2021-22).

*Transformation coefficients.*These coefficients are established every two years (before 2019 they were updated every three years) according the most recent life expectancy estimates.Table 2.1 presents the transformation coefficients for the biennium 2021-2022

Table 2.1: Italian transformation coefficients for the biennium 2021-2022

Retrirement age	Coefficient
57	4,186%
58	4,289%
59	4,399%
60	4,515%
61	4,639%
62	4,770%
63	4,910%
64	5,060%
65	5,220%
66	5,391%
67	5,575%
68	5,772%
69	5,985%
70	6,215%
71	6,466%

Source: *The Italian pension system: financial and demographic trends of the pension and welfare system in 2020*, Report n.9, 2022

The reasoning behind these coefficients is that the later you retire, the higher the coefficient and consequently the pension check will be, since the government will pay it for a shorter period of time. Therefore, they could incentivize postponement of retirement. On the other hand, the fact that Italian coefficients are applied to all individuals that retire in a given biennium, regardless of the year of birth, produces inequalities and violates the the fairness principle of NCDs schemes (Gronchi et al., 2019). Disparities arise both between and within cohorts. It set different mortality rates to individuals with the same age that do not retire in the same years. Consequently, if we predict a progressive increase in the mortality beliefs, Mr. Rossi, born in 1960, who will retire in 2024-25 at 64-64 will benefit of a lower coefficient with respect to Mr. Bianchi, born in the same year who will retire in 2026-27 at 66-67. The same reasoning can be carried forward in the case where two individuals with different ages retire in the same biennium.The mortality rates assigned to Mr. Verdi, born in 1958 who retires in 2024-25 at 66-67 will be the same

assigned to Mr. Bianchi. This approach produces unfairness and uncertainty, as a result early retirement is encouraged: workers are afraid that increasing divisors would nullify the sacrifice of prolonging work to reach higher pensions (Gronchi et al., 2019).

Replacement rates The gross replacement rate expresses the ratio between the annual amount of the first pension and the annual amount of the last salary, or work income.This indicator measures the variation in the worker's gross income in the transition from the active phase to retirement. With the same working career, it reflects the differences linked to the different ways of calculating the pension, and as already mentioned, the introduction of the contributory-based system has decreased the replacement rate (Paci et al., 2010).

Table 2.2 and 2.3 show the forecasts of replacement rates carried out by the Ministry of Economy and Finance. The replacement rates are estimated for two different types of workers, corresponding to employed and self-employed.The temporal comparison underline the effects of the gradual introduction of the contribution-based calculation system and the periodic revision of transformation coefficients: an individual employed in the private sector, that would have received in 2010 a pension equal to 73.6% of final salary, in 2070 will see his transformation rate reduced to 60.%, with the same contribution path (first row of the table). A similar reasoning holds also for self-employed: the replacement rate suffers a contraction of 23 points, falling from 72.1% in 2010 to 55% in 2020 and then 49.2% in 2070. If we consider the hypothesis linked with the old-age pension (second row), it can be observed that replacement rates, especially for employees, record higher and more sustainable values, but conditional on a retirement age above 70 years.

Table 2.2: Forecasts of first pillar gross replacement rates for employees, percentage values

	2010	2020	2030	2040	2050	2060	2070
				38 year of contribution			
Baseline scenario	73,60%	71,90%	64,60%	58,30%	59,60%	60,70%	60,80%
Age	(65+4m)	(67)	(67+9m)	(65+8m)	(66+6m)	(67+2m)	(67+10m)
				Age-indexed contribution years			
Old Age pension	68,40%	70%	64,20%	65,60%	68,50%	70,80%	72,60%
Age	(65+4m)	(67)	(67+9m)	(68+8m)	(69+6m)	(70+2m)	(70+10m)
Years of contribution	35+4m	37	37+9m	38+8m	39+6m	40+2m	40+10m
				Age-indexed contribution years (Hired after 1/1/1996)			
Earlier retirement	-	-	53,00%	54,90%	57,50%	59,40%	60,60%
Age	-	-	(64+9m)	(65+8m)	(66+6m)	(67+2m)	(67+10m)
Years of contribution	-	-	34+9m	35+8m	36+6m	37+2m	37+10m

Source: *Italian Ministry of Economy and Finance*

Table 2.3: Forecasts of first pillar gross replacement rates for self employed, percentage values

	2010	2020	2030	2040	2050	2060	2070
				38 year of contribution			
Baseline scenario	72,10%	55,00%	44,90%	44,70%	47,70%	49,00%	49,20%
Age	(65+4m)	(67)	(67+9m)	(68+8m)	(69+6m)	(70+2m)	(70+10m)
				Age-indexed contribution years			
Old Age pension	67,60%	53,00%	44,40%	45,40%	49,30%	51,60%	52,80%
Age	(65+4m)	(67)	(67+9m)	(68+8m)	(69+6m)	(70+2m)	(70+10m)
Years of contribution	35+4m	37	37+9m	38+8m	39+6m	40+2m	40+10m
				Age-indexed contribution years (Hired after 1/1/1996)			
Earlier retirement	-	-	35,30%	38,40%	41,70%	43,20%	44,10%
Age	-	-	(64+9m)	(65+8m)	(66+6m)	(67+2m)	(67+10m)
Years of contribution	-	-	34+9m	35+8m	36+6m	37+2m	37+10m

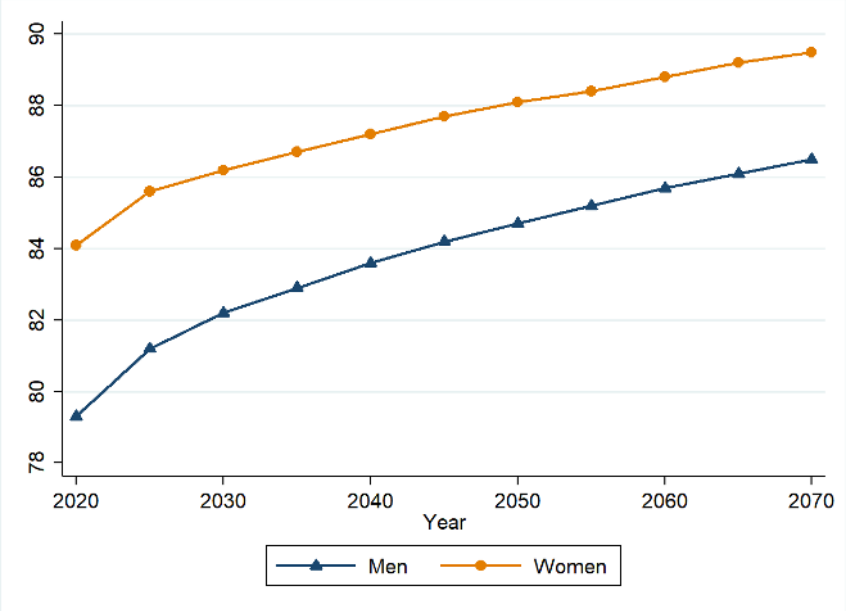
Source: *Italian Ministry of Economy and Finance*

2.1.3 Demographic data and long term stability of the public system

This section presents data on key demographic and economic indicators that affect the stability of the pension system. Long-term balance is influenced both by demographic trends, related to the ageing of the population and the decrease in births, and by the economic dynamics of the labour market and public finances.

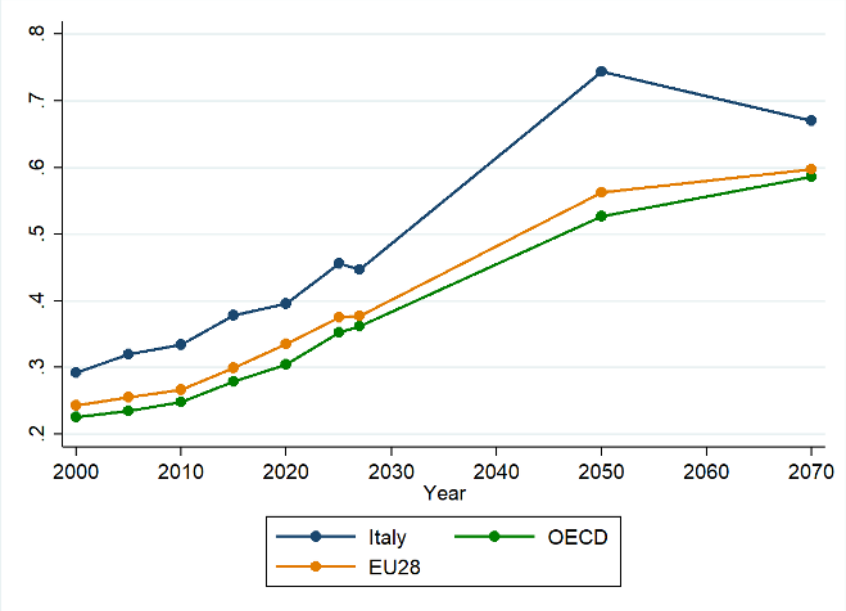
Life expectancy and population aging. Figure 2.5 shows the life expectancy forecasts for women and men elaborated by ISTAT. The trend, common to all OECD countries, is clearly increasing: by 2070, life expectancy at birth for women is estimated to be nearly 90 years for women and 87 for men. It reflects the rising living standards and the greater access to high quality health services (OECD, 2021). The gender gap in life expectancy at age 65 is predicted to be between almost two and four years in favour of women in nearly all OECD countries in 2060-65, and this factor may also negatively influences the amount of the pension allowance for female workers: longer life expectancy leads, in an NDC scheme, to a lower pension. The old-age is the ratio of the number of people older than 64 relative to the number of people in the working-age (15-64 years), Figure 2.2 represents the estimates of the average value for the OECD countries, the countries of the European Union and Italy. This indicator, too, is projected to follow an upward trend until 2050, when it reaches for Italy a value of more than 70% (more than 7 elderly people every 10 working-age individuals). The values estimated for Italy are higher than those of the OECD and the European Union for the entire period under consideration.

Figure 2.1: Predictions of life expectancy at birth in Italy, 2020-2070



Source: *Our elaboration on ISTAT data*

Figure 2.2: Old-age dependency ratio, Total Percentage, 2000 – 2075

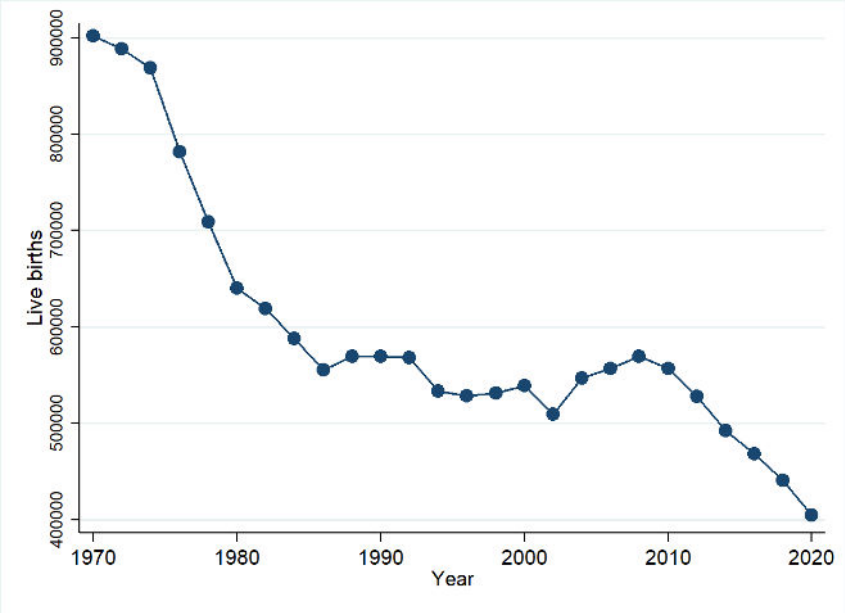


Source: *Our elaboration on OECD data*

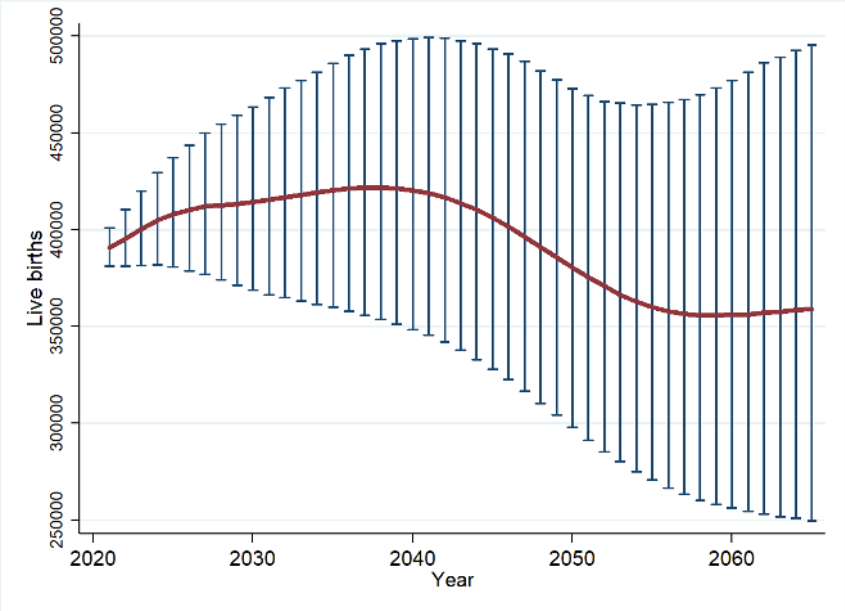
Fertility and births. The fertility rate and the number of births are crucial variables in determining the demographic balance of a country, and therefore those of a NDC scheme. As can be seen in Figure 2.3a , since the 1970s the decline in live births has been very pronounced, and the stabilization of the 2000s was interrupted by the economic crisis of 2008, from which the trend turned negative again. The projections made by the Italian Statistical Institute, and presented in Figure 2.3b confirm the trend: according to the median scenario, once the short-term shock

imposed by the pandemic has been overcome, births should undertake a trend of slight recovery, reaching 414 thousand in 2030 and a maximum of 422 thousand by 2038. After that, the number of births should stabilize in a range around 350 thousand units.

Figure 2.3: Live births in Italy, historical data and projections



(a) Historical data, 1970-2020



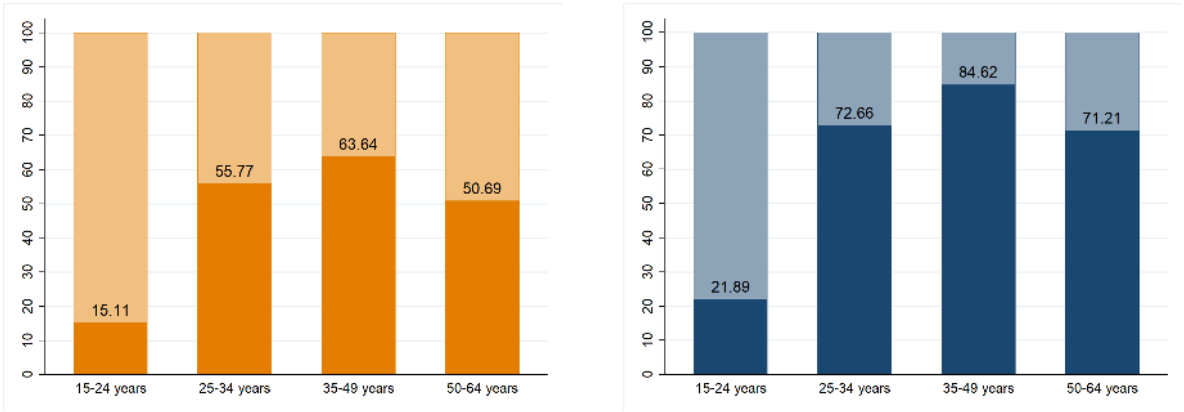
(b) Projections, 2020-2065 (90% confidence interval)

Source: *Our elaboration on ISTAT data*

Labour market. Beyond demographic indicators, the occupation rate is another crucial indicator of pension system stability. Workers are those who pay the contributions needed to pay current pensions. Italy in 2020 has an employment rate of 58.08%, a level lower than the OECD average (OECD, 2021). Figure 2.4a presents

employment rates by gender in Italy in 2020, with further classification by age group. High employment differences between men and women lead to large differences in pension entitlements, especially as employment gender gaps have historically been even wider (OECD, 2021). Although in the last 10 years the employment rate among women, as opposed to men, has increased (from 46% in 2010 to 49% in 2020), in the three main cohorts the female rate is still 20% lower than the male rate.

Figure 2.4: Occupation rates for age cohorts in Italy, 2020



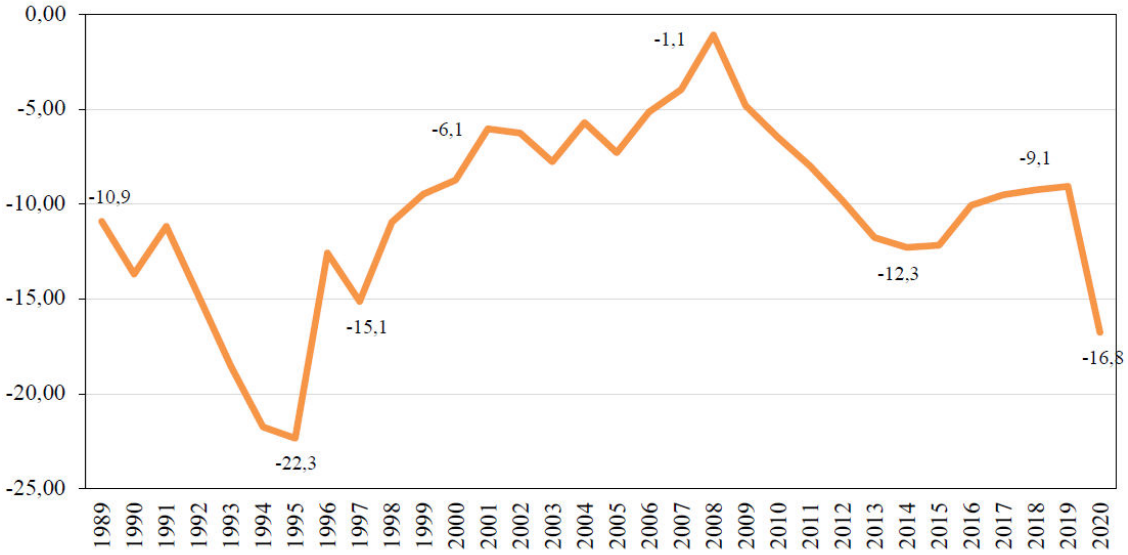
(a) Females (b) Males

Source: *Our elaboration on ISTAT data*

Pension spending. In 2020, spending on social security benefits in the mandatory system amounted to 234.7 billion euros, an increase of 4.5 billion euros (+1.95%) compared with 2019 . The negative effects on incomes and employment caused by the pandemic had a significant impact on contributions which, with a total of 195.4 billion euros, fell by almost 14 billion euros compared with the previous year(-6.7%). Due to these trends, in 2020 the balance between contributory income and pension expenditure was negative by 39.3 billion euros. If welfare spending is added, the negative balance of the compulsory system not financed by contributions, charged to general taxation, rose to 79.3 billion euros, 20.7 billion euros more than the previous year, with an incidence of 4.8% of GDP. (Itinerari Previdenziali, 2021). Figure 2.5 shows the ratio between the deficit registered every year and pension expenditure in the period 1989-2020.Although operating results have worsened greatly in the years of the economic crisis (from just over 1% in 2008 to 12.3% in 2014) or in 2020 due the covid-19 pandemic (-16,9 %), the deficit registered in the early 1990s before the reforms (22,3%) has not been reached anymore. By the years pension expenditure has been slowed down by the different reforms, but a much more unstable trend in contributions has occurred, with variations that have fluctuated in line with GDP trends. Therefore, it can be said that the more contained increases in pension expenditure have had a significant positive impact on the operating balances, but the latter have been negatively conditioned by the lack of contributory revenues

due to GDP fluctation (Itinerari Previdenziali, 2021).

Figure 2.5: INPS operating deficit as a % of pension expenditure, 1989-2020



Source: *Itinerari Previdenziali Ninth report*

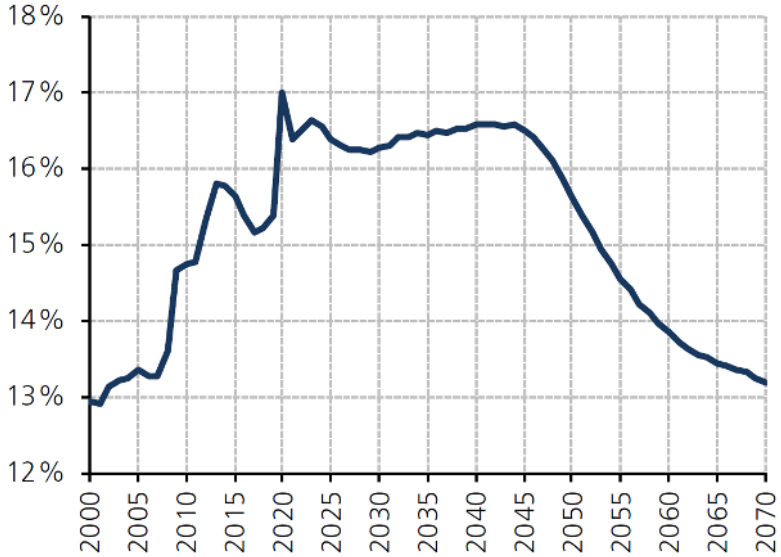
The Italian Ministry of Economy and Finance (MEF,2020) makes annual forecast on the evolution of the pension system, figure 2.6 plots the forecasts on pension expenditure in relation to the GDP. The ratio of pension spending to GDP increases from 2019 through 2024, with a peak in 2020. Spending increases significantly due to the decrease in GDP related to the pandemic. After that, there is a three-year period of stability followed by a decade of further spending growth, which rise from 16.1 percent in 2026 to a peak of 17.4 percent in 2036. After that maximum, the ratio begins to decline until 2045, when it reaches a level of 17.0 percent. In these years, the growth in the ratio is due to the higher number of pensions as the baby-boom generation enters retirement. After 2045, the ratio of pension expenditure to GDP rapidly begins to decline until it converges to 13.4 per cent in 2070. This reduction is determined by the general application of the contribution-based calculation method and the stabilization of the ratio between the number of pensions and the occupation rate. The estimation is based primarily on the following assumptions:

- Increasing fertility rate, from 1.3 in 2020 to 1.6 in 2070;
- Increasing life expectancy for both sexes over the period;
- A net migration flow attested at an average annual level of 162 thousand units.
- Growing productivity with a rate of approximately 1.5% per year;

- Real GDP growth rate around an average annual value of 1.1%;
- Increasing occupation rate in the 15-64 age group, from 58.8% in 2020 to 64.9% in 2070. This increase is mainly due to the growth of employment in the female population and the increase in the retirement age.

In conclusion, the unsustainability of public spending on pensions has led to numerous reforms since the 1990s, which mainly introduced the contribution-based calculation method and progressively changed the requirements for retirement. The current system, according to estimates made by the Ministry of the Economy, can be maintained in equilibrium through the indexation of pension requirements with life expectancy and the lowering of the replacement rate according to contributions paid and age at retirement. In addition, an important role is played by the continuous growth of the economic system. This requires a positive immigration balance, an increase in the employed population and a growing gross domestic product that provides a stable flow of contributions necessary to pay pensions.

Figure 2.6: Projections of public expenditure for pensions in relation to GDP, baseline scenario



Source: *Italian Ministry of Economy and Finance*

2.2 The private pension scheme

This section presents the main characteristics of the Italian complementary pension system. The first subsection describes the general functioning of the second and third pillar and the most important regulatory aspects, the second subsection presents market data and on enrollment and contributions, with a focus on financial management.

2.2.1 Legislation and general functioning

Private retirement funds, the so called "Pre-existing funds, were established even before the introduction of a systematic legal framework on pension schemes. These funds were introduced by private institutions like banks and insurance companies as benefit programs intended for internal employees. Since no legislation existed at time, they operated autonomously. Nowadays, they are closed to new participants (Paci et al., 2010).

A comprehensive legislation was first established in 1993, with the Legislative Decree No. 124/93, in the following years further changes were introduced, including tax relief, to incentivize participation. The law currently in force is the Legislative Decree 252/2005. According to this legal framework, the basic structure of supplementary pension funds is based on funded schemes where the individual, who voluntarily joins, pays contributions which are invested in financial markets by institutional managers (like banks, SGRs, insurance companies). At the moment all pension funds are defined as contribution schemes, and they are financed through contributions from both the employee and the employer, and through the TFR, which will be discussed later. The activities of the funds are supervised by a specific authority, the Commissione di vigilanza sui fondi pensione (COVIP). There are three types of pension schemes (Paci et al., 2010):

- *Closed Pension Funds.* Closed, or negotiated, pension funds are set up on the basis of collective contracts and agreements on the initiative of the social parties (i.e. representatives of workers and employers), and constitute an autonomous legal entity with its own social bodies. Membership is voluntary but on a collective basis. This means that to be eligible, the worker must belong to a certain collective agreement, which may be national, regional or defined by the individual company. Dependent family members can also join, if this is allowed by the statute of the fund. Both own contributions and employer contributions are provided. The management of the financial assets is entrusted to parties external to the fund. This type of fund is non-profit, which leads to lower costs with a competitive advantage over other forms.

- *Open Pension Funds.* Open pension funds are established by banks, securities brokerage companies, insurance companies and asset management companies, and constitute an autonomous legal entity with respect to the instituting company, with its own corporate bodies. Membership is voluntary both on an individual basis, therefore any individual can join, and on a collective basis, when membership is provided by labour contracts. Dependent family members can also join. Both own contributions and employer contributions

are provided. The management of the financial assets may be carried out directly by the fund or may be entrusted to external parties. This type of fund is for-profit, which on average entails higher costs than negotiated funds, but often offers in exchange more services to the individual.

- *Individual Pension Plans.* Individual pension plans (Italian abbreviation "PIP") are set up by banks, securities brokerage companies, insurance companies and asset management companies, and constitute an autonomous legal entity with respect to the instituting company, with its own corporate bodies. Membership is voluntary and on an individual basis, therefore any individual can join. The choice of how much to contribute lies with the adherent, but there is no contribution from the employer. The management of the assets is usually the responsibility of the instituting company, but may be entrusted to external parties. This type of fund is also for-profit, which on average means higher costs than other funds, but PIPs often offer more services to the individual in return.

Given these differences, open and closed pension funds and individual plans have many shared characteristics, which are now presented.

Investment rules. Whichever supplementary form is chosen, the contributions paid are invested in the financial markets. Given the economic and social purpose of guaranteeing a supplementary income in retirement, the resources invested by pension funds must follow precise rules of prudence, in order to avoid that future benefits will be too low. The financial management of pension schemes is regulated by Decree No. 703/96 for open and closed pension funds, and Decree No. 209/05 for PIPs (Paci et al., 2010). According to the first Decree, pension funds operate so that their resources are managed in a safe and prudent manner, pursuing objectives of: diversification of investments and efficient portfolio management, diversification of risks, containment of transaction costs, maximization of net returns. Investments are allowed in bonds, equities, closed end funds, derivatives and cash and bank deposits, real estate investment is approved only via real estate closed end funds. Individuals can choose how to invest their contributions in four main investment sub-funds, whose characteristics as described by COVIP are as follows:

- Guaranteed Fund: It guarantees a minimum return or repayment of the capital paid in, invests primarily in cash and bonds.
- Bond Fund: Investments are only or mainly in bonds.
- Mixed bond Fund: Invests in equities but not more than 30 percent.
- Balanced fund: Invests in stocks and bonds in approximately the same percentage.

- Equity Fund: At least 50 percent of assets are invested in stocks.

Benefits. Contributions deposited in the fund are accumulated year by year and, together with the returns obtained from the investment, constitute the final amount that will be transformed into an annuity when retirement is reached. In some specific cases, it is possible to obtain an advance payment on the capital even before retirement. For private sector workers, it is possible to ask for an advance of up to 75% of the position at any time for the purchase or renovation of their first home, or after 8 years up to 75% of the position to incur healthcare expenses, or after 8 years up to 30% of the position for any reason. At retirement, fund participants can choose between three alternatives (Paci et al., 2010):

1. A monthly life annuity calculated on the basis of the accrued position and other criteria such as the member's age, gender, life expectancy.
2. Benefit from 50% of the position immediately in the form of a lump sum, and the remaining part as a life annuity.
3. In the case where the annuity calculated on 70% (50% for public sector) of the amount is less than 50% of the social allowance (2.991 € in 2021) for the reference year, it is possible to have the entire position accrued liquidated in the form of a lump sum.

All forms of pension schemes have the option to buy an annuity, usually closed and open funds outsource this service, while insurance companies promoting PIPs offer their own products. Many types of annuity are provided (Paci et al., 2010): Single lifetime, reversible, certain for 5 or 10 years, lifetime with reimbursement in case of death, lifetime, increased in case of long term care. It is important to note that annuity options that offer greater long-term guarantees also have higher costs, and therefore pay lower monthly amounts. Not all funds offer the same options, which is why the possibility of transferring the position to other funds free of charge after two years of membership has been introduced.

Fiscal treatment. With the aim of encouraging adhesion to forms of supplementary pension, the Italian government has designed a system of tax benefits. A ETT (exempt/taxable/taxable) scheme of taxation has been adopted (Paci et al.,10). This implies that contributions are tax exempt, while returns from investment and benefits are taxed. Contributions paid by the employee and employer to the pension fund are deductible up to a maximum limit of €5,164.57. In addition, for workers hired after January 1, 2007, from the 6th to the 25th year in the pension fund it is possible to recover the deductibility that was not used in the first five years, thus the deduction limit increases to €7,746.86 per year. The tax rate is 20% on returns

from financial securities (as opposed to 26% for non-pension fund investments) and 12.5% on returns from government securities and equivalents. The expected tax rate on both lump sum payments and annuites corresponds to 15%, with a reduction of 0.30% each year after the 15th, up to a minimum of 9% by the 35th year of membership.

Finally, an interesting aspect of the Italian private pension system is the choice on how to allocate the TFR. Law No. 297 of 29 May 1982, reforming previous legislation, established the severance indemnity fund (TFR), which consists of a sum set aside annually by the employer and paid to the employee when the contract of employment ends. The amount is equal to 6.91% of the gross annual salary, corresponds approximately to a monthly salary, and every year, if left in the company,it must be revalued at a rate resulting from 1.5% + 75% of annual inflation. The measure was created with the intention of providing coverage for the worker in the event of a prolonged period of unemployment after his or her last work experience (Paci et al., 2010). Since 2007, in companies with fewer than 50 employees, within 6 months after hiring, the workers of private sector must decide what to do with his or her severance pay: leave it in the form of liquidation in the company or deposit it in a pension fund. In the absence of an explicit choice, the mechanism of silence-consent operates: the worker tacitly joins a pension fund. In this case, resources are invested in a guaranteed fund, while if an employee consciously chooses to allocate resources to a pension fund, then he is free to decide on the investment compartment. If the firm size exceeds 49 workers the amount set aside must be transferred to a specific pension fund, the Fondo Tesoreria INPS, consequently employees do not have any choice.

2.2.2 Data on enrollment, contributions and financial management

According the to 2020 annual report published by COVIP (COVIP, 2021), the participation to pension funds reached in 2020, if double adhesions are not considered, 8.4 million members, an increase of 2.2% with respect to 2019. Looking at professional categories, 6 million were employees, 1.1 million were self-employed workers and 1.3 million were "other" members. The corresponding participation rate was 33% of the workforce, but it totalled only 24.1 percent if are excluded the individual accounts that were not fed with contributions. Looking at gender, men are 61.7 percent of members: 73 percent in contractual pension funds, 58.6 percent in open pension funds and 53.5 percent in PIPs. Considering the age distribution, 51.6 percent have an age between 35 and 54, while 31 percent are older than 55 years.

The average age of members is 46.8 years. Considering the type of fund chosen, the distribution of the 8.4 million members was: 3.2 million in contractual funds, 1.6 million in open funds, 3.3 million in "new" PIPs, 617.000 in pre-existing pension funds and 339.000 in "old" PIPs. Total assets under management were 197.9 billion euro (6.7 percent more than the previous year), which correspond to the 12% of Italian GDP. In 2020, contributions amounted to 16.5 billion euro, and 57 percent of these were deposited in an occupational pension funds. The TFR paid into pension funds amounted to 6.5 billion euro. Outflows were 8.6 billion euro: 4 billion euro in pension benefits, out of which lump-sums were 3.4 billion and annuities 600 million, while early withdrawals summed up to 1.8 billion. Main data are presented in the table **??**.

Table 2.4: Private Pension System – Main statistics at the end of 2020

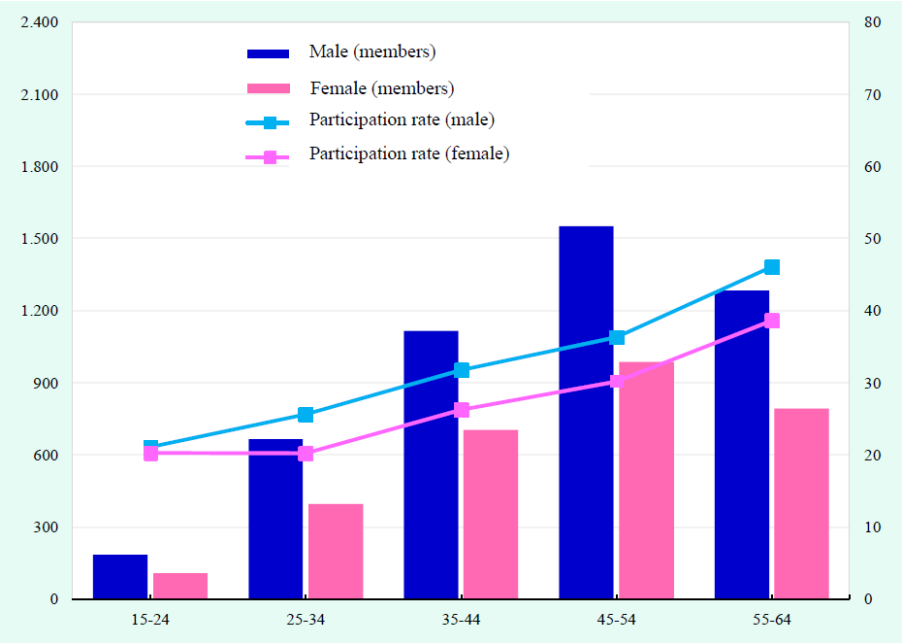
	Pension funds	Individual accounts		Members		Assets	
		Number	var. %	Number	var. %	Amount	var. %
Contractual pension funds	33	3.261.244	3,2	3.184.463	2,9	60.368	7,5
Open pension funds	42	1.627.731	4,9	1.590.319	4,9	25.373	11,1
Pre-existing pension funds	226	647.574	-0,4	616.640	-0,1	66.111	3,6
New PIPs	71	3.510.561	2,7	3.349.337	2,6	39.059	10,1
Total	372	9.047.110	2,7	8.150.559	2,5	190.910	7
Old "PIPs"		338.793		338.793		7.009	
Total		9.341.721	2,5	8.445.170	2,2	197.919	6,7

Source: COVIP 2020 annual report

Members. In the population enrolled in a pension fund in 2020, men represented the 61.7 per cent and women the 38.3 per cent. Compared to 2017, where it was 37.7 percent, there was a slight increase in the female component. The repartition by geographic area shows a prevalence of members in the north (57 percent), while 19.8 percent of members reside in the center and 23.1 in the south. Compared to the labor force, the participation rate is 33 percent, an increase from the 28.9 recorded in 2017. This is due for the effect given by the growth in enrollment and also the decrease, particularly in the last year, in the labor force. As Figure 2.7 shows, the participation rate of men exceeds that of women: 35.5 versus 29.7 percent.This stands for all different age cohorts The lower participation of the women can be linked to the same problems present in the labor market: even if they are employed, they participate in supplementary pensions with a 17% lower propensity. This is due to the wage gap and more discontinuous careers than men, which make it less easy to open and maintain a supplementary pension plan (COVIP, 2021).

Contributions. The contributions made during 2020 were, for all the comple-

Figure 2.7: Private Pension System – Members, workforce and participation rate by age group and gender



End-2020 data; members in thousands of units on the left-hand scale of the y-axis; members as percentage of the labour force on the right-hand scale of the y-axis
Source: *COVIP 2020 annual report*

mentary forms, of a greater value compared to those made in the previous year. Table 2.5 collects the data relating to the contribution in the various funds: in the negotiated funds, the contributions paid were equal to 5.5 billion euros, open funds collected 2.3 billion euros, the "new" PIPs 4.5 billion and the pre-existing funds 3.9 billion. The average per capita contribution stands at 2,840 euros, slightly higher than that of 2019 (2,800 euros). Employees contributed a total of 13.5 billion euros, while the self-employed deposited 1.5 billion euros. The average contribution per member is, however, different: for employees it is 2,840, while for the self-employed it is around 2,550 euros. But beware, this average is heavily influenced by the pre-existing funds, where the average contribution of employees comes to 7,690 euros. The total flow of TFR that was generated in 2020 in the production system can be

Table 2.5: Contribution flows by employment status

	Contractual funds	Open funds	New PIPs	Pre-existing funds	Total
Employees	5344	1524	3613	2990	13478
Of which: TFR	3297	641	1773	822	6538
Self-employed	16	487	42	910	1454
Other members	128	331	247	654	1360
Total	5488	2343	3902	4554	16293

2020 flow data; amounts in millions of euros
Source: *COVIP 2020 annual report*

estimated at around 27.2 billion euros, and of these, 6.5 billion were paid to forms of supplementary pension. Since the start of the reform, the portion allocated to complementary pension schemes has been 75.2 billion euros, which is the 21.6 percent of the total (COVIP, 2021).

Benefits. Last year, the private pension system sustained outflows to the value of 8.6 billion euros, 15 million less than the previous year. Specifically, anticipations totaled 2.6 billion euros, while purchases required had a value of 1.7 billion. Both decreased compared to 2019. In contrast, disbursements of advance temporary supplementary annuities (RITA) and lump-sum pension benefits increased. Lump-sum pension benefits totaled 3.4 billion (419 million more than in 2019). The majority of lump-sum benefits are recorded in the negotiated funds with 1.4 billion euros. Positions transformed into annuities that were transferred to insurance companies amounted to 237 million euros. As a result, it can be said that more than 90% of pension benefits were paid in lump sum.

Table 2.6: Outflows of the supplementary pension system

	Contractual funds	Open funds	Pre-existing funds	New PIPs	Total
Anticipations	817	189	597	234	1837
Purchases	679	149	632	160	1661
RITA	39	33	784	1	857
Lump Sum	1431	341	688	750	3394
Annuities	41	31	149	17	237
Annuities directly delivered			574		574

2020 flow data; amounts in millions of euros
Source: *COVIP 2020 annual report*

Costs. In order to make possible the comparison between different funds, COVIP has developed the Synthetic Cost Indicator (ISC is the Italian abbreviation), which is an indicator aimed at easily communicating all the costs charged to a member over the accumulation phase in percentage of the assets of his individual account. Since negotiated funds are non-profit, only the administrative and financial costs actually incurred by the fund are charged to the members, while in the other forms the expenses charged to the members also serve to remunerate the company in addition to covering the costs. This results in a higher SAI for open pension funds and PIPs than for closed funds. As always when discussing retirement savings, it is a good idea to evaluate the indicators with medium to long time horizons. Figure 2.8 compares the 10-year SAI by fund type and segment, also adding a time comparison of costs in 2008 and 2020. It can be seen that:

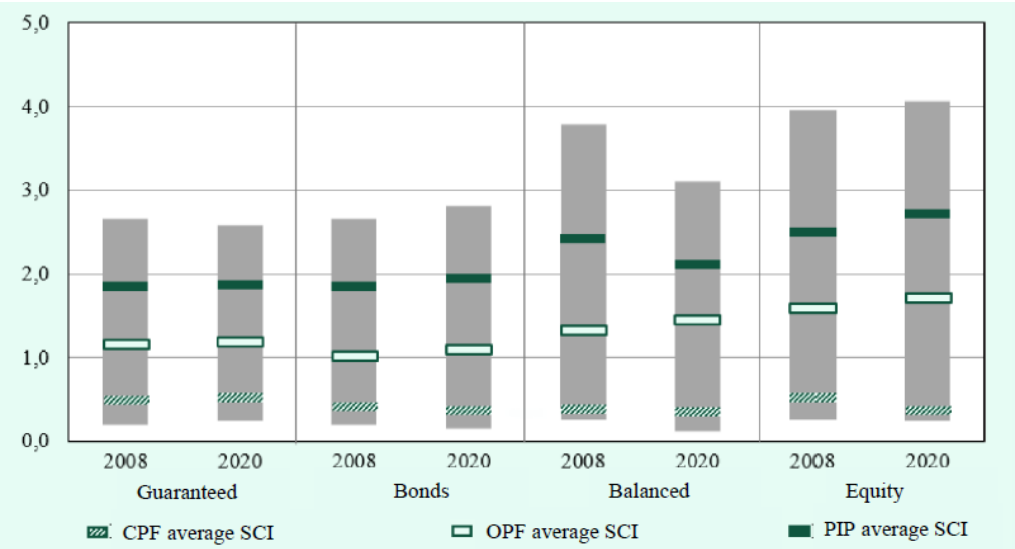
1. The ISC of the negotiated pension funds (dashed green bar) is consistently lower than that of the other pension forms. This finding is valid both in

2008 and in 2020, and for all investment segments. Furthermore, in all the investment options, the products offered by the PIPs are confirmed as the most expensive.

2. As the equity component of the investment compartment increases, the costs charged to the member also increase.

3. Following the 2008-2020 comparison, the average costs have risen for all the investment options offered by the open pension funds, while in the PIPs there are substantially stable values and, finally, in the negotiated funds, with the exception of the guaranteed lines, there has been a decrease for all the investment segments and, in particular, for the equity ones

Figure 2.8: Synthetic Cost Indicator (10 years) in the period 2008-2020 by type of investment sub-fund



Source: *COVIP 2020 annual report*

Asset allocation and financial results. In 2020, aggregate returns, net of management costs and taxation, were on average positive for all complementary pension schemes. The best results were observed in the investment lines with a greater exposure to equities, specifically the returns of the equity sub-funds averaged 5.6% in the negotiated funds and 3.9% in the open funds. Positive results were also recorded by the bond and guaranteed funds. Table **??** presents the avarage return registered, distinguishing by type of pension fund and investment line. In addition to the financial results of the individual year, a long-term investment horizon should be considered in order to best evaluate the returns achieved. Considering a ten-year horizon (2010-2020), all sub-funds recorded positive average returns. Specifically, the sub-funds with a greater equity component have had a greater average com-

pound return than the others, with the best average result obtained by the equity sub-funds of the negotiated funds (5.7%).

Table 2.7: Compound average annual returns, 2000-2020

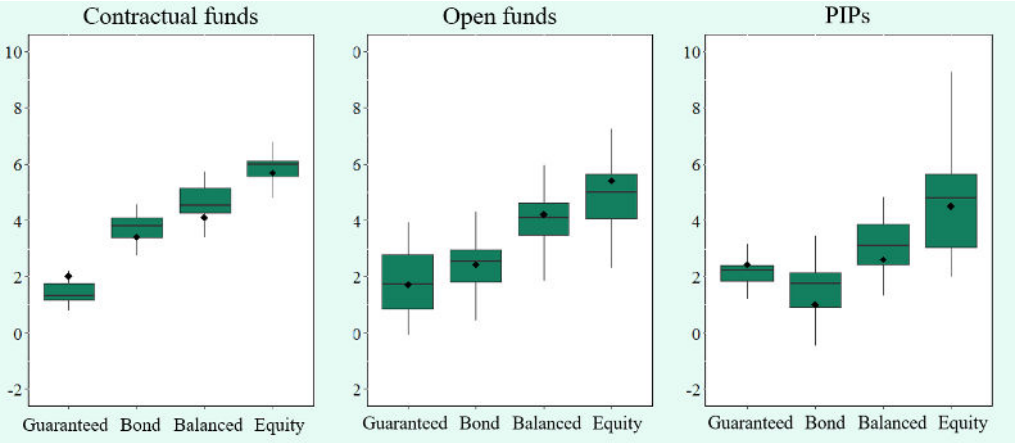
	31.12.2019-31.12.2020 1 year	31.12.2015-31.12.2020 5 years	31.12.2010-31.12.2020 10 years	31.12.2000-31.12.2020 20 years
Contractual funds	3,1	2,6	3,6	3
Guaranteed sub-funds	1,0	0,7	2	-
Bond sub-funds	0,7	0,2	0,8	-
Mixed-Bond sub-funds	3.5	2,8	3,9	-
Balanced sub-funds	3.3	3	4,1	-
Equity sub-funds	5,6	4,4	5,7	-
Open funds	2,9	2,4	3,7	2
Guaranteed sub-funds	1,1	0,7	1,7	2,1
Bond sub-funds	2,2	1,3	2,2	2,5
Mixed-Bond sub-funds	1,3	1,1	2,7	2,5
Balanced sub-funds	3,6	2,9	4,2	2,4
Equity sub-funds	3,9	4,1	5,4	2
PIP "new"				
Gestioni separate	1,4	1,7	2,4	-
Unit linked	-0,2	2,1	3,3	-
Bond sub-funds	0,7	0,2	1	-
Balanced sub-funds	1	1,5	2,6	-
Equity sub-funds	-1,3	3,2	4,5	-
TFR	1,2	1,6	1,8	2

Source: *COVIP 2020 annual report*

Observing then, in figure 2.9, the dispersion of the returns recorded in these years, it can be seen how the average annual compound returns of the negotiated funds are much less dispersed (also in the equity sub-funds) compared to those obtained by the open funds and by the PIPs for all types of sub-fund. This occurs due to the dispersion of the costs practiced by the individual forms (COVIP, 2021). Having mentioned this fact, it can be seen that in the sub-funds with a greater equity component, above all in the open pension funds and in the PIPs, the distribution of returns shows a greater dispersion around the average. A great variability is also recorded in the guaranteed segment of the open pension funds.

Analysing the asset allocation choices, that is, which investment compartment to choose, it can be seen that profiles with a low or even zero equity weight remain prevalent in the PIP and pre-existing funds, while in the open-ended and negotiated funds the majority of resources are invested in the balanced compartments (53.1% in both cases). Open funds are the complementary form with a greater investment

Figure 2.9: Distribution (Box-plot) of returns, 2010-2020



Source: *COVIP 2020 annual report*

in equity sub-funds. Observing the distribution of members by investment profile (Figure 2.10) and age, there is a greater propensity for equity and balanced profiles in the very young age groups (up to 29 years), although the percentage of members enrolled in secure compartments in this age group is very high compared to what life-cycle theories predict. ; in the central brackets (30-54 years) the profiles with lower risk are maintained at levels above 50%, of which three quarters are made up of investments in guaranteed sectors. These latter profiles gradually become predominant from the age of 55.

Table 2.8: Members by type of pension fund and investment sub-fund

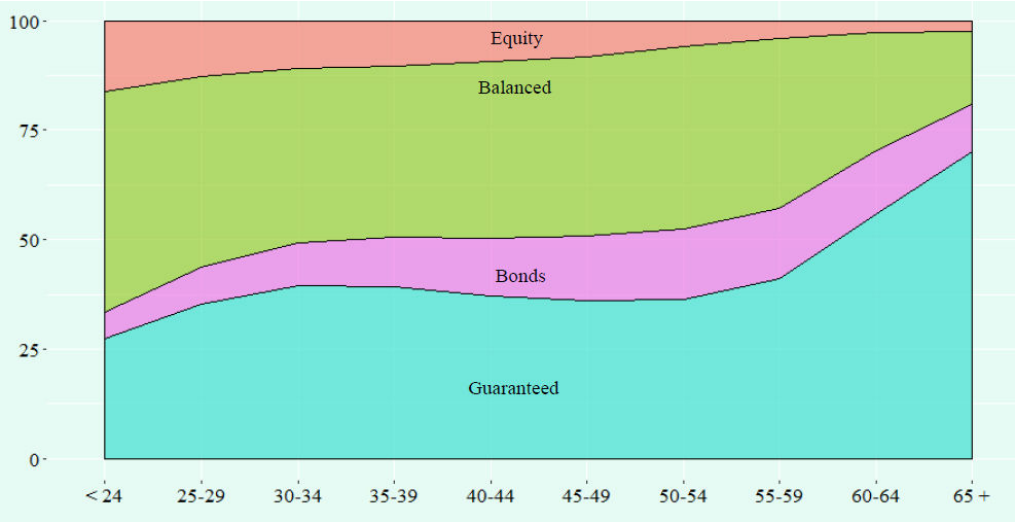
	Contractual funds	Open funds	New PIPs	Pre-existing funds
Guaranteed sub-funds	24,4	17,1	72	42,6
Bond sub-funds	19,6	12,1	4,5	14,1
Balanced sub-funds	53,1	53,1	15,3	39,8
Equity sub-funds	2,9	17,7	8,2	3,5
Total	100	100	100	100

Source: *COVIP 2020 annual report*

The categorisations of the investment sub-funds carried out by COVIP lead to considering within the same group also products that are quite different from each other. This occurs mainly for the balanced sub-funds, which include investment lines with the weight of the equity component that can vary greatly (as it is possible to see in Figure 2.11).

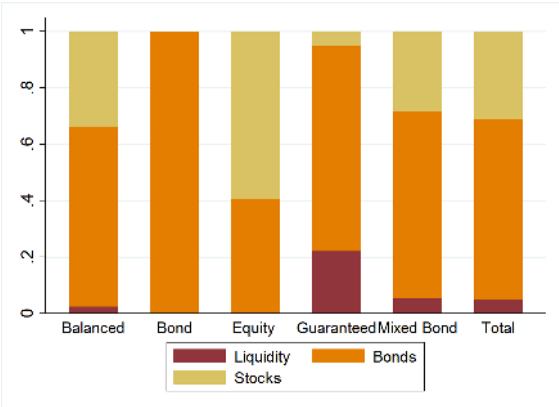
The calculation of the share component in the portfolios, therefore, is a better tool to understand the investment choices and evaluate their adequacy with respect to the goals of pension savings (COVIP, 2021).Figure 2.12 shows that for young age classes and those under 25, made up primarily of a small number of dependent children enrolled (4.8% of the total), the share of equities is on average close to 40%.

Figure 2.10: Members by investment sub-fund and age group

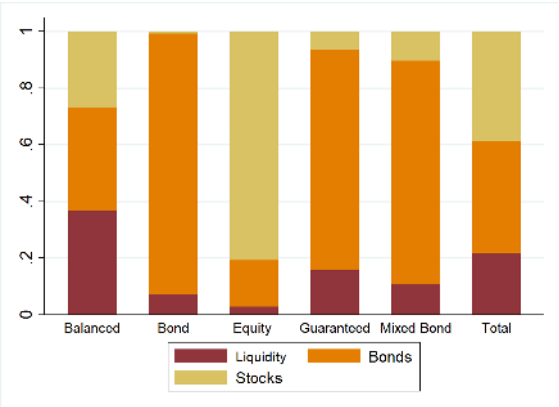


Source: *COVIP 2020 annual report*

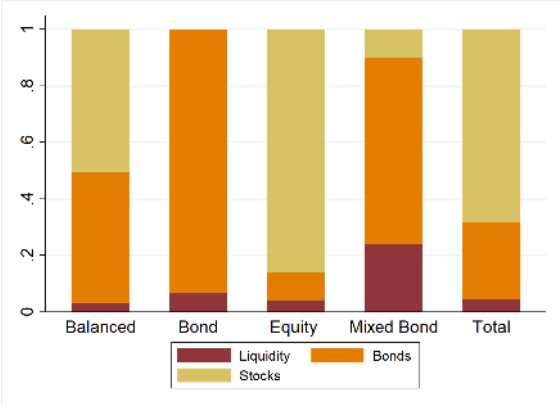
Figure 2.11: Average asset allocation by sub-funds and pension schemes



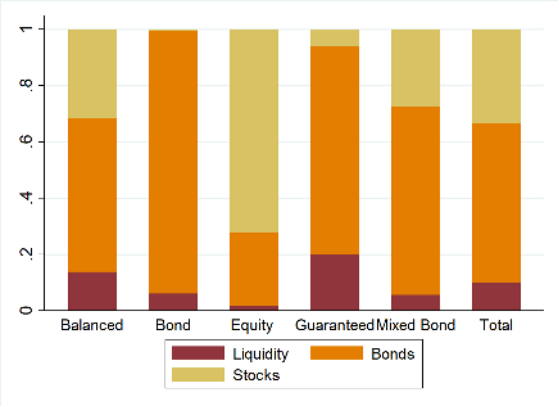
(a) Closed pension funds



(b) Open pension funds



(c) PIPs



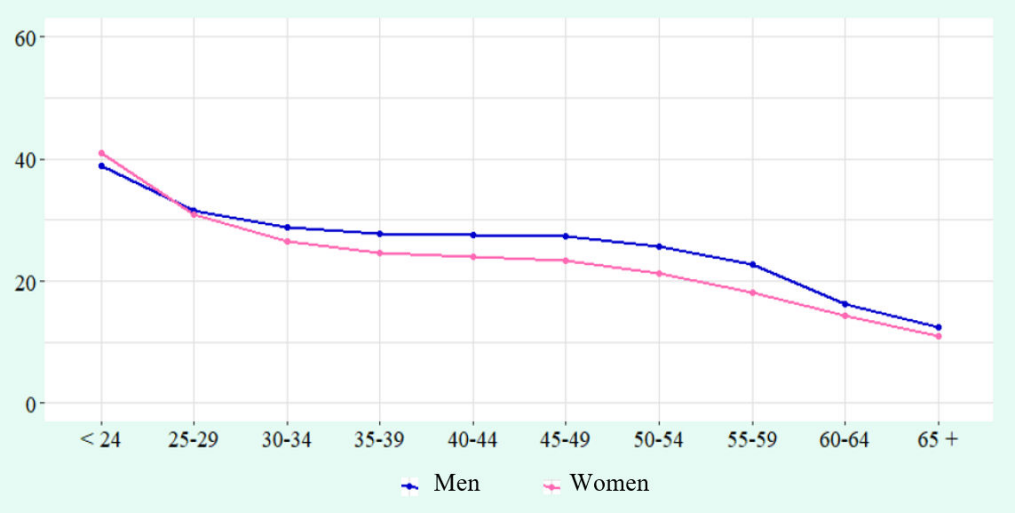
(d) All pension funds

Source: *Our elaboration on Mefop data*

While, in the middle age groups (over 50% of enrolled), the weight of equities is lower and registers a value of around 25-30%, decidedly low, with a greater incidence among men than women. In the older classes the decrease in the share component

becomes increasingly pronounced, reaching around 10-15% for those over 60 years of age. More than 80% of the members enrolled in a form of supplementary pension invest less than 30% of their savings in equities.

Figure 2.12: Equity share in members' pension portfolios



Source: *COVIP 2020 annual report*

2.3 Summary

The Italian pension system was created at the end of the 1800s with the introduction of the "National Welfare Fund for Workers' Invalidity and Old Age". Inspired by liberal principles, it provided for both membership and contributions to be voluntary, but a very small portion of workers decided to participate. The social and economic emergencies produced by the First World War led to the introduction of a compulsory pension system, which was designed as a funded system where a fixed portion of wages was transferred to a fund and invested.

This system, chosen for its simplicity and the lower costs associated with it, went into deep crisis in the 1940s due to the progressive devaluation of the lira, which caused the value of the accumulated resources to collapse, making the amount of the pension allowance paid miserable. At the end of the war, the Italian government decided to abandon the capitalization system in favor of a pay-as-you-go system, immune to the risks of inflation. The choice of the pay-as-you-go scheme determined the end of the private insurance view of the welfare, and introduced the modern principle of a social assistance based on individual needs where the government takes on some of the economic burden.

At the end of the 1960s, two important reforms were introduced: the earnings-based method of calculation and a direct social pension for all citizens over the

age of 65. The progressive changes introduced led to an imbalance in the state budget, in addition there was a large incentive to use early retirement and an unequal situation in which those who received a higher salary in their last years of work unfairly received a higher check. These instances led to various reforms, implemented in the 90s, with which the contribution period and retirement age were lengthened and the contribution-based calculation system was adopted.

The scheme is based on personal virtual accounts where contributions are deposited during the working life, and then withdrawn as pension annuities. In 2022 the minimum age for old-age retirement (pensione di vecchiaia) is 67 years of age, equal for all men and women, and the minimum tenure is 20 years. There is also the opportunity to access earlier retirement (pensione di anzianità) with at least 42 years and 10 months of contribution for men, and 41 years and 10 months of contribution for women, independently of age. The contribution rate for employees is 33% (paid 2/3 by the employer and 1/3 by the employee), while for the self-employed it is between 24 and 26%.

The calculation method currently in force is the contribution-based method, which is based on transformation coefficients, established on the basis of the age of the individual and estimates of life expectancy, which are applied to the contributions paid (revalued at a rate that follows the average trend of Italian GDP over the last 5 years). For those who had already paid contributions prior to the 1995 reform, a mixed system of calculation is adopted, with a retributive and a contributory component. With these rules, estimates drawn up by the Italian Ministry of the Economy foresee a replacement rate for employees of around 70% of their salary, but with a progressive increase in the retirement age (over 70). If early retirement is considered at approximately 67 years of age, then the projected rate is around 60%. For the self-employed, the estimates are significantly more pessimistic, with a projected rate of 50%.

Long-term balance of the Italian pension system is influenced both by demographic trends, related to the ageing of the population and the decrease in births,and by the economic dynamics of the labour market and public finances. Looking at demographic predictions, in Italy by 2070, life expectancy at birth is estimated to be nearly 90 years for women and 87 for men. The old-age ratio, which is the ratio of the number of people older than 64 relative to the number of people in the working-age (15-64 years), projected to follow an upward trend until 2050, when it reaches for Italy a value of more than 70% (more than 7 elderly people every 10 working-age individuals). According to the ISTAT prediction, after the pandemic births should undertake a trend of slight recovery, reaching 414 thousand in 2030 and a maximum of 422 thousand by 2038. After that, the number of births should

stabilize in a range around 350 thousand units. Beyond demographic indicators, the occupation rate is another crucial indicator of pension system stability. Workers are those who pay the contributions needed to pay current pensions. Italy in 2020 has an employment rate of 58.08%, which has been relative stable between 55% and 60% in the last 30 years.

In 2020 the balance between contributory income and pension expenditure was negative by 39.3 billion euros. If welfare spending is added, the negative balance of the compulsory system not financed by contributions, charged to general taxation, rose to 79.3 billion euros, with an incidence of 4.8% of GDP. The current system, according to estimates made by the Ministry of the Economy, can be maintained in equilibrium through the indexation of pension requirements with life expectancy and the lowering of the replacement rate according to contributions paid and age at retirement. In addition, an important role is played by the continuous growth of the economic system. This requires a positive immigration balance, an increase in the employed population and a growing gross domestic product that provides a stable flow of contributions necessary to pay pensions.

Looking at the private pension scheme, the basic structure of supplementary pension funds is based on funded schemes where the individual, who voluntarily joins, pays contributions which are invested in financial markets by institutional managers like banks and insurance companies. There are three different forms of complementary pension:

- Closed Pension Funds: access is through a collective agreement established by the social partners, in which both the employer's and the employee's contribution is foreseen. This type of fund is non-profit and therefore has lower costs than the other forms.

- Open Pension Funds: enrollment is free and voluntary, in some cases also collective, both employee and employer contributions are foreseen, and are for profit, consequently they present an average value of costs.

- Individual pension plans: enrollment is by free choice, only own contributions are foreseen and being for profit, they present high costs.

Given these differences, open and closed pension funds and individual plans have many shared characteristics. Whichever supplementary form is chosen, the contributions paid are invested in the financial markets. Given the economic and social purpose of these funds, the resources invested must follow precise rules of prudence. Individuals can choose how to invest their contributions in five main investment sub-funds, which differs in the composition of asset(from investing most

in bonds to almost entirely in stocks) : the guaranteed Fund, the Bond fund,the Mixed bond Fund, the Balanced Fund, and the Equity fund.

At retirement, fund participants can choose between three alternatives: A monthly life annuity, 50% immediately as a lump sum and 50% in a life annuity, or year, it is possible to have the entire position accrued liquidated in the form of a lump sum if the annuity given by the 70% of the position accumulated is less than 50% of the social allowance. With the aim of encouraging adhesion to forms of supplementary pension, the Italian government has designed a system of tax benefits. This implies that contributions are tax exempt (deducible up to a maximum of 5164.57€), while returns from investment and benefits are taxed, but with a favourable rate (20% for returns and from 15% to 9% for benefits).

An interesting aspect of the Italian private pension system is the choice on how to allocate the severance indemnity fund (TFR), which consists of a sum set aside annually by the employer and paid to the employee when the contract of employment ends. In 2007, a mechanism was introduced whereby workers in companies with fewer than 50 employees, if they do not communicate a different will within six months, have their severance pay invested in a pension fund in a guaranteed compartment. If the firm size exceeds 49 workers the amount set aside must be transferred to a specific pension fund, consequently employees do not have any choice.

Finally, looking at data, in 2020 in Italy 8.4 million people are members of a pension fund, of which 61.7% are men. The corresponding participation rate was 33% of the workforce, but it totalled only 24.1 percent if are excluded the individual accounts that were not fed with contributions. The repartition by geographic area shows a prevalence of members in the north (57 percent), while 19.8 percent of members reside in the center and 23.1 in the south. The lower participation of the women can be linked to the same problems present in the labor market: even if they are employed, the wage gap and the more discontinuous careers make less easy to open and maintain a supplementary pension plan.

Total assets under management were 197.9 billion euro, which correspond to the 12% of Italian GDP. The total flow of TFR that was generated in 2020 in the production system can be estimated at around 27.2 billion euros, and of these, 6.5 billion were paid to forms of supplementary pension. Last year, the private pension system sustained outflows to the value of 8.6 billion euros, the greater part of which consisted in lump sums and anticipations.

Observing the registered returns of all the pension forms, and considering a ten-year horizon (2010-2020), all sub-funds recorded positive average returns. Specifically, the sub-funds with a greater equity component have had a greater average

compound return than the others, with the best average result obtained by the equity sub-funds of the negotiated funds (5.7%). Analysing the asset allocation choices, that is, which investment compartment to choose, profiles with a low or even zero equity weight remain prevalent in the PIP and pre-existing funds, while in the open-ended and negotiated funds most resources are invested in the balanced compartments. There is a greater propensity for equity and balanced profiles in the very young age groups, for the cohort 30-54 years the profiles with lower risk are maintained at levels above 50%, of which three quarters are made up of investments in guaranteed sectors, profiles that gradually become predominant from the age of 55.

The equity under-investment resulting from these data is the starting point for this thesis project. As noted throughout the chapter, the public NDC scheme, with a calculation method based on contributions, will provide low replacement rates, especially for self-employed, women with part-time contracts and workers with precarious careers. Moreover, the stability of the public system is deeply influenced by demographic trends and linked to economic GDP growth, that has been unstable in the last years. As a result, supplementary retirement savings are becoming a crucial factor in ensuring an adequate standard of living during retirement. However, while failure to save resources for old age poses a risk to an individual's economic stability, failure to invest the resources saved can expose one to great risk as well, since the amount of resources accumulated may not be sufficient to meet one's needs, if not properly invested.

Chapter 3

Reteriment savinvgs: a brief literature review

In the previous chapter, it was highlighted how supplementary pensions in Italy are acquiring an increasingly important role in guaranteeing a decent standard of living once retirement has been reached. For this important objective to be achieved, it is not only necessary to save an adequate level of resources, but also to invest them in such a way as to accumulate sufficient capital. Analyzing the 2020 data, it can be seen that the majority of individuals under invest their retirement savings, preferring by far the guaranteed and bond funds over the equity funds, even when the investment horizon, as for younger people, is thirty or forty years.

This behavior has been observed for several years, and has gained a certain importance in the academic debate under the name of "Equity premium puzzle", i.e., the tendency to prefer investing in risk-free securities despite the fact that they yield a decidedly lower return than equities. In the following chapter we will present the main empirically observed data about this puzzle, one of the main explanations provided by behavioral finance and some experiments that have been carried out to try to limit this behavior within investment choices. The first section is present as an introduction, and quickly summarizes the neoclassical principles regarding savings and investment choices.

3.1 The rationale behind saving: Life Cycle Theory

According to neoclassical economic theory, savings arise from the choice of individuals to exchange current consumption for future consumption. Households compare

the benefits of consuming a certain bundle of goods today with the benefit of consuming more in the future, which is made possible by income savings. One of the main models describing the dynamics of savings is the Life Cycle Model, introduced by Modigliani and Brumberg in the 1950s (Modigliani and Brumberg, 1954) , according to which individuals rationally plan their consumption (and consequent savings needs), considering the entire horizon of their lives.

Modigliani and Brumberg set their work starting from the theory of consumer choice, where the following variables are considered: the individual's consumption in year t, the income y_t in year t, the amount saved equal to s_t and a_t which is the value of assets available before period t. The time interval of the analysis is defined as L, and is given by the sum of N, the time interval in which one acquires earnings, and M, the time of retirement one has no income other than that from previous savings. The individual's utility is assumed to depend on current consumption, consumption expected to occur in the future, and assets that will be bequeathed.

$$U = U(c_t, c_{t+1}, ..., c_L, a_{L+1})$$

This utility must be maximized under the budget constraint that the present value of available wealth (given by the initial assets and expected earnings) cannot exceed the present value of consumption and the assets that are to be bequeathed.

If current income $y_t + r * a_t$ does not equal c_t, then the individual will save (or dissave) , and the same reasoning applies for a future time: in the event that disposable income in a future period is not expected to be enough to consume as much as desired in that period, then it will be necessary to save. This also includes the concept of uncertainty, i.e., the fact that the individual may not be aware of his or her exact future income, or the consumption plan he or she will desire at a time far removed from the one in which he or she must make the decision.

The authors do not expand, at least initially, the role that uncertainty may play in their model, but they consider it when they determine the reasons for saving. They identify four different reasons:

- The reason for estate planning i. e. the desire to leave a certain level of wealth to one's heirs. The need for savings arises in the case where a_{L+1} is greater than a_t.

- The second reason is that in which, as already mentioned, the path of future consumption drawn does not correspond with that of income. This leads to saving, or dissaving, in different periods of one's life even without the first reason being present.

- The third motivation is linked to the dimension of uncertainty, and is defined as the precautionary motivation. Saving thus makes it possible to deal with sudden shocks to one's income, which cannot be adequately anticipated.
- Uncertainty also leads to having to save in order to make sure that one can purchase durable goods before receiving services from them, since one cannot be sure that the income is sufficient to pay for them.

Building on this approach, the authors add 4 key assumptions to their model:

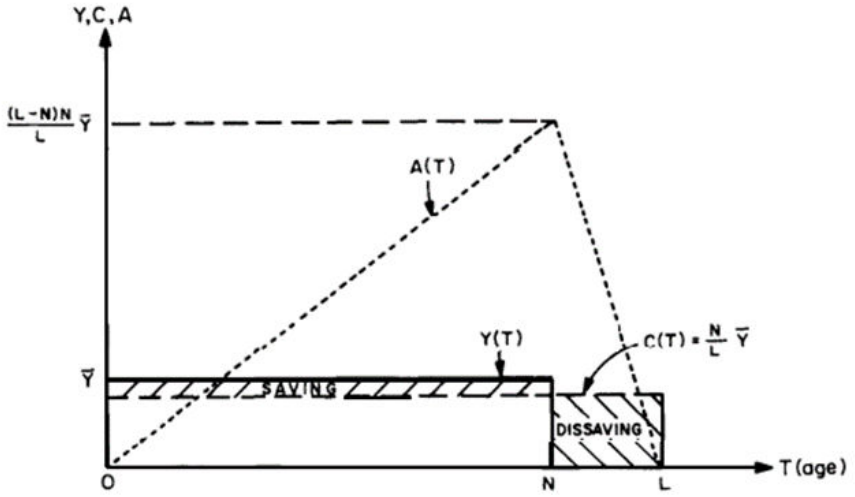
1. First assumption: Individuals do not inherit significant amounts of wealth and do not expect to leave any to their heirs. Consequently, $a_{L+1} = a_t = 0$ Since no wealth is received before beginning to have earnings, the individual can only accumulate assets through savings.
2. Second assumption: the form of the utility function is such that the proportion of resources that the individual chooses to allocate to consumption in any given period is due only to his preferences, and not to the size of his resources. This means that any increase in available wealth will be equally distributed over the remaining periods.
3. Third assumption: the interest rate is zero, r=0.
4. Fourth assumption: individuals expect to consume their wealth at a uniform rate over their lifetime, a rate close to the anticipated lifetime average consumption.

Given these assumptions, the result is a "simplified" model of savings along the life cycle, represented by figure 3.1 : the interval of retirement that follows that of "earnings" requires a constant level of savings previously to be able to maintain the same lifestyle (given by the constant value of c) this savings leads to accumulate a wealth a(t) along the working period, wealth that is then progressively eroded in retirement.

Current consumption is therefore a function of current income, the expected value of future income and the assets available in that period, but these values are weighted with coefficients that depend on the age of the individual.

According to the life cycle model individuals are rational subjects capable of accumulating (or decumulating) resources to maximize a lifetime utility function. This requires having considerable cognitive skills to solve a rather complex multi-period optimization problem, and then having sufficient self-control to execute the plan. Once the preferred consumption plan is chosen, and consequently the amount

Figure 3.1: Income, consumption and saving as a function of age



Source: *Life Cycle, Individual Thrift, and the Wealth of Nations, 1986*

of resources that must be saved in individual periods, individuals must decide how to invest their savings.

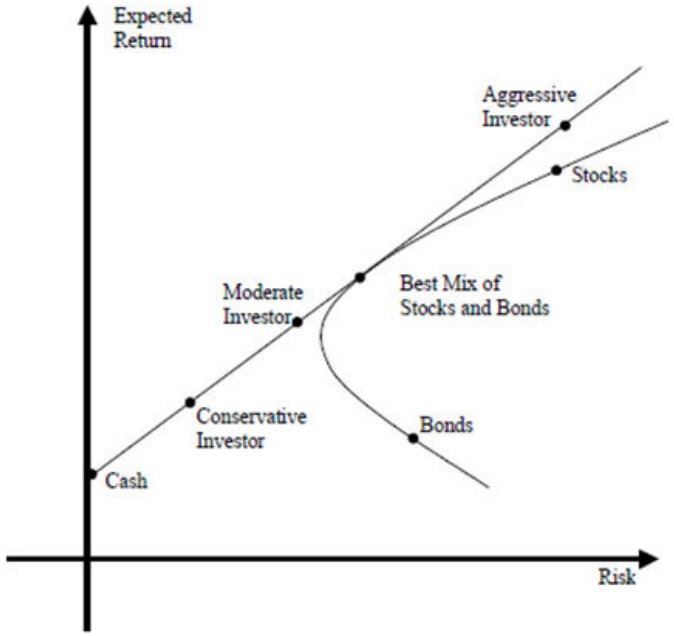
3.1.1 The rationale behind investing: Return-Risk analysis

A further pillar of classical financial theory is the model presented by Markowitz (1952) of mean-variance analysis. This model will now be quickly presented according to the simple version reported by Campbell and Viceira (2001).

The mean-variance analysis is based on the idea that any security is identified by its expected return and its risk (described in terms of the standard deviation of returns), and the greater is the expected return of a security, the greater will be its risk. Return-Risk analysis can be applied to portfolios of securities, which is a combination of securities in given proportions ("portfolio shares"). A portfolio is still identified by its own expected return and standard deviation. For simplicity we can consider 3 types of assets, which are stocks, bonds and cash. Stocks have a high expected return and a higher SD, bonds have a lower expected value and a lower SD and cash has the lowest expected return but is risk free. This situation can be represented in a Cartesian plan where the expected value is placed on the axis of the ordinates and the risk (standard deviation) on the x-axis, like is made in figure 3.2.

The curve line represents the different combinations of return and risk that can be obtained from different risk portfolios made up of stocks and bonds (the lower the correlation between the returns of the two securities, the better the portfolio formed). If we also consider the risk-free case, then the set of returns and risk that

Figure 3.2: Risk-return diagram and Capital Market Line



Source: *Strategic asset allocation: portfolio choice for long term investors, 2001*

can be obtained from a portfolio that includes all three securities is represented by the straight line, called Capital Market Line. Along the CML are grouped the combinations that offer the highest return for a given level of risk. The point of tangency between the CML and the efficient portfolio frontier allows to identify the best portfolio.

The conclusion is that all investors who are only interested in expected value and associated risk will choose the same combination of risky assets. Finally, the optimal portfolio chosen by each individual will depend on the shape of his or her risk preferences: savers with greater risk aversion (in the graph "conservative") will reduce their exposure by buying cash, while particularly risk-taking savers may go into debt to invest in a portfolio that is higher than the tangency. Consequently, the final choice made by investors is the product of two components: the Capital Market Line that identify the best combination of securities and the individual preferences concerning risk.

3.2 Stocks, bonds and the equity premium puzzle

In the previous section, we presented the neoclassical models that constitute the basis of the theory of savings and investment decisions of rational agents. According to what has been described, once an individual has established his or her optimal consumption plan, one identifies the best combination of securities, both risky and not,

in which to invest his savings. The difference between the return on risky securities, which in the market are mainly equities, and the return on risk-free securities, often identified as treasury bills, is defined as the risk premium and represents the higher remuneration offered to bear the risk of not seeing one's investment returned. Given the optimal portfolio identified in the market, the rational agent on the basis of his risk preferences chooses to invest savings in the preferred combination. Starting from these theoretical predictions, various researchers have found in the empirical reality of financial markets the presence of contradictory tendencies, which will now be presented.

3.2.1 The equity premium puzzle

The historical series on the returns of financial securities record a clear trend, which has lasted for over a century, for which equities have recorded significantly higher returns than government bonds, which are considered the risk-free securities par excellence (Mehra, 2008). Table 3.1, presents data on the risk premium registered in the US financial market according to various publications in the literature. In the original paper by Mehra and Prescott (Mehra and Prescott, 1985), the inflation-adjusted average annual real return achieved by equities was 7.67%, while that of non-risk securities was 1.31%. This results in a risk premium, given by the difference in the returns of these two classes of securities, of 6.36%.

Table 3.1: US equity premium using different data sets

	Real return on a market index	Real return on a relatively riskless security	Equity premium
Data set	Mean	Mean	Mean
1802–2004 (Siegel)	8.38	3.02	5.36
1871–2005 (Shiller)	8.32	2.68	5.64
1889–2005 (Mehra–Prescott)	7.67	1.31	6.36
1926–2004 (Ibbotson)	9.27	0.64	8.63

Source: *The Equity Premium Puzzle: A Review, 2008*

This difference in realized returns produces very important consequences when one analyzes the results of investing a dollar in the two different assets over very long periods. Table 3.2 shows the estimated final values given by this investment in the years 1802-2004 and 1926-2004. In the first case, a dollar invested in a stock index would have returned a final wealth of $655,348, while if it had been invested in bonds it would have produced a wealth of only $293. Considering the shorter

period, the corresponding final values are $230.30 for the stock investment and $1.54 for the bond investment. The assumption behind these calculations is that all dividends produced are reinvested in the stock annually.

Table 3.2: Final value of $1 invested in stocks and bonds

	Stock		T-bills	
Period	Real	Nominal	Real	Nominal
1802–2004	$655.348	$10.350,07	$293	$4.614
1926–2004	$238.30	$2.533,43	$1,54	$17,87

Source: *The Equity Premium Puzzle: A Review, 2008*

In light of the data presented, Mehra and Prescott questioned whether there could be a rational explanation, provided by the available economic models, that would justify such a difference in returns. The first possible explanation given by classical financial theory is that the return on equities is higher because they are riskier than bonds, following the fundamental law of finance for which the riskier securities pay higher returns.

In an effort to test the validity of this explanation, they study a class of exonomies for which the elasticity of substitution for the composite consumption good between the year t and year t + 1 is consistent with findings in micro, macro and international economics (Mehra and Prescott, 1985). The starting point is that, according to modern asset pricing theory, the price of financial securities is related to their role in savings and consumption dynamics. Securities are priced so that the loss in marginal utility caused by the decrease in current consumption is equal to the expected increase in marginal utility given by the increase in consumption achievable when the asset is realized in the future. According to the Capital Asset Pricing Model (CAPM), there is a linear relationship between the expected return on an asset and its beta, which is a measure of risk. Assets with a large beta have a higher expected return. Moreover, as already presented in the Life Cycle Model, individuals have a preference for smooth consumption. Therefore, the resulting considerations are two:

- An asset with a high beta will pay more when the market experiences good times and the economy is growing.

- However, the increase in utility given by the return is lower when the market experiences positive moments and consumption is plentiful, compared to when the marginal utility of consumption is high because consumption is low, and therefore an increase in wealth allows for an increase in utility given by consumption.

Thus, securities with high beta that are realized in low marginal utility states will be sold at a lower price than similar securities that pay in high marginal utility contexts. Starting with this theoretical framework, the authors (Mehra and Prescott,1985) construct a model in which the expected return of securities is found to be a function of the risk-free rate and a risk premium dependent on the covariance between asset returns and the marginal utility of consumption. Given this model, the question then becomes whether the magnitude of the covariance between the marginal utility of consumption, recorded in the period in question, is sufficient to explain the observed 6% risk premium.

The answer was no.They substituted the values recorded by the U.S. economy over the period considered, and they made assumptions about the main factors that determine the preferences of a rational agent, namely the risk aversion rate and the future value discount rate. This resulted in an estimation according to which the return on equities should not exceed that on safe securities by more than 0.35%, much less than the observed 6%. Given the discrepancy for which the available data, over a reliable time period of more than 100 years, recorded a risk premium significantly higher than the one estimated, Mehra and Prescott realized they had uncovered an important puzzle.The authors made emphasis on the fact that the equity premium puzzle is a quantitative puzzle, since standard theory is consistent with the observed fact that on average equities should have and higher return than bonds. The puzzle occurs when the quantitative predictions formulated according with the theory are very different from what has been historically recorded (Mehra and Prescott, 1985).

3.2.2 Pension wealth investment analysis by MaCurdy and Shoven

Mehra and Prescott (1985) showed how historically observed returns data do not prove to be consistent with the theoretical model. MaCurdy and Shoven (1992), on the other hand, without considering a specific model, with the empirically observed historical data tried to test which investment strategy would have produced the greatest accumulation of wealth.

The starting point of analysis is that most people, when faced with deciding how to invest their retirement savings, are aware that bonds have a lower average return than stocks, but with a lower variance, thus they offer greater "security" in exchange for a lower return. If this conviction is correct for short investment horizons, the authors decide to investigate the case in which, as happens in the daily reality of many workers, savings are invested for a long horizon with naïve investment

strategies. The intent is not to determine an optimal investment portfolio, but to verify empirically how these simple strategies would have performed if employed in the past.

The data available to the author to perform his analysis are the inflation-adjusted annual returns of the Standard and Poor's 500, an index of long-term corporate bonds, and U.S. Treasury bills, for the period 1926-1988. The average values of the returns are summarized in Table3.3. Note how stocks have an average risk premium of 6.4% over corporate bonds. As for the simulation of contributions, the authors took university professors as a reference, collecting salary data for the period 1926-89 and assuming that each individual contributes a fixed portion of their earnings to a fund for the entire length of their career.

Table 3.3: Average annual return for asset class

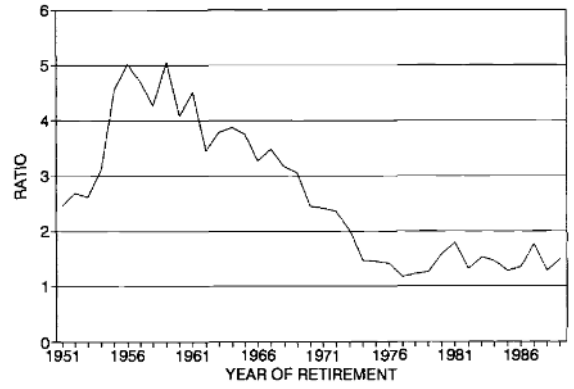
Asset	Arithmetic Mean (%)	Standard Deviation (%)
S&P 500	8.8	21.1
Long-term corporates	2.4	10
U.S. Treasury bills	0.5	0.5

Source: *Stocks, bonds and Pension Wealth, 1992*

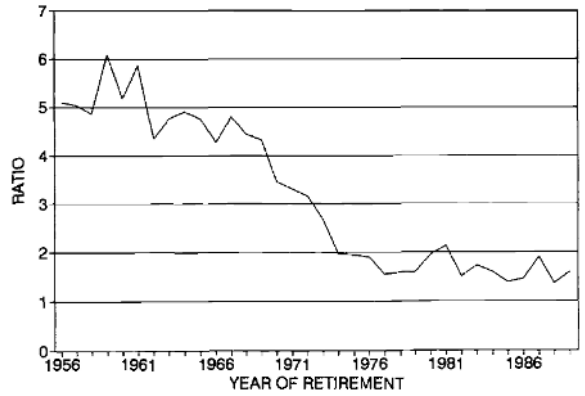
The first comparison is made between a "pure stock" strategy, under which the individual invests all of his or her contributions in stocks for the entire career, and a "pure bond" strategy where the individual invests all of his or her resources in bonds. To compare the performance of these two strategies, it is calculated the ratio of the wealth accumulated at retirement by adopting an equity strategy to that accumulated with a pure bond strategy. Figure 3.3 presents the ratios for the different working careers considered. The "pure stock" strategy turns out to yield greater wealth in all simulations performed, for any possible career, even the short one (Figure 3.3a). Looking at the investment horizons more in line with a standard working career, i.e. those at 35 and 40 years, in the first case the ratio varies from 1.56 to 6.52, with an average value of 3.58. This means that a person who had invested his entire contribution in stocks would have accumulated, in the worst case, 56% more wealth than someone who had invested the same amount in bonds exclusively. The ratios for the 40-year career are even more significant, as the "worst" case scenario for an investor in stocks would be the one in which he or she would have accumulated 95% more wealth.

The final wealth accumulated, if invested only in equities, could be heavily influenced by the returns recorded by the equity markets in the last months before retirement. To control the effects of a different policy, the authors introduce two additional strategies. The first is to gradually convert equity investment to bonds, with a 25% reduction in equity investment every 3 months in the 9 months before

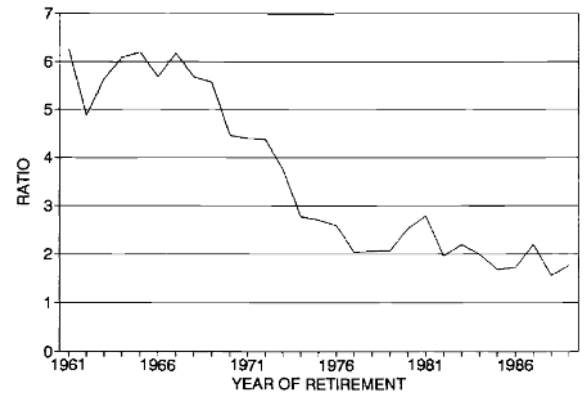
Figure 3.3: Ratio of stocks to bond accumulation



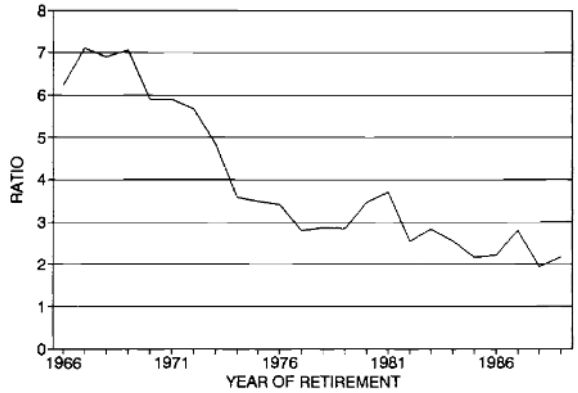
(a) 25 years career



(b) 30 years career



(c) 35 years career

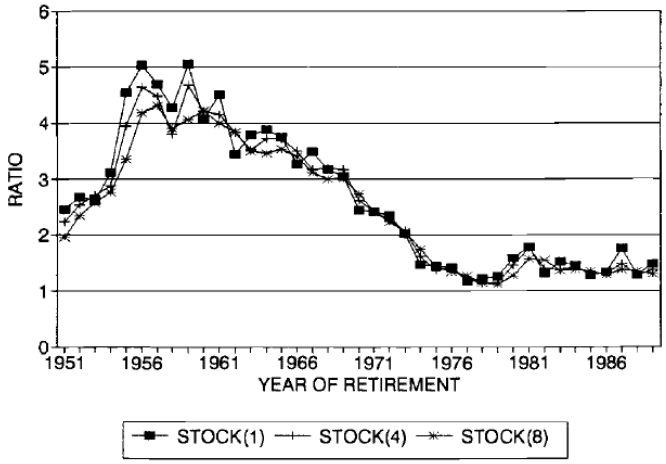


(d) 40 years career

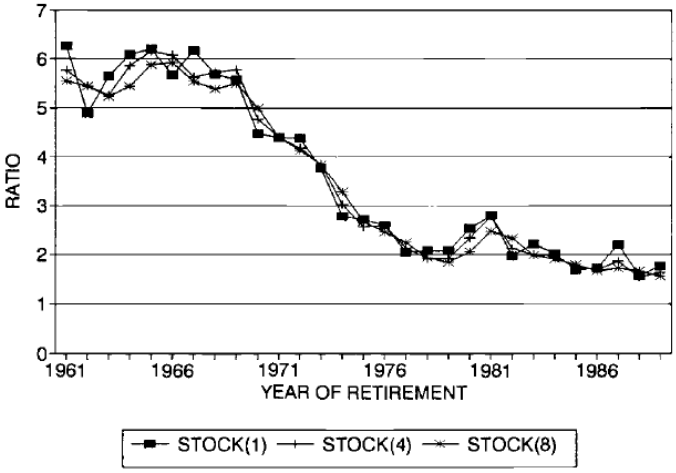
Source: *Stocks, bonds and Pension Wealth, 1992*

retirement (stock 4). The second strategy involves disinvestment over a longer horizon, i.e., a reduction at 8 different times starting 21 months before retirement (stock 8). The idea is to reduce the variance of returns in the final months of investment. These short-term strategies do not significantly change the final value of the accumulated capital, and consequently neither does the trend of the ratio previously considered, as can be seen in Figure 3.4. In any case, they successfully reduce the vulnerability due to large fluctuations in equity prices in certain periods, such as in 1961, 1962 and the period 1986-88.

Figure 3.4: Ratio of stocks to bond accumulation



(a) 25 years career



(b) 35 years career
Source: *Stocks, bonds and Pension Wealth, 1992*

The conclusion of this article, therefore, is that the systematic investment of one's retirement savings in equities has always produced a greater final wealth than any other strategy that includes a bonds component. This empirical finding, which does not include any model interested in identifying an optimal portfolio, leads the authors to affirm that the choice of investing in a portfolio including bonds rather than one with equities only, for a period longer than 25 years, would require an

infinite degree of risk aversion, given that there has never been a period of time in which this strategy has been successful. A further analysis of interest is carried forward by Skinner in the comment to the article, in which he extends the period of analysis to the interval 1872-1988. In the second half of the 19th century railroad bonds recorded higher average returns than equities, so the analysis could identify some 25-year periods in which the pure bond strategy outperformed the equity strategy. The result of the study is that, in the interval 1872-1988, one can only identify a single 28-year long period and some 15-year periods concentrated between 1885 and 1900, in which the bond portfolio outperformed the equity portfolio.

3.3 Myopic loss aversion and the equity premium puzzle

The evidence presented by Mehra and Prescott (1985) on the equity premium is difficult to explain with acceptable levels of risk aversion, the same authors estimated that investors should have a coefficient of relative risk aversion greater than 30 to justify such a difference in returns, while theoretical models usually estimate the value of this coefficient to be one. MaCurdy and Shoven then showed that, since 1951, there has not been a 25-year period where the complete investment of retirement savings in stocks yielded less than any other strategy, thus asking why there is anyone willing to invest in bonds without demonstrating a virtually infinite level of risk aversion.

Benartzi and Thaler (1995) propose an answer based on two concepts from the psychology of decision-making. The first concept, introduced by Kahneman and Tversky as one of the main elements of Prospect Theory, is loss aversion. According to this concept, the psychological value attributed to a loss is greater than that attributed to a gain; its magnitude is usually empirically estimated as 2. The second concept proposed is that of mental accounting, according to which individuals tend to organize and evaluate economic transactions in separate accounts. In a mental accounting perspective, resources in one account are not perfect substitutes of resources in another account.In financial decisions, the effect of mental accounting concerns aggregation rules, that is, how transactions are grouped together to be evaluated: both between types (securities are evaluated individually or as a portfolio) and between periods (how often they are evaluated).

The combination of these two effects can have very important consequences in the way investment decisions are made. To explain how, the authors propose a problem first presented by Samuelson in 1963. Samuelson asked one of his colleagues

if he would be willing to accept a bet where there was a 50% chance of winning \$200 and a 50% chance of losing \$100. His colleague declined, but said he was willing to accept playing 100 of these bets, justifying this choice with the argument that losing \$100 would be felt much more than winning \$100, thus stating that he was applying loss aversion. The second interesting statement is that he would be willing to take two or more bets as long as he did not have to watch every single draw. This is where the role of mental accounting is introduced: even if the single bet has a positive expected value, the outputs of each draw are not attractive when evaluated one at a time, but are attractive when evaluated as a whole. The example wants to show how a subject averse to losses is more willing to accept the risks if he evaluates the resulting performance infrequently. As a result, the attractiveness of investing in equities, which have a high yield but wide short-term volatility, may depend on the investment horizon and the frequency at which realized returns are evaluated. Loss aversion and short valuation periods may lead to not investing in assets that, over the long investment horizon, could realize much higher returns. The authors call this combination myopic loss aversion.

To assess the role of myopic loss aversion in the equity premium puzzle the authors investigate the combination of loss aversion and valuation periods that could justify the risk premium that has historically occurred. The starting point of the model is the prospect theory formulated by Kahneman and Tversky, according to which utility is defined in terms of gains and losses, with a function of the following form:

$$u(x) = \begin{cases} \mathrm{x}^{\alpha} & \text{if } x \geq 0 \\ -\lambda(-x)^{\beta} & \text{if } x < 0 \end{cases}$$

Where λ is the coefficient of risk aversion. The empirical estimates made assign a value of 0.88 to α and β and 2.25 to λ. The utility given by a gamble G with a payoff x_i and probability p_i is given by:

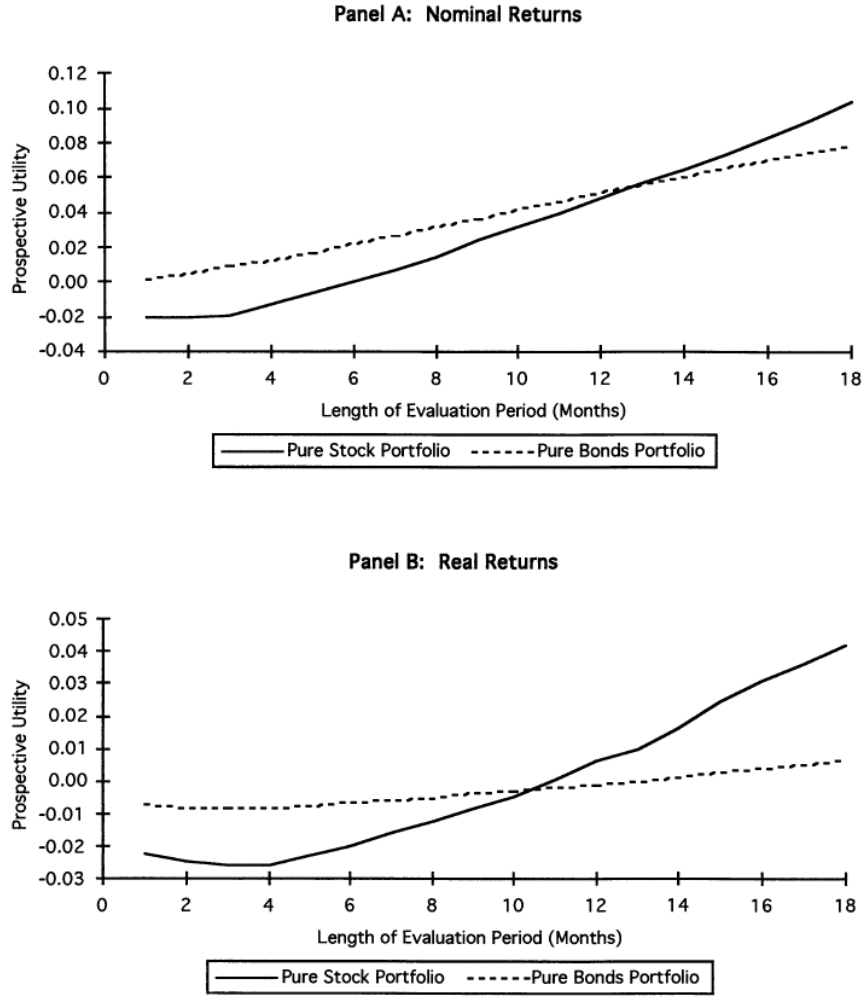
$$V(G) = \sum \pi_i u(x_i)$$

π_i corresponds to the decision weights associated with each outcome, these were initially defined as a simple nonlinear transformation of p_i, while in the cumulative prospect theory version π_i depends on the cumulative distribution of the gamble, not only on p_i. π is an increasing function of p, with $\pi(0) = 0$ and $\pi(1) = 1$, the impact of a given change in probability diminishes with its distance from the boundary (certainty or impossibility),consequently the π function is concave near 0 and convex near 1.

With this model of preferences, the authors pose the question of which valuation

period would justify the observed equity premium. Starting with data on monthly returns recorded over the period 1926-1990 for stocks, 5-year bonds, and treasury bills, they calculate the utility of holding these different types of assets for different valuation periods, starting with one month and then progressively adding one month at a time. Returns were considered in both nominal and real terms. The results of this analysis are presented in figure 3.5. The lines represent the utility values associated with a pure-stock or pure-bond portfolio as a function of the length of the evaluation period. The point at which the two lines intersect corresponds to the evaluation period for which one is indifferent between investing in stocks or bonds. In the case of nominal returns, the equilibrium point is approximately 13

Figure 3.5: Prospective Utility as Function of the Evaluation Period



Source: *Myopic loss aversion and the Equity Premium Puzzle, 1995*

months, while for real returns it is between 10 and 11 months. Thus, the estimate is concentrated around an annual period. Each individual investor will adopt his or her own strategies for evaluating the performance of their investments, and it is not easy to establish a single behavior common to all, but the authors point out that various institutional investors and pension funds report annually on the financial

results obtained through specific reports that are sent to members. In addition, individuals annually fill out tax returns and deduction claims, so one would assume that a year is an evaluation period that can be easily adopted by individuals.

These analyses are robust to changes in the model, such as using true probabilities rather than decision weights. The variable that most influences the results is the degree of loss aversion, e.g. by increasing λ from 2.25 to 2.77 the valuation period for which bonds and stocks are found to be indifferent becomes 20 months. By analyzing the behavior of individuals rather in terms of their investment portfolios than in terms of evaluating the returns of single securities, the authors identified as 50-50 the proportion of stocks and bonds that would maximize the prospective utility of an investor with a one-year horizon.Even in this case, the result is roughly consistent with observed data on asset allocation of pension funds.

In the framework of the equity premium puzzle described so far, investors are unwilling to invest in equities, which show a certain volatility in returns, but they still choose to postpone their consumption in order to earn in exchange a measly 1 percent annual return from bonds. Benartzi and Thaler propose as an explanation for this behavior the combined effect of a strong aversion to losses with the prudent tendency to frequently monitor the performance of one's investments, which leads to falling into the trap of myopic loss aversion and demanding a higher return in order to invest in riskier securities.

3.3.1 An experimental test on Myopic Loss Aversion

Building on the theoretical framework designed by Benartzi and Thaler, in 1997 Thaler, Tversky, Kahneman and Schwartz (Thaler et al., 1997) carried out an empirical study of myopic loss aversion. To do so, they designed an experiment consisting of a series of investment decisions, where participants can decide in what proportion to invest in two securities with different levels of risk, over a long series of periods. All individuals make the same basic choice, but the time horizons of investment and the frequency with which information is given about the returns achieved are changed. The hypothesis is that individuals treated with longer investment horizons and less frequency of information will be willing to take on more risk.

In practice, the experiment requires dividing an endowment of 100 between two securities, fund A (bond) and B (equity), without knowing what their expected return is. Through the investment experience, participants had to learn the distribution of returns and the relative risk. Four conditions are applied:

- Monthly condition: the allocation choice is made 200 times, as if it were every month, and in each the return obtained is given back.

- Monthly inflationary condition: the allocation choice is made 200 times, as if it were every month, and in each case the return obtained is returned increased by 10%, so that the returns are always positive. The hypothesis is that the decrease in possible losses decreases the effect of loss aversion, making the equity fund more attractive.

- One-year condition: the allocation choice is made 25 times, so an average return obtained in 8 periods is shown.

- Five-year condition: the allocation choice is made 5 times, so an average return obtained in 40 periods is shown.

After each decision it was presented a graph representing the yield of each fund of their portfolio for the periods established by the treatment. Finally, at the conclusion of the trials, to each subject was asked to make a final investment choice, equal for all conditions, valid for 400 periods.

Table 3.4 presents the average final investment choice for the different conditions. According to myopic loss aversion the allocation in equities is expected to increase as the investment horizon increases and in the condition where no losses are present. These predictions are both respected, in the monthly condition almost 60% is invested in bonds, while in the other three treatments the average is close to 30%. The difference with the first treatment is statistically significant, while it is not among the others. The lack of difference between the two treatments with aggregate returns is probably due to the lack of experience in the fourth treatment (only 5 choices), and to the small difference in the probability of recording negative returns (39% in the first condition, 14% in the second and zero in the other two). Another interesting aspect of analysis is that the average allocation chosen in the last 5 years (therefore 40, 5, 1 round depending on the condition) turns out to be very similar to the final one. This seems to support the hypothesis that the subjects suffer from myopic loss aversion, in fact, if the subjects of treatment 1 had been sophisticated once offered the opportunity to invest for a long period of time they would have had to accept a higher level of risk.

The authors designed this experiment with the intent of empirically testing the effects of loss aversion and myopic loss aversion in the domain of investment choice. Both hypotheses were empirically confirmed. Once all returns were turned positive, eliminating the loss experience (a factor considered to be the main driver of risk aversion), the allocation in stock increased significantly. Some subjects were then

Table 3.4: Percent Allocated to Bonds by treatment

Treatment	n	Mean	SD	SE
	A. Final decision			
Monthly	21	59.1	35.4	7.73
Yearly	22	30.4	25.9	5.51
Five-yearly	22	33.8	28.5	6.07
Inflated Monthly	21	27.6	23.2	5.07
	B. During last 5 years			
Monthly	840	55	31.8	1.1
Yearly	110	30.7	27	2.57
Five-yearly	22	28.6	25.1	5.36
Inflated Monthly	840	39.9	33.5	1.16

Source: *The Effect of Myopia and Loss Aversion on Risk Taking: An Experimental Test, 1997*

forced to adopt a non-myopic framing of decisions and outcomes, investing for longer periods and receiving feedback less frequently. This treatment significantly reduced the experience of losses by statistical aggregation of returns, again producing an increase in investment in risky stocks and confirming the role played by myopic loss aversion.

3.4 Experiments on asset allocation

In the light of the theory on myopic loss aversion presented by Bernatzi and Thaler (1990), several behavioral economists, including the authors themselves, have conducted experiments on investment choices aimed at empirically verifying the accuracy of the hypotheses formulated. The main insight is that the way in which information about the distribution of returns is presented can significantly influence investment in risky securities. All of the experiments that will be reported confirm this intuition, but they also present additional results and different features that deserve attention.

3.4.1 Benartzi and Thaler: displaying long term returns

Bernatzi and Thaler (1999) tested their hypothesis about the role of myopic loss aversion in investment choices by applying it to the domain of retirement investment funds. The starting point of this experiment is the assumption that individuals prefer to play repeated rounds of a bet with positive expected value if they are shown the explicit distribution of possible outcomes. So, workers who invest their savings should be more willing to invest in equities, with high returns but also high volatility, if they are presented with the distribution of long-term returns. Two

experiments were conducted to test this hypothesis.

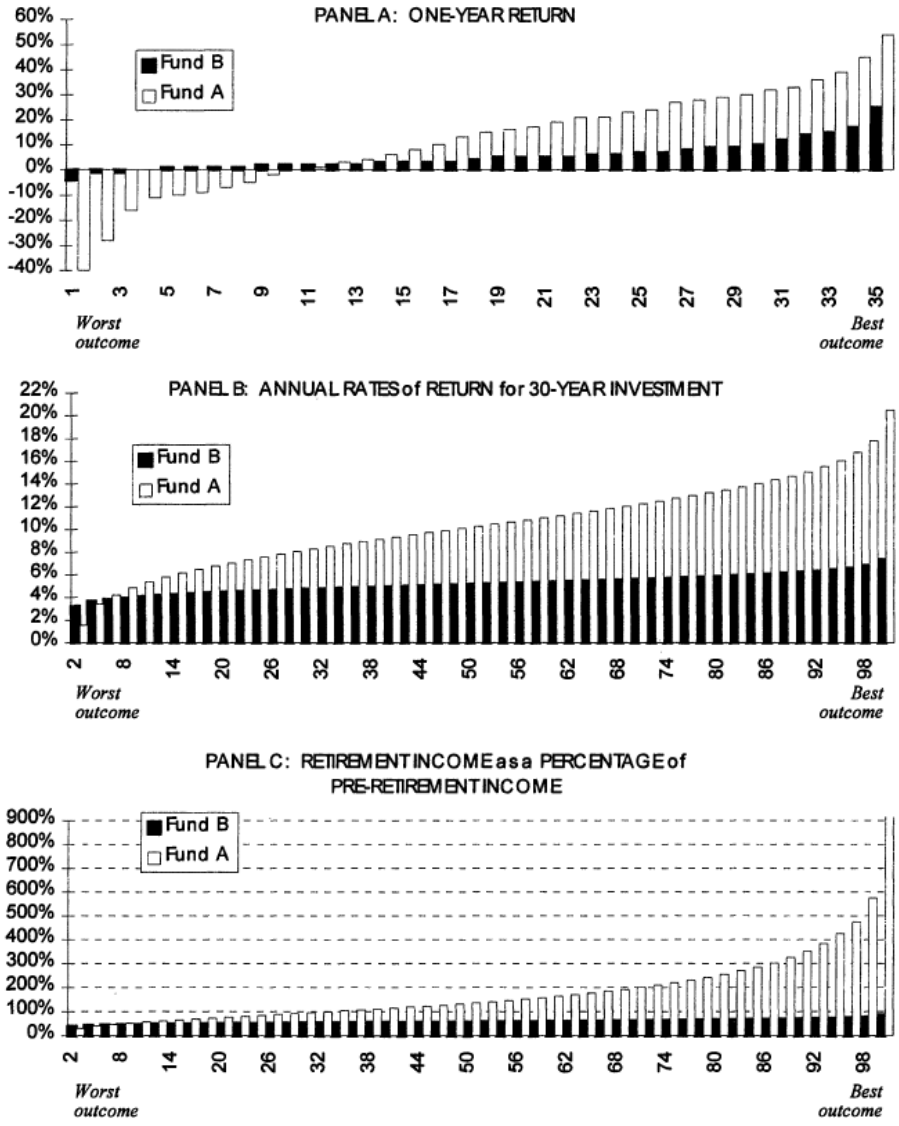
In the first, participants were recently hired university staff employees. The experiment consisted of choosing how to invest their pension contributions, being able to choose between two different securities, Fund A and Fund B. The choice was based on given information on historically realized returns. The returns of fund A corresponded to those of a stock index, while those of fund B corresponded to the historical series of returns on 5-year bonds. The different treatments applied were related to the way in which the distribution of returns was presented:

- In the first case the returns of individual years recorded in the interval 1926-1993 were exhibited, representing them in a bar graph where the single returns were paired and ordered from worst to best.
- In the second case, 30-year returns were presented, calculated from a simulation where 30 returns were extracted from the previous sample for 10,000 times and then used to compute the average return. The distribution has been presented in the same way of the previous treatment, that is through a bar graph.
- The third treatment follows the same reasoning as the second, but it is presented, instead of the return, the replacement rate between pre- and post-retirement income that could be guaranteed by wealth accumulated through investment in stocks or bonds.

Figure 3.6 presents the different distributions shown to the participants. Under the assumptions, the authors predicted that investment in Fund A would be greater for those treated with the second and third distributions, with the returns presented over a 30-year horizon, where as can be seen stocks perform better than bonds in almost all cases. The results are presented in table 3.5 and the difference in investment choices between the different groups is very pronounced: the average allocation to equities is 41% for those who saw the one-year distribution, while it varies between 75% and 82% for those who saw the 30-year distribution. The difference in allocation between the short-term version and the long term versions is statistically significant at the 0.001 level.

In contrast, there is no significant difference between the two long-term versions ($p = 0.80$, t-test). In conclusion, the results indicate that the way in which information on returns is presented can have a large influence on investment choices. On the other hand, these results may have been influenced by some specific aspects of the experiment design. No truly negative outcomes are presented while investors may be influenced by seeing very low returns. A further point of analysis could be

Figure 3.6: Returns representation by treatment



Source: *Risk Aversion or Myopia? Choices in Repeated Gambles and Retirement Investments, 1999*

Table 3.5: Percent Allocated to Stocks by treatment

Treatment	N	Median	Mean
One-year returns	25	40	41
Thirty-year returns	25	90	82
Retirement income	25	90	75
P-values comparing the mean allocation to stocks	75	0.001	0.001

Source: *Risk Aversion or Myopia? Choices in Repeated Gambles and Retirement Investments, 1999*

to verify how the effect of the different representations can diminish with a lower risk premium. In fact, several observers consider unrealistic that the premium will continue to be so high in the future. Finally, one could test the robustness of the

results with a more sophisticated sample of decision makers.

In order to control for these aspects the authors conducted the second experiment.In this second module, professors from the University of California had to make the same investment choice, but the information was presented in a different way. The first three treatments were the same as those of the original study, with the addition of a graph representing 30-year returns with a more pronounced left tail, i.e. a case of negative stock returns. To these were added three treatments similar to the previous ones, but with each annual stock return reduced by 3%. Panel A of table 3.6 reports the results of the module with the same characteristics as the previous experiment: the difference between the allocation choices remains (63% for the short term representation vs 81% and 83% for the long term representation), and introducing a more pronounced left tail in the 30-year distribution has no significant effect (81% vs 83%), so the higher allocation in equities cannot be attributed to not representing this case. The results confirm the previous ones, the only change is the increase in the average allocation in treatment 1, probably given by the higher degree of knowledge of financial instruments in the participants.

Table 3.6: Percent Allocated to Stocks by treatment

Treatment	N	Median	Mean
Panel A: using historic equity premium			
One-year returns	32	65	63
Thirty-year returns	26	92	83
Thirty-year returns with left tail	30	87	81
Retirement income	15	100	81
P-values comparing the mean allocation to stocks	103	0.006	0.005
Panel B: using half the historic equity premium			
One-year returns	33	70	63
Thirty-year returns	32	70	69
Retirement income	19	70	62
P-values comparing the mean allocation to stocks	84	0.47	0.462

Source: *Risk Aversion or Myopia? Choices in Repeated Gambles and Retirement Investments, 1999*

Panel B presents the effect of the decrease in the equity premium of 3%. There is no significant effect across treatments; the average allocation for the short horizon is 63%, while for the other two treatments it is 62% and 69%. This could be due to the fact that once the premium is reduced by 3%, the percentage of scenarios represented where equities perform better than bonds turns out to be the same for the different treatments.

Aggregating annual stock returns, representing them over a 30-year horizon, produced the effect of significantly increasing investment in equities. This result

was robust even in the case of a financially sophisticated sample or the modification of the distribution with the introduction of negative returns, although very unlikely. The effect disappeared only in the case where the equity premium was reduced by half, suggesting to the authors that the effectiveness of the different representations would fail if the premium decreased (the premium would likely be considered insufficient to justify the risk of collecting less wealth). The authors point out that their results may be of particular interest to the field of asset allocation choice in pension funds. In contribution-based pension plans, employers are required to inform employees about different choice alternatives, but they are forbidden to influence them, but these requirements can become difficult to put into practice if the way returns are presented significantly influences the final choice.

3.4.2 Does return aggregation affect allocation decisions? Beshears et al. critique to Benartzi and Thaler

In a paper pubblished in 2015 Beshears, Choi, Laibson and Mandrian (Beshaers et al., 2015) attempt to question the previously observed effect of returns aggregation. The starting point of their analysis is to ask whether a financial institution would be able to increase risk exposure in its clients' portfolios if it began to provide aggregate information (both at the portfolio level and at the time horizon level) on asset returns. The difference with previously conducted studies is to replace experiments done in the laboratory to students with simulated investment choices for small amounts of money, with an experiment conducted in the field which would be as realistic as possible with respect to real investment choices. Following this aim, the authors carried out a framed field experiment involving 597 adults of the U.S. population, The experiment consisted in choosing how to invest during a year an initial endowment of $325 among four different financial securities: U.S. stocks, international stocks, U.S. bonds and U.S. money market asset classes. At the end of the experiment what was earned was paid to the participants.

The information provided to participants varied across four dimensions:

- The first dimension is the frequency with which returns are shown: half of the participants received a weekly email with their returns, the other half received it every six months. To ensure that subjects opened the emails containing the information a small economic incentive was tied to it.

- The second dimension concerns the level of detail shown, half of the participants saw the return achieved by the selected portfolio, the other half the return of the single securities chosen.

- The third dimension concerns the way in which the historical returns of the different securities are presented. Some subjects had access to historical one-year returns, others to five-year returns, and some to no representation of past returns at all, to see if the allocative choice was affected by receiving this information or not.

- The final dimension relates to the access of information on past returns. Some participants were provided with information only on the returns of four "pure" portfolios, each invested 100% in one of the securities. Other participants, on the other hand, were able to access the distributions of the returns of any of the portfolios derived from a possible desired allocation (this option could have made the benefits of diversification more apparent, thereby incentivizing investment in risky securities).

The graphs depicting the returns were similar to those used in Benartzi and Thaler's (1999) experiment.

Initially, participants allocated an average of 65.7% in equities (with 34.8% invested in international equities and 30.9% in U.S. equities), 18.6 in bonds, and 15.8% in money markets. Analyzing the results of the initial choice, no effect comes from anticipating how often they will receive information, contrary to the studies carried by Gneezy, Kapteyn and Potters (1997, 2003) which predict that individuals who are aware that they will receive frequent feedback tend to reduce demand for risky assets from the first round. Anticipating that aggregate returns will be reported in portfolio form has no effect compared to seeing single security returns. Being exposed to any form of chart represented past returns significantly increases the first allocation to equities, by 9.2% in the case of 1-year returns and 11.2% in the case of 5-year returns, compared to the case where no information on past returns is given. But there is no significant difference between the two different time horizons. Looking at individual assets, the 5-year chart has a significant effect in increasing investment in US equities (+4.2%), but also has a statistically significant effect in decreasing investment in foreign equities. This effect could be due to the fact that in the 5-year chart foreign stock returns are lower than US stock returns in the middle values and only slightly higher in the right tail.

In an effort to control for the robustness of these effects in individuals who may be more likely to suffer from loss aversion, participants were given a bet designed to measure their degree of it. The choice was to accept a bet with the following possible outcomes: 50% chance of winning \$8 vs 50% chance of losing \$5 in their final gain. Those who should refuse this bet are considered particularly loss-averse. 47% of the experimental sample rejected it, thus forming a sub-sample in which the analysis on allocative choices was repeated. The previous results were all confirmed.

Finally, the authors also tested for the possible emergence of effects over the course of the experiment by monitoring the changes made to all portfolios in the middle and end of the year of analysis. The incentive linked to emails achieved in producing a significant effect in the number of times subjects logged on to the study website to view the returns earned: in the weekly condition, participants viewed returns an average of 60 times over the year, clicking 87% of the times they received an email, while in the biannual treatment, participants viewed returns 18 times per year, clicking 74% of the times they received an email. Despite this, the results of the analysis are again confirmed: the only treatment that produces an effect is viewing past returns, but there is no significant difference between the one- and five-year graph.

Table 3.7 presents the results of the main models considered.

Table 3.7: Aggregation effects on average equity allocation

	Initial	Middle	Final
Biannual e-mail	0.0	2.4	1.4
	(1.7)	(2.1)	(2.2)
Portfolio-level return reporting	1.7	0.1	1.2
	(1.9)	(2.4)	(2.4)
1-year graph	11.2**	7.4*	9.0**
	(2.6)	(3.4)	(3.4)
5-year graph	9.2**	9.1**	7.5*
	(2.6)	(3.4)	(3.4)
Asset class mixes shown	0.5	1.5	1.0
	(1.9)	(2.4)	(2.4)
Constant	58.3**	48.7**	54.6**
	(2.8)	(3.5)	(3.6)
Sample size	597	597	597

Source: *Does Aggregated Returns Disclosure Increase Portfolio Risk Taking?, 2015*

The authors therefore conclude by noting that the results previously found in the literature are not confirmed once the experiment is taken into the field, performed on a non-student population and carried out over a long period of time. Through a second experiment performed, they hypothesize that the failure to report effects is primarily due to the shape of the distribution of risk stock returns: once the risk premium is lower, then the effectiveness of the aggregation of returns decreases significantly.

3.4.3 The role of experience on learning and risk appetite

In a recent paper Kaufmann, Wever, and Haisley (Kaufmann et a., 2013) studied how risk appetite in investments can vary depending on the form in which the distri-

bution of returns is visually presented. Before discussing their work in more detail, it is necessary to introduce the interesting study carried out by Hertwig, Barron, Webwe and Erev (Hertwig et al. 2004), on how individuals learn information about probability distributions in risky choices.

The fundamental pillar of decision making in uncertainty contexts is given by the concept of expected value, introduced by Blaise Pascal, according to which a rational choice requires choosing the option with the highest expected value (EV), established by the following notation:

$$EV = \sum p_i x_i$$

Where p_i is the probability associated with outcome x_i. This elegant definition of rational choice was soon called into question by the mathematician Bernoulli, who pointed out that it operates poorly in some contexts, such as that of the St. Petersburg paradox. Bernoulli, in an effort to bring the theory closer to observed behavior, suggested to replace the value of monetary outcomes with the concept of subjective utility. Finally, his work was taken up and strengthened by Von Neumann and Morgenstern (1947) which introduced the theory of expected utility, according to which the utility given by an amount of money increases non-linearly with its amount, increasing at a decreasing rate. This theory is defined with the notation:

$$EU = \sum p_i u(x_i)$$

Where $u(x_i)$ follows a positive but decreasing function with respect to the value of x_i.

Over time, even this theory has been progressively questioned in light of the violations found in observing the behavior of real decision makers. The main modification to the theory formulated by Bernoulli is Prospect Theory, mentioned earlier in this thesis, introduced by Kahneman and Tversky. Under Prospect Theory, the value of each outcome is multiplied by a decision weight, a weight that comes from inference about choices, and reflects the impact that a certain outcome has on the decision. In this context, individuals tend to overestimate the impact of extreme events relative to their objective probability of occurring. This assumption has played a crucial role in explaining some of the contradictions observed empirically in decision-making processes, but in several recent studies the authors note that the opposite of what was predicted has been found, namely that individuals tend to underestimate rare events. This contradiction is the starting point of their study.

A possible explanation for the fact that individuals overestimate rare events in some cases and underestimate them in others could lie in the way subjects acquire

information about the probabilities associated with events. First, the authors introduce a distinction between choices derived from description and from experience. In choices that derive from description, subjects are provided with a simple description of each option, where the probability associated with each possible outcome is provided; the information is presented in visual or numerical form. An example can be represented by the following bet:

A: get €4 with a probability of 80%, zero otherwise

B: get €3 for sure

In decisions deriving from experience, on the other hand, subjects do not have information regarding the probability of possible outcomes, they can only deduce them from what they observe empirically in the environment in which they act.

To study the effect of these two different approaches on decision making, the authors constructed an experiment where 100 students were offered 3 bets from a total sample of six, two with negative expected value and four with positive EV. Half of the participants, the description group, saw the problem described in a form similar to the one previously mentioned, while the other half, the experience group, had to choose between two different buttons on their screen, each associated with a different distribution of unspecified payoffs. Clicking a button resulted in receiving back a payoff extracted from the distribution, with replacement. Participants in the experience group were incentivized to click on the buttons until they felt confident to choose which option they preferred. Once they decided, they could proceed to the next choice.

The results of this experiment, presented in Table 2.8, show how the two different ways of acquiring probability information significantly change the final choice: in every problem except problem two there is a significant difference between the two groups in the percentage of subjects who chose the outcome with a higher expected value. To explain how the difference in representation acts, in problem one the rare event is present in option H (i.e., the 20% probability that a payoff of 4 does not occur). This event is underestimated in the Experience Group, where therefore 88% of the subjects choose this option. In problem 3, on the other hand, the rare event is given by option L (-32 with a probability of 10%), and the underestimation of this possibility leads to choose this option more.

The authors continue the analysis investigating which are the factors that most influence this underestimation. Analyzing the number of draws made by the experience group in each problem, it turns out that on average individuals made 15 draws, fairly balanced between the two available options. The lower the number of extractions, the greater the probability that the rare event is never encountered,

Table 3.8: Summary of the Decision Problems and Results

	Options		Expected value		% choosing H		
	H	L	H	L	Description	Experience	Difference
1	4, 0.8	3, 1	3.2	3	36	88	52
2	4, 0.2	3, 0.25	0.8	0.75	64	44	- 20
3	- 3, 1	- 32, 0.1	- 3	- 3.2	64	28	- 36
4	- 3, 2	- 4, 0.8	- 3	- 3.2	28	56	28
5	32, 0.1	3, 1	3.2	3	48	20	- 28
6	32, 0.025	3, 0.25	0.8	0.75	64	12	- 52

Source: *Decisions From Experience and the Effect of Rare Events in Risky Choice, 2004*

and is thus ignored. Another example: in problem 5 the button that predicts a payoff of 32 with probability 10% has been pressed on average 7 times, so that most of the participants have never experienced a payoff of 32. The statistical explanation of this fact is that in a binomial distribution an outcome with probability p to occur in n independent draws tends to have a skewed distribution when n and p are small, i.e. to be observed less frequently than n*p.

A further analysis is carried out on the so-called "recent effect", according to which the outcomes that occurred in a time horizon close to the moment of the final decision have a greater weight than those that occurred in a distant moment. The presence of this effect in the experience group is confirmed by the fact that, dividing in half the number of extractions made for each problem, the extractions made in the second half predict better (75% of the times vs 59%) what the final choice will be.

The conclusion is that how individuals learn the probability distribution of an uncertain choice has a dramatically important effect on the final choice. If information is presented in a descriptive form, then choices are made by overestimating the probability that extreme events will occur, as predicted by prospect theory. In contrast, when knowledge is derived from experience, individuals tend to underestimate rare events, and this is likely due to the reliance on small samples of information and the giving greater weight to outcomes recently occurred.

The study just presented verified that the way in which we learn the probability distribution in a context of uncertainty can significantly influence our choices. Learning in descriptive form leads to overestimating the probabilities associated with rare events, while learning in experiential form leads to underestimating them, thus inducing a higher risk tolerance in lotteries that have a small probability of making losses.

Building on these findings, Kaufmann, Weber, and Haisley (2013) investigate how learning by experience can influence investment choices for risky securities.

To do so, they introduce a specific tool useful for learning the distribution of stock returns in an experiential form, the risky tool. The risky tool is a graphical interface representing the returns of different assets. Based on the mix of securities selected, the toll plots on a Cartesian plane, in the form of straight lines, the expected return and the range defined by the standard deviation, if the return is risk-free then it represents a single simple straight line. Participants are asked to simulate at least eight times the return of the risk security, but may proceed with the simulation until they are satisfied. Based on the simulations that are performed, a distribution of possible achievable returns is then constructed. Once this distribution is seen, they proceed in the same manner constructing different allocations of the two securities together until the final choice is made.

The authors make the following assumptions:

- Hypothesis 1: The risky tool will lead to allocations with a greater risk security component than those made by subjects informed via a description of the probability distribution.
- Hypothesis 2: the greater propensity to risk given by the risky tool will persist even at the moment in which the subjects will know the result of their own choice, even if this result should be inferior to the expected value. Therefore, the presence of regrets is not previewed.
- Hypothesis 3: the risky tool will lead to a greater knowledge of the real probability distribution, this implies that the subjects treated with it will be better able to recall it, to estimate the probability of a loss and will attribute a lower degree of risk.

To test these hypotheses, the authors conducted three different experiments.

Experiment One: Risky Toll vs Description. Participants had to choose how to allocate $1,000 between a risk-free Fund A and a risky Fund B whose returns are based on those historically realized by a U.S. stock index. The returns of the risky stock were presented in two different ways to participants, one in descriptive form and one with the risky toll previously described. The descriptive condition presents the distribution in written form, and explains the variance by offering examples "in 70 cases out of 100 the final payoff will result between X and Y...".

The results, presented together with those of the following experiments in Table 3.9, confirm hypothesis 1, the average allocation in the risky tool condition corresponds to 74.5%, against 60.4% in the description condition, the difference is statistically significant in a linear model that includes several control variables. To check hypothesis 2, after receiving the outcome of the final decision subjects

were asked to report a satisfaction index for the choice, no significant difference was reported between the two samples, and to make a further choice, where the difference in allocation between conditions persisted. The result obtained leads the authors to ask which component of the risky tool, the extraction or viewing of the distribution, might have conditioned the higher risk exposure. To control for this, experiment two was conducted.

Experiment Two: Experience sampling vs Distribution function. Experiment Two: Experience sampling vs Distribution function. Participants' task was to choose how to allocate $100 over a 5-year horizon between two securities, one risky (B) and one risk-free (A). In addition to the two previous conditions, the experience condition is introduced, where individuals simulate for several repetitions first the return of one security and then the other, and receive back a return randomly extracted from the distribution and presented in numerical form. Once this is done, they repeat the operation for the portfolio of securities until they choose their preferred allocation. In the distribution condition, participants can view the bell of the distribution as a function of choice, and then adjust the allocation by seeing the change in the distribution represented.

Looking at the results, the difference between the first two conditions remains present (54.3% vs 66.53%), but no significant difference is observed between the experience condition and the distribution condition (61% vs 59.5%). A difference emerges, however, in the allocation following the final one, where individuals in the experience condition chose to invest 64% in the risk security, while those in the distribution condition chose 53%. The results thus highlight that the greater investment in risk stocks is due to a combination of factors, experience sampling and the addition of the distribution of returns, but the subsequent commitment to the decision appears to be due to experience sampling alone.

Experiment three: Potential psycological drivers and further analysis. In this experiment, the same setup as the previous one was maintained, with only the addition of some questions in the final questionnaire. The sample size was also increased, from 190 to 362 participants. To test hypothesis three, five "recall" questions were proposed that required estimating aspects of the distribution of returns: expected value, probability of incurring a loss and probability of incurring a gain, how risky the stock was perceived to be, and the confidence found in investing.

The effectiveness of the risky tool with respect to the description condition is maintained, but a greater allocation to risky securities in the experience condition also emerges, which becomes significant due to the increase in sample size. From the analysis of the questionnaire, it emerges that the subjects treated with the risky tool are willing to bear a higher level of risk but do not have unrealistic

expectations about the distribution, on the contrary: they are better at estimating the expected value of the distribution, such as that of incurring a loss (both for the description condition and the distribution condition, suggesting that it is the experience sampling that leads to a better estimate of possible losses), and they do not overestimate more than the other conditions the probability of obtaining a gain. Confidence with the choice made also turns out to be higher in the risky tool condition, a judgment maybe linked to positive feelings about one's choice, than in the description condition.

Table 3.9: Final Allocation to tne Risky Fund - results by experiment

	Experiment I	Experiment II		Experiment III	
	Description vs. Risk Tool	Description vs. Risk Tool	Experience and Distribution vs. Description	Description vs. Risk Tool	Experience and Distribution vs. Description
Risky tool	132.72***	13.83***		12.273***	
	(38.42)	(5.24)		(3.6)	
Experience			7.5		9.74***
			(5.13)		(3.79)
Distribution			7.78		4.94
			(5.21)		(3.86)
Risk Attitude	137.69***	10.09***	8.70***	10.25***	7.38***
	(22.63)	(2.91)	(2.42)	(1.99)	(1.76)
Controls	Yes	Yes	Yes	Yes	Yes
Constant	-189.03	2.89	27.12**	27.60***	31.83***
	(156.06)	(13.45)	(11.78)	(8.99)	(7.62)
Observations	133	89	145	192	268
R-squared	0.33	0.32	0.17	0.21	0.13

Source: *The role of experience sampling and graphical displays on one's investment risk appetite, 2013*

In conclusion, in the proposed experiments, the authors found that the way in which risk is represented, if experience sampling and probability distribution display are taken into account, can significantly influence the investment in risky securities. An important result is that this increase in sustained risk is not due to a lesser understanding of the choice, but on the contrary the subjects declare themselves more confident with it, show a willingness to maintain it in the future, and demonstrated to estimate more accurately the main aspects of the associated probability distribution. This study, therefore, aims to help individuals make more informed choices under conditions of uncertainty such as investment choices, by constructing a portfolio with a larger share of risky securities, if it is consistent with their preferences, given the greater understanding of the decision.

3.5 Boosting vs nudging: providing competences

The risky tool employed in the paper described in the previous section has some very interesting features compared to the interfaces used in other experiments to represent the distribution of returns. The authors explicitly state that its purpose is not simply to increase investment in risky securities, but rather to provide people with a tool that allows them to better understand the characteristics of the distribution of returns, so that they can consciously make a choice consistent with their preferences.

In recent years, a debate has emerged around different forms of public intervention based on the main insights provided by behavioral economics. Once institutions realized the potential, in terms of effectiveness and low costs, of policies based on behavioral science, several programs aimed at designing public interventions emerged. The most successful approach is the one proposed by Thaler and Sunstein (2008), known as "Nudge", where individuals are targeted with non-regulatory and nonmonetary interventions aimed at directing them towards a specific choice while preserving their freedom of judgment. This approach was challenged in a recent paper by Hertwig and Grune-Yanoff (2017), where an alternative is presented: boosting.

Boosts are behaviourally informed policy interventions aimed at improving people's decision-making competence, by fostering existing competences, or instilling new ones, about a specific domain or many domains. In boosts people are encouraged to exercise their agency, they are not considered passive and unconscious. On the contrary, nudges are defined by Thaler and Sunstein (2008) as "any aspect of the choice architecture that alters people behaviour in a predictable way without forbidding any options or significantly changing their economic incentives" (p.6). They are founded on the concept of libertarian paternalism, according to which policies should legitimate try to influence people's behaviour to improve the quality of their lives, but these interventions should not prevent people from choosing their preferred alternative, freedom to chose must be preserved.

Nudging is inspired by the heuristics and biases program, where people rely on heuristics that can lead to systematic errors that we call biases. However, the authors argue that in the heuristic and biases studies subjects are almost never given feedback about their mistakes, they are rarely asked to repeat their judgments and decisions and they are almost never asked to make judgements in group settings.On the other hand, boosts are inspired mainly by the simple heuristics or ecological rationality program (Gigerenzer, Hertwig and Pachur, 2011; Gigerenzer, Todd and ABC group, 1999). An important contribution in this field is Simple heuristics

that make us smart (Gigerenzer et al. 2011), according to which people use fast and frugal heuristics to make complex decisions in condition of time pressure, high uncertainty and lack of knowledge. In these domains, less information, computation and time can help improve the accuracy of inferences and predictions. Some of these rules result to be very effective and robust.

In the paper are distinguished two different types of nudges and boosts.

- Non-educational nudges: are directed to intervene on the behavior of agents, starting from the cognitive biases present in the domain of intervention, they modify the choice architecture so that the individual is incentivized to take the best direction defined by those who design the intervention, yet he can simultaneously be free to choose the alternative preferred by him. A classic example of this type of nudges are the default options.

- Educational nudges: these are aimed at intervening on the motivations of individuals and their cognitive skills, in order to address some decision errors present in specific domains. An example would be messages aimed at reminding people of the importance of something, or informing them of the consequences of their behavior.

- Short term boosts: aimed at fostering a specific competence that is limited to a single context of choice.

- Long term boosts: produce a permanent change in the individual's capabilities, creating an imaginary "capital" that can be extended to different domains and is resilient over time.

The authors identify a certain similarity between educational nudges and short term boosts, although they point out that nudges do not have as their ultimate goal to increase individuals' ability to make choices, but rather to make a specific choice at that moment. In this, boosts are distinguishable since they produce effects that endure over time, even when the behavioral intervention is removed, while nudges are no longer effective when removed, although some of them, if repeated several times or protracted for a few years, can produce routines that maintain their effectiveness.

A further distinction results in the degree of involvement that the individual experiences. Nudges are often considered to be less transparent, in so far as they operate behind the individual's back, manipulating the context of the choice without making him aware of it, or without allowing him to understand how the intervention may modify his behavior. On the other hand, boosts require the active collaboration of the individual involved, so they must be explicit and visible. Since the individual

chooses in the boost to allocate his cognitive capacity or not, then it can be assumed that that choice is respectful of his actual preferences.

Boosts are not like school education, since they are not something that teaches you to read, algebra or else, they are directed to boost competencies in areas not covered in schools (e.g., how to deal with self-control problems), and they are typically used in cases of limited resources (as time and knowledge). Given their different nature with respect to nudges, boosts need to be costly, since they require the individual to make an investment in time and cognitive effort. However, this cost does not have to be great, many boosts require only few minutes, or no more than few hours.

Thus, it can be concluded that the tool designed by Kaufmann et al. (2013) is a boost precisely aimed at fostering skills in the statistical field of understanding probability distributions. With it, participants in the experiment were able to better understand how the risk they face when making a financial investment is distributed, so that they could choose the combination of assets that best represents their risk preferences. This intervention reflects several characteristics of boosts: it increases financial competence, it is maintained over time, it requires cognitive engagement and participation from the individual, and it is transparent.

3.6 Summary

According to neoclassical theory, saving is the result of the choice to postpone a portion of current consumption in exchange for possible greater consumption in a future period. The Life Cycle model (Mogliani and Brumberg, 1954) describes the pattern that underlies the consumption-savings relationship over the course of the working life of individuals, identifying as one of the first motivations for savings the need to guarantee a constant level of consumption, or standard of living, once work has ended. Having chosen the preferred path of consumption, the individual must choose the portfolio of financial securities in which to invest his or her saved resources. The choice is made according to the mean-variance analysis model, which makes it possible to identify the best combination of risk-free securities and risky securities that maximize the individual's utility given his preferences for risk.

Beginning with the seminal work of Mehra and Prescott (1985), an important debate emerged about the difference in returns experienced between stocks (risky) and Treasury bonds (considered risk-free) and how this can be rationally justified by the models presented. According to their study, the observed risk premium cannot be justified by consumption profiles, so a rational investor cannot be so risk-

averse as to not invest in equities but simultaneously be willing to postpone their consumption in order to receive a return of less than 1%. An additional empirical fact extraneous to the models is recorded by MaCurdy and Shoven (1992), who in their simulation based on historical returns showed that the wealth created by investing in equities only was higher than any other strategy in all but one of the 25-year periods between 1872 and 1988.

Benartzi and Thaler (1995) identify as a possible explanation for the equity premium puzzle the combination of two concepts derived from decision psychology, namely loss aversion and mental accounting. According to loss aversion, individuals value a loss more than twice as much as a gain, while mental accounting postulates that individuals tend to organize and evaluate economic transactions in separate accounts, and this is also true for financial transactions in terms of types of securities and time frequency. The combination of these two effects can have very important consequences in the way investment decisions are made: a loss-averse individual who frequently evaluates equities may prefer bonds because they experience fewer losses and less frequently, as opposed to equities which have a high volatility. Applying the value function formulated by prospect theory (Kahneman and Tversky, 1979, 1992) the authors estimated that the observed value of the equity premium makes stocks and bonds indifferent for individuals with a loss aversion value of 2.25 and a performance evaluation period of 12 months. Both of these estimates turn out to be reasonable. Given this theoretical framework, Thaler, Tversky, Kahneman and Schwart (1997) constructed an experiment to test its empirical validity. The results confirmed the hypothesis that loss aversion and myopic loss aversion influence investment decisions: once all returns are presented as positive, eliminating the loss experience, the allocation in stock increased significantly, a result that is also valid for individuals who make their investment choice with longer horizons (receiving less frequent feedback).

The theoretical conclusions proposed by the myopic loss aversion model led several authors to conduct experiments to test how it was possible to incentivize investment in risky securities starting from the representation of returns, and the frequency with which they are made known. The first experimental study was carried out by Benartzi and Thaler (1999). They found that aggregating annual stock returns, representing them over a 30-year horizon, produced the effect of significantly increasing investment in equities. This result was robust even in the case of a financially sophisticated sample or the modification of the distribution with the introduction of negative returns. The effect disappeared only in the case where the equity premium was reduced by half.

Beshears, Choi, Laibson and Mandrian (2015) criticize the design of the study

of Benartzi and Thaler, and other authors who have performed similar experiments, arguing that performing them in the laboratory, having a sample mainly composed of students, the small value of the amounts invested and the choice made in a single-period can hardly represent the context in which investors make real choices. Therefore, they conduct a framed field experiment with the intention of verifying the robustness of the previous results in a more realistic context with an annual horizon. The results of the experiment confirm the positive effect on risky investments of representing the distribution of returns, but there is no difference between short- and medium-term returns. They hypothesize that the failure to report effects is primarily due to the shape of the distribution of risk stock returns: once the risk premium is lower, then the effectiveness of the aggregation of returns decreases significantly.

Finally, building on the seminal study done by Hertwig, Barron, Webwe, and Erev (2004) on learning from experience or description, Kaufmann, Weber, and Haisley (2013) investigate how learning from experience can influence investment choices for risky securities. They design a useful tool for learning the distribution of stock returns in an experiential form, the risky tool, which is a graphical interface that allows one to sample the returns of different assets and construct a distribution of possible outcomes through experience. Through the application of the risky tool in three different experiments, the authors found that if the returns are presented taking into account experience sampling and probability distribution, the investment in risky assets is significantly increased. An important finding is that the increase in sustained risk is not due to a diminished understanding of the choice; on the contrary, subjects have been demonstrated to more accurately estimate key aspects of the associated probability distribution and are willing to maintain the choice in the future without experiencing significant regret.

The tool employed by Kaufmann et al. (2013) was then presented as an effective example of boosting. In the literature on public policies informed by behavioral science, a boost is defined (Hertwig and Grune-Yanoff, 2017), as a behaviourally policy interventions aimed at improving people's decision-making competence, by fostering existing competences, or instilling new ones, on a specific domain.The strength of this approach lies in the fact that it is not simply aimed at conditioning individuals' choices by exploiting their cognitive biases, but is intended to provide individuals with the skills to better understand and cope with the choices they must make, so that they can choose the alternatives that best reflect their preferences.

All the experiments presented confirm that the way, and the frequency, in which information about the distribution of returns is presented can significantly influence investment in risky securities. In the next chapter we will present the experiment we

have conducted, in which, starting from the specific case of the rules concerning the representation of returns for Italian pension funds, we applied some of the evidence found in the literature to influence an investment choice with risky securities.

Chapter 4

The experiment: learning by experience and myopic loss aversion

All of the experiments presented in the previous chapter found that the way, and frequency, in which the distribution of returns is presented can have a positive effect in investing in risky securities. In light of the different alternatives presented in the literature, we conducted an experiment to study how these results can be applied in the field of choosing the investment sub-fund in a pension fund. To do so, we studied what obligations established by Italian, and European, law pension funds must comply with when presenting their returns to their clients. Using these rules as a starting point, we constructed an experiment, based mainly on the work of Kaufmann et al. (2013), where we studied the effect of different representations of returns on the final allocative choice.

This chapter is organized as follows. The first section presents the structure of the experiment conducted, with the hypotheses tested and the main characteristics. The second section presents the obtained results and the third discusses them.

4.1 The experiment

The conducted experiment consisted in the simulation of a financial investment. participants had an initial endowment and had to choose how to allocate the amount between risky and risk-free securities.The starting point is to compare the status quo of how returns are displayed, presented in the appendix A, with the main insights identified in the literature and described in chapter two of this thesis.The intent is to test whether it is possible to increase the allocation in equities through a different

representation of the distribution of returns. The proposed experimental environment allows to provide feedback to participants as they make their investment choice, and through this they can link the decisions made with their consequences, thus learning important information. Following the example of the boosting literature, the experiment is not intended to unconsciously influence the choice by leading to greater risk exposure, but rather to allow for a better understanding of the distribution of returns so that participants can make more conscious choices.

Before presenting the experimental hypotheses and the proposed treatments, it is worth reflecting on one of the main criticisms presented by Bashear et al. (2015) to the original work of Benartzi and Thaler (1999), namely that the laboratory environment is not very representative of reality when investment choices are made only once, with small amounts of value, and the distributions of returns are determined ex ante instead of being taken from historical series. In the experiment we conducted, as much as was possible given infrastructure and budget constraints, some of the criticisms were considered, such as selecting participants not just from students and using the true time series of returns, but one important observation can be made. In the real world, new members of supplementary pension schemes choose the investment line of their savings only once, at the time of adhesion, and with limited information (see Appendix A. The choice made initially remains unchanged for the majority of members, in fact, during 2020 only 2.4% of those enrolled in a pension form changed their initially chosen investment line (COVIP, 2021). Therefore, to represent the choice of investment compartment as an individual decision made after receiving some information and followed by feedback seems to us to be a procedure that respects a certain external validity.

Experimental Hypotheses. The first hypothesis that we wanted to test with the experiment is related to the conclusions of Benartzi and Thaler (1995, 1999) on myopic loss aversion, namely that for loss-averse individuals the attractiveness of investing in equities, which have a high yield but wide short-term volatility, may depend on the investment horizon and the frequency at which realized returns are evaluated. From this it is derived the first experimental hypothesis.

1. *Hypothesis 1: the share of capital invested in risky securities increases when returns are aggregated and presented with medium to long-term investment horizons.*

The second experimental hypothesis derives from the studies of Hertwig et al. (2004) and their application in the financial field carried out by Kaufmann et al. (2013), according to which when the probability distribution is learned through experience, and not through a description, then subjects tend to underestimate the probability

of rare events, and consequently that of suffering a major loss when investing in risky securities. Hence, the second experimental hypothesis is:

2. *Hypothesis 2: The proportion of capital invested in risky securities increases when the distribution of returns is learned through experience rather than description.*

Experiment Task. The experiment was conducted online, participants of the experiment accessed it by clicking on a link shared through different channels. On the first page, participants were given access to general information about the experiment and asked to provide consent to process their data. Once consent was given, the second page was accessed with specific instructions for the experiment (see Appendix A for the exact instructions provided). Participants were asked to allocate an initial allocation of 100 ECU between two securities, one risky and one risk-free. An initial explanation of the main characteristics of the two securities was provided, security B was described as a bond with a certain return while security A was described as an equity security with an uncertain return. The question asked was how much of the initial allocation to invest in security A, the remainder would automatically be invested in security B. The choices were 0%, 25%, 50%, 75%, 100%. With this set of possibilities we intend to simulate the different investment funds available in the pension funds: the 0% allocation in equities corresponds to the guaranteed sub-fund, the 25% allocation to mixed bond sub-funds, the 50% allocation to balanced sub-funds, the 75% allocation to equity sub-funds.

Distribution of returns. Given the complementary nature of the choice between bonds and equities, it was decided to define a certain yield for the bond, equal to 3% per annum. The distribution of stock returns was instead given by the historical series of the "FTSE MIB ITALIA" index, which can be downloaded from the website of the Italian Stock Exchange for the period 1975-2019. From this series, the distribution of one-year returns was extracted, resulting in a distribution with 44 values, average return of 11.4% and standard deviation of 32%. The distribution of 10-year returns was constructed by simulation, following the procedure used by Benartzi and Thaler (1999). Ten single-year returns from the available series were taken at random, and from the resulting sample, the 10-year compound average return was calculated using the geometric mean formula. This process was performed 1000 times, thus forming a distribution of 1000 possible 10-year average compound returns. The resulting distribution has an expected return of 7.1% and a standard deviation of 9.1%.

Treatments. In order to test the presented hypotheses, subjects were randomly directed to three different treatments, which differ in the way the distribution of

risk stock returns is presented. The three proposed treatments are:

- Treatment 1: description and short horizon. The returns have been presented in descriptive form, following the directives defined by ESMA guideline 34-45-1272 (for more details look at Appendix A. The return of security B is described in written form, presenting it as a security that guarantees 3% per year for certain. The return of security B is presented through a bar chart (see Appendix A), where each bar represents the return recorded for that year, and the time interval presented is from 2009 to 2019. In addition, a summary table with cumulative returns for that 3, 5, and 10-year period is presented. The participant, once the returns were presented, was asked to make an investment choice. Once the choice was made, it was quickly summarized and the subject was informed of the return obtained. The return was calculated as the weighted average between the fixed return on the bond and a randomly drawn return for the stock from the 1-year return distribution.

- Treatment 2: Experience and short horizon. The return of security B is described in written form, presenting it as a security that guarantees 3% per annum for certain. The distribution of returns of security A was presented through a repeated series of different simulations where the allocation of a given amount was returned a yield with a time horizon of one year, in a procedure similar to that applied for the experience treatment by Kaufmann et al. (2013). The participant was asked to repeat the choice for 8 rounds, choosing in each round the percentage of shares he or she preferred. At the end of each round, the choice made was quickly summarized and the participant was informed of the return obtained. The return was calculated as the weighted average between the fixed return of the bond and a randomly drawn return for the stock. As the rounds continued, a history of the returns obtained in previous rounds was displayed at the top of the screen (see Appendix A). After 8 rounds of testing, the participant was asked to make his or her final investment choice.

- Treatment 3: experience and medium horizon. The distribution of returns is learned in the same manner as treatment 2, but in this case the investment horizon is 10 years, and the distribution of returns used in the extraction is the 10-year distribution.

Treatment 1, which complies with the requirements of current legislation, presents a graph of returns over the last 10 years, where there were 4 years with clearly negative returns and one year with a return of practically zero (-0.4%). Thus, in the sample represented, the years with negative returns are 5 out of 11, or

about 45.5% of cases. In the actual distribution of one-year returns, the number of years with negative returns is 17, or 38% of cases. It is therefore noteworthy that treatment 1 represents in percentage terms a larger number of cases where the return is negative than in the true distribution. In the 10-year distribution, on the other hand, negative returns are 215 out of 1000, corresponding to 21.5%, a further significant difference. The random extraction that characterizes treatments two and three should lead, as theorized by Hertwig et al. (2004), to underestimate rare events, which are defined by them as events occurring in 20% of cases or less (thus particularly in the case of treatment 3), while the descriptive representation of treatment 1 should lead to overestimating the probability of incurring a loss. Given this approach, a loss-averse individual would have to operate under assumptions 1 and 2, and thus increase investment in stock A in treatment 2 and especially in treatment 3.

Control variables. In the last section of the experiment some useful information was collected in order to construct control variables to be included in subsequent models of analysis of investment choices. First of all, each participant was asked to report age, gender and level of education, between middle school and university degree. They were also asked to self-assess their confidence with financial instruments, indicating their level on a scale between 1 and 5. Two financial literacy questions inspired by the study of Hastings and Mitchell (2018), one on compound interest and one on risk diversification, were proposed to assess knowledge of the basic mechanisms of financial investment. Finally, to test for any different perception of the riskiness of security A across treatments, subjects were asked to estimate how risky they had been perceived the security A to be in a range between 1 (not risky) and 5 (very risky).

Monetary Incentive. To incentive participants to make choices that could be representative of their behavior and not due to chance, a monetary incentive was provided. On the first page of the experiment, subjects were informed that 4 participants would be drawn at random, and would receive an Amazon voucher with a value equal to the payoff of their final choice divided by 10. Consequently, the possible payoff was between $59/10 = 5.90$ euros, corresponding to the worst possible payoff, and $220/10 = 22$ euros, the highest achievable payoff. The 4 subjects drawn obtained on average a final payoff of 11 euros.

4.2 Experiment results

4.2.1 Descriptive statistics

The experiment was opened on the morning of Tuesday 8 March 2022 and ended on Sunday 13 March 2022. During the five days that the link was active 143 individuals participated in the experiment, but only 109 concluded it by completing all its parts. Table 4.1 presents the main descriptive variables of the sample. Among the 109 participants, 40.3% were female, the average age was quite young (34 years), and 36% had a university degree. Looking at the age distribution (figure 4.1) of the participants, we can see that the sample is composed of a good portion of individuals of study age (about 50% are under 25), but there is also a certain component between 40 and 60 years of age (35%). Looking at the variables aimed at controlling the degree of financial literacy and confidence with financial instruments, the sample generally declares itself to be not very confident with financial instruments (on average 1.42 on a scale between 1 and 5), but on the other hand responds correctly to the two questions of financial knowledge posed: 57.7% for compound interest and 73% for risk diversification.

Table 4.1: Descriptive variables by treatment

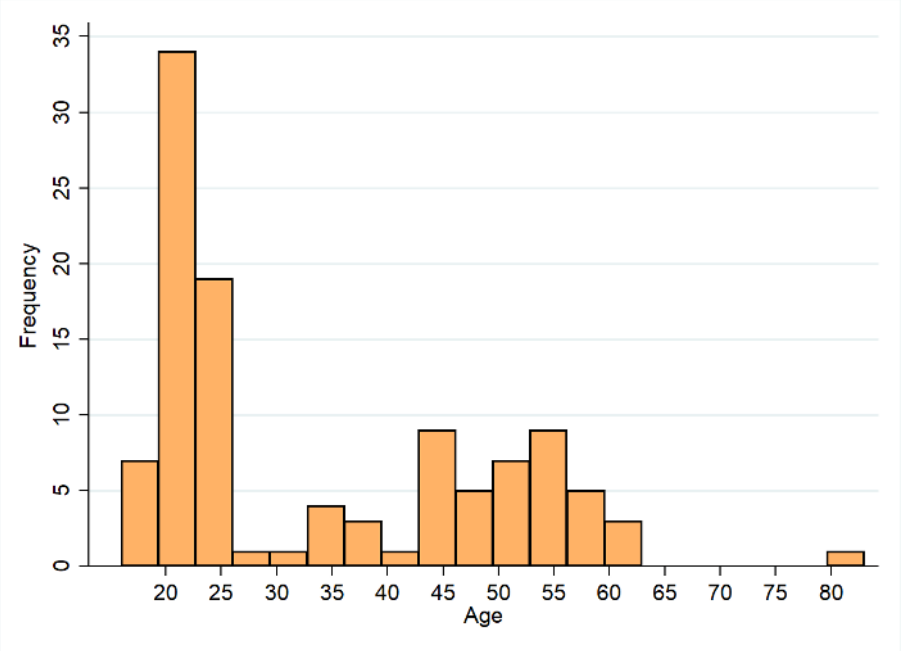
Variable	Treatment 1	Treatment 2	Treatment 3	All sample
Age (average)	35	32	34	34
Female (%)	50	38	34	40.3
University degree (%)	30	33	44	36
Confidence with financial instrument	1.1	1.3	1.74	1.42
Correct compound interest (%)	60	61	53	57.7
Correct diversification (%)	63	83	83	78
N	30	36	43	109

Source: *Our elaboration of experimental data*

The diffusion of the link to participate in the experiment took place through various social channels (such as Whatsapp and Facebook), and it is necessary to note that this sample may be biased representing mainly a population of young people, especially university students in economics, or even residents in the Province of Treviso or Trento, two of the richest and most educated provinces in Italy: according to ISTAT in 2018 the NORD-EST was the Italian macro-region with the greatest average annual household income. For this reason, the control variables considered were included, but these may not be sufficient to allow generalization of the results obtained.

Observing the data presented in Table 3.1, another important consideration

Figure 4.1: Distribution of participants age



Source: *Our elaboration of experimental data*

arises: apparently, but it was not, the randomization mechanism of the treatments seems to have failed, as it resulted in 30 responses for treatment 1, 36 for treatment 2 and 43 for treatment 3. Not only the number of participants, but also some of the control variables present different characteristics among the samples. The sample of treatment 3 turns out to be more composed of men than that of treatment 1 (34% vs 50%), with a higher education (44% with a degree vs 33% and 30%), but above all they declare to be more confident with financial instruments (statistically significant difference for an ANOVA test with $p = 0.06$). However, being the control variables collected on the last page, we cannot use these to make inference as to why the subjects did not complete the experiment, otherwise we would risk falling into "survivor bias". On the other hand, the randomization mechanism originally worked correctly: the 143 subjects who accessed the link were equally redistributed to the three treatments, with 47 subjects going to treatment 1, 47 to treatment 2, and 49 to treatment 3. However, it is possible to study at which point subjects dropped out of the experiment.

Table 4.2 shows the data for the pages on which participants left the experiment. Of the 143 individuals who clicked "I consent" to the data processing on the first page, only 109 ended the experiment. 21 subjects dropped out on the page presenting the experiment instructions, and this behavior differed across treatments. 23.4% of the subjects who read the instructions of treatment 1 decided not to continue, whereas this was the case for only 12.75% of those who read the instructions of treatment 2 and 8.2% of those who read the instructions of treatment 3. The

difference was significant for a test on the analysis of variance ($p = 0.09$). The behavior on the other pages does not show significant differences between the treatments. This result is difficult to explain, because the instructions of treatment 1 were shorter and simpler than those of the other treatments, and the required task itself was simpler because it required a single choice of investment, and not eight as in the other two cases.It can be hypothesized that precisely the brevity of the instructions in treatment 1 led to a worse understanding of the required task, and therefore to a higher drop rate than in the other treatments.

Table 4.2: Drop pages by treatment

Drop at instructions page		
Treatment	Frequency	Percentage
Treatment 1	11	23.4
Treatment 2	6	12.7
Treatment 3	4	8.2
Total	21	14.7
Anova TEST	p = 0.09 (*)	
Drop at investment page		
Treatment	Frequency	Percentage
Treatment 1	3	8.3
Treatment 2	5	12.2
Treatment 3	2	4.4
Total	10	8.2
Anova TEST	p = 0.44	
Drop at questionnarie page		
Treatment	Frequency	Percentage
Treatment 1	3	9
Total	3	2.6
Total drops	34	23.7

Source: *Our elaboration of experimental data*

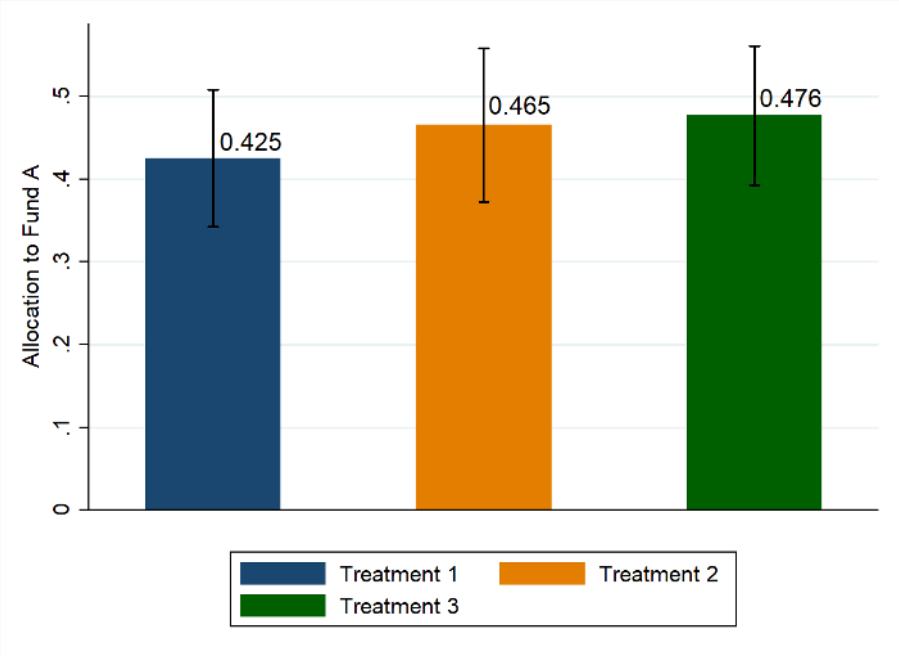
4.2.2 Analysis of results

Figure 4.2 represents the average allocation to Fund A (risky security) for the different treatments. At a first analysis, it can be observed that the allocation to Fund A is slightly higher in treatments 2 and 3 than in treatment 1, while there is no clear difference between the two experiential treatments. To study the effect of the different treatments in a parametric way, we propose the following linear model:

$$Allocation\ to\ fund\ A = \alpha + \beta_1 ExperienceST_i + \beta_2 ExperienceLT_i + \beta_3 Controls_i + \epsilon_i \tag{4.1}$$

In this model, the control group is defined as the subjects treated with the descriptive condition, which is found to be as compliant as possible with current legal constraints. Given this, the investment choice (how much is allocated to fund A) is studied as a function of having been treated with one of the two experiential treatments with short or long term ($ExperienceST$ and $ExperienceLT$), and with the following control variables: age, sex (dummy variable equal to 1 if female), degree of education (dummy variable equal to 1 if having a university degree), degree of confidence with financial instruments (categorical variable between 1 and 5), financial literacy (dummy variable equal to 1 if having correctly answered both questions asked).

Figure 4.2: Average allocation to Fund A by treatment



Source: *Our elaboration of experimental data*

According to hypothesis 2, we expect both treatments to have a positive and significant coefficient, i.e., the allocation to fund A increases if subjects learn the distribution of returns in way based on experience. Moreover, according to hypothesis one, the effect of aggregating returns over a 10-year horizon should produce a further increase in allocation to Fund A in treatment 3. Regarding the control variables, we predict a positive coefficient for the degree of confidence with financial instruments, i.e., greater investment in risky securities for those who judge

themselves to be more confident with these instruments.

Table 4.3 presents the results of the described model, and two other models that have the same characteristics but individually compare the effect of one of the two experience-based treatments versus the descriptive treatment. In none of the three models our hypotheses are confirmed; both treatments are not found to have a significant effect on final allocative choice, either when considered together or individually. The only positive predicted effect that occurred is an increase in investment in Fund A for those who reported a higher degree of confidence with financial instruments, indeed the coefficient turns out to be positive and significant at a 95% level.

Table 4.3: Final allocation to Fund A, OLS regressions

	MODEL 1 Description VS Experience short and long term	MODEL 2 Description Vs Experience short term	MODEL 3 Description VS Experience long term
Experience short term	0.022	0.016	
	(0.065)	(0.0624)	
Experience long term	0.007		0.014
	(0.0643)		(0.064)
Age	-0.002	-0.002	0
	(0.001)	(0.002)	(0.001)
Female	-0.017	-0.072	0.029
	(0.055)	(0.066)	(0.550)
University degree	0.055	0.139*	0.033
	(0.053)	(0.070)	(0.053)
Confidence	.048**	0.037	0.0554**
	(0.023)	(0.031)	(0.022)
Financial literacy	-0.068	-0.116	-0.022
	(0.537)	(0.067)	(0.053)
Constant	0.471***	0.523***	0.381***
Observations	109	66	73
R-squared	0.086	0.154	0.082

Source: *Our elaboration of experimental data*

The fact that neither hypothesis was confirmed, even in the sample treated with treatment 3, which had a distribution of returns with a significantly lower probability of incurring a loss, prompted us to proceed with further analysis. A first hypothesis advanced was that the experience-based treatments backfired, in these conditions participants suffer the psychological experience of incurring a loss when a negative return was extracted, whereas this did not happen in the descriptive treatment where the choice was made only once after reading a graph, and the experience of suffering losses is not really lived but only estimated. Assuming

participants suffer from myopic loss aversion, the psychological burden associated with these losses may have resulted in greater underinvestment in the fund A for subjects who learned the distribution of returns through experience.

3. *Hypothesis 3. Individuals who experienced losses in the test rounds of the experience-based treatments invested less of their endowment in the risk security in their final choice.*

To test this hypothesis, we focused on the two experience-based treatments. Observing the performance of individuals during the random draws of the test rounds, we measured losses according to two dimensions: that of the individual security and that of the portfolio. The first variable (Negative returns) is the number of negative returns of fund A that each subject realized over the eight rounds of draws; the second (Losses) corresponds to the number of times the subject obtained a negative portfolio payoff, given by the weighted average of the recorded returns of the investment in fund A and fund B.

Assuming treatment 2 as the control group, to study the effect of having suffered losses in the test rounds, we propose the following linear models:

$$\begin{aligned} Allocation\ to\ fund\ A = \alpha\ +\ \beta_1 ExperienceLT_i\ +\ \beta_2 Negative\ returns_i + \\ \beta_3 ExperienceLT_i * NegRet_i\ +\ \beta_4 Controls_i\ +\ \epsilon_i \end{aligned} \tag{4.2}$$

$$\begin{aligned} Allocation\ to\ fund\ A = \alpha\ +\ \beta_1 ExperienceLT_i\ +\ \beta_2 Losses + \\ \beta_3 ExperienceLT_i * Losses_i\ +\ \beta_4 Controls_i\ +\ \epsilon_i \end{aligned} \tag{4.3}$$

Under Hypothesis 3, we expect to find a significantly negative coefficient for both the number of negative returns and the number of losses incurred.

Table 4.4 presents the estimated coefficients. Model 4 reported in the table presents the results of Equation 4.2, and contrary to expectations the number of negative returns obtained in the trial round does not have a significant effect on final choice. This is despite the fact that, on average, participants in the two treatments obtained 2 negative returns (out of 7), with several subjects (20 out of 79) experiencing 3 negative returns or more. An even more striking result is provided by Model 5, which states that the number of losses incurred has a positive (and significant with a 90% confidence interval) effect on the allocation in Fund A. The resulting interpretation is that individuals who experienced a greater number of negative payoffs during the trial rounds then allocated more of their endowment to the risk security in their final choice.

Table 4.4: Final allocation to Fund A, OLS regressions

	MODEL 4 Experience ST vs Experience LT	MODEL 5 Experience ST vs Experience LT	MODEL 6 Experience ST vs Experience LT
Experience LT	0.0336	0.0193	0.028
	(0.139)	(0.105)	(0.050)
Number of negative returns	- 0.0048		- 0.086 ***
	(0.0432)		(0.032)
Exp LT * Neg return	- 0.0264		
	(0.0619)		
Number of losses		0.0789*	0.003
		(0.0436)	(0.053)
Exp LT * Losses		0.0697	
		(0.0668)	
Losses * Neg returns			0.030 *
			(0.015)
Avarage choice			0.849***
			(0.123)
Constant	0.551***	0.424***	0.0239
Controls	Yes	Yes	Yes
Observations	79	79	79
R-squared	0.088	0.223	0.621

Source: *Our elaboration of experimental data*

This result can seem counterintuitive, according to the formulated hypothesis in fact loss-averse individuals would have to decrease their investment in risky securities when they realize repeated negative returns, or realized losses of wealth. For what reason would a rational individual continue to invest in a security that produces losses? In addition to trying to answer this question, it is worth noting that we have not yet found a variable that can explain the behavior of individuals in the trial and final rounds. To do so, we have investigated what are the conditions under which an individual can suffer a loss, beyond the random extraction, to verify the presence of a possible omitted variable bias.

To pursue this analysis, we transposed the available dataset, analyzing it as if it were a panel data. With the intent to study the causes of suffering a loss, we studied a probit model where the probability of having incurred a loss is regressed on several variables (see Appendix B for all estimating results). We find that the probability of suffering a negative payoff in a round is negatively affected by being treated with treatment three (coefficient = - 0.68, p.value = 0.000) and positively related to the choice made in that round (coefficient = 1.21, p.value = 0.000). Treatment three presents the distribution of the ten-year returns, with less variance than that of the single-year returns, and therefore as has already been said it is more difficult to obtain a negative return in it. The second interesting consideration is

that subjects who invest a greater part of their endowment in the risky security are more likely to incur a negative payoff. This result is not difficult to understand: under-investment in fund A protects the individual from the possibility of obtaining a negative payoff in the event that a return below zero is extracted, since this is balanced by the positive return of fund B, while as the allocation to fund A increases, the "protection" capacity of fund B decreases.

In view of these findings, we created a new variable, given by the average of the allocative choices made in each round of trials, and added it to the equation of model 4.3, resulting in the following model:

$$Allocation\ to\ fund\ A = \alpha + \beta_1 ExperienceLT_i + \beta_2 Negative\ returns_i + \beta_3 Losses + \beta_4 Losses_i * NegRet_i + \beta_5 Average\ choice_i + \beta_6 Controls_i + \epsilon_i \quad (4.4)$$

We expect that once we control for the number of negative returns obtained and the average choice, which are the main variables that can lead to a negative payoff, the positive effect of having suffered a loss found in the previous model will disappear. We also wanted to study the effect given by the interaction between negative returns and negative payoffs. As already explained, having obtained a negative return is a necessary but not sufficient condition to incur a loss, if the individual has invested only a small part in the risky security then the balance with the bond leads to have a positive payoff, even if small. With the interaction between the two variables we want to study what is the implication of having simultaneously obtained a negative return and a loss. Finally, according to the dynamics of the experiment the average value of the choices made in the trial rounds should not have a high predictive value of the final choice. In the test round a decision maker could rationally choose different allocations between the two stocks to observe how the payoff changes accordingly, without worrying about the payoffs obtained, since the choice that matters is the one in the final round.

The estimated results of model 4.4 are reported in the third column of Table 4.4. As predicted, once we control for negative returns and the average choice, the number of losses obtained has no longer a significant effect on the final choice. Moreover, we identify a negative and significant effect (coefficient = - 0.09, p.value = 0.01) of the number of negative returns obtained, thus confirming hypothesis 3: experiencing a high number of negative returns in the trial rounds produces the effect of reducing the final allocation in risky securities. On the other hand, the interaction between negative returns and losses produces a positive effect on the final choice, which means that those who suffered a higher number of losses after having incurred in negative returns have then chosen to invest more in the risky security. This may be due to the so called break-even effect (Kahneman and Tversky, 1979;

Thaler and Johnson, 1990). According to this concept, a prior loss has a positive correlation with risk taking in sequential investment decisions. The greater risk taking is due to the fact that after experiencing a loss, individuals will be looking for options that allow them to reach an opportunity to break even. Consequently, if some of our participants have viewed the trial rounds as real investment decisions, their behaviour could be affected by this bias, and so the realization of losses in their wealth could have lead to a grater allocation to the risky fund.

The average value of the choices in the trial rounds turns out to be highly correlated with the final choice (p.value = 0.00), this relationship can be also observed in Figure 4.3. Graph 4.3a represents the average allocation to Fund A for each round in both experience-based treatments; in it, participants were grouped according to their choice in the final round. The next two graphs report the same analysis but present data for treatment 2 (4.3b) and 3 (4.3c) only. After an initial variability in the first few rounds of choice, it can be seen that participants stabilized their choices at a level similar to the one of their final allocation. In treatment two participants took only three rounds to stabilize their investment pattern, in treatment three this was true for subjects with a greater propensity to invest in the risky security, while there was greater volatility for the cohort that chose not to invest anything in fund A. This higher volatility in treatment three, which if noted is upward directed, i.e., toward greater investment in the risky security, could be due to the greater number of positive returns observed (given the 10-year distribution).

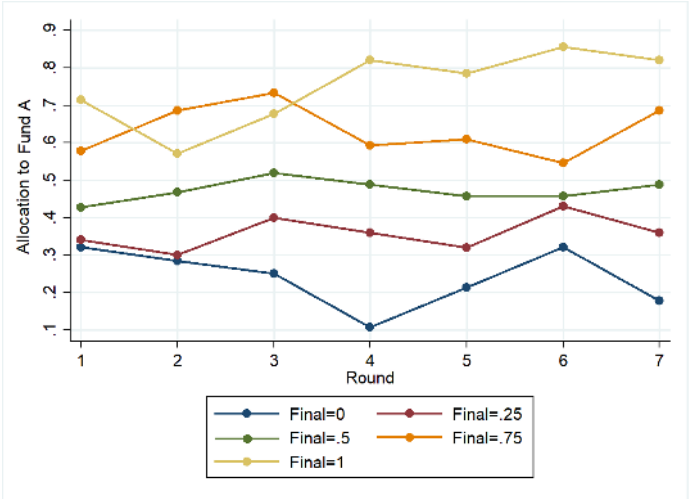
Table 4.5: Risk assessment by treatment

Treatment	Mean	S.d.	Freq.
1	2.4	1.22	30
2	2.75	1.29	36
3	2.37	1.41	43
Total	2.504	1.343	109

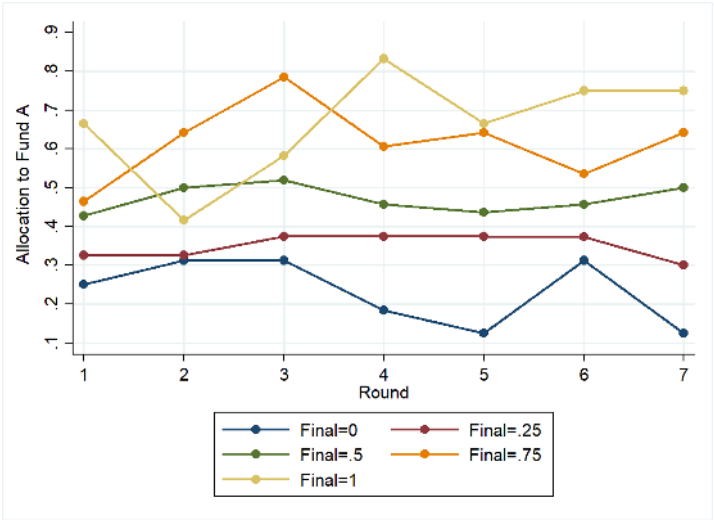
Source: *Our elaboration of experimental data*

Finally, Table 4.5 presents the estimates produced on the riskiness of Title A by participants, divided by treatment group. The question required them to estimate how risky Security A was perceived to be on a scale from 1 to 5. Recall that the graph depicted in treatment one had 5 out of 11 (45.5% of cases) negative returns, while on average over the course of the trial rounds subjects realized 2.3 out of 7 (33%) negative returns in treatment two, and 1.65 (23%) in treatment three. In addition, in the final choice round, 33.3% of participants in treatment one, 38% of participants in treatment two, and 25% of participants in treatment three obtained negative returns. Looking at these data, we would expect treatment one and two participants to (correctly) estimate their security as more risky than treatment

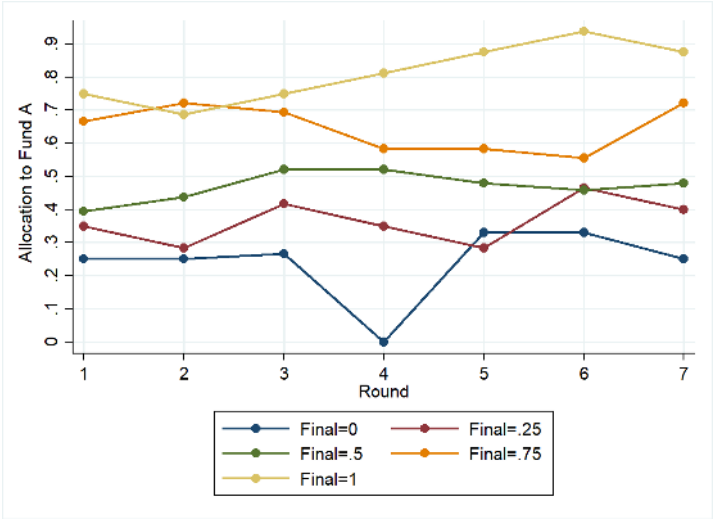
Figure 4.3: Average allocation to fund A by round



(a) Treatment 2 and 3



(b) Treatment 2



(c) Treatment 3

Source: *Our elaboration of experimental data*

three. Instead, as Table 3.5 presents, there is no difference in the estimates of riskiness between treatment one and three, while in treatment two Title A is judged to be more risky.

What are the variables that may have led to the estimate of a higher degree of riskiness? By first analyzing the data from the entire sample, we propose the following model:

$$Risk\ assessment = \alpha + \beta_1 ExperienceST_i + \beta_2 ExperienceLT_i + \beta_3 Final\ Loss_i + \beta_4 Final\ NegRet_i + \beta_5 Controls_i + \epsilon_i \tag{4.5}$$

It emerges that the fact of having been treated with treatment 2 has a slightly significant positive effect, while having obtained a negative payoff in the final round has a positive and significant effect (p.value = 0.04) and the degree of confidence with financial instruments has a negative effect that is also significant (p.value= 0.017) (see Appendix B for all estimated result). These results confirms an effect of the treatment proposed, which could again be due to the fact that in the experiential treatments participants not only observed possible returns, but also actually experienced the possibility of incurring gains and losses. This led to correctly estimating the distribution of treatment two as riskier than the ten-year distribution of treatment three, but also produced an increase in the estimated riskiness of the latter distribution with respect to distribution presented in the graph of treatment one. In fact, looking only at the sample treated with the two experience-based conditions, the number of negative payoffs incurred turns out to have a positive and significant effect (p.value=0.09) on the riskiness attributed to Fund A (see Appendix B for all estimated results).

4.3 Discussion of results

The intention of the proposed experiment was to verify whether the introduction of a different method, compared with that currently established by law for pension funds, for representing the returns of securities could lead to greater investment in risk securities. The experiment carried out did not lead to confirmation of the two hypotheses put forward, subjects who learned the distribution of returns through experience did not invest more in risk securities, not even when this presented the ten-year distribution.

The behavior observed by participants in the experiment therefore did not verify the hypotheses advanced, but there are nonetheless some results that can be

informative. First, the literature reports that showing the distribution of returns on a risky security produces a positive effect on allocative choices. The experiment we conducted has several limitations that do not allow us to easily generalize the results obtained, mainly the small amount of money involved and the simplification of the choice into two securities, but it confirms that in this choice context subjects choose to allocate an amount between 40% and 50% of their endowment in risky securities. In reality, as was presented in chapter 1, the percentage allocated in equity securities by the population enrolled in pension funds is decidedly lower, and as a matter of fact at the moment when new members must choose their investment line there is no legal obligation to show the distributions of the returns realized by the various sub-funds. Consequently, the introduction by law of an obligation to show the historical returns obtained by the various funds, possibly following a specific representation, at the time when the member has to make the choice of the investment sub-fund could be a simple measure to increase the investment in the equity component.

In analyzing possible explanations for the lack of effect of the proposed treatments, we hypothesized that the experience-based conditions produced backfiring returns that were not expected. In the original paper by Kaufmann et al. (2013), all treatments proposed to participants involved a random extraction of different returns that were then described with various formulas (via hypothetical cases, via a graph of the distribution, or simply in numerical form). In the experiment we proposed, however, treatment one involved a single choice, similar to the one made by subscribers to pension funds in Italy, while the other treatments involved the random extraction of returns, which could turn out to be both positive and negative. The hypothesis put forward is that the positive effect given by the experiential treatments in underestimating the probability of a loss may have been contrasted by the negative psychological value associated with having experienced real losses. In fact, individuals averse not only to risk but also to loss might attribute greater value to the negative returns experienced through extraction rather than those merely observed in the treatment one graph. Analyzing the data from treatments two and three alone, we found a significant negative effect of the number of negative returns extracted on the final allocation choice. However, when these negative returns also produced a large number of negative payoffs (thus corresponding to subjects who invested heavily in the risk stock), the effect was found to be positive.

These results are not necessarily to be interpreted as wrong, the intent of the study is not to change the context of choice so that individuals unconsciously choose to invest more in risky securities, but to help them make more informed choices given their preferences, without falling into decision biases. Experience-based treatments did not reduce the effect of myopic loss aversion, since individuals responded more

to losses in their final choice, and the expected effect of the underestimation of the probability of suffering a loss did not produce significant results. In the original paper by Benartzi and Thaler (1999), the authors found a significant result in presenting the distribution of 30-year returns, whereas we chose, following hypothesis one, to aggregate returns for a 10-year horizon. This difference could be the explanation why treatment 3 aggregation did not mitigate myopic loss aversion and produce a significant increase in investment. Following the same procedure used to create the distribution of 10-year returns, we created a distribution of 30-year returns, in which it is found that the probability of incurring a negative return falls from 21% to 4.9%. Therefore, we have likely chosen an aggregation interval that was too short to sufficiently mitigate myopic loss aversion, and the probability of incurring losses was still high enough that there was no incentive for participants to invest more in the risk stock.

In the experience-based treatments, subjects correctly estimated the 10-year distribution as less risky than the annual distribution, but, contrary to what was expected in the descriptive treatment the riskiness of Fund A was estimated to be lower than in treatment two and equal to that of treatment three. The higher estimated riskiness appears to be positively correlated with the number of negative payoffs experienced in the descriptive treatments, confirming again the hypothesis that the extraction of negative returns carried more weight than their presentation in graphical form.

In conclusion, hypothesis 2 according to which learning the distribution of returns through experience would have increased the investment in the risk security was not confirmed. The explanation advanced is that the number of negative returns extracted during the trial rounds produced a negative effect on the final choice, an effect greater than that given by their representation in graphical form. In addition, in the experience-based treatments the distributions were perceived as more risky, and this perception was related to the number of negative payoffs obtained in the test rounds. Hypothesis 1, regarding the effect of yield aggregation was also not confirmed; presenting the distribution of returns over a 10-year horizon did not produce an increase in investment in the stock. This was explained by an aggregation interval that was too short compared to that needed to mitigate myopic loss aversion.

Given these results, the direction we propose to follow is first to test whether aggregating returns at investment intervals longer than 10 years (such as 20 or 30 years) produces any effects. Regarding the way the distribution of returns is represented, having more resources to design the graphical interface of the experiment, we can propose a method similar to the risky tool used by Kaufmann et

al. (2013). This involves simultaneously extracting different allocations between risky and non-risky securities and representing the obtained returns in a bar graph, which progressively shows the distribution of returns resulting from the different extractions. The purpose of using this tool continues to be to increase participants' awareness of their investment choices by better understanding the relationship between increased allocation to risky securities and subsequent returns in the medium and long term, without falling into the traps of decision-making biases.

Finally, it is worth making an observation on the limits of the online environment for this kind of experiments. Using an online platform indeed allows to reduce a lot the costs, both economic and in terms of time, to run the experiment, but it also has limitations. As presented in the initial results section, there is a significant difference between the number of subjects who dropped out of the experiment after reading the instructions of treatment one compared to the two treatments. It is possible that this result is due to a lack of clarity in the instructions of treatment one, which were shorter or perhaps because of this less clear. If the experiment had been conducted in a classroom setting, with fewer time constraints and the opportunity to answer any questions from the participants, this problem probably could have been remedied. Another simple modification that could have been introduced is a practice round for all subjects, thus allowing participants to better understand the assigned task.

Chapter 5

Conclusions

At the beginning of the 1990s the Italian pension system was experiencing a profound imbalance, with a large spending deficit and an unfair method of determination of pension benefits. Following the reforms implemented in that decade and in the years following the 2008 economic crisis, the system has experienced profound changes, such as the introduction of the contribution-based calculation method and the indexation of the retirement age to life expectancy forecasts. These changes have brought the system to stabilization, but at a high cost: the replacement rate has fallen significantly and the retirement age has become increasingly longer. Several groups, such as women, part-time workers, and individuals with intermittent careers face the risk of receiving meager public pensions that will not allow them to maintain a decent standard of living.

In this context, the role of the complementary pension has decidedly grown, being a fundamental instrument to integrate the public allowance and guarantee a decent lifestyle. Once an individual has chosen to join a pension form, he or she must then make an important choice: the line in which to invest his or her contributions. This is probably the most important financial choice that individuals will make in their life, and the data observed tells us that the majority choose guaranteed or bonded sub-funds, with a strong under-investment in the stock market, even when the subscribers are very young.

In the economic literature, this phenomenon goes under the name of equity premium puzzle. Mehra and Prescott (1985) were the first to observe how the difference between the returns historically recorded by equities and treasury bond indices could not be rationally justified by classical models. MaCurdy and Shoven (1992) then showed how, over the interval 1872-1988, an investment strategy based only on equities would have produced the highest wealth in all but one of the possible 25-year periods in the sample. Benartzi and Thaler (1995), building on

the seminal work of Kahneman and Tversky on Prospect Theory, identified as a possible explanation for this puzzle the psychological mechanism of myopic loss aversion: loss-averse individuals who frequently evaluate the returns obtained from their investments might associate a lower degree of utility with securities that have greater short-term volatility, such as stocks. Applying the value function formulated by Prospect Theory the authors estimated that the observed value of the equity premium makes stocks and bonds indifferent for individuals with a loss aversion value of 2.25 and a performance evaluation period of 12 months. Both of these estimates turn out to be reasonable.

The theoretical model of the myopic loss averision led several authors to conduct experiments on investment choices, in order to verify whether by modifying the way and frequency with which returns are represented, it would be possible to incentivize investment in risky securities. The first experiment, conducted by Benartzi and Thaler (1999), confirmed that aggregating stock returns with a 30-year horizon, where the volatility of equities is significantly reduced and in most cases positive results are achieved, produces a significant increase in the allocation to risk securities. Beshaears et al. (2015) criticized the results obtained by Benartzi and Thaler and other similar studies, arguing that the laboratory setting in which the study was conducted, with small samples of students, a small value of resources invested, and an immediacy of choice-return feedback, could not be representative of the actual investment choices. In proposing a study with similar characteristics but conducted in the field, they concluded by confirming the positive effect on risky investments of representing the distribution of returns, but they found no effect of the representation of short or medium-term returns.

These experiments were aimed at studying how, by changing the way in which returns were presented to individuals, the choice of investing in risky securities could be incentivized. The effectiveness of the proposed treatments was in the fact that individuals, visualizing a distribution of long-term returns where the possibility of incurring a loss was decidedly reduced, evaluated as preferred the investment in the stock given the higher return. Nothing was added to allow individuals to understand the true distribution of risk in the short and long term, so the choice was driven by the simple non-activation of the bias (loss aversion), rather than a greater comprehension of the required task.

Kaufamm et al. (2013), building on the distinction between learning by description or through experience theoretically realized by Hertwig et al. (2004), introduced a new tool aimed at pursuing a different purpose. The risky tool, as defined by the authors, is a graphical interface that allows one to sample at random the returns of different assets and build a distribution of possible outcomes through

experience. Through the random extraction of the returns and the observation of the distribution that follows, the authors have verified experimentally how individuals are able to better estimate the riskiness of a security and some key aspects of its distribution, then choosing to invest more in risky securities and declaring themselves confident with their decision, without experiencing regret.

We presented the tool proposed by Kaufmann et al. (2013) as a form of boosting. According to the recent debate on policy designs inspired by behavioral sciences, boosting is defined by Hertwig and Grune-Yannoff (2017) as interventions aimed at improving people's decision-making competence, by fostering existing competences or instilling new ones, in a specific domain or in many ones. This approach is opposed to the nudging approach, introduced by Thaler and Sunstein (2008), which focuses on how to exploit decision biases and altering people behaviour by modifying the choice architecture, without changing the economic incentives, so that individuals are still free to choose their preferred alternative. Both approaches have as their starting point the main insights of the psychology of decision-making, but they differ in one fundamental aspect: the degree of consciousness and involvement of the individual. In boosting the individual is actively involved in the choice, the intervention is transparent and cannot be effective without the cognitive participation of the individual. Nudging is considered less transparent, it acts by manipulating the context of the choice without making the individual aware of it, or without allowing him to understand how the intervention may modify his behavior.

In the context of financial choices, we believe it is essential to make the individual more aware of the consequences of his decisions. The starting assumption is that a long-term investment in risky securities leads to a higher return than other strategies, but this choice in the short term can also lead to losses in the wealth invested. It is important that the individual understands this mechanism, so as to consciously maintain this choice in the future, without experiencing forms of regret. We do not consider the treatment proposed by Benartzi and Thaler (1999) to be effective in achieving this goal; the simple representation of all realized returns over a 30-year investment horizon in no way prepares the individual to deal with the fluctuations that will instead occur in the early years. On the other hand, the risky tool allows the individual to gradually build up the distribution of returns, and thus better understanding the properties of it. A subsequent increase in investment in the risky tool therefore follows an increase in the competences behind the ability to understand statistical probability distributions, leading to a greater awareness of the individual of the consequences of his or her choice.

Building on these considerations on the literature, we conducted an experiment on investment choices. In order to place the investment choice in the field of pension

funds, we have studied the way in which the returns of the funds are represented. In Italy there is no legislation which makes it compulsory to present the returns to the member at the moment in which the latter makes the choice of investment line. Assuming that the member requests information on the returns, or that the provider chooses to show them, the regulations covering the way in which the returns are presented are CONSOB Communication No.DIN/1031371 and the ESMA Guidelines 34-45-1272. These guidelines have been used to construct our control treatment.

The experimental hypotheses to be tested were that the allocation in the risky fund would increase when returns were aggregated with a medium-term horizon (10 years), or when the distribution of returns was presented through experience. The first hypothesis is based on the assumption that individuals suffer from myopic loss aversion, and therefore aggregation of returns can have a positive effect, while the second is built on the assumption that representation through experience, compared to the descriptive form, leads to underestimation of the possibility of incurring a loss. In order to verify these hypotheses, three treatments have been designed: the first one represented a graph and a table (description) with the returns realized in the last 10 years, the second one with the learning by experience of the returns distribution by year, the third one with the learning by experience of the 10-year returns distribution. The distribution of returns was constructed starting from the Italian stock index FTSE MIB ITALIA.

None of our hypotheses were confirmed by the experiment performed; the proposed treatments did not show a significant effect. We hypothesized that the experience-based conditions backfired in a way we did not expect. The positive effect given by underestimating the probability of a loss may have been contrasted by the negative psychological value associated with having experienced real losses, once negative returns are extracted. Individuals averse to losses might attribute greater value to the negative returns experienced through extraction rather than those merely observed in the treatment one graph. Indeed, subjects that have learned the one-year distribution through experience estimated the risky fund to be riskier than the subjects who view, in the description treatment, the graph built whit the same distribution. Following these reasoning, we direct our attention to the two treatments based on experience. We found that final allocation to the risky fund was negative correlated, at a significant level ($p = 0.01$), with the number of negative returns sampled in the trial rounds.

We found another interesting result: the interaction term between the number of negative returns and the number of negative payoffs had a positive effect ($p = 0.09$). Sampling a negative return is not sufficient to incur in a negative payoff,

it is also necessary to invest a great part in the risky fund. This result could be explained by hypothesizing that some participants fell in the so-called break-even effect: after experiencing a loss, people tend to seek for options that give them the opportunity to break-even, consequently shifting to more risky options.

In addition, the mean value of the choices made in the trial rounds also proved to be highly correlated with the final choice. Looking at the choice made round by round (Figure 4.3), we observed that most of the participants stabilized their choice at a level similar to the one of their final allocation relatively soon, after the third or fourth round. This result is consistent with what has been found also in the literature, Hertwing et al. (2004) confirm that in experience-treatment people tend to display a limited search effort, considering few extractions sufficient to make decisions.

Finally, the lack of effect recorded by the aggregation of returns over a ten-year horizon can be explained by the length of the aggregation interval chosen. In the original paper Benartzi and Thaler (1999) found a significant result in presenting the distribution of 30-year returns, while we have chosen an interval with significant differences: we carried another simulation to build a distribution of 30-years returns, and we found that the probability of incurring a negative return drops from 21% to 4.9%. Therefore, we have likely chosen an aggregation interval that was too short to sufficiently mitigate myopic loss aversion.

These results, although they did not lead to confirm the experimental hypotheses, outline the possible future direction. First of all, as shown by all the experiments conducted in the literature, and as also in the one we proposed, the simple representation of the distribution of returns produces a positive effect in the equity allocation. Therefore, a first intervention, effective and cost-free, could be to introduce in the legislation on pension fund enrollment the mandatory representation of the returns obtained by the different sub-funds.

As a future direction, we propose to study the effectiveness of a representation of returns that follows the graphical interface presented by Kaufmann et al. (2013), which implies the extraction of different allocations between risky and non-risky securities and the representation of the obtained returns in a bar graph, which summarizes the resulting distribution. Based on the results obtained from our experiment, in order to counteract the mechanism of myopic loss aversion that could be activated even during the extraction, we propose to perform this operation twice: first with the distribution of annual returns, then with the distribution of returns over a long time horizon. The 10-year distribution was not effective, so we propose to test the effects of 20- and 30-year aggregation. This approach is designed to make the individual understand the risk-return relationship in both

the short and long term, so that he or she can consciously choose the preferred allocation. This intervention, aimed at strengthening individuals' competence in the field of probability distributions, can be intended as an example of boosting: once introduced, it can produce results that are maintained over time, it requires active participation of the individual (in this it is costly: it requires time and a certain effort), and it is transparent, a criterion that we consider crucial in the field of financial decision-making.

Choosing an inefficient investment line can seriously affect the size of the final pension benefit, reducing the ability of the supplementary pension to protect the saver's lifestyle in retirement. The proposed intervention is designed to support individuals in this complex choice, so that they can freely and consciously choose the best asset allocation consistent with their preferences.

Chapter 6

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Appendix A

Experiment design

A.1 The Italian legal framework

Before testing the effect of the representation of returns as proposed in the literature, we thought it important to study which are the legal obligations concerning the investment choice established by Italian law.

An individual who for the first time chooses a supplementary pension scheme in Italy is guided in the choice of the fund in which to invest his or her contributions by a self-assessment questionnaire proposed by COVIP (Deliberazione COVIP del 31/10/2006). The questionnaire is aimed at favouring the choice of an investment option that is as consistent as possible with the characteristics of the member.

The questionnaire is divided into two parts, the first concerns "Knowledge of complementary pensions" and is characterized by questions on the level of knowledge of pension funds and pension expectations. The second part, on the "Appropriateness of the pension choice", guides the choice by means of questions relating to the savings capacity (defined between the intervals: less than 3000€, between 3000 and 5000€, more than 5000€), the investment time horizon (given by the period that separates the member from retirement), and the personal propensity to risk (in the question is underlined the correlation greater risk - greater potential return). The answers given in the second part form a score between 3 and 12: on the basis of this, the member is guided in his choice between the various investment options proposed, although this result is not binding. The questionnaire has been constructed in the form of a self-assessment and its adoption is required by all pension funds: negotiated pension funds, open pension funds, PIPs and pre-existing funds.

At the time of subscription there is no legal obligation to disclose the past returns

recorded by the various sub-funds, but it is likely that these will be required by the subscriber or presented by the provider. The regulations concerning the reporting of returns achieved by pension funds were defined from 2001 to February 2022 by CONSOB Communication No. DIN/1031371 of 26-4-2001, while the one currently in force is contained in the ESMA "Guidelines on marketing communications under the Regulation on cross-border distribution of fund" (ESMA 34-45-1272).

In the CONSOB guidelines, which are worth mentioning because they have in fact been applied up to the present time, the minimum criteria to be respected are two:

- It is required to represent the compound annual average return of the investment lines relative to the last five years as of the end of the nearest quarter. If such data are not available (or a significant change in the investment policy has occurred) the average annual compound return for the shortest period of availability, with a minimum of one year, is reported.

- A line graph or histogram representing the returns for the last five years to the end of the nearest quarter must be included in the disclosure.

In addition to these representations, it is possible to publicize the returns referring to multiples of 12 months elapsed at the end of the nearest completed calendar quarter, up to a maximum of 120 months.

In the new ESMA guidelines the representation of returns must be based on historical data and indicate the reference period chosen to measure performance and the source of the data. It is mandatory to disclose past performance for the previous 10 years for funds that produce a KIID, or the previous 5 years for other funds, or the entire period for which the funds in question are offered if this period is less than 10 years for funds that produce a KIID or less than 5 years for other funds. In all cases, past performance information must be based on complete 12-month periods, but such information may be supplemented with the current year's performance updated to the end of the most recent quarter. Where cumulative performance is reported, the disclosure must also show the fund's performance for each year of the reporting period. Cumulative performance may be presented in chart form.

Both regulations require the representation of the returns of the single years, for periods between 5 and 10 years. The ESMA guideline specifies that if cumulative returns are presented, then it is also necessary to represent those of the single years considered. In light of what Bernatzi and Thaler (1995) presented in their study on myopic loss aversion, the representation of returns with a small time horizon (1

year) and with a relatively short time series (5 - 10 years) could produce a significant effect in the choice of investment compartment. Specifically, these representation rules could lead to underinvestment in equity sub-funds, which experience greater volatility in returns, than bond sub-funds.

A.2 Experiment instructions

Here are reported the instructions given to the participants, in Italian which is the language in which the experiment was conducted.

Introduzione

Salve, sono Nicola Favero, uno studente della Laurea Magistrale in Economia comportamentale e applicata dell'Università degli studi di Trento. In questo modulo penderà parte a un esperimento economico volto a studiare le scelte d'investimento; i risultati saranno presentati e discussi nella mia tesi di laurea in forma anonima e aggregata, nel rispetto della legge sulla privacy. Legga attentamente queste istruzioni.In questo esperimento si potrà, in funzione delle tue decisioni, guadagnare una certa somma di denaro. Le somme di cui disporrà nell'esperimento non saranno definite in euro ma in ECU alla fine dell'esperimento la somma di ECU guadagnata sarà convertita in euro con il seguente cambio: 1€ = 10 ECU. Quattro partecipanti all'esperimento verranno estratti causalmente, e a loro sarà pagato un buono Amazon del valore determinato tramite la conversione. Per qualsiasi problema o interesse riguardo allo studio, può inviare una mail a nicola.favero@studenti.unitn.it

Dichiarazione di consenso informato

Sono consapevole che tutti i dati ottenuti attraverso il presente esperimento saranno trattati nel rispetto della normativa vigente in tema di privacy e trattamento dei dati (GDPR; regolamento UE 2016/679)Sulla base delle informazioni riportate sopra, confermo che voglio partecipare allo studio e autorizzo:

- L'uso dei dati per scopi scientifici e la pubblicazione dei risultati dello studio in riviste scientifiche e libri, sapendo che i dati sono anonimi e che nessuna informazione sulla mia identità sarà rivelata.
- Il riutilizzo di dati anonimizzati in ricerche future e la loro pubblicazione su piattaforme "open science" per essere condivisi con altri ricercatori.

La prego di cliccare sulla casella corrispondente al "Si" per acconsentire al trattamento dei dati sulla base della dichiarazione di consenso informato riportata sopra, e proseguire con l'esperimento Acconsento al trattamento dei dati?

o Si, acconsento al trattamento

Istruzioni per l'esperimento

Inizialmente si avranno in dotazione 100 — e si dovrà decidere come investirli scegliendo tra due differenti titoli finanziari:

- Titolo A: consiste in una quota del debito contratto da una società. Chi investe in questo titolo presta un capitale che verrà rimborsato al termine del prestito maggiorato da un certo rendimento. Il rendimento alla scadenza di questi titoli è assicurato.

- Titolo B: consiste in una quota del capitale di una società. Chi lo acquista diventa un socio e il suo investimento viene remunerato con una quota dell'utile realizzato dalla società. Se l'azienda genera utili, il valore dell'investimento aumenta; se l'azienda realizza delle perdite, il valore dell'investimento diminuisce. Dunque questo titolo è rischioso: da un lato vi è la possibilità che i soci perdano una parte del loro capitale investito, ma d'altro canto questo rischio è premiato con la possibilità di ottenere rendimenti maggiori quando la società realizza utili.

The following instructions are diversified by treatments:

Treatment 1:

Il rendimento del titolo A è il 3%. Significa che, investendo tutta la propria dotazione nel titolo A, si avrà un capitale finale assicurato di 103 ECU. Il rendimento del titolo B non è certo, sono riportati in una tabella e in un grafico i rendimenti di questo titolo degli ultimi 10 anni. In base a queste informazioni, viene chiesto di scegliere quanta parte della propria dotazione investire nel Titolo B, mentre la restante verrà automaticamente investita nel titolo A. In base a questa scelta, verrà determinato il guadagno finale.

Treatment 2:

Il rendimento del titolo A è il 3%. Significa che, investendo tutta la propria dotazione nel titolo A, si avrà un capitale finale assicurato di 103 ECU.Il rendimento del titolo B non è certo, ha un rendimento annuale atteso dell'11,4% e una deviazione standard (che è un indicatore di rischio, e misura la volatilità di rendimenti intorno al valore medio) del 32%. Questo significa che investendo 100 ECU il valore atteso dell'investimento è 111,4 ECU. Tuttavia questo non è certo, il valore potrebbe essere minore o inferiore. Sarà chiesto di compiere la scelta d'investimento in 8 round di prova. In ognuno di essi saranno comunicati il rendimento ottenuto e il corrispondente valore finale dell'investimento. I rendimenti del titolo B saranno

diversi per ogni round, nella parte superiore della schermata vi sarà uno storico dei rendimenti ottenuti nei round precedenti. Alla fine dei round di prova, sarà chiesto di effettuare la scelta d'investimento, che determinerà il guadagno finale.

Treatment 3:

Il rendimento del titolo A è il 3%. Significa che, investendo tutta la propria dotazione nel titolo A, si avrà un capitale finale assicurato di 103 ECU.Il rendimento del titolo B non è certo, ha un rendimento composto decennale atteso dell'7,1% e una deviazione standard (che è un indicatore di rischio, e misura la volatilità di rendimenti intorno al valore medio) del 9,1%. Questo significa che investendo 100 ECU il valore atteso dell'investimento è 107,1 ECU. Tuttavia questo non è certo, il valore potrebbe essere minore o inferiore. Sarà chiesto di compiere la scelta d'investimento in 8 round di prova. In ognuno di essi saranno comunicati il rendimento ottenuto e il corrispondente valore finale dell'investimento. I rendimenti del titolo B saranno diversi per ogni round, nella parte superiore della schermata vi sarà uno storico dei rendimenti ottenuti nei round precedenti. Alla fine dei round di prova, sarà chiesto di effettuare la scelta d'investimento, che determinerà il guadagno finale.

A.3 Graphical interface

This section presents the graphical interfaces used in the experiment.

A.3.1 Treatment 1

Subjects referred to treatment one displayed as their first screen a graph and table representing the returns achieved by Title A over the past 10 years, as it is shown in figure A.1, while Figure A.2 presents a specific enlargement of the graph showed to participants.

After having seen this representation, the have to choose how much of their initial endowment invest in the risk found. Figure A.3 shows how the choice was presented.

Once the choice was made, given that this group have to make only one choice, participants were redirect to the final page, where they were informed of the return obtained and the consequent final payoff, given by the weighted average of the returns (figure A.4).

Figure A.1: Return representation for treatment 1

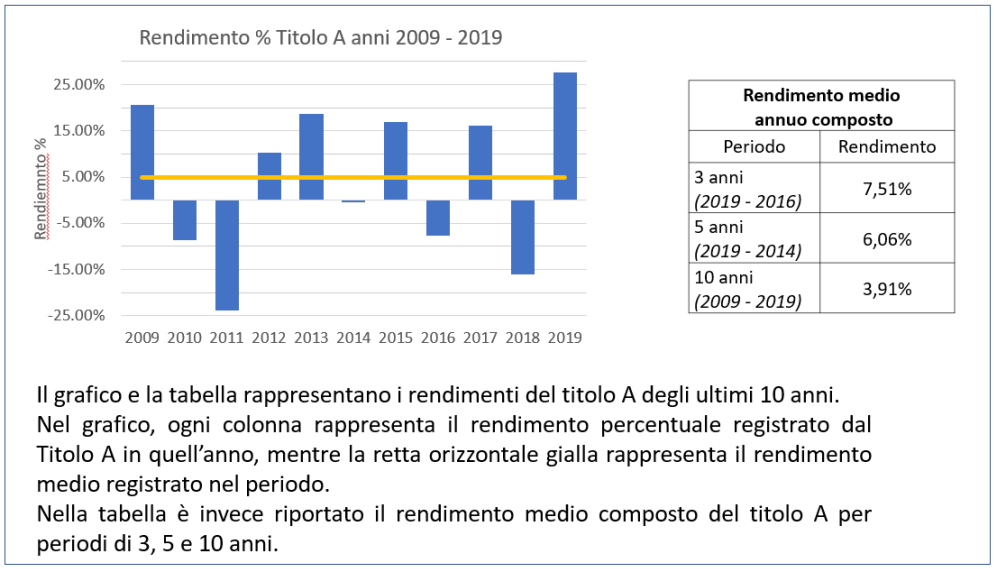
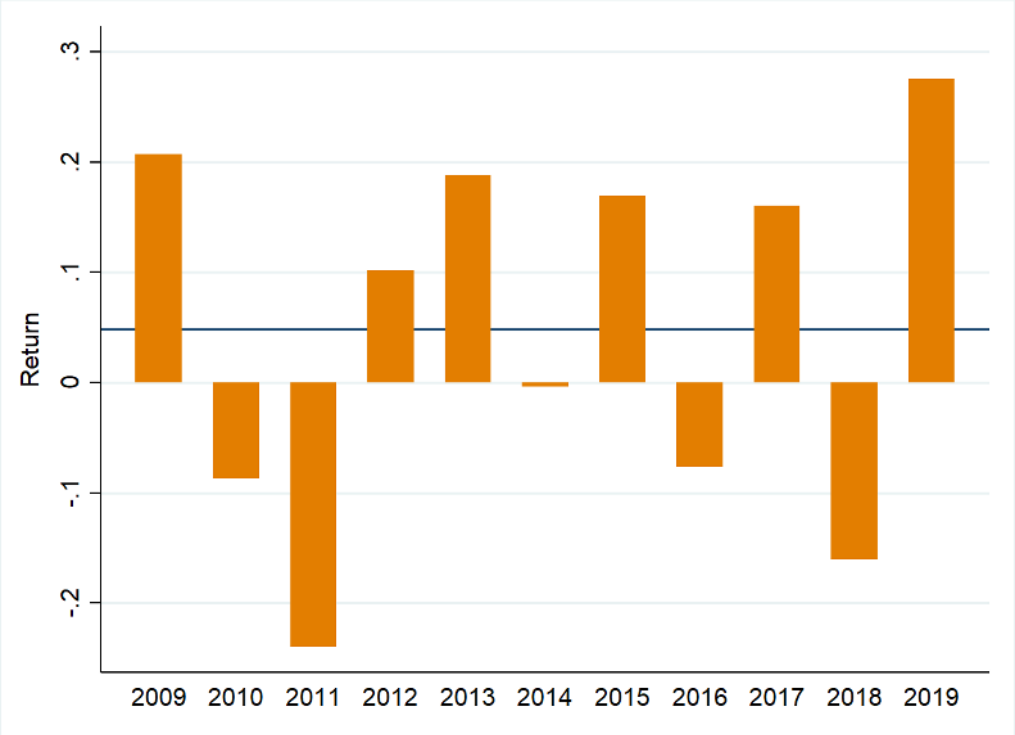


Figure A.2: Annual returns on Fund A, 2009-2019



A.3.2 Treatment 2 and 3

In the experience-based treatments, participants did not have access to any graphical or tabular representation of returns, but were immediately directed to a choice page (as in Figure A.3) and then asked to repeatedly perform the choice task. The difference with the previous treatment is that, in the rounds following the first, the choice page also reported the returns obtained in previous trials, as can be seen in

the figure A.5.

Figure A.3: Choice screen

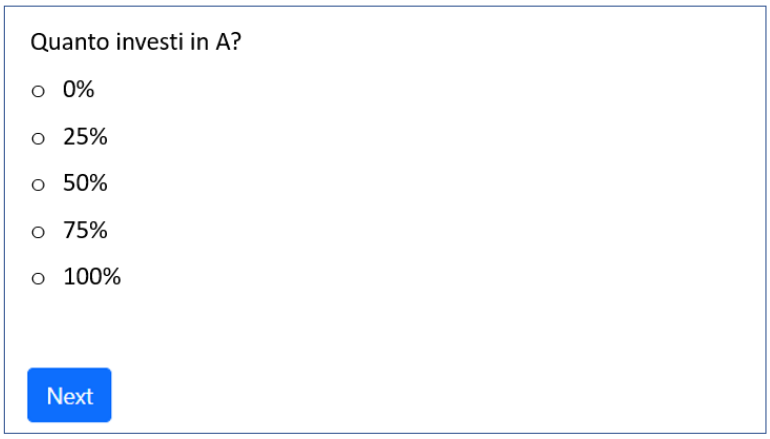


Figure A.4: Payoff screen

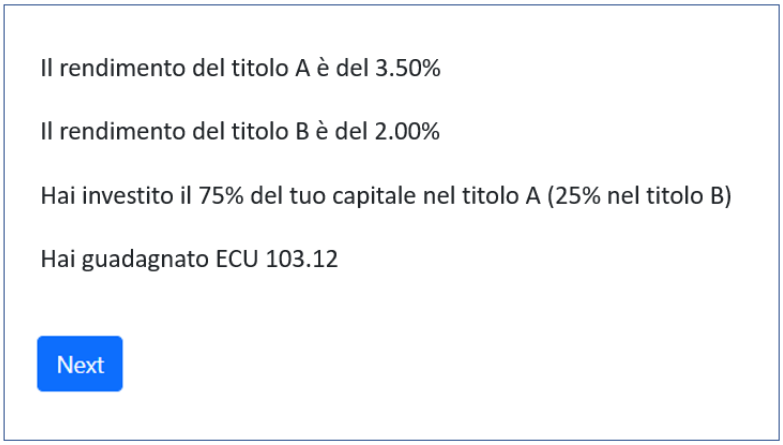
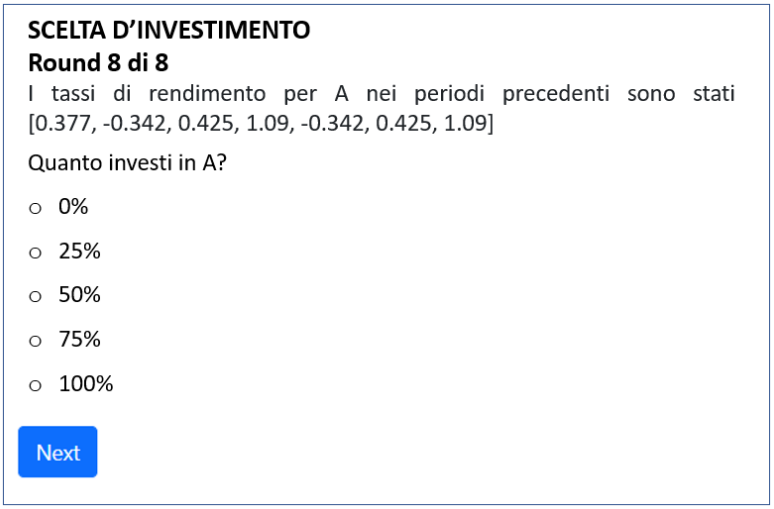


Figure A.5: Choice screen for experience-based treatments



Appendix B

Further experiment results

Table B.1: Probit Model, Incurring in a loss in round t as a function of being treated with Treatment 3, allocation choice in round t and control variables

	Coefficient	Standard Error	P >t
Experience LT	-0.65281	0.1303582	0
Allocation to Fund A	1.21644	0.2333131	0
Age	0.0057488	0.0040334	0.154
Female	-0.010564	0.1365258	0.938
University degree	-0.244168	0.1327163	0.066
Confidence with fin. Instruments	-0.056283	0.0533163	0.291
Constat	-1.284267	0.208931	0
Observation		631	
Pseudo R2		0.099	

Source: *Our elaboration on experimental data*

Table B.2: Estimated riskyness of Fund A as a function of being treated with Treatment 2 and 3, having extracted a negative return in the final round, having incurred in a loss in the final round and control variables

	Coefficient	Standard Error	P >t
Experience ST	0.517	0.31	0.099
Experience LT	0.314	0.309	0.312
Final negative return	-0.433	0.387	0.266
Final negative payoff	0.948	0.455	0.04
Age	0.002	0.008	0.04
Female	0.207	0.276	0.456
University degree	-0.198	0.259	0.446
Confidence with fin. Instruments	-0.259	0.106	0.017
Financial literacy	-0.037	0.265	0.888
Constant	1.708	0.429	0
Observations		109	
R-squared		0.197	

Source: *Our elaboration on experimental data*

Table B.3: Estimated riskyness of Fund A as a function of being treated with Treatment 3, number of negative returns in trial rounds, number of negative payoffs in trial rounds, and control variables

	Coefficient	Standard Error	P >t
Experience LT	-0.004	0.335	0.991
Number of negative returns	-0.177	0.183	0.339
Number of losses	0.34	0.202	0.093
Age	0.002	0.009	0.011
Female	-0.091	0.323	0.779
University degree	-0.218	0.307	0.481
Confidence with fin. Instruments	-0.359	0.128	0.007
Financial literacy	0.149	0.312	0.632
Constant	2.228	0.592	0
Observations		79	
R-squared		0.226	

Source: *Our elaboration on experimental data*