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**From Pension Funds to SRI Pension Funds:
analysis and performance comparison
with a DEA methodology.**

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Introduction

Life expectancy is increasing in the most developed countries and the so called “ageing population issue” is more than a problem for the national states who have been traditionally in charge of providing the payment of a pension to the workers once they reach the retirement age. This system has worked properly for decades but in the last years it started showing signs of weakness.

As a result, receiving the payment of a public pension able to guarantee a lifestyle comparable to the one enjoyed during a person’s working career is not that predictable anymore. National states are adapting to the evolution in the population age pattern and are gradually reducing their exposure to this phenomenon by pursuing the involvement of the active population in the welfare arena, asking the workers to take care of their future and to integrate their public pension with private solutions.

Due to the several opportunities available in the financial markets, not getting lost among the many investment proposals may be difficult, and can get even harder because the knowledge of this sector is still limited within the larger part of the population.

Last but not least, a still small but growing area in the investment universe is represented by the Socially Responsible Investing branch which is getting the attention of the institutional investors (pension funds included) around the world.

This dissertation is the result of putting together all these inputs in the attempt of shedding some light on the functioning of the pension funds, which are very popular instruments subscribed by the investors in order to obtain a supplementary amount of wealth once retired. Knowing the mechanics of a pension fund may be of help in order to make informed investment decisions and to understand the investment process which originates the financial returns. Moreover the possibility of combining pension financial returns together with an ethical approach appeared as a good opportunity to be extended to pension funds, which are socially engaged institutional investors by definition.

The purpose of the project, which is articulated in five chapters, is to highlight the differences existing between the non ethical and the ethical investment approaches both from a qualitative and from a quantitative point of view.

Chapter 1 introduces the topic and gives an overview of the pension funds functioning, covering aspects like the differences existing between the different regimes of benefit and contribution. At this first stage the pension funds are also analyzed under an organizational point of view, delineating the roles of the subjects involved in the managing process.

Chapter 2 is focused on aspects concerning the financial management of a fund like asset allocation and active and passive strategies of investment; here the main measures of performance used to describe the financial results of an investment are explained.

These concepts will be recovered in Chapter 3, which is all about socially responsible investing. The core of this chapter is explaining this vast and growing new trend in finance and the differences existing between classical and ethical approach to investment. These are explained in detail so that the reader has the opportunity to evaluate the peculiarities of both styles.

Chapter 4 introduces and explains the DEA methodology, which is a convenient method of assessing the productive efficiency of a group of units. This method is exploited to assess whether it is true or not that ethical pension funds represent a valid alternative to classical investments.

Chapter 5 concludes with an empirical analysis conducted on a sample of both ethical and non ethical pension funds using the DEA methodology in order to assess if one investment approach is dominant over the other.

1. Pension funds overview

1.1. Preliminary background

Europe, which is the geographic focus of this study, is facing a serious demographical change, driven by two main long-term trends in the population pattern: *higher life expectancy* for both males and females and a *decline in the fertility rate*. Put in other terms, Europe is 'turning increasingly grey' in the coming decades (European Commission, 2015a).

EUROSTAT¹ equips us with some revealing numerical evidence on this topic (see Table 1): at the beginning of 2015, the 0 to 14 years old cohort makes up 15.6% of the EU-28's population, dropping -0.70% from 2005. The 65.6% of the population is in the so called "working age", declining -1,60% in ten years. Older persons represent the 18.9% of the population, with an increase of +2.3% in the ten years running between 2005 and 2015.

Age group	2005	2015	Change
Young (0-14)	16.3%	15.6%	-0.70%
Working age (15-65)	67.2%	65.5%	-1.60%
Old (>65)	16.6%	18.9%	+2.30%

Table 1: EU-28 population age structure by major age groups between 2005 and 2015 (% of the total population). Own elaboration based on data provided by EUROSTAT.

The 2015-2080 EU-28's *population pyramid* in fact (see Figure 1), portrays a forecasted percentage distribution of the population sorted by age and sex, and highlights that the European population is simultaneously *ageing at the top and at the bottom*. It confirms that the ageing trend of the European population, which commenced in the past, is likely to continue in the future too, despite a small foreseen increase in the number of young people. But the pyramid tells us much more: as we can notice, while at the beginning of 2015 the pyramid's shape resembled a diamond, at the beginning of 2080 it will look much more like a rectangle. Then it is expected that the number of the working age population will reduce, on the contrary the older

¹ EUROSTAT, which was established in 1953, is the statistical office of the European Union. Its mission is to analyze data and provide statistics for Europe. Its actions are vital in order to deliver comparable figures that support the European Union across the decision-making process at all levels.

cohorts will become more numerous as soon as the *baby boomers* will have completed their retirement. It is interesting to notice that in the forecasted time horizon, the share of population aged over 80 is expected to double roughly.

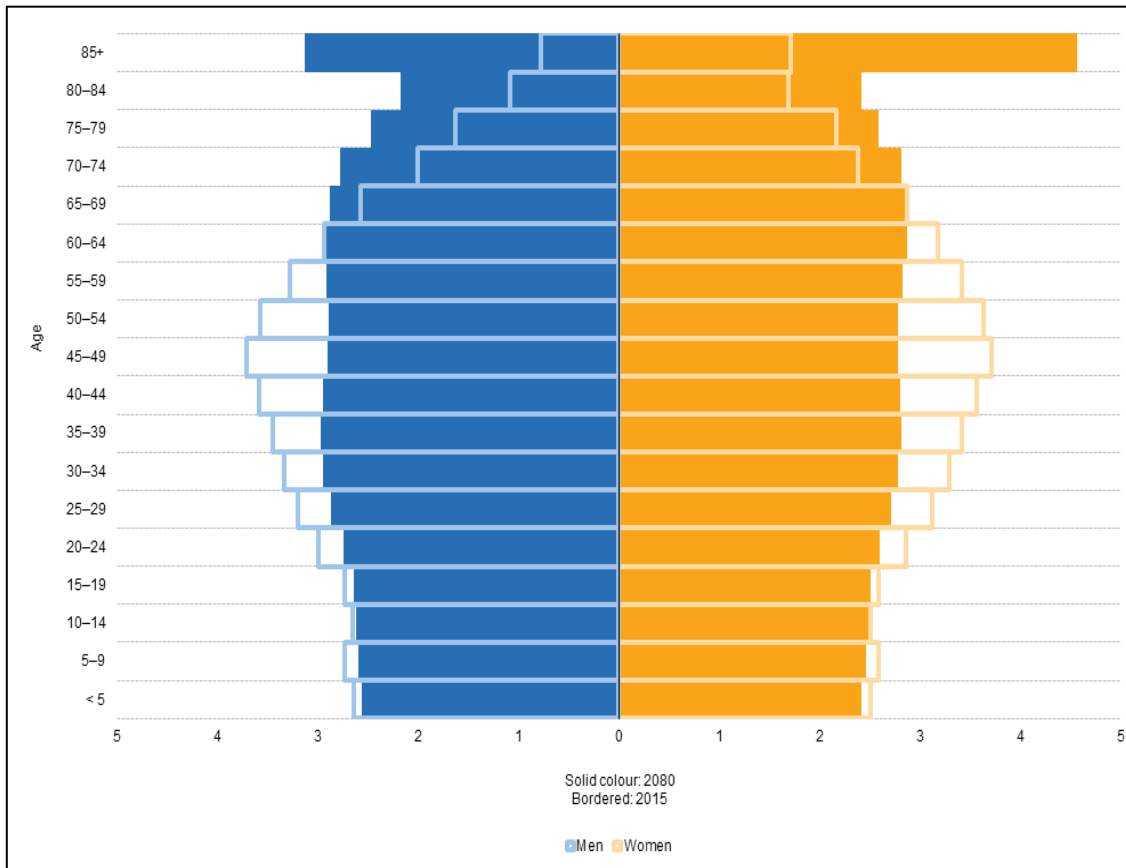


Figure 1: Population pyramids, EU-28, 2015 and 2080 (% of the total population).
Source: EUROSTAT.

The *old age dependency ratio*² allows us to notice that in 2005 we had around four people in working age for every old person, this number decreased to almost 3.6 in 2015 with a -12% reduction in ten years; this figure is going to worsen dramatically over time if the forecasted scenario presented below will become reality.

Such demographical changes are affecting the welfare policies put in place by the European countries, and the reshaping of pension systems is one of the crucial areas of intervention of the European governments.

The design of the pension systems have been widely changing all over the World for the last years and with regard to this fact, Europe doesn't constitute an exception. The ongoing *reforms* aim to provide adequate and sustainable pensions in

² It is calculated as the ratio between working age population and old population.

the long term through a dual class of parallel measures. On one side there are provisions whose scope is to *postpone the pension payments*: they are finalized to shift forward the retirement age, trying to match the increased life expectancy and enlarge the individual contribution period. For this purpose, twenty-five Member States have already raised or are in the process of raising the pensionable age. Seven countries have linked the pensionable age to life expectancy (European Commission, 2016).

Simultaneously the future predicted *theoretical replacement rates*³ are going to be less generous (Banks, J., Disney, R., Duncan, A. and Van Reenen, J., 2004), moreover most of the reforms will result in lower replacement rates (...) in the future (European Commission, 2015b); that is why the other side of such reforms consists in promoting *complementary fully-funded retirement saving schemes*, which may help the countries who introduce them to complement their basic *Pay-As-You-Go (hereafter PAYG) pension schemes*⁴.

Participation in second and third pillar schemes has been encouraged or even made mandatory in several countries to decrease the financial burden of ageing populations on public finances (European Commission, 2015c), shifting from a public-only pension system towards a *multi-pillar pension system*. Yet for this to happen efforts to promote the development of cost-effective vehicles for complementary retirement savings would need to be stepped up in several of these countries (European Commission, 2016).

The underlying idea is to share the responsibility for the future pension payments between multiple subjects. The new designed systems rely of course on the original first public pension tier, but also on a second occupational tier and they are completed with a third private and voluntary one. The relevance of private occupational and individual schemes in the total pension provision has increased in several Member States in recent years (European Commission, 2015c), especially in

³ The theoretical replacement rate for a typical earner is defined as the ratio of the pension to final earnings.

⁴ PAYG pension schemes are the form that characterizes the First Welfare Tier which is state-managed, more about this topic will be said in the next section.

light of the pressure brought by the *population ageing* on the ability of the states to provide public social pensions at a constant pace to the retired population.

It seems appropriate to underline that involving the private sector (employers and employees as well) turned out to be not only necessary, but vital in order to keep on ensuring to the retired workers a decent lifestyle, possibly comparable to the one enjoyed during their careers.

The main characteristic of the complementary pension funds is being *fully-funded* and *asset-backed*, which means that the final payment depends on the performance of the *owned assets* and/or⁵ on the contribution level. As participants are going to be increasingly exposed to the *market risk*, the tricky part is understanding what pension funds are and how they work, in order to make informed decisions when it is time to choose the pension fund to contribute to. The main characteristics of the Pension funds are going to be outlined in the following paragraphs.

1.2. Features of a pension fund

1.2.1. Defined Benefit and Defined Contribution pension funds: trade-offs and risks

As said before, pension funds are the form around which the Second and Third Tiers Welfare are organized. They are *fully-funded* by the sponsor and/or by the adherents with their own contributions, and entitle the beneficiaries to receive either a lump sum or a series of payments upon retirement. This sets a discontinuity with respect to what happens with classic First-Tier-PAYG pension schemes, where the contributions paid by the workers are immediately used to fund the pensions of other workers already retired.

The two main pension fund types are: Defined Benefit pension funds (hereafter DB pension funds) and Defined Contribution pension funds (hereafter DC pension funds). DB pension funds promise the payment of a deferred nominal life annuity⁶: the amount of the benefits depends on a formula which takes into account the years of tenure at the sponsoring firm (Second Tier Welfare and DB pension funds are strictly

⁵ Depending on the nature of the pension scheme which can be either Defined Contribution or Defined Benefit.

⁶ A deferred nominal life annuity consists in a stream of nominal cash flows paid at regular time intervals to the beneficiary, starting from a certain date and for the whole remaining life period.

linked) and the salary history (*pay-related formula*). Such sum can be alternatively computed as a percentage of the employee's wage or salary itself, typically calculated as the average amount perceived over a limited pre-specified period (*final-salary formula*). As a result the salaries earned in the final part of the career (usually the last 3 or 5 years) play a more decisive role than the early ones. The benefits accrue to the beneficiary on a regular basis but become of his property according to a vesting schedule.

On the other side, in DC pension funds each employee has a personal account where he and the employer make periodical contributions. The value of the plan at each point in time can be obtained by simply looking at the value of the assets it invested in, and the sole obligation of the sponsor is to make the periodical contributions. In this category the final benefit is not known in advance and depends on the returns obtained by the assets deposited in the account and on the level of the periodical contributions over the *accumulation phase*⁷. These contributions are expressed as a percentage of the salary during the employee's career, so that the whole salary history matters in the same way. The benefits, which equal the assets value in every moment, are directly owned by the beneficiary.

The difference between the two types is clear: in DB pension funds the level of benefits is constant and known, they become property of the employee only from a certain moment in advance and the level of contribution may vary over time. In DC pension funds the final benefits are not defined a priori, they are immediately owned by the beneficiary and the periodical contributions are generally constant.

DB plans are defined as *back-loaded* due to the heavy reliance on the entity of the last salaries, which turns out to be a risky feature of DB plans with respect to DC plans, where all the premiums count the same (*front-loading*) and the beneficiaries can rely on a smoother salary path. Moreover in DB plans the sponsor's liability is difficult to estimate because it is tied not only to the expected salary, but also to the expected number of years of service at the company, which is quite unpredictable. In this type of plans the value of the assets does not always match the level of the liabilities: the fund

⁷ This phase is referred to as the period in which contributions are made to the fund, more details will be provided in section 1.2.4.

is said to be *overfunded* when the assets are valued more than the liabilities, *underfunded* in the opposite situation. In this last case the level of contribution needs to be promptly adjusted.

Portability is also a feature that deserves some space in this treatise, due to the impact it has on the assessment of the benefits. If for DC plans it does not constitute an issue, since the dimension of the contributions is not linked to the number of years of service in a company, in DB plans on the contrary it constitutes a source of concern. Portability is the possibility to maintain the indexation of the already acquired pension rights in the process of switching from a pension plan to another; a common circumstance when a change of plan is required happens in the phase of moving to another job. It is typical that each firm adheres to some specific company plan, and migrating from one plan to another implies that DB pension funds beneficiaries renounce to the indexation of the accrued benefits and to the incremental effect that future higher compensations would have had on the final pension. So basically a highly fragmented career can result in poorer pension results than a career entirely spent in a single company or in a few ones.

The *risk profiles* of the two pension fund types differ under many aspects, either from the employee's and from the employer's perspective. Despite the fact that some of the risks deriving from adhering to one plan or another have been already exposed above, a more complete presentation is offered below.

In DB pension funds the risks factors for the employee are:

- *inflation risk*, because he is entitled to a nominal annuity which can be eroded in real terms by a high inflation rate;
- *portability risk*, because the benefits are loaded over long-lasting employment relationships and are not portable;
- *vesting risk*, deriving from changing job and pension plan;
- *insolvency risk* in case the employer declares bankruptcy and the pension plan is not fully funded.

In DB pension funds the risks faced by the employer are:

- *replacement rate risk*, deriving from the guaranteed final benefit which is expressed as a replacement rate of the pre-retirement earnings;
- *market timing risk* that the assets level may fall beneath the threshold required to pay out the benefits;
- *investment risk* that the value of assets spared in order to pay the benefits falls below expectation, forcing the employers to raise the contribution levels. Note that the perspective is reversed if compared to DC pension funds;
- *longevity risk*, that the retired employees live longer than expected, forcing the firm to pay out benefits for a time horizon longer than expected.

In DC pension funds the employee (in fact the investor) bears:

- *investment risk*, that the asset returns fall below expectation;
- the *longevity risk* of living longer than expected, which would lead to a shortage of the means necessary to provide the correct amount of benefits; this risk can be hedged by using the assets in the account to buy a life annuity directly from an insurance company;
- *market timing risk* at the point of retirement, because differently from what happens in DB pension funds, the assets are directly controlled by the beneficiary. In this type of plan, an unfavourable market movement may erode the balance of the pension fund;
- *interest rate risk*, because this factor can affect the number of purchasable annuities at the moment of retirement;
- *replacement rate risk*, which depends on the final value of the investments which is known only at the moment of retirement.

For what concerns portability risk and employer insolvency risk, they are not an issue because these type of plans are portable and fully funded.

In DC pension funds the sponsor (if any) encounters the following risks:

- a *legal risk* that the beneficiary at the moment of withdrawing the benefits finds the account with insufficient income.

It seems that in DC pension funds the risk profile is much more shifted towards the investor, than in DB pension funds. Being DC pension funds the main form of Third

Welfare Tier, having a grounded knowledge of these instruments can be a valuable asset, especially when the employee is asked by the pension fund to take active decisions, like the ones that will be illustrated shortly.

1.2.2. *Single-strategy and Multi-strategy: the choice of the compartment*

Pension funds offer either a *Single-strategy* investment approach or a *Multi-strategy* one. In the first case the fund treats all the investors as if they had the same risk-return profile, offering to all the participants the same possibility of investment. Of course not all the investors can be adequately represented with a single investment strategy that perfectly matches their individual risk-return appetite, but the *Multi-strategy* method makes a step ahead providing a range of investment possibilities tailored over multiple macro-risk-return profiles.

Single-strategy pension funds are easier to run than Multi-strategy ones either for the management, that needs to set-up a single investment strategy (one investment goal, one asset allocation, one risk-return profile) that encompasses all the participants, and also for the participants because they are not asked to act much once they joined the fund.

On the contrary Multi-strategy pension funds, sometimes also referred to in the industry as a “umbrella funds”, provide the participants with multiple investment proposals all included under the same fund; hence the investor has the responsibility to choose the one that best fits his saving purposes. The compartments differ for the asset class mix, for the investment strategy and consequently for the risk embedded in the investment, and are designed to effectively respond to the changing necessities that arise during the investor’s life.

There are some factors that can affect the choice of the worker when he joins the pension fund, such as age, salary, risk and inflation; these have to be taken into account by the management in the process of defining the investment strategies. Take for example age and expected period of permanence in the fund: at the beginning of his career the worker has a long term investment horizon and is expected to stay in the fund for several years, as retirement age gets closer his investment horizon shrinks with obvious consequences on the asset allocation, that turns from “aggressive” to

“conservative⁸”. If no choice is performed, the investor is automatically addressed to the most conservative compartment. Moreover the actual level of the salary and the maintenance of a comparable lifestyle upon retirement, are drivers to seek high returns. As already sketched before, inflation should be taken into account and real returns in the mid-long term should be sought instead of nominal ones.

Once the compartment selection is completed, the investor is given the option to move (*switch*) from a fund to another or from a compartment to another upon request; if no choice is performed, the investor is normally addressed to the most conservative compartment at disposal (typically a monetary fund). The switch procedure is regulated by the pension fund in order to avoid too frequent switches that could result in speculative purposes more than in saving ones. Some plans allow to jump automatically from a compartment to another within the same pension fund making the management of the position easier for the adherent (*Life-Style and Life-Cycle Plans*).

1.2.3. *Life-Style plans and Life-Cycle plans*

The pension funds market shows one trend that is certain, that is the shift from DB schemes, where the employer shoulders the risk, to DC schemes, where the risk lies with the individual worker (OECD, 2015).

As outlined before DC pension plans require the adherents to the funds to operate some complex decisions which require some degree of financial knowledge which is not that common among the workers. DC plan sponsors are only responsible for the design of the plan and for its administration and record keeping (Viceira, 2008). With regard to this, OECD is actively engaged since 2002 in implementing programs to spread financial education among investors in order to facilitate and promote long-term investment.

In light of these evidences two pension funds management styles, named *Life-Style* and *Life-Cycle*, have been proposed by the pension fund industry to the market. The goal is to make the management of the investor’s position easier, through a plan

⁸ An aggressive profile is characterized by a major presence of risky and more volatile assets e.g. equities, while a conservative profile focuses more on less risky and more liquid instruments e.g. fixed income or cash instruments.

that, operating automatically following a preordained set of instructions, doesn't need much action. Life-Style pension funds follow a "risk-based approach" to determine the asset allocation⁹. This approach implies that the equity fraction of the portfolio depends on the investor's risk tolerance and not on his investment horizon: in practice the more risk-tolerant the investor is, the larger the share of his wealth that he will invest in equity. The asset allocation is then kept fixed in its proportions across the various asset classes, so that the targeted risk level remains constant over the investment period.

Life-Cycle pension funds instead, follow a different approach to the investment and come up to age-based considerations to calibrate the optimum asset mix. Age-based investing relies on the proposition that equity are less risky in the long run than in the short term⁸. This view is based on the evidence that stock returns are less volatile when they are measured over long holding periods (Viceria, 2008). Moreover Bakshi and Chen (1994) hypothesized that an investor's relative risk aversion increases with age.

A basic model of Life-Cycle saving and investing proposed by Bikker, Broeders, Hollanders and Ponds (2009), can be of interest in order to show how factors other than equity returns can condition the size of an investment in stocks. Consider for example the definition¹⁰ of human capital: "the skills the labour force possesses [...] regarded as a resource or asset". Clearly young workers possess more human capital since they have long careers still to come (and more pay checks to get). Assuming human capital to be a safe asset, so bond-like in terms of risk, it appears that young workers can diversify investment risk more easily than old ones.

⁹ The topic of asset allocation and related backing theories will be treated in further detail in a dedicated section in Chapter 2.

¹⁰ This definition was borrowed from the Oxford English Dictionary.

The model uses the following inputs to derive the optimal allocation in equity:

$$w = \frac{H+F}{F} \cdot \frac{\mu - R^f}{\gamma \sigma^2}$$

where:

w : optimal size of equity allocation

H : value of the individual's human capital, computed as current and discounted future wages

F : value of the individual's financial investment

$\mu - R^f$: stock market risk premium

γ : individual's constant risk aversion

σ^2 : variance of stock market returns

The equation sketches a positive relation between equity investment size, human capital and market risk premium; on the contrary the relation is negative towards the value of the individual's financial investment, risk aversion and stock market variance. Since more human capital calls for a heavier equity investment, this simple model boosts the confidence towards a negative relation between age and equity exposure.

Some evidence about this inverse relation is provided *inter alia* by a study conducted in 2009 by Bikker, Broeders, Hollanders and Ponds. Analyzing the asset allocation of Dutch pension funds in relation to the mean age of the funds' population, they found out that an increase of the average age in the participants led to a – 0,17% linear reduction in the equity exposure. This percentage dropped to – 0,48% when the number of participants was used as a weight in the regression. They also specified a non-linear model that incorporated the mean age of the active participants as explanatory variable. This last model evidenced an even heavier impact of age on equity exposure: - 0,44% in the unweighted model and – 0,56% in the model weighted with the number of participants, meaning that large pension funds seems relying more strongly on the Life-Cycle hypothesis.

In line with these theories, pension sponsors started offering plans that are heavily loaded of equity at the early stage of the investment period, and gradually tilt towards fixed income and cash in the phase before retirement. After retirement the funds are allocated into a Life-Style scheme where the asset mix and the risk profile are kept constant.

1.2.4. *From Accumulation to Pay-Out: the role of the fees*

The period of stay in a pension fund can be subdivided into two main phases that were already treated implicitly in the former sections; now it is time to define them properly. The *Accumulation Phase* is the first and maybe most important one and is characterized by an active role of the participant in the fund. After choosing the pension fund, the adherent starts paying the contributions on a regular basis and carrying out other relevant operations such as the choice of the investment compartment and potentially the switch between compartments.

On its side, the pension fund receives the *premiums* and invests them on the adherent's behalf until retirement: they will form the principal¹¹. Pension funds operate in financial markets buying and selling assets like normal institutional investors would do to reach their investment goals; however in this phase some aspects are quite peculiar. A pension fund in fact (especially a young one) faces incoming cash flows prevailing on outgoing ones in its first years of activity: such imbalance is squared as soon as retired people start having their benefits paid out, and might also reverse if the number of active participants stops matching the number of retired participants.

The cash flow dynamics, which are quite predictable, are driven by the lack of payouts in the first years and by the necessity of adequately valuing the premiums paid. This leads to a natural implementation of a long-term investment horizon: in this sense, and differently from what happens with other financial intermediaries, pension funds are said to manage "*patient money*" which are invested according to a productive and non speculative approach.

Then, during the *Pay-Out Phase* the principal matured during the Accumulation Phase is paid out in a lump sum or converted to an annuity and the beneficiary starts

¹¹ "Principal" is the technical name to identify the amount of an investment.

to receive the benefits he is entitled to. The final size of the principal just before retirement, depends positively on some factors such as the extent of the premiums paid, the duration of the investment and the returns obtained by the fund during the Accumulation Phase. An important remark needs to be made about the returns as they are assessed net of all the fees loaded by the fund to cover its operating costs.

The costs are important to know because they reduce the rate of return on the investments of pension funds and consequently raise the cost of retirement security (Bikker and De Dreu, 2009).

The main sources of cost for the pension fund are sustained for: marketing the plan to potential participants, collecting contributions, sending contributions to investment fund managers, keeping records of accounts, sending reports to participants, investing the assets and converting account balances to annuities and paying annuities (Tapia and Yermo, 2008). Such costs are then spread along the participants in the form of fees. Having a clue on the nature of the fees and on how they impact on the final performance is essential, since they are periodically charged during all the period of permanence in the fund. Fees can be either fixed or variable: the advantage of the first is that they are easy to understand and compare across multiple funds; variable fees instead are more complicated as they are expressed as a percentage for example of the payments or of the asset managed, which makes a comparison harder. To protect the retirement income of participants, fees are usually capped at national level.

The fees can be deduced from the KIID¹² and can be grouped into the following categories:

- *Initial fees* can be expressed as a nominal amount or as a percentage of the premium paid and are needed to set up the investment. Such fees end up reducing the invested amount.

¹² The Key Investor Information Document (KIID) is a compulsory document which has to be provided to the investors prior to the conclusion of the investment contract. This document is compiled according to some strict rules and aims to protect the consumer, providing useful and relevant information in order to understand and evaluate the nature of the investment, the risk/return profile and the cost structure.

- *Ongoing fees* represent the cost of running the fund and are ascribed on daily basis. The *Fund Management Fees* (FMF) fall into this category and cover the costs for the investment management, and for other services such as accounting, valuation, audit, custodian and payments to legal and professional advisers. The Ongoing fees are summarized by a cost indicator called Total Expense Ratio¹³ (TER).
- *Performance fees* accrue to the fund management in case the performance of the fund exceeds the benchmark¹⁴ and are calculated as a percentage of such over performance. Performance fees are not always applied because, as explained later, they may lead to decisions that could compromise the long term performance of the pension fund and affect the fiduciary duty of the adherents towards the fund management.
- *Switch costs* are charged if the adherent to the fund decides to switch fund staying within the same pension fund sponsor's boundaries, which means that he will opt for another fund managed by the same fund house. The adherent can either redirect his entire position or only a part of it. In this last case he needs also to specify where he want the following contributions to be made.
- *Transfer costs* arise if the adherent decides to move its position to a pension scheme managed by a different sponsor.
- *Early exit costs* are applied in case the adherent decides to surrender. Exit costs can be set with a decreasing degree of penalization proportional to the period of permanence in the fund.

Generally speaking it is possible to assert that costs impact negatively the performance of a pension fund; Gerber and Weber (2007) put some emphasis on the determinants of such costs, among which they identify the presence of short term-liabilities (such as a high number of pay outs) as drivers for administrative expenses, so higher shares of pensioners make pension funds more costly (Bikker and De Dreu, 2009). On the contrary they sustain that the size, defined as the total value of asset managed, of the pension fund itself can produce economies of scale, resulting in a negative correlation between scale and costs. A negative impact on the pension plan

¹³ The Total Expense Ratio is calculated as the ratio of the total costs paid during one year over the average of the total asset value registered during the same year.

¹⁴ The benchmark (usually an index listed on the market) is a measure against which the fund's performance is compared. More information about this topic will be provided in Chapter 2.

type on both administrative and asset management expenses is assessed: namely CD pension funds seem to have higher costs efficiency with respect to DB pension funds (Bikker and De Dreu, 2009).

Pension funds' scale advantages have been outlined also by Bauer, Cremers and Frehen (2010) who affirm that, thanks to their dimension, their cost structure is substantially lower than mutual fund ones. More specifically larger pension funds have lower costs than smaller ones. But they also noticed that big scale is not always a positive feature as the benefits it carries, may be offset by a limited capacity to promptly react to news or by over investing in illiquid¹⁵ assets. Also the decision of internally/externally and actively/passively¹⁶ managing the fund impact the cost structure, with internally and passively managed funds experiencing lower costs.

Alda and Ferruz (2012) focus on management fees and confirm that fees adversely affect fund returns and performance; moreover they found out that worse before-fee performing pension funds, charge higher fees than better before-fee performance pension funds do. Due to this trend as final returns are net of fees, bad-performing pension funds end up performing even worse because of the "fee effect". Then it seems that high fees have the effect of reducing manager's performance. As a consequence better funds do not charge higher fees for the better performance obtained, and bad managers impute higher fees to compensate their poor results.

1.3. The organizational structure of a pension fund

Pension funds are provided with a set of bodies which oversee the various functions that need to be carried out during the life of the fund. The main characteristics of each body will be illustrated in this paragraph in order to draw a comprehensive picture of the organizational structure of a pension fund.

¹⁵ An asset is said to be illiquid if there is no active market where to easily buy or sell such asset. Real estate investments are typical example of illiquid assets because an *ad hoc* market needs to be set up for each transaction; on the contrary sovereign bonds are typically seen as liquid assets because in each moment there is an active market ready to trade such securities. In this case the traded volumes can be an adequate proxy to categorize an asset as liquid or illiquid.

¹⁶ These concepts will be illustrated in the next Chapter.

1.3.1. *Constitution of a pension fund*

The process to start, access to and govern a pension fund differ according to the nature of the pension fund itself which can be either a close or an open one. The main difference running between the two is that *close pension funds* can be joined only by the workers who belong to a certain category, which has to be specified in the statute of the fund. On the contrary, *open pension funds* target the generality of the workers, without making any kind of distinction. Thanks to their flexibility open pension funds are at the core of the Third tier welfare system.

Close pension funds are rooted in contractual agreements between workers (or their representatives) and employers; open pension funds instead are promoted by the same subjects (financial institutions) which are deputed to manage the financial resources of the close pension funds.

Either they are open or close, pension funds necessitate of a specific organizational structure to operate, which is articulated across three main bodies: Board of Directors for Open Funds and Fund Manager for Close funds, Financial Manager and Administrative Manager. These bodies need to be constituted ad hoc if the fund is a close one, otherwise they can coincide with the ones already operating in the financial institution which promotes the fund.

One of the first formal acts of the fund is the definition of the *statute* which contains the description and the characteristics of the fund; on top of that it illustrates the operating rules (such as single or multi strategy, definition of the benchmark) that will guide the management towards the achievement of the pursued investment goals. The statute also contains useful indications for the adherents, such as the risk and return profile of the fund, costs and modality to surrender.

1.3.2. *Board of Directors*

The Board of Directors is the decisional body of a pension fund, whose function is very important because it takes several relevant arrangements. For example it evaluates if it is advantageous to outsource the financial management and the

administrative management, and if this is the case, stipulates the necessary agreements with the external financial and administrative managers and with the Custodian Bank.

The *make or buy decision*¹⁷ represents a big trade-off. Establishing these functions internally leads generally to lower the costs and provide better after-costs performance and a higher level of confidentiality; however as internal management is function of the fund's size, this result cannot always be reached (MacIntosh, Scheibelhut, 2012).

Outsourcing can provide several advantages too, such as buying great professionalism and specific knowledge, remaining flexible without building wide internal departments. Moreover thanks to this practice, the fund maintains the freedom to change the service provider if it is not happy with the delivered results.

The board deals also with technical aspects related to the financial management of the positions, such as the definition of the asset allocation, for which it can recur to external advisors to set up the optimal portfolio mix. It is evident that in order to deal with such delicate issues, members of the board need to possess an adequate background. A survey by Kakabadse N., Kakabadse A. and Kouzmin (2003) highlighted that only a limited fraction of the interviewed trustees possessed a background in finance and the vast majority did not possess relevant qualifications in finance. In reason of this they were willing to take advices from investment consultants and investment committees, maintaining a critical and conscious approach in decision making.

1.3.3. *Custodian Bank*

Before continuing with the description of the remaining functions, it is critical to introduce one more actor in this story namely the *Custodian Bank* which must be an external entity with respect to the fund. The Custodian Bank, whose presence is mandatory for both close and open pension funds, manages the financial resources received from the pension funds it is working for, executes the orders coming from the

¹⁷ "Make or buy" is an expression used to indicate the option between producing a service internally or outsourcing.

financial management of the fund and checks that the operative limits set by the law and by the statute of the fund are observed.

The Custodian Bank can also offer additional services to the fund such as financial advisory and an independent assessment of the performance obtained by the financial manager. Of course the Custodian Bank can manage resources coming from several funds, in this sense the relationship with a pension fund is not exclusive. The fact that the Custodian Bank and the pension fund are two distinct and separate entities, represents a guarantee of transparency for the people adhering to the pension fund.

1.3.4. Financial Manager

The *Financial Manager* is deputed to manage the investments of the pension fund. A close pension fund can manage the investments either directly, following the limits set by the national law (provided it possesses an adequate and verifiable level of knowledge and skills among its managers), or indirectly outsourcing this particular function to a company specialized in asset management. In the case this phase of the process is outsourced, the pension fund needs to select an external financial manager. The rationale behind this choice is to ensure a professional management of the premiums, through the knowledge and the solid organization built over time by professionals in this field. Factors influencing the choice of the financial manager are: the entity of the managing costs, the financial manager's reputation and its capacity to offer services coherently with the investment policy of the pension fund.

To manage their complex portfolios, pension funds can take advantage of the skills of more than one financial manager, subscribing multiple agreements¹⁸. In fact, because a financial manager could be more focused and skilled in dealing with a specific asset class, it could be more profitable for the fund to delegate to him the management of only the asset category it is specialized in, instead of an entire and

¹⁸ The agreement stipulated between the pension fund and the financial manager, contains a number of provisions that define either the operating guidelines and the operating boundaries that must be carefully followed during the process of managing the investments. Last but not least, the fund is given the possibility to surrender from the agreement. Such option acts as a stimulus for the financial manager to perform positively and to not upset the fund neither with a poor performance nor with a bad management.

heterogeneous portfolio. As already said before, open pension funds carry out this function internally.

Broadly speaking the main task of the Financial Manager consists in providing the efficient management of the portfolio, guaranteeing an adequate diversification of the investment according to the chosen investment style, to the benchmark and to the assigned asset classes. Chapter 2 is entirely devoted to dig deeper in these aspects.

Even if the fund outsources the financial management, it maintains the control over the voting rights deriving from the ownership of the assets it has invested in; according to the fiduciary duty that exists between the pension fund and the adherents, only the fund is entitled to act on the behalf of the participants and can't allow other subjects to take autonomous decisions that may harm them.

1.3.5. Administrative Manager

The *Administrative Manager* carries out the accounting, fiscal and administrative duties and takes care of the external relations, among which there is the relationship with the adherents to the fund who receive periodic updates about the results obtained by the fund. The reporting to the investors is done periodically and describes the individual's position: the main information are the amount of the premiums deposited, the fees paid and the returns obtained.

Reporting is not only a way to keep the investors informed but also a way to promote the fund, drawing the attention on the results obtained, to encourage new subscriptions and to communicate news regarding any possible change in the financial and administrative management. This function is very important and requires a solid organization, that is why the fund may decide to outsource this function to an external specialized company in order to get higher efficiency and avoid the massive costs that setting up this activity internally would imply.

2. Pension fund Financial Management

This second chapter is entirely dedicated to examine the aspects regarding the Financial Management of a pension fund. Financial Management is probably the most decisive activity within the wider process of managing a pension fund because the success of the investments and the consequent entity of the final benefits paid out, largely depend on the decisions assumed during this phase.

Way before thinking about where and how to invest the premiums, a pension fund needs to define the *strategic objective* of its investment policy in a way which is consistent with the adherents' income objectives, through a written statement. In fact, one of the two¹⁹ main pension fund's purposes is to collect the premiums and invest them in the financial markets applying a set of established rules. The investment policy is driven by the cash inflows' peculiar characteristics, which are stable and foreseeable and embed long term liabilities for the pension fund. The pension fund needs also to apply a rigorous risk management approach through concepts like diversification and Asset Liability Management²⁰ (ALM).

2.1. Investment policy

"The investment policy should at minimum identify the strategic asset allocation strategy for the pension fund [...] and should also include any broad decisions regarding tactical asset allocation, security selection and trade execution" (OECD, 2006).

2.1.1. Strategic and tactical asset allocation

Asset allocation was already introduced in a preliminary way in the previous chapter while speaking about Life-Cycle pension plans; the scope of this paragraph is to dig deeper in this topic.

The final asset allocation can be seen as the solution of the trade-off between risk and return preferences of the pension scheme participants. Gerber and Weber

¹⁹ The other one is paying out the benefits.

²⁰ ALM is a technique that permits to assess the matching between asset and liabilities of a bank or other financial institution, and to quantify the risk associated to interest rate fluctuations from which potential gains or losses depend.

(2007) studied how some factors could possibly influence the asset allocation. First of all a negative relationship holds between short-term liabilities and the attitude to invest in risky assets such as equities, recalling the adoption of ALM policies. With regard to this, Alestalo and Puttonen (2006) got the same result: that a higher average age of the employees adhering to the pension fund (more short-term liabilities) carries a more conservative investment attitude, which implies a more intense exposition towards fixed income (a positive +2,3% relation was found between the two variables) and a lighter one towards equity (a negative -1,7% relation was found between the two variables). This trend might be smoothed by the presence of substantial cash reserves acting as a cushion that allows financial managers to take a superior amount of risk, investing more heavily in stocks. The two authors also found a positive link between average age and real estate providing pretty stable cash flows which result very helpful in meeting the obligations.

Asset allocation and subsequently *security selection*, are the two preparatory phases to invest the premiums. The first one leads the pension fund to choose the asset classes to invest in, and the investment proportion (*weights*) to assign to each one: (it) starts with the relevant beliefs about future performances and ends with the choice of portfolio (Markowitz, 1952). The second one implies the selection of the securities in accordance to the directions deriving from the first phase.

The asset allocation passes through a periodical assessment of the matching between the portfolio's declared and actual risk-return profile. To stay coherent to its objectives, the pension fund must specify a set of characteristics which the securities must possess at any time in order to be eligible to be part of the investable universe. Moreover it has to clearly state the quantitative limits that each asset class must not exceed. Just to give an idea of the characteristics that an asset must possess, the fund may decide to invest in securities only if they are listed, or in corporate bonds with investment²¹ grade rating or in floating rate bonds.

²¹ A corporate bond and a municipal bond as well, are qualified as investment grade if the issuer has a strong capacity to repay its debts and consequently a low risk of default. Fitch and Standard and Poor's consider the bonds in the range AAA / BBB- to be investment grade, Moody's adopts a categorisation that goes from Aaa to Baa3. All the three agencies express the same concept but using a different nomenclature.

It is possible to distinguish two approaches in order to determine a proper asset allocation: a strategic and a tactical one. *Strategic asset allocation* represents the bulk of the pension fund's long-term investments and aims at defining an efficient²² portfolio which reflects the risk-return appetite of the adherents; such portfolio is expected to remain pretty constant over time for what concerns its objective.

	Amundi Seconda Pensione					
	Difensiva	Garantita	Sicurezza	Progressiva	Sviluppo	Espansione
Stocks	0%	6,91%	12,56%	23,47%	40,06%	66,29%
Bonds	92,11%	77,69%	76,33%	60,09%	40,39%	17,37%
Liquidity	7,87%	9,35%	9,52%	15,91%	18,73%	15,18%
Other	0,02%	6,05%	1,58%	0,53%	0,82%	1,17%

Table 2: Strategic Asset Allocation of the pension fund named Amundi Seconda Pensione.

Source: Own elaboration of data collected from www.morningstar.com²³

Table 2 reported above displays an illustrative asset allocation of a pension fund which is also an example of umbrella fund. On the left column, it is possible to see the asset classes the fund invests in: stocks, bonds and liquidity. The most interesting part consists in analyzing the weights assigned to each asset class: going from the left to the right, the exposure to the stock market increases and the bond percentage becomes lighter, suggesting some sort of design tailored to satisfy multiple risk-return tastes. The riskiness of each compartment, in a scale of colours varying from bright green (low risk) to dark red (high risk), varies accordingly.

Tactical asset allocation is an active and highly dynamic way to allocate and consequently manage financial resources in a portfolio. The policy statement should include [...] the extent to which deviations from the strategic asset allocation will be tolerated (OECD, 2006). For this purpose a residual fraction of the total financial resources under management are set aside and devoted to the attempt of beating the market, exploiting price inefficiencies and price movements in the short-term.

²²The E-V (Expected value - Variance) rule states that the investor would (or should) want to select one of those portfolios which give rise to the (E, V) combinations indicated as *efficient* [...], those with minimum V for given E or more and maximum E for given V or less (Markowitz, 1952).

²³ Morningstar is a company operating on a global scale which offers independent research on financial investments, the website provides also a wide variety of data about funds aimed at private investors.

Alestalo and Puttonen (2006) studied the asset allocation of Finnish pension funds between 1999 and 2004 and found out that it remained on average stable over time. This finding made them suppose that tactical allocation is not the driver of the performance.

2.1.2. Asset classes and fund typologies

To cook a proper asset allocation it is necessary to be aware of the ingredients' main characteristics. It follows a brief illustration of the most common investible asset classes.

i. Fixed income instruments which can have either short or long maturity; they are issued by corporations and governments and promise periodical payments²⁴ and the redemption of the principal at maturity. Government bonds are generally considered *risk-free* because a State is seen as a safe issuer, for corporate bonds it is not the same since the issuer is more subject to *default-risk*. Moreover, if well rated, bonds represent quite liquid assets.

These characteristics turn out to be particularly appealing for pension funds because they can conveniently build fixed income long-term portfolios and match their duration with the liability stream deriving from the periodic benefits to be paid out (Alestalo and Puttonen, 2006).

While maturity simply defines the redemption date of the bond, *duration* is a measure of sensitivity to interest rate variations. The duration gives a measure of the length of time (financial life) needed to the investor to receive back the capital invested according to the formula:

$$D = \sum_{t=1}^T t_i \frac{c_t(1+r)^{-t}}{P_0}$$

where:

- i. r : represents the bon yield;
- ii. c_t : are the cash flows streaming from the bond at time t ;

²⁴ Zero-coupon-bonds constitute an exception: they do not pay coupons during their life and provide only the redemption of the principal at maturity.

- iii. P_0 : is the bond price;
- iv. t_i : is the time when each coupon payment occur.

The duration is calculated as the weighted average of the time when the coupon payments occur. The weights consist in the ratio between the present value of each coupon and the bond price.

The cash flows are usually expressed in nominal terms, that is why in the long run bonds could be inconvenient due to the corrosive effect of inflation; to overcome this issue it is possible to underwrite inflation-linked bonds which index the cash flows to the level reached by inflation (Plantinga, 2006).

ii. Equities represent the ownership of a fraction of a corporation, they do not have a maturity and do not entitle the owner to fixed payments, on the contrary they constitute a residual²⁵ claim over the company's assets.

The obtainable returns derive from periodical dividends (uncertain) and capital appreciation (uncertain). From the Capital Asset Pricing Model²⁶ (CAPM) it is known that equities' returns embed a premium for investors, that is why equities are used in financial portfolios to get expected returns higher than the ones accessible through an investment made exclusively of fixed-income securities.

Equities can be used instead of bonds as a long term instruments to hedge²⁷ against inflation (Gibson, 1996), in fact researchers hypothesize that real stock returns are not affected by inflation in the long run (Bodie, 1995). To this end, it must be paid attention to the intrinsic different nature that stands between the two financial instruments. As reminded by Bodie (1995), with inflation-linked bonds investors know

²⁵ Bondholders and more in general creditors, have a priority with respect to stockholders to exercise claims over a company's revenues and assets.

²⁶ CAPM is a mathematical model introduced by Sharpe in 1964 which splits the expected asset's (or portfolio's) return into two components: a risk free one (R_f) and a risky one according to the formula:

$$E(R_i) = R_f + \beta_{im}(E(R_m) - R_f)$$

Where $\beta_{im} = \frac{Cov(r_i, r_m)}{Var(r_i)}$ represents the sensitivity of the analyzed security to market movements.

A Beta equal to 1 indicates a portfolio as risky as the market portfolio, a Beta higher than 1 indicates a portfolio riskier than the market portfolio and a Beta lower than 1 indicates a pool of assets safer than the market portfolio.

²⁷ From his study on stock and bond market performances between 1925-1994, Gibson (1996) found out that while U.S. investments bonds outpaced the inflation only by reinvesting their income, for U.S. stocks it was different. Stocks in fact produced so high average returns (and volatility) on capital, that could outpace inflation even after distributing dividends.

that at maturity they will receive the real promised repayment whatever happens to the bond price before maturity. Stockholders on the contrary cannot be sure of the stock's value at any time in the future.

It is commonsense that stocks possess the interesting property of being less risky and more rewarding in the long term, which makes of them the perfect instrument for long term investors. Bodie (1995) challenged²⁸ this belief and stated that the long term horizon cannot be the sole factor to undertake an investment in equity.

iii. Real estate remarkably differs from the previous asset classes. First of all each real estate property has unique features ranging from location to dimension and use, which makes them hardly comparable. A second distinguishing factor is the illiquidity of this market: the accomplishment of a transaction needs a long preparatory period which results in expensive and time consuming activities; follows that it is likely to be a less efficient market if compared to the fixed income or stock ones.

Real estate investments can be a natural hedge against the risk of inflation as their price varies accordingly. A portfolio of real estate assets can be adequately diversified by including properties located in different locations and with a different use like residential, industrial, commercial or more simply raw lands. It not infrequent that pension funds keep real estate investments in their portfolios in order to lease them to the sponsoring company.

Once the asset allocation is complete, the pension funds can be assigned to a fund category according to the asset class prevailing in the asset mix. At European level, there is not a unique and harmonized classification, and the prevalence criteria is adopted: for example a pension fund is labelled as "Equity pension fund" if it invests the majority of its assets into equities. Other popular categories are "bond funds", "real estate funds" and "mixed funds" which are named in this way because they do not have a prevailing investment policy in favour of a particular asset class. The

²⁸ Bodie (1995) used a Put-option pricing model to compute the cost of ensuring against the risk of a Shortfall, which occurs if the value of a portfolio of stocks, within a specific period of time, falls below a certain specified rate of return. He verified that the price of buying such insurance increased over time; it follows that the risk does not diminish as the time horizon widens. (The mathematical proof goes beyond the scope of this research and, if of interest, can be found in Bodie's paper).

classification can have different parameters (such as minimum quotas per asset class) across the different European countries, in this case the national regulation prevails.

Security selection comes in a successive phase with respect to asset allocation: it consists in traducing the weights assigned to each asset class in investments. Securities can be selected either actively or passively simply buying for example index funds, in this way a good diversification is automatically ensured.

2.1.3. *Optimal portfolios and diversification*

It is task of a portfolio analyst to incorporate predictions about securities future performance into broad portfolio performance and then select portfolios that are efficient (Sharpe, 1966). Optimal portfolio theory was firstly developed by Markowitz (1952) who proposed a criterion²⁹ to select a financial portfolio based on two elements: expected return (desirable feature for the investors) and variance of the returns (undesirable element for the investors).

Markowitz (1952) states that *"the rule serves better [...] as an explanation of, and guide to, "investment" as distinguished from "speculative" behaviour"*, which sounds like a great approach to define the financial structure of a pension fund, which for its own nature aims at defining long term and profitable investments.

The research underlined that there exist a feasible set of efficient portfolios (*efficient frontier*) able to provide the maximum expected return given a level of variance or vice versa with the smaller variance given a desired expected return. The choice of the optimal portfolio is then driven by the investor's unique and particular utility function³⁰ which allows him to select a unique portfolio that provides him with the highest possible utility.

If a portfolio of investments is taken into account, it is common practice to maximise investor's utility by controlling the variance; instead when a pension fund is under scrutiny it is possible to modify the previous criterion adopting the Tracking

²⁹ Deeper analytical details about either Markowitz's and Roll's models fall beyond the scope of this thesis.

³⁰ Given his risk tolerance level, the investor will maximise his utility.

Error Volatility³¹ as a measure of risk. Under this circumstance, the optimization process is performed with respect to the Tracking Error Volatility with a no-short-selling³² constraint. This approach was developed by Roll (1992) and draws a Tracking Error/Tracking Error Volatility efficient³³ frontier to select the optimal portfolio.

Bikker and De Dreu (2012) observe that institutional investors are generally considered to be more sophisticated than private investors and are therefore assumed to invest more optimally. They investigated the behaviour of 857 Dutch pension funds between 1999 and 2006 to understand what is the impact of investors' sophistication on the asset allocations. The authors developed three main indicators of interest:

- i. the use of "*appealing numbers*" like multiples of 2% or 5%, to select the weights of each asset class, which is a naive approach that does not take into much consideration modern ALM techniques;
- ii. the *tilt in the asset allocation* towards asset classes like bonds and equities rather than alternative investments³⁴ to ensure a proper diversification of the portfolio;
- iii. the substantial preference for "*home equity*"³⁵ rather than for international equity.

It was found evidence of all the outlined factors, suggesting respectively that some investment funds used human judgment to allocate the assets, and a suboptimal diversification either across asset classes and from a geographical point of view. The effect of the aforementioned factors is enhanced by the fund size too: smaller funds are more likely to adopt such approaches than larger ones.

As previously observed, three main asset classes are more frequently included in financial portfolios: stocks, fixed income and real estate. However to build a well

³¹ Tracking Error Volatility is a measure of risk with respect to a benchmark. It will be presented in section 2.3.1.

³² If short selling is allowed, an investor can keep in his portfolio negative asset quantities. This result can be obtained asking a market dealer to sell a not owned asset with the promise of buying it back later in time.

³³ In this case the concept of efficiency is meant in Tracking Error/Tracking Error Volatility terms, and not in Mean/Variance terms as it was in the Markowitz's framework.

³⁴ Bikker and De Dreu (2012) split the alternative category of investments into two subcategories namely *relatively simple assets* (money market funds and mixed mutual funds) and *more complex assets* (real estate, commodities and loans).

³⁵ More precisely, equities listed in the Euro area.

diversified portfolio it may be worth considering a wider spectrum of asset³⁶ classes because, as they are characterized by different and peculiar return patterns, they can produce, once mixed together, smoother return paths with a reduced level of volatility. This practice is called *diversification* and allows the financial managers to reduce the overall portfolio risk by investing in a range of financial activities correlated with different intensity to the market and among them. Diversification however, despite being a desirable feature for a financial investment, cannot eliminate the risk completely: an accurate diversification in fact can minimize the risk carried in the portfolio by the securities (*specific risk*), but cannot eliminate the risk embedded in the market (*systematic risk*).

2.2. Investment strategy

2.2.1. Active and passive strategies

Adopting a *passive portfolio management strategy* does not mean that the assets bought are held in the portfolio in the same proportion whatever trend occurs in the financial markets. On the contrary, a passive strategy implies a periodical activity of rebalancing. Rebalancing means to harmonize the portfolio to some specific and predetermined parameter which could be for example an index benchmark. To conform a portfolio to a benchmark, the financial manager has to adopt a *Contrarian* approach (Di Gialleonardo, Luzi, Marè and Motroni, 2011): in order to square the price variations occurred in the portfolio, the weights of the assets need a periodical rebalancing; to do so, the financial manager will be asked to sell off the assets which registered a price increment, and vice versa.

A strategy of this kind requires a monitoring activity by the portfolio manager who is asked to track and replicate an indicated parameter; among other things, this approach ensures also a stable diversification across the chosen asset classes which are kept constant in the proportions, moreover it is easy to explain to an investor who can verify the results without much effort.

Instead, a financial manager who adopts an *active portfolio management strategy* monitors the price movements of the assets in the attempt of performing

³⁶ Such as money market instruments and commodities.

better than the market, by trading on both the buy and sell side of the portfolio according to a rule which could be summarized as: “*sell low and buy high*”. Basically when the asset price drops, the asset is sold to limit the potential loss; when the price rises a supplemental amount of asset is bought to follow the upside trend.

Sometimes the financial manager may decide to alter the normal weights of the asset classes held in the portfolio in order to anticipate a foreseen market movement and take a position to improve the returns or reduce temporarily the overall risk of the portfolio. This strategy is called *market timing*.

Let’s picture, for example, a situation where the portfolio manager assumes that common stocks are overvalued: he thinks that he has spotted a bullish³⁷ trend and will react to his assumption by selling part of his common stock portfolio to cash in some profit. Portfolio managers often use *technical analysis*³⁸ as a tool to spot and deal with market trends. Behind this approach stands the belief that there are portfolio managers skilled enough to identify and take advantage of these signals before their competitors. Since a pension fund is not an hedge fund³⁹, specific limits are set to avoid a massive recourse to market timing so that the chosen risk-return profile cannot be drastically altered.

Among the various approaches which can be used to ride a market trend, it is interesting to mention at least two of them called Momentum and the aforementioned Contrarian. *Momentum strategies* (also known as positive feedback strategies) imply selling off assets which underperformed the average return in order to reduce a future potential greater loss, and buying the assets which over performed the average return to widen the future potential profit. *Contrarian strategies* (also known as negative feedback strategies) have an opposite attitude: they imply buying underperforming assets hoping in a future recovery, and selling off over performing ones and cashing in a profit.

³⁷ The definition of *bullish* market applies when the asset prices are rising. If the prices drop, the market is said to be *bearish*.

³⁸ Technical analysis is a strategy that aims at spotting market trends through the observation of asset’s price charts, by applying articulated set of rules.

³⁹ A hedge fund operates in the financial markets adopting a *speculative approach* in order to create consistent extra profits (stated in technical terms, high levels of *alpha*) with respect to a benchmark. To do so it makes use of a wide variety of financial instruments such as derivative contracts, and strategies such as short selling, hedging and leverage.

Of course the first style of strategy acts as amplifiers of the shocks occurring in the financial markets; the second one instead, going against the prevailing trend, acts as a price stabilizer. From the above considerations, it emerges with strength the determinant role embodied by institutional investors like pension funds, in maintaining the financial markets transparent and healthy: to obtain such effect, pension funds necessitate to manage big capitals and to direct them towards the stock market (Di Gialleonardo, Luzi, Marè and Motroni, 2011).

Whether strategic asset allocation is more important than tactical asset allocation is an interesting topic of discussion among experts in the field. There is evidence that active management is important but the value added from that activity is small relative to asset class returns as a whole (Brinson, Hood and Beebower, 1986).

Brinson, Hood and Beebower (1986) used a sample of 91 U.S. corporate pension funds in the attempt to decompose the returns variation in active and passive management components. They arrived to define the following equation:

$$\sum_{j=1}^M \omega_{ajt} r_{ajt} = \sum_{j=1}^M \omega_{njt} r_{njt} + \sum_{j=1}^M \omega_{njt} (r_{ajt} - r_{njt}) + \sum_{j=1}^M (\omega_{ajt} - \omega_{njt}) r_{njt} + \sum_{j=1}^M (\omega_{ajt} - \omega_{njt}) (r_{ajt} - r_{njt})$$

where:

- $J = 1, \dots, M$ indicate the asset classes contained in the funds
- ω_{njt} = is the “normal” weight assigned to an asset class in the strategic asset allocation
- ω_{ajt} = actual weight of the asset class at time t
- r_{njt} = represents the portfolio return expected under the “normal” asset allocation
- r_{ajt} = represents the portfolio return at time t

Stated in different terms, the formula breaks the total return (left side of the equation) into normal return (first member of the right side), return from security selection (second term), return from market timing (third term) and residual return (fourth term). Of course, the smaller the residual returns effect is, the better the equation is at

capturing the effect of each active strategy. Moreover accurate measures of “normal weights⁴⁰” and “normal returns⁴¹” are needed.

Investment activity	Explanatory power
Passive portfolio benchmark	93,60%
Timing	1,70%
Security selection	4,20%
Other	0,50%
Total	100%

Table 3: Total return variation explained by investment activity. Source: Own elaboration of data gathered from Brinson, Hood, Beebower (1986).

The information reported in Table 2 show that market timing, security selection and more in general active management strategies, have a limited power to explain the variation of the returns of a pension fund’s portfolio. On the contrary, the asset allocation planned during the investment process has a predominant role. Then, these figures may be of some help to effectively direct the efforts of a portfolio manager in the right direction.

Blake, Lehmann and Timmermann (1999) got the same conclusion after investigating the same topic on a sample of U.K. funds. They found out that the strategic asset allocation was the main driver for most of the returns variation and that the vast majority of the sampled funds received a negative performance from market-timing. This last finding led them to affirm that: “A randomly selected pension fund would have been better served by applying its strategic asset allocation to passively managed index funds”. However the authors remain dubious about the answers obtained as they might be the result of the managers’ behaviour more than the real economic role of the asset allocation.

The aforementioned activities are quite risky that is why they represent only a residual part of the portfolio of a pension fund. Due to the delicate task of providing income to retired people, the investment process must be carried out with the *prudent person standard*⁴², so that the investment is undertaken with care; with regard to this,

⁴⁰ A 10-years mean average of the holdings in each asset class was used as an approximation of the “normal holdings” measure.

⁴¹ It is possible to use an appropriate external benchmark to define what a “normal return” should be.

⁴² The OECD states that the prudent person standard refers to the process used to carry on the investment rather than to the final outcome. High attention is put on the fund’s ability of hiring qualified

it is widely accepted to define portfolio upper⁴³ limits in order to promote the prudential principles of security, profitability and liquidity. (OECD, 2006).

2.2.2. Fund manager selection

It may be the case that pension fund sponsors outsource the financial management, on the contrary sometimes sponsors possess the necessary skills to manage the fund internally. At this stage a key role is played by the *Fiduciary Manager* which helps the sponsor to select the financial managers among the applicants.

Just to give an idea of how banks, insurance companies and asset management companies share the market, Table 4 reported below shows the Italian market breakdown for Open and Contractual Pension Funds at the end of 2015. *Open pension funds* are mainly provided by insurance companies (58,4% of total market AUM) followed by asset management companies (39% of total market AUM). It is interesting to note the disproportion between AUM and number of funds (40 versus 9), showing a better ability of asset management companies to attract capitals.

Open Pension Funds 2015 Market Structure				Contractual Pension Funds 2015 Market Structure		
Type of financial intermediaries	N° of financial intermediaries	N° of funds/ Sub funds	AUM %	N° of financial intermediaries	N° of mandates	AUM %
Insurances	28	40	58,4%	5	32	15,6%
Banks	1	1	3%	2	12	5%
Asset management companies	9	9	39%	14	113	37%
Total	38	50	100%	21	157	58%
Other EU financial intermediaries	-	-	-	43	102	42%
Total	38	50	100%	64	259	1

Table 4: Italian pension funds market structure at the end of 2015. Source: COVIP (2015)

people and, through a careful monitoring of their activity, implementing a proper control scheme of the investment process.

⁴³ Lower portfolio limits would not be considered consistent with these principles as they would imply to hold a fixed minimum investment level in some financial activities no matter how bad the market conditions are. Such approach may turn out to be detrimental for investors.

Contractual pension funds show a leading role of asset management companies (113 mandates and 37% of total AUM), closely followed by other EU financial intermediaries (102 mandates and 42% of total AUM). Insurance companies take on a secondary role (32 mandates and roughly 16% of total AUM).

In order to decide who is the financial manager that best meets the pension fund's scopes, the plan sponsor together with the Fiduciary Manager are called to examine many proposals. The final decision is taken taking into account some factors among which:

- the total value of the *asset under management* (hereafter AUM), which can be an indicator of the financial manager's ability to carry out his tasks;
- the possibility to *oversee and operate on multiple financial markets*, which is a valuable asset in order to pursue a wide diversification of the investments;
- the *robustness* of the company where financial manager operates;
- the *track record of past returns* obtained by the manager under scrutiny, since a good background can be a good sponsorship for future success⁴⁴. This last aspect is quite tricky because assessing how the performance was produced is not immediate: it could be the outcome of some random events as well as the result of the ability of few people who do not currently work in that asset management company anymore;
- availability of relevant *technological tools*, which can smooth the investment process making it safer and faster.

The price asked by the financial manager to assume the task can be split in two entries: a *fixed management fee* and a *brokerage fee* to trade and manage each asset. The size of the brokerage fee is strictly tied to the frequency at which the portfolio is rebalanced and is negatively related to performance (Carhart, 1997). Predicting future prices in order to pick underpriced securities is a common activity among active financial managers who want to impress the investors with a superior performance. Back in 1966 Sharpe sustained that there is scarce capacity to assess the future states of the prices starting from past returns due to the fact that they follow a random walk

⁴⁴ It is true that a past positive performance is not a predictor of likewise future good results, but a bad past performance is likely to discourage a plan sponsors to take into consideration a financial manager's application for managing its assets.

process⁴⁵; as a consequence managers are better spending their resources not in the activity of detecting potentially underpriced assets, but evaluating correlations between securities and diversifying the investments.

Jensen (1968) concluded his research on 115 mutual funds between 1955 and 1964 bringing evidence that the sampled funds were not capable to deliver price forecasts accurate enough to allow them to perform on average better than expected. Moreover such forecasting activities revealed having a negative impact on the performance because they hijacked precious resources from more rewarding and less random activities.

Once the financial manager is signed up, the role of the plan sponsor and of the Fiduciary Manager is not over: they have to periodically oversee and measure the financial manager's results, to verify if any style shift occurred in the asset management process and if there was any relevant staff rotation able to threaten the future efficiency. The importance of interpersonal relations cannot be undervalued because for example inefficient administration or excessive staff turnover may lead to a lack of confidence towards the responsible of the fund and to his substitution (Hager, 1980). The choice of the manager is reversible and a substitution can happen under some circumstances such as the sponsor's decision to direct its investments towards new asset classes which require new skills, the case of an increase of the sponsor's assets and in case that the agreement with the financial manager has been terminated.

2.3. Performance measurement

The policy statement should include appropriate performance benchmarks and assessment timeframes (OECD, 2006).

2.3.1. The role of the benchmark

The *benchmark* is defined as an efficient portfolio whose scope is to objectively represent the characteristics (geographic focus, risk, return) of a certain financial market, so that the investor can have a periodic term of comparison to evaluate the performance registered by the pension fund, also in relation with similar investment

⁴⁵ The Random Walk process is used in finance to explain the price changes. The theory implies that past returns are not useful to predict future price changes which are then unpredictable.

opportunities adopting the same benchmark. It follows that, through the comparison of the fund's results with the benchmark, it is also possible to perform a parallel evaluation of the financial manager's skills, and to include reward and penalization mechanisms. Once understood the importance of this metric, it is easy to understand the reason why a pension fund must clearly specify its benchmark in the agreement underwritten with the financial manager (in case they are closed pension funds⁴⁶), and in the communications towards the investors regarding the performance assessment.

A benchmark needs to be *coherent* with the pension fund's desired risk-return profile, *representative* of a determined market, and always *measurable* and *verifiable*. Problems can arise from the inclusion of non listed securities in the portfolio because their performance cannot be directly captured by a benchmark index. Socially Responsible Investments⁴⁷ may create some issues in this sense.

Being the benchmark a virtual portfolio, it does not suffer the detrimental effect of the costs deriving from the day-to-day management and from the taxation; it follows that while the benchmark's return is a gross one, the pension fund's performance comes net of the aforementioned costs. This fact has to be kept in mind whenever a comparison between the two is done.

According to the strategy adopted by the pension fund, the intrinsic function of the benchmark turns out being opposite. In fact if the financial manager is ordered to put in place a passive strategy, he has a minimal discretionary margin of action because he simply has to replicate the benchmark which becomes de facto the main driver of the fund's results. On the contrary, in presence of an active strategy the pension fund indicates an oscillation margin within which the manager is allowed to depart from the benchmark. In this last case the benchmark does not act as a driver anymore, but as a parameter to be systematically beaten.

Choosing an appropriate benchmark is a delicate task because it must mirror the characteristics of the pension fund's portfolio. For example a pension funds adopting a conservative investment approach, which invests a large part of its portfolio in European Government Bonds is likely to adopt as a benchmark, an index tracking

⁴⁶ In case of an open pension fund, the pension plan sponsor and the financial manager coincide.

⁴⁷ Socially Responsible Investing (SRI) will be treated in detail in the next chapter.

the returns of the Government Bonds issued by the European countries. A pension fund with an attitude towards equities, will adopt a similar thinking but with an “equity-driven-logic”. In case none of the indexes available in the market is considered suitable alone to mimic the portfolio’s specific characteristics, it is admissible to create *ad hoc composite benchmarks* by simply weighting together multiple benchmarks with various specifications, according to the proportions dressed by the asset classes encompassed in the portfolio. Firms like Modern Index Strategy Index (commonly known as MSCI), Standard and Poor’s (S&P), FTSE, Russel and Morningstar are among the main world index providers.

A comparison between the benchmark and the pension fund has to be done on a regular basis, and the minimum information requirement to be disclosed is generally the performance over the last one, three and five years. An evaluation of the financial manager on a shorter time horizon would be likely to lead him to adopt *ad hoc* short term investment strategies to inflate the returns and get a better impression (and possibly richer performance fees) or even worse, to adopt strategies of *window dressing*⁴⁸; moreover in presence of a short term assessment some of the performance may be consequence of casual events.

The benchmarks can differ under many points of view, such as the calculation of the weights to be assigned to each component. In this sense it is possible to distinguish between *price weighted* benchmarks if the weighting process is based on the market price, *equally weighted* benchmarks if the components are all weighted the same and *value weighted* benchmarks if the weighting process is calibrated on the market capitalization of the components.

The relative measure of deviation of the returns from the benchmark is called *Tracking Error* and comes with a measure of risk called *Tracking Error Volatility* and with an index of relative performance called *Information Ratio*; the rationale behind these measures is exposed below.

⁴⁸ Window dressing is referred to as a practice aimed to alter the portfolio composition in proximity of the evaluation of the performance. It is particularly dangerous because it not only alters the risk-return profile of the portfolio, but also carries additional and unnecessary costs of trading.

The *Tracking Error* (hereafter TE) is defined as:

$$TE = \frac{1}{N} \sum_{i=1}^N (RP_i - RB_i)$$

where:

- RP_t : is the pension fund's return at time t ;
- RB_t : is the benchmark return at time t .

At a first and superficial sight, the formula simply calculates of how much the portfolio departs from its benchmark. But it tells much more: in fact in presence of positive and high values, the index gives information on how good was the financial management in producing extra returns; in practice the TE reflects the choices adopted by the financial manager during the investment process. Moreover thanks to this index, it is also possible to grasp some insights on the strategy adopted by the portfolio: high TE values suggest large deviations from the benchmark and the adoption of active strategies, symmetrically low TE values may indicate that passive strategies are in place.

The *Tracking Error Volatility* (hereafter TEV) is defined as:

$$TEV = \sqrt{\frac{\sum_{i=1}^t [RP_t - RB_t - \overline{(RP_t - RB_t)}]^2}{n-1}}$$

where:

- RP_t and RB_t have the usual meaning
- $\overline{(RP_t - RB_t)}$: is the average TE observed in the period under analysis.

The TEV is a measure of dispersion of the deviation of the portfolio's returns (*excess returns*) with respect to a selected benchmark; minimization of TEV has become an important criterion for assessing the overall manager performance (Roll, 1992). High TEV values indicates that the financial manager largely departed from the benchmark, which is totally fine if he was asked to perform an active strategy, but can also raise a warning flag if the agreed strategy was a passive replicating one. Generally

speaking in presence of passive strategies low TEV values are expected, the opposite holds in case of active strategies.

The last measure presented here is the *Information Ratio* (hereafter IR), which is defined as:

$$IR = \frac{TE}{TEV}$$

where:

- *TE* and *TEV* have the usual meaning.

The IR indicates the ratio between the excess return of the portfolio and the returns' volatility, and is an useful instrument to measure the ability of the financial manager to outperform the benchmark in relation to the amount of risk assumed. An active manager is expected to produce a positive ex-ante IR value, while a passive manager a close-to-zero ex-ante IR. The ex-post IR (which can be a negative value too) depends on the obtained excess return, and establishes if the financial manager accomplished his task (El-Hassan and Kofman, 2003).

2.3.2. *Risk- return metrics and performance assessment*

The investment phases examined before, are the building blocks needed to produce returns aligned with the investors' expectations. Then, the measurement of the performance is essential in order to investigate whether the financial manager's behaviour did match with the pension fund's guidelines or not and in case it did not, to correct the route through a rebuke or, more drastically, a change of financial manager. To carry out the performance valuation, there is a range of indexes (in addition to the ones already specified in the section above) which arise from a *combination of return and risk measures* and permit to quantify the performance per unit of risk assumed.

Since the *assessment of the returns* is done looking backwards, it is of practical interest to express pension funds' returns based on past NAV⁴⁹ data adopting the following notation:

$$R_{p,t} = \frac{NAV_t - NAV_{t-1}}{NAV_{t-1}}$$

The comprehension of the formula is straightforward and permits to measure the portfolio's returns at a specific point in time ($R_{p,t}$), choosing a time frame of interest.

Returns can be computed according to a *time weighted* or a *money weighted* approach: while the first style weights the same all the daily returns, following the second methodology more weight is attributed to the periods when the capital invested was more consistent. Returns per se⁵⁰ are not really interesting in this contest, that is why the next step is to integrate them with a roster of risk metrics in order to finally calculate some *risk-adjusted indexes*.

The *volatility* is an appropriate measure of risk if the returns are normally distributed, it is calculated as:

$$\sigma = \sqrt{\frac{1}{n} \sum_{t=1}^n (R_{p,t} - \bar{R})^2}$$

where \bar{R} is the average return of the portfolio in the period under exam. Since a positive departure from the average value represents a well-accepted circumstance for an investor, the limit of this measure of risk stands in the fact that it categorizes as risky whatever departure from the average value, either they are positive or negative.

The *Downside Risk* (hereafter DSR) is an *asymmetric* measure of risk and differs from the aforementioned *Volatility*, which is a *symmetric* measure of risk. Opting for

⁴⁹ NAV is an acronym for Net Asset Value and expresses the value of a single investment unit of the fund. The NAV is calculated as: $\frac{\text{Fund's assets value} - \text{Fund's liabilities value}}{\text{Number of Fund's shares}}$

⁵⁰ Because the return is a function of risk (captured respectively by the β and by the Duration whether Stocks or Bonds are under scrutiny), assessing the first without the second is like telling only one half of the story.

DSR implies to agree that an investor is concerned only with negative returns (or returns lower than a certain threshold) and not with positive departures from the expected value.

The DSR is defined as:

$$DSR = \sqrt{\frac{1}{n} \sum_{t=1}^n [\min(R_{P,t} - MAR, 0)]^2}$$

where:

- $R_{P,t}$ has the usual meaning;
- MAR indicates the Minimum Accepted Return (for example the benchmark or another targeted return).

The last two measures of risk taken in exam are the *Value at Risk* (hereafter VAR) and the *Expected Shortfall* (hereafter ES)⁵¹.

The VAR is widely used among financial analysts to quantify the maximum loss that may be suffered by a financial portfolio with a probability α over a certain time horizon, where α is known as the *confidence level* (see the light blue region in Figure 2).

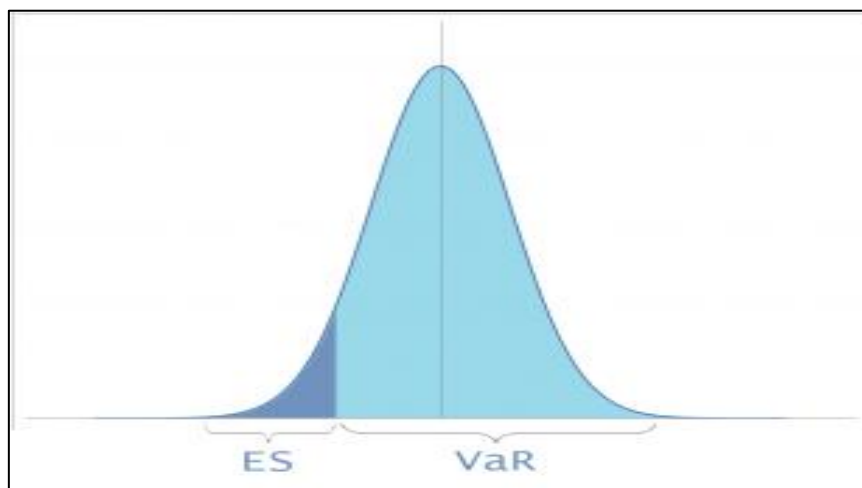


Figure 2: Graphical representation of VAR and ES.

⁵¹ VAR and ES are mentioned here for the sake of completeness. A more complete treatise is beyond the scope of this work.

Because VAR does not quantify the actual possible loss suffered by the portfolio, ES is helpful in order to complete the information provided by the VAR; in fact it quantifies the actual dimension of the average losses suffered in case of *extreme events* occurring in the left tail, corresponding to the $1 - \alpha$ area of the distribution (see the dark blue region in Figure 2).

At this stage it is possible to mix the measures of risk and return and derive some widely used indexes. The *Sharpe Ratio*, originally known as “*reward-to-variability ratio*”⁵², was formulated by William Sharpe as:

$$I_{SH} = \frac{R_P - R_f}{\sigma_P}$$

The ratio is thus the reward per unit of variability (Sharpe, 1966) with respect to a risk free security. This ratio is widely used to rank a series of investment opportunities according to an approach for which the higher the ratio, the better the fund’s past performance. In his study, Sharpe (1966) evaluated the performance of thirty-four mutual funds over two decades and found out that the ones which had a past good performance, had also the tendency to deliver a good performance in the following period too. Alternative formulations and interpretations of the ratio were suggested by Sharpe later in 1994, when the author suggested to substitute the risk free return with the return of a similar passive security; the difference between the two activities was termed “*active return*”⁵³.

While the Sharpe Ratio measures the excess return against both the portfolio specific and market risks faced by the portfolio, the *Treynor Ratio*, which is another popular measure of absolute performance, measures the portion of risk deriving exclusively from the market (measured by the portfolio’s β):

$$I_{TR} = \frac{R_P - R_f}{\beta_P}$$

The foundations of this index are grounded in the assumption that in a perfect financial market it is not possible to find mispriced securities, so that the only portion

⁵² Definition borrowed from Sharpe (1966), p.123

⁵³ See Sharpe (1994), p.52.

of risk to be aware of is the market risk. For what concerns especially highly diversified portfolios, main departures from the returns may be either temporary or attributable to random events (Sharpe, 1966), in this sense the Sharpe and Treynor indexes provide quite similar rankings within a sample of funds, while the same does not hold in presence of not perfectly diversified portfolios.

Recalling the notion of DSR, it is possible to introduce one more index, namely the *Sortino Ratio*:

$$I_S = \frac{R_p - R_f}{DSR}$$

If a pool of well diversified funds' portfolios need to be ranked, the Sharpe Ratio is probably the first metric to use and can be usefully integrated by the Sortino Ratio, which may be of help when two portfolios have statistically significant equality in the Sharpe Ratio: in this case the Sortino Ratio provides a better rank to the less underperforming portfolio.

Taking advantage of the CAPM model (see footnotes page 25), Jensen derived a measure known as *Alfa Jensen*:

$$\alpha = E(R_p) - [R_f + \beta_{p,M}(R_M - R_f)]$$

where:

- $E(R_p)$ is the portfolio's theoretical expected return;
- R_f is the risk free rate;
- $\beta_{p,M}$ is the beta of the portfolio;
- R_M is the market return

This metric assesses the entity of the portfolio's excess return measured as the difference between the portfolio's return and the return that the same portfolio should have produced on the base of the market risk (beta of the portfolio) embedded in the investment. It allows to express a judgment on how good the financial manager was at "*predicting future asset price states and investing accordingly*" (Jensen, 1968): a positive α -value means that the financial manager had a positive stock-picking attitude that allowed him to outperform the market while a negative α -value means that the

financial manager had a bad stock-picking result which led him to underperform the market. Note that positive α -value could be consequence of random events rather than of the superior forecasting ability of the financial manager; to have a better understanding of possible random results, it is good practice to evaluate the dispersion in the distribution of α through a Least Squares Regression and test the significance of the positive/negative value observed.

3. SRI Pension Funds

Socially Responsible Investing (hereafter SRI) is a relatively new investment approach which has been gaining in popularity in many countries; its ultimate scope is to match the desire felt by a growing group of investors to combine their need of ethics in business, with the classical purpose an investment has: generating financial returns. SRI is something different from either *traditional investing* and *charitable giving* because the first is focused only on financial returns, the second does not care about returns at all.

In a newspaper article appeared on *The New York Times*, the world famous economist Milton Friedman (1970) expressed big concerns about the possibility of attaching social responsibilities to the field of business because of their *“analytical looseness and lack of rigor”*, in fact according to his thought *“business as a whole cannot be said to have responsibilities”*. Friedman sustained that loading the idea of business with additional scopes going beyond the *“increase [of] its profits so long as it stays within the rules of the game”*, was an hazardous exercise, which would give origin to behaviours capable to ruin the fiduciary link existing between corporate executives and stockholders. Incorporating pure social scopes would de facto lead to the imposition of implicit taxes on the business without the approval of all the stockholders. According to the author, it would be different if such *“social practices”⁵⁴* were adopted to indirectly strengthen the business and the company’s position in the market because in this case they would be *“a cloak for actions that are justified on other grounds rather than a reason for those actions”*.

Laying the foundations of this discipline on such a loose ground is not a wise move because it exposes the practitioners to critics about the rigor of the discipline itself. The fact is that despite everything, an always greater number of investors is showing concern not only with the extent of financial returns produced by their investments, but also with the way such returns are produced. It is said that SRI has a *bottom-up* approach because it exploits the investor’s power in order to promote

⁵⁴ Friedman brings as example an hypothetical corporation that is the major employer in a certain area and provides the local communities with some facilities in order make the employer’s more motivated through a more comfortable life-style and attract more and better employers in the future.

socially responsible choices. Pension funds, and more in general institutional investors, intercepted the urgency felt by many investors and began to design and offer pension plans and other investment products which take into account the investors' ethical instances.

Whether the shareholders' wealth maximization goes together with the best interest of society is a legitimate question and by adopting a different point of view, it is possible to reconcile two apparently irreconcilable positions. In this sense, Eurosif⁵⁵ (2016) provides us with the following definition of SRI:

"Sustainable and Responsible Investment ("SRI") is a long-term oriented investment approach, which integrates ESG factors in the research, analysis and selection process of securities within an investment portfolio. It combines fundamental analysis and engagement with an evaluation of ESG factors in order to better capture long term returns for investors, and to benefit society by influencing the behaviour of companies."

Paraphrasing the above definition of SRI, it seems natural to stress the creation of value in the *long term*, which excludes the possibility of short sighted and speculative behaviours. The sustainers of the SRI approach think that improving the firm's environmental, social and governmental (hereafter ESG) performances can lead to more efficient processes and generate new business opportunities which should be then reflected in the market price of the firm's stock; their main purpose is to create financial portfolios able to deliver superior risk-adjusted financial returns (Kiymaz, 2012) with respect to non SRI investments. Financial theory is critical towards this last point because in efficient market conditions information is fully incorporated in the stock prices, consequently firms with better ESG performance trade at higher prices, erasing the possibility to consistently obtain superior returns. Moreover SRI investments theoretically suffer diversification costs deriving from a narrower investible universe due to the strict screening practices adopted in the security selection phase.

⁵⁵ Eurosif is the main European association dealing with Socially Responsible Investing. It aims at promoting and developing SRI across Europe, supporting members to improve SRI practices and lobbying to develop regulations at European level able to support SRI growth.

Against these considerations stand many recent researches such as Guenster (2012), Kiymaz (2012), Holzauer (2013) who conducted extensive analysis on the literature about SRI financial performance. The authors concluded that from the direct observation of empirical results, investors who adopted a SRI approach did not obtain performances worse than non-SRI investors and on the contrary they performed similarly to conventional investors. These evidences give breath to the SRI movement and result in fresh air to keep on developing these strategies.

3.1. Evolution of the SRI style

Despite not scientifically codified, traces of SRI approaches are present as religious precepts dating back in the centuries. Judaism and Christianity have always put a ban on usury, Islam under the Sharia (le Islamic religious law) teaches not to invest involved in pornography, gambling and pork production and prohibits the charge of interests (*riba*) because considers such practice as creating wealth without any productive activity. Other well known examples derive from the Quaker doctrine which prohibited to take part to war and to profit from slavery. The Methodist doctrine on its side condemned practices like gaming, usury lending, liquor production and also polluting activities like leather tanning. The general prohibition of activities like alcohol, tobacco, gaming and weapons production behaved as a faith-based filter and was the first kind of SRI investment filter ever adopted (Sparkes, 2002).

In the 20th century, as more complex forms investment showed up in the markets, the SRI screening policies became more sophisticated and abandoned the individual and religious sphere to approach a collective dimension. 1928 is an important date because it saw the foundation of the Pioneer Fund, the first mutual fund adopting ethical screening: more precisely investment in alcohol and tobacco were avoided systematically. From the very beginning the SRI movement became consistent in the United States where pension funds were the first to adopt ESG criteria to select the investments. The United Mine Workers of America for example invested heavily in medical facilities and sponsored the construction of several hospitals in the Appalachia region. After these embryonic examples, SRI showed its strength during the Vietnam War, when weapons producers' stocks like Dow Chemical were labelled as "*sin stocks*".

In that period (1971) the PAX World Fund was established from an idea of Luther Tyson and Jack Corbett who belonged to the Methodist Church; their scope was to *“make it possible for investors to align their investments with their values [and] at the same time, [...] to challenge corporations to establish and live up to specific standards of social and environmental responsibility⁵⁶”*.

In the same period a strong criticism arose towards the South African's apartheid⁵⁷ regime. In 1963 the United Nations imposed an embargo against South Africa which was followed by an interruption of the commercial and financial relations with several countries. Many companies were put under pressure to divested from South Africa, harming its economy.

In 1984 Friends Provident Stewardship Fund was the first ethical fund operating in the UK, on one side it excluded from its investments those companies that did not match the fund's standards or that were harmful for the society, on the other side it focused its investments on the companies which made positive contributions to the society and encouraged the adoption of high business standards through dialogue and shared ownership.

SRI is a more recent trend in Europe and appeared first in the UK which is second only to the US in terms of asset under management. There is a reason for the European delay in the SRI field: as after 1950 most of the European countries experienced low levels of inflation, the equity investment did not take off because there was not much need of an hedge against inflation and consequently mutual funds had a slower development with respect to what happened in the Anglo-Saxon countries.

A pioneering role in the European market was traditionally assumed by the Scandinavian countries and among them, by Sweden. This is probably due to the high environmental awareness that always characterized that region. Netherlands is a benchmark at European level for what concerns SRI practices, not only with respect to

⁵⁶ <http://paxworld.com/about/welcome/history>

⁵⁷ The apartheid regime became operative in South Africa in 1948 and was terminated in 1994. During that period the white minority dominated and discriminated the black majority of the population and imposed them to suffer a physical segregation in separated areas.

investment and pension funds, but also in the ethical savings field thanks to banks like Triodos and SNS Real Groep.

Nowadays SRI runs on solid tracks and receives strong support from many international organizations such as the United Nations Global Compact⁵⁸ (hereafter UNGC) which released a Decalogue that constitutes a best practice benchmark for companies approaching business; it touches themes like: human rights, labour, environment and anti-corruption.

Another milestone in the industry is represented by the United Nations Principles for responsible Investment (hereafter UNPRI or simply PRI) that were launched for the first time at the NY Stock Exchange in 2006 after a long developing promoted by the most prominent institutional investors at global level. The PRI operate independently from any government and are supported by the United Nations. The PRI work to promote a sustainable global financial system in order to create value in the long term through the implementation of good governance practices. The idea is that by adhering to the PRI, institutional investors commit themselves to take into account of ESG issues in their investment approach.

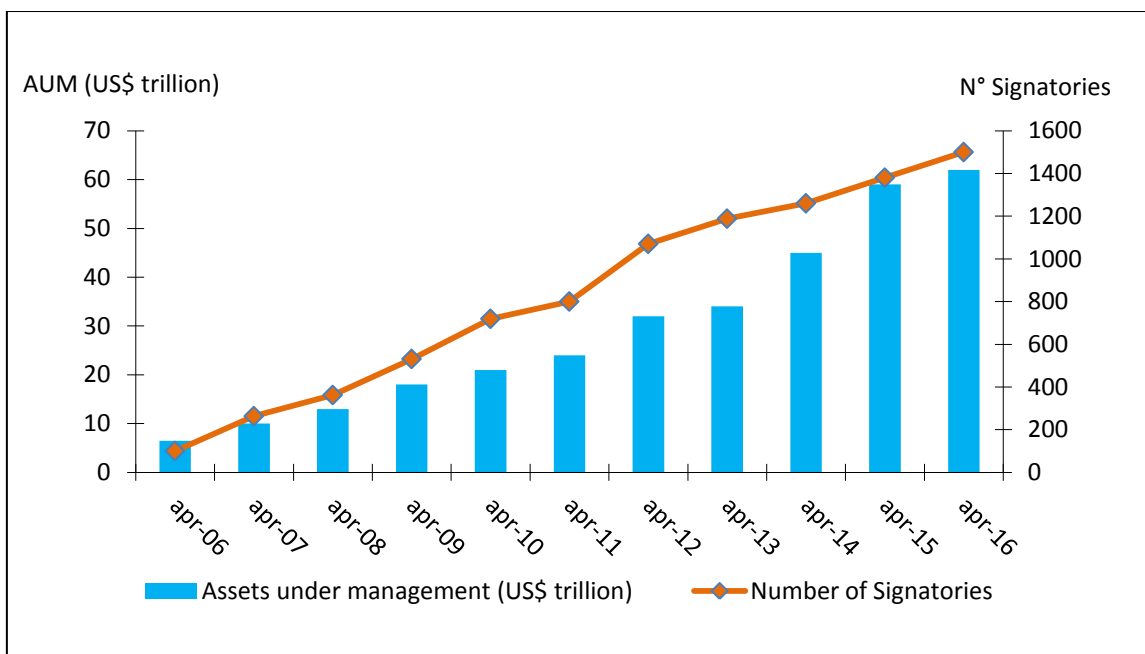


Figure 3: UNPRI growth since inception in April 2006. Source: www.unpri.org

⁵⁸ The UNGC is an international organization which operates to create a worldwide network of sustainable companies. To do so it promotes the adoption of the Ten Principles and the enforcement of “strategic actions to advance broader societal goals”.

As from Figure 3 it is possible to measure the rapid growth of the UNPRI at international level either from a numerical point of view (from 100 to roughly 1500 subscribers in ten years) and from an AUM point of view (from 5 US\$ trillion, to roughly 60 US\$ trillion in ten years). All these facts put together are indicators that the SRI growth in popularity is solidly backed by a parallel quantitative increase of the financial mass under management. This is also due to the presence of several studies showing that investors do not have to sacrifice financial returns when investing in a socially responsible way.

3.2. Putting SRI into practice

Up to now two concepts should be clear: that SRI is an extended panorama which, embedding ethical elements, is somehow hard to define sharply and that SRI approach aims to create value in the long term not only for the stockholders, but for the stakeholders too. The concept of ESG approach to investment was encountered in the previous paragraph and it is appropriate to define it deeper. ESG practices deal with three main themes: Environmental, Social and Governmental. Speaking about Environmental issues, they include among other: climate changes, air and water pollution, carbon dioxide emissions, deforestation and wastefulness. The Social branch targets themes regarding gender-equality policies, human rights, labour standards, relations between the firm and the surrounding communities. The third area regards all the company's government practices such as manager's compensation, board of directors composition, supervision of apical officer's behaviour and observance of laws.

There are some strategies that are adopted in the SRI process in order to select and manage the investment opportunities over time:

i. Screening methods behave as filters to select securities. *Negative screens* are the building blocks of the so called "avoidance approach", they are a relatively simple to manage and are used to avoid certain stocks or entire economic sectors on the base of a specific set of criteria like social (see the aforementioned South African example) and environmental ones. Among the most used exclusion criteria are the production of weapons, tobacco, alcohol, gambling, pornography and animal testing. Adopting negative criteria implies not investing at any level of the

production chain. *Positive screens*, on the contrary, focus on finding assets and companies which behave according to well accepted practices such as: community development, supporting diversity, empowering labour relations, respecting the environment and producing high-quality products through research and innovation. The selection based on a positive screening method is not easy to perform because it can be flawed by human judgment.

- ii. Adopting the *International agreements* method, implies investing in companies and stocks which demonstrate a respectful attitude towards ESG international standards such as PRI and UNGC. In practice each investment is benchmarked with these standards and is admitted in the investable universe if it possesses minimum requisites. The final results deriving from negative screening and international agreements methods may coincide. Taking another point of view, if the securities that fail the screening test are already in a portfolio, the financial manager has two distinct options at his disposal: he can either decide to divest or starting an engagement process with the company to sort the problem out.
- iii. The *best in class* approach actively selects and tends to overweight those assets that are judged to be the best in the adoption of ESG practices, among a specific group or sector; it is important to say that, differently from what happens with the negative screening methodology, no sector or business is excluded a priori. Within this category also lie the *best in universe approach*, which simply focuses on the best assets, without any consideration about the sector. In the end *best effort* practices tend to reward the companies that showed the best improvements in the adoption of ESG criteria.
- iv. *Thematic investment* is about selecting a portfolio of investments respectful of ESG criteria with a common thematic focus such as climate changes, health, energetic efficiency. The essential part of this approach is identifying a global trend to promote actively.
- v. *Engagement* is a practice which implies a long-term oriented dialogue between the company and the investors who participate to the company's meetings, and take part to the decision process exercising their voting rights in the general meetings to enhance good management practices, promote transparency and sustainability themes. What is usually encompassed under the definition of Engagement can be

split into two subcategories, namely soft and hard engagement. *Soft engagement* practices can be fulfilled by whatever kind of investors and comprehends actions like taking part to the periodical meetings occurring between the company's spokesmen and the investors, the participation to conference calls and the dispatch of reports. *Hard engagement* pertains to shareholders as they boast rights on the company's capital, and includes more invasive practices like filing motions in the assembly to integrate the meeting's agenda with additional topics of critical interest, direct interventions during the meetings and direct exercise of the voting rights. Due to the characteristic just mentioned, engagement can be carried out only if the investment is already in place and is a way to monitor and redirect a firm's conduct. It is typical that engagement is undertaken by the investment companies so that it results as being part of the fiduciary duty existing between the individual investor and the institutional investor which acts in his best interest.

vi. *Impact investing* is performed in those cases when beside financial returns, it is interest of the investor to have a social or environmental impact on a certain area. Examples are investments in emerging countries with the intention to promote social housing or renewable energy production. Communication is a key aspect for this specific strategy and investors do not only report the dimension of the obtained financial returns, but also the progresses obtained by the project where the capital is invested.

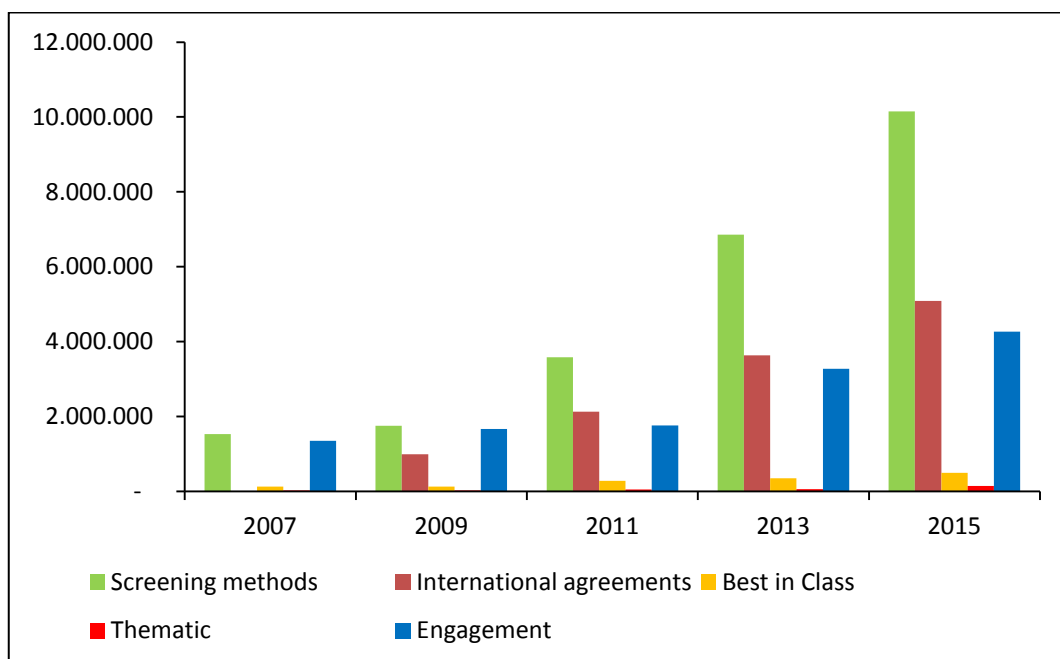


Figure 4: Growth of SRI strategies in Europe between 2007 and 2015. Source: Eurosif (2016)

The preference among investment strategies is not homogeneous, as evidenced in Figure 4. There is a clear preference for the Screening methods which dominate the scene followed by the compliance with International agreements and by Engagement strategies. With respect to the most common approaches, the Best in Class approach as well as the Thematic investment method lag behind.

3.3. ESG Rating

A traditional rating system is a good and easily understandable way to express an opinion on the financial riskiness of an investment (however, as it captures the company's situation in a specific moment, it can be a flawed metrics if relevant events occurred in the period running between one assessment to another). *Sustainability rating* aims in some sense to integrate "classic-rating-measures" by incorporating Corporate Social Responsibility (hereafter CSR⁵⁹) considerations through the measurement of ESG factors. In this way companies are evaluated not only for their financial performance, but also for the impact they have on the stakeholders and on the society (Schäfer, 2005).

Sometimes the stakeholders are able to express ESG judgments on their own but most of the times they necessitate of some intermediaries capable to do the job in an efficient, reliable and timely manner. It follows that sustainable rating providers act as a bridge between the company and the stakeholders. CSR rating agencies often are independent bodies and share the NGO's approach to social and environmental issues; the first step to rate a business is collecting enough information and then formulate a rating based on some filters which can be either purely social and environmental or social, environmental and financial too. To play this game companies must create adequate information systems in order to guarantee constant flows of information towards the market and the rating agencies.

The first rating agencies appeared for the first time in the United States in the 1970^s to strengthen the institutional investors' investment process. A first kind of

⁵⁹ The CSR was fostered and gained in importance across Europe as consequence of the EU council meeting occurred in 2000 in Lisbon: integrating social and environmental consciousness in the business operations as well as fruitful relations with stakeholders was (and still is) a priority task. Despite the absolute importance recognized to this matter, there is no current obligation weighting on the companies in terms of information disclosure, which is made on a voluntary basis. It follows that the degree of CSR requirements varies widely across European member States.

rating agencies have their origin deeply rooted in already existing research centres for the capital markets, such as banks' ones. Then there are two more categories: rating agencies deriving from NGOs (which have no direct link to the capital markets) and finally agencies established ad hoc to provide sustainability ratings. The sustainability rating market is fragmented and differently from what happens in traditional rating, reports the presence of many operators. Among the many players, Vigeo-Eiris is a worldwide operator born from the merger occurred in 2015 between Eiris (founded in 1983) and Vigeo (founded in 2002), which promotes and measures companies' ESG approach to investment providing sustainability ratings.

A major difference between traditional rating and sustainable rating is that the latter is often unsolicited, which means that companies do not ask to receive such service; sometimes stakeholders or investors are happy to pay to receive the rating of the company they are interested in. It is plausible that, since in many cases the rating request comes directly from the stakeholders, the responsible rating market is more transparent than the traditional one which may be biased due to the fact that the rating process is done under the company's request. There are four main approaches to rate a company's sustainability (Schäfer, 2005):

- i. assessing the risks faced by the company from an environmental and social point of view;
- ii. measuring the managerial strategies directed towards increasing the firm's sustainability in the long term;
- iii. focusing on companies growing in innovation at an above-average rate, and companies adopting innovative models;
- iv. building models to identify managerial best practices in term of CSR responsibility.

Despite the advantages, these methods carry also some drawbacks because the various approaches suffer a lack of standardization.

3.4. SRI Pension Funds

Up to now this work has introduced the two blocks necessary to hit the core of this thesis: the SRI pension funds described in this section arise as the result of the merger between pension funds and the SRI attitude towards investment. Just to give a first ad general idea, they are pension funds that adopt a SRI approach in selecting and managing the investments.

Recalling some facts described before, it is not hazardous to find some contact points between the two areas, in fact they both share a similar ultimate goal in producing positive and, even more important, sustainable returns in the long term. *Sustainability* which is then the possible link between the two areas, is a very flexible concept and can be stated as company's healthy, safe and harmonized survival. In favour of this approach stand several considerations. Think of the size of a pension fund's investments: in case of poorly performing results the easiest option for them is to divest, producing not only massive price shocks in the market but also losses for the fund itself. In this case the pension fund may be better off starting a dialogue with the company in order to correct the route instead of stepping out. Another aspect to be taken into account is that, following SRI principles should allow pension funds to invest in companies which minimize bad externalities, drastically lowering the financial risks deriving from unsafe business practices. This means that it is not only the returns that need to be considered, but also the quality and the source of the returns because if on one side producing bad externalities (environment polluting, poor employing practices, low community engagement etc.) might be rewarding in the short term, they are likely to result in dramatic consequences (lawsuits, bad reputation, loss of customers etc.) able to threaten the company's survival in the long term and to drastically compromise the pension funds' return. In this way pension funds can not only balance companies' power, but also become promoters of good corporate conduct.

These sound like reasonable and sufficient justifications to admit SRI pension funds in the social welfare arena but unfortunately they are not. Consider the *fiduciary duty* placed on pension funds: they are responsible only towards the investors of the returns maximization in a financially measurable way. Moreover SRI pension funds'

financial performance⁶⁰ may be badly affected by including non financial considerations in the investment process. The same holds for what concerns corporate performance which already embeds long term risk assessment through the Discounted Cash Flows method⁶¹ (Sethi, 2005): in this perspective adding SRI considerations appear to be a redundant exercise.

Sandberg (2013) proposed some possible ways out to solve these conceptual issues, trying to look differently at the fiduciary duty. He reinterpreted "*the traditional view*" focusing on the strong connection that seems existing in the long term between corporate social performance and financial performance, but then recognized that this link alone cannot justify the SRI approach because "*the SRI of pension funds could only be reactive and never truly proactive on this view*". A different strategy could be considering "*ethical opinions of the beneficiaries*" according to the idea that each investor should be able to put his money in a fund reflecting his ethical attitude; but it would be of course impractical, if not impossible, to identify all of them due to the many differences existing among investors. One more solution could be to redefine the category of the beneficiaries intended not only as the people who will directly enjoy monetary benefits once retired, but also as a broader stakeholder group affected at various stages by the pension funds' investment decisions. This last approach however is dangerous as it extends the status of beneficiary also to groups which have a loose connection with the pension fund. The author suggests finally the existence of "*independent social and environmental obligations*" which must find justification outside the fiduciary duty and which need to be addressed at a legal and political level. He suggests to create, with political participation, some clear guidelines for pension funds to pursue social and environmental scopes. Like in a loop, this last intuition takes us back to the possible central role that sustainability may cover in adding value to pension funds' investment policy, and fosters an idea pursued by Woods and Urwin (2010) who say that sustainability "*is a consideration for governments*" because it "*implies ensuring that the conditions for responsibility remain intact*".

⁶⁰ The relation between Sri pension funds and performance will be discussed in the next section.

⁶¹ The Discounted Cash Flow method (DCF method) is used to measure the profitability of an investment by calculating the future estimated cash flows present value. The risk of the investment is reflected in the discount factor by using the Weighted Average Cost of Capital (WACC) which is calculated as the weighted average of cost of equity (stocks) and cost of debt (obligations).

Beyond these disputes stands the fact that SRI pension funds do exist and operate in the financial markets paying benefits to retired people in the same way traditional pension funds do. There are some variables that are indicative of the propensity towards responsible investment. In particular Sievänen et al. (2013) found out that the legal origin has an impact on the SRI attitude: at European level, Scandinavian, Anglo-Saxon and German are the areas where SRI is more developed. Public pension funds are more likely to undertake a socially responsible attitude followed by corporate ones, the same holds for what concerns defined benefit contribution style. The size of the fund, intended as AUM, number of staff, participants and people receiving benefits, is also a good predictor: large and small funds with respect to the aforementioned variables are more likely to adopt SRI practices. This is because small pension funds are supposed to have a closer relation with the stakeholders and because bigger ones are more exposed with the media.

Involving ESG principles in the investment process of a pension fund implies also some slight changes in the funds' financial management approach. Three main strategies (De Graaf, Slager, 2009) can be put in place to implement a pension fund's Sri practices:

- i. a *financially driven* approach points to take advantage of SRI market inefficiencies; basically the financial objectives remain central and the ESG principles are seen as accessory and non binding restrictions;
- ii. an *ethically based* approach prescribes an investment strategy mainly driven by ethic considerations which are consequently dominant. This kind of approach could be financially consuming as it may overshadow risk and return effects. This approach has in screening techniques and SRI-rating the main source to direct investments;
- iii. a *value ensuring* approach is funded on the idea that the fund's performance is not only the result of the securities' performance, but also of the market's well functioning. Especially large pension funds can be successful in adopting this approach if they aim to create a good investing environment in the long term; they can do that thanks to the massive size of their investments, which allow them to have enough authority to direct these issues.

This approach may imply to smoothly include ESG principles that can be used in decision-making analysis and provide the asset managers with indications on ESG criteria to follow and engagement practices with the invested companies. Moreover the adoption of suitable benchmarks and a longer-time horizon may be supportive. In a more radical view, these measures can be enriched with a focus on sustainably-themed products which can be channelled through the action of specialized external managers (Woods and Urwin, 2010).

In practice pension funds address their ESG intentions through the statement of investment principles where the environmental and social aspects taken into consideration must be exhaustively indicated. These intentions are ultimately reflected in the asset allocation decisions; the board should then be in accordance with the financial manager(s) about the meaning to give to the SRI policy they want to actuate. Then the financial manager is expected to build a portfolio which reflects the fund's appetite in terms of risk, return and ESG principles. Hirschberger et al. (2012) suggest the presence of a two step portfolio selection procedure which considers a first step based on SRI screening and a second step consisting in financial optimization. The final evaluation of the process comprehends not only the assessment of the strictly financial results but also the realization of the ESG principles initially stated.

It follows that all the processes need to be integrated and updated to cope with the new fund's ESG needs; if the pension fund or the financial manager do not possess an adequate knowledge, an external ESG consultant is hired; in fact in the market operate several ESG consulting companies which possess specific skills spendable in many fields. At the beginning they can help the board of trustees in defining the ESG investment policy and subsequently they can support the financial manager in defining the borders of the investible universe and in evaluating the ESG performance of the investments held in the portfolio.

If the financial manager is assigned a *close management mandate*, the ESG strategy has already been specified by the board and the financial manager must adopt the received guidelines. On the contrary, the management mandate can be an *open* one, in this case the manager has discretionary power to decide the modality to put in

practice the general indications received by the pension fund but, because generality does not mean vagueness, the fund must specify also some interpretative guidelines.

Norway's Government Pension Fund Global (hereafter GPFG), beyond being one of the biggest in the world with AUM 8000 billion NOK⁶² (about 857 billion Euro), is a great example of pension fund which integrate a SRI strategy in its operations. The fund started in 1990 under the name of Oil Fund, with the intent of managing the wealth deriving from the oil production in a sustainable way, and adopted a responsible investing framework in 2004. The fund is controlled by the Ministry of Finance and has two main ethical obligations: producing positive returns for future generations and respecting the rights of the people touched by the companies the fund invests in. These purposes reveal a positive attitude towards long term investment and a deep interest towards ESG issues (Chambers, Dimson and Ilmanen, 2012). The GPFG is managed by Norge Bank and can promote actions to promote ownership rights (under the responsibility of the fund manager) or screening tests to exclude companies from the investible universe (under the responsibility of the Ministry of Finance); the level of transparency through the circulation of periodical publications and reports is remarkable.

As reminded by Woods and Urwin (2010), as pension funds play a pure intergenerational role, it is important that they change according to the surrounding environment. Thinking of the ageing population issue outlined in the first chapter, not adopting an adequate long time horizon and a ESG attitude towards investment, would be not only irresponsible and short-sighted but also may "*violate their* [the pension funds'] *fiduciary risk management duty*" (Hoepner, 2010).

3.5. Performance evidence from Sri pension funds

It was already explained that the fiduciary duty binding pension funds together with beneficiaries implies a duty for the firsts to maximize returns; whether this is possible or not in presence of ethical constraints is the question addressed in this section.

⁶² This data was gathered from the Norges Bank Investment Management's website on 2017, April 27th (www.nbim.no/en/the-fund/market-value/).

Since Markowitz's (1952) first seminal study, financial portfolio theory lies on two pillars: return maximization and risk minimization. Recalling from Chapter 2, risk can be efficiently lowered thanks to diversification, which allows portfolio managers to lower overall portfolio risk exposure by including inversely correlated assets in the portfolio. The risk of a financial portfolio is classically assessed with a risk measure called *portfolio variance* which is defined as:

$$\sigma_p^2 = \sum_{i=1}^N w_i^2 \sigma_i^2 + 2 \sum_{i=1}^N \sum_{j=i+1}^N w_i w_j \rho_{i,j} \sigma_i \sigma_j$$

where:

- w_i is the weight assigned to each security in the portfolio;
- σ_i^2 is the single security's variance;
- $\rho_{i,j}$ is the correlation coefficient between each couple of securities included in the portfolio which tracks how each security's risk interact with the others.

In this formula there are two main elements whose effects are worth considering: the number of securities (N) included in the portfolio and the aforementioned correlation coefficient. To illustrate their behaviour consider a simple example⁶³ of portfolio composed of equally weighted assets ($w_i = 1/N$) and, after rearranging the equation stated above, take the limit for $N \rightarrow +\infty$:

$$\lim_{n \rightarrow \infty} \sigma_p^2 = \lim_{n \rightarrow \infty} \left(\frac{1}{N} \overline{\sigma_i^2}(N) + \frac{N-1}{N} \overline{\sigma_{i,j}}(N) \right) = \overline{\sigma_{i,j}}(+\infty)$$

where:

- $\overline{\sigma_i^2}(N)$ is the average variance of the returns of the assets included in the portfolio;
- $\overline{\sigma_{i,j}}(N)$ is the average covariance of the returns of the assets included in the portfolio.

⁶³ For more details see Elton, E. J., Gruber, J. M., Brown, S. J. and Goetzmann, W. N. (2014)

The equation suggests that increasing the number of securities in the portfolio, the importance of the amount of variance carried in by each additional asset tends to zero and that the overall portfolio risk is given by the average covariance.

At this point the role of the correlation coefficient (which can take values $-1 \leq \rho \leq 1$) kicks in because it may allow the financial manager to reduce the portfolio variance below the lowest variance of the assets included in the portfolio. Figure 5 represents the shapes that the efficient frontier can assume in a hypothetical portfolio composed of two assets (A and B) correlated with various degrees of intensity ranging between -1 and 1.

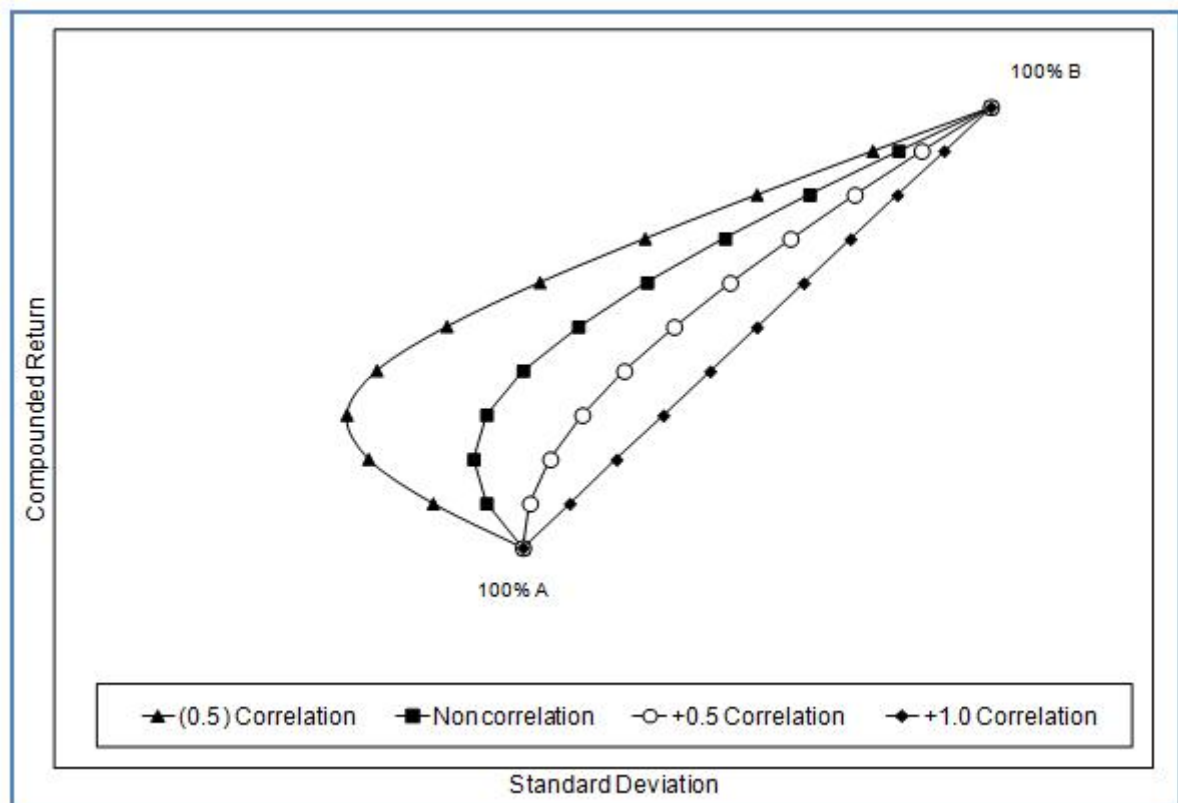


Figure 5: Example of efficient frontier for a two assets portfolio. Source: *All About Asset Allocation*, 2nd Edition, Richard Ferri, McGraw-Hill, 2012

Even in a simple two assets portfolio it is possible to appreciate the *variance contraction* effect (portion of the efficient frontier situated at the left of the green line) that can be obtained by selecting securities with uncorrelated returns.

The ESG approach towards security selection seems threatening the theoretical framework described above because, reducing the investible universe through the application of ESG filters, it shrinks the possibilities of diversification putting the

investor in the condition of selecting less diversified portfolios (Hirschberger et al, 2012).

Hoepner (2010) makes an ulterior step in the reflection about diversification including a third factor: the role of the assets' variance, which is often overlooked. In fact the possibility of erasing completely such element holds in mathematical terms but in reality it is virtually impossible to realize due to the impossibility of including infinite assets in the portfolio⁶⁴. In this sense it is worth including "*lower total risk and specific risk of stocks with high ESG rating*". The author reports the results of several studies which agree on the fact that the adherence to ESG principles reduces firm's specific risk.

Indeed if on one side ESG criteria may have a negative impact on the overall portfolio variance through factors like the number of assets and the correlation coefficient, on the other side they may reduce portfolio's risk through the smaller firm's specific risk embedded in ESG compliant assets.

Bauer, Koedijk and Otten (2005), after reviewing a wide literature on the topic, analyzed a 103 mutual funds sample coming from developed markets like US and UK and from a relative young one like Germany, for the period 1990-2001. Dividing the time period into three sub periods, the authors evidenced that to an initial *learning phase* when SRI funds underperform their equivalent unscreened funds, follows a *catching up* phase where the funds consolidate their performance obtaining comparable results. Moreover a so called *age effect* based on launch date was observed. Generally speaking the investment style is different with respect to traditional funds because ethical funds seem to be more "*growth oriented than value oriented, if compared to conventional funds*", moreover the age of the fund seems having explanatory power in determining the investment style too: older funds diverged from traditional funds for a weaker exposure towards market risk and higher attitude for small cap investments than younger funds.

⁶⁴ With regard to this, many more practical considerations come into play: after a few hundred stocks the marginal beneficial effect deriving from diversification is negligible, moreover having a too wide portfolio implies also higher maintenance and transaction costs.

Theory also suggests that investors must give up to a fraction of the returns deriving from a classic investment in order to label their investment as SRI. This is known as “*ethic sacrifice*” and is perceived like a cost imposed on people showing a socially responsible attitude towards investment. It would be a real issue for a broad development of SRI but, according to specific studies it does not constitute a real problem as the empirical difference between “normal” and “ethical” returns in some markets and in some periods was not really significant.

The performance measurement, as for classic pension funds, is done against a market benchmark; SRI benchmarks were created with the intent of allowing a sound comparison and include only ESG compliant assets. Of course the more restricted the benchmark is (i.e. Euro Area) the harder it will be to exclude one or more assets from the investible roster; on the other side the wider the benchmark the easier it will be to perform a SRI strategy. Just to mention some of the SRI indexes currently available on the market, MSCI ACWI SRI Index, S&P 500 ENVIRONMENTAL & SOCIALLY RESPONSIBLE INDEX, Domini 400 Social Index, FTSE4Good US, Calvert Social are among the most used.

There are not much studies about the returns of SRI pension funds performance, on the contrary there is abundance of material about mutual funds. The first studies on SRI performance has been done between restricted versions of traditional indices. Using indices presents some advantages as they can be directly compared to the benchmark because they both do not need to be adjusted for the impact of costs and other issues related to the fund management. The procedure consisted in applying ESG filters to financial indices (such as S&P500 or FTSE All-Share) and then back-testing the restricted version of the index on past data to see what would have happened if such index had existed, finally a comparison between the two versions of the index was done. In 1972 Moskowitz was one of the first to perform this type of analysis and suggested that SRI could provide not dissimilar returns with respect to traditional investments. Sparkes (2002) brings several examples in this sense and recalls a study published in 1999 by EIRIS called *Does Ethical Investment Pay?* Which considered five ESG indexes between 1991 and 1999 which showed similar returns if compared to the benchmark (All-Share). The study included also a survey on

some funds' performance; the author commented that in some cases returns were lower but in other circumstances they showed consistently superior performance.

Working on the returns of pension funds or mutual funds is more complicated because the costs must be taken into account. Galema, Plantinga and Scholtens (2009) used a sample of stocks provided by KLD Research and Analytics⁶⁵ for the period going from 1991 to 1994 to detect (investigating five areas: social, governance, environment, product and sin) if ESG screening imply a reduction of risk and/or a minor returns. Their conclusion was that: *“socially responsible investors [...] suffer only in terms of foregone risk reduction opportunities, not in terms of foregone returns”*.

⁶⁵ KLD Research & Analytics was founded in 1988. It is an independent investment research company providing sustainability research and indexes.

4. DEA methodology

The Data Envelopment Analysis methodology (hereafter DEA methodology) became popular thanks to an article⁶⁶ written by Charnes, Cooper and Rhodes and published in 1978; their purpose was “*centred on decision making by not for profit entities rather than more customary firms and industries*”⁶⁷. The proposed methodology was directed to the evaluation of the efficiency of productive units, called Decision Making Units (hereafter DMU’s), through a measure of efficiency fed by inputs and outputs. In such a framework, the inputs are defined as the factors necessary in the productive process to generate the outputs. To make the assessment possible and significant, the DMU’s must share common inputs and outputs even if not necessarily in the same amount, otherwise the comparison does not make sense. The big advantage is that inputs and outputs do not need to be homogeneous.

As said before, this methodology originally found its application ground in evaluating the efficiency of hospital departments, schools and educational programs, and after it was applied also to financial issues thanks to the contribution of authors like Basso and Funari (2003) who applied this approach to measurement of the efficiency of either non ethical and ethical mutual funds.

The features of this methodology, which will be discussed in this chapter, are appealing for the purpose of this dissertation as they may allow to evaluate a number of pension funds in order to design a ranking representative of the best investible opportunities. Of course a ranking could be done just exploiting the risk adjusted performance measures (hereafter RAPMs) described in the second chapter, but the DEA methodology offers a more comprehensive and complete approach to the problem as it allows to take into account a wider variety of factors.

In fact, being the DEA methodology able to consider a more abundant spectrum of inputs and outputs during the analysis, it provides the user with the advantage of evaluating several aspects of a pension fund, which would be otherwise

⁶⁶ See references: Charnes, Cooper and Rhodes, (1978)

⁶⁷ Quoted from Charnes, Cooper and Rhodes, (1978), page 429

ignored and which go beyond the classical risk-return approach typical of the performance measures already discussed.

4.1.A first, basic model

Just to give an initial idea of the problem, let's picture a very basic example in which an analyst is asked to evaluate, on the base of the elements necessary to characterize the Sharpe Ratio (the average excess return with respect to the risk free rate over the standard deviation of the portfolio's returns), the efficiency of four open equity pension funds chosen from a larger Morningstar⁶⁸ peer group (International Equity Large Cap).

There is an analogy between decision making in productivity theory and in financial theory according to which outputs (returns) have to be maximized, while inputs (risk) are something undesirable that have to be minimized. That is why it is possible to configure this problem of financial nature, as a single input (standard deviation) single output (excess return) productivity problem, and label the observed pension funds as DMUs (Tarnaud and Leleu, 2015).

In this circumstance the efficiency is measured as the ratio of the output with respect to the single input at disposal:

$$efficiency = \frac{outputs}{inputs}$$

Basically the higher the ratio is, the more efficient the DMU is.

Among the four considered funds (see Table 5) Anima, which exhibits the highest Sharpe Ratio, is the most efficient⁶⁹ followed by Intesa and Allianz, while Sella ranks last. What we learn from this example is that, borrowing the concept of efficiency from productivity theory, it is possible to rank the DMUs from the most efficient to the less efficient starting from the inputs and the outputs at our disposal.

⁶⁸ Morningstar is a worldwide financial data provider. It provides reliable data and information on Pension Funds, Mutual Funds, ETFs and other kind of securities.

⁶⁹ Anima is the most efficient in converting the inputs (risk) into outputs (excess return).

Pension fund name (DMU)	3-Yrs mean excess return ⁷⁰ (Output)	3-Yrs Standard Deviation (Input)	Sharpe Ratio ⁷¹ (Efficiency)	Ranking
Allianz Insieme - Linea Azionaria	9,98%	9,31	1,03	3
Anima Arti&Mestieri Crescita 25+A	9,15%	8,86	1,14	1
Intesa Prev. Giustiniano Azionario	8,74%	8,26	1,04	2
Sella Eurorispargio Azionario Int.le	8,05%	8,46	0,94	4

Table 5: Efficiency measurement of four randomly chosen pension funds. Source: Morningstar.

The measurement of the efficiency becomes a more delicate task as more inputs and outputs are taken into consideration. The use of multiple inputs and outputs may be advantageous as it may lead to a more powerful and comprehensive explanation of the efficiency of a DMU. For what concerns pension funds for example, integrating the analysis by considering inputs like the costs, may lead to the inclusion of relevant factors that contribute to determine the final performance. It is at this point that the DEA methodology kicks in.

In its original formulation, the measurement of the efficiency was modelled as the ratio between the weighed sum of the outputs over the weighted sum of the inputs according to the following rule:

$$efficiency = \frac{w_1 output_1 + w_2 output_2 + \dots + w_N output_N}{w_1 input_1 + w_2 input_2 + \dots + w_N input_N}$$

Thanks to the contribution of Charnes, Cooper and Rhodes (1978), the model took the form of a fractional programming problem with the following characteristics:

⁷⁰ Gross of the risk free-rate. See footnote 70 for more explanatory details.

⁷¹ This example is meant as an introduction to the concept of *efficiency*, not as an example of how to calculate the Sharpe Ratio. That is the reason why no further research was done in order to identify the most appropriate risk free rate to subtract from the 3Yrs Mean Rate of return. This was due especially to the fact that, according to the Morningstar methodology, the appropriate risk free rate is already deducted in the calculation of the Sharpe Ratio. For more information see Morningstar (2005) in the References.

$$\max\{u_r, v_i\} = \frac{\sum_{r=1}^s u_r y_{r0}}{\sum_{i=1}^m v_i x_{i0}} \quad (1.1)$$

subject to the following constraints:

$$u_r \geq \varepsilon; \quad r = 1, \dots, s$$

$$v_i \geq \varepsilon; \quad i = 1, \dots, m$$

where:

- y_{rj} are the positive known outputs of the j -th DMU;
- x_{ij} are the positive known inputs of the j -th DMU;

$$\frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \leq 1; \quad j = 1, \dots, n \quad (1.2)$$

- u_r are the positive optimal weights which have to be attributed to each *output* variable through the solution of the optimization problem;
- v_r are the positive optimal weights which have to be attributed to each *input* variable through the solution of the optimization problem;
- ε a positive number small enough to be close to zero but non negative.

In the problem the target function (1.1) has to be maximized finding the set of optimal weights. The optimal weights for each DMU are determined as the result of the solution of the optimization problem exploiting all the information embodied in the DMU's inputs and outputs, with the constraint that the efficiency ratio of any DMU has a common upper bound set equal to 1. Differently from the introductory example where no constraint was applied, the efficiency measure can only range between 0 and 1.

Inputs and outputs come with no weight and are assumed to be positive. Since this models allows only for positive inputs and outputs to be considered, it may be of

limited use on the analysis of pension funds efficiency because of course pension funds may exhibit negative returns, which cannot be adequately treated in this framework⁷².

The concept of efficiency has a reciprocal nature: maximizing the outputs with respect to the inputs or minimizing the inputs with respect to the outputs. Charnes et al. (1978) stretched the fact that the fractional programming problem can be converted into a linear programming problem and proposed an input oriented solution in which the outputs are maximized and an output oriented model in which the inputs are minimized.

The input oriented linear solution to the problem (also known as input-oriented CCR linear model) presented now, is the direct consequence of the fractional one proposed before. In this case, the objective function becomes:

$$max = \sum_{r=1}^s u_r y_{rj_0} \quad (1.3)$$

subject to the following constraints:

$$\sum_{i=1}^m v_i x_{ij_0} = 1 \quad (1.4)$$

$$\sum_{r=1}^s u_r y_{rj} \leq \sum_{i=1}^m v_i x_{ij} \quad (1.5)$$

$$u_r \geq \varepsilon \quad r = 1, \dots, t$$

$$v_r \geq \varepsilon \quad i = 1, \dots, m$$

The terms of the linear version of the model have the same meaning of the ones listed before. Constraint (1.4) reduces to 1 the denominator of (1.1) while (1.5) is the result of the multiplication of both sides of (1.2) times the denominator of the left side of the same equation.

Once computed the optimal weights for the first DMU, the same problem has to be solved for all the DMUs under scrutiny. A DMU is considered to be completely

⁷² This issue will be tackled in the next paragraph.

efficient if and only if it obtains a score of 1 with non negative optimal weights, u_r^* and v_r^* . If this is the case, it exists at least one optimal solution with optimal weights greater than zero (meaning that all the inputs are taken into account). If the DMU does not achieve efficiency under u_r^* and v_r^* , it will not achieve efficiency under any other weight given the DMU set of information at disposal.

Inefficiency covers the residual cases: an efficiency ratio smaller than 1 and the presence of optimal weights equal to 0, meaning that the highest efficiency ratio is obtained not using all the inputs at disposal. All the efficient DMUs put together form the efficient frontier which is the set of efficient producers.

4.1.1. Extension of the basic model

In 2001 Basso and Funari presented a model suitable for non ethical mutual funds called IDEA-1 which uses the returns as outputs and a variety of risk measures (volatility and beta for example) and costs (subscription and redemption costs) as inputs. Considering the running costs in this phase would be misleading because, as they are already subtracted from the gross asset value (GAV) to obtain the NAV, it would result in accounting twice for the same cost.

Using a slightly different notation than before, the linear version of objective function becomes:

$$\max \{u, v_i, w_i\} = \frac{u o_{j_0}}{\sum_{i=1}^h v_i q_{i j_0} + \sum_{i=1}^k w_i c_{i j_0}}$$

subject to the usual constraints:

$$\frac{u o_j}{\sum_{i=1}^h v_i q_{i j} + \sum_{i=1}^k w_i c_{i j}} \leq 1$$

$$u \geq \varepsilon$$

$$v_i \geq \varepsilon \quad i = 1, \dots, h$$

$$w_i \geq \varepsilon \quad i = 1, \dots, k$$

where:

- o_{j_0} is the return of the fund (the model uses one output only);
- q_{ij} represents some appropriate risk measures;
- c_{ij} represents the costs;
- u, v_j and w_j represent the weights of respectively: return, risk measures, costs;
- ε is a number small enough to be close to zero, but not negative.

It is possible to notice that, neglecting for a moment the costs, and using the volatility as risk measure the IDEA-1 index resembles a scaled version of the Sharpe Ratio which takes values between 0 and 1.

4.2. A more sophisticated model

This section's aim is to go beyond the basic model just described; the scope is to deal with the realistic issue represented by the presence of negative data and with the necessity of considering also an ethic indicator able to gather the main ethical aspects of the investment under scrutiny.

4.2.1. Evaluating ethical funds

The first proposed model called IDEA-E (Basso and Funari, 2003), implies the inclusion of an ethical indicator in order to capture the ethical level of a fund and to treat it as an output. This is coherent with what we have said when talking about those investors who look for returns and ethical engagement at the same time. The IDEA-E model can be formalized in mathematical terms by adding an output at the numerator of the IDEA-1 model which is:

$$\max\{u_r, v_i, w_i\} = \frac{u_1 o_{j_0} + u_2 e_{j_0}}{\sum_{i=1}^h v_i q_{ij_0} + \sum_{i=1}^k w_i c_{ij_0}}$$

subject to the usual constraints:

$$\frac{u_1 o_j + u_2 e_j}{\sum_{i=1}^h v_i q_{ij} + \sum_{i=1}^k w_i c_{ij}} \leq 1$$

$$u_r \geq \varepsilon \quad r = 1, 2$$

$$v_i \geq \varepsilon \quad i = 1, \dots, h$$

$$w_i \geq \varepsilon \quad i = 1, \dots, k$$

The notation does not change from the previous model, with the only exception of e_j which represents the ethical measure.

4.2.2. *Dealing with the presence of negative data*

As already observed, the DEA methodology requires the use of non negative inputs and outputs only in order to provide meaningful results.

Basso and Funari (2005) report clear examples of how negative returns can at first hurt the efficiency score obtained from conventional RAPMs and after, when operating in a DEA framework, of the analyzed DMUs too. Take for example the case of the Sharpe ratio with negative excess return: the authors show that, if the numerator is negative, the index increases with the standard deviation providing counterintuitive results which would take a risk averse investor, to assume a long position in the highest risky asset at parity of return.

Imagining the circumstance of measuring the DMU efficiency in presence of negative output is everything but an hard exercise when dealing with investments. Financial instruments in fact can periodically exhibit negative rates of return, which can create problems when applying a DEA methodology.

In this sense the authors provide another good example of how, in adopting a one-input two-outputs model, the efficient frontier may be altered if one of the DMUs has even only one negative output value. In particular if the DMU outputs chosen for the model are the average investment return and the ethical level, and one of the returns were negative, the presence of a positive ethical level would compensate for the negative return, leading the investor to base his investment decision on the ethical performance despite how bad the investment is performing, which does not make sense at all since ethical investors are interested in obtaining positive financial returns .

In order to overcome this problem and make the DEA methodology viable in this contest, it is possible to redefine the output variable.

Among various possible approaches, it is possible to use the capitalization factor:

$$\bar{U}_j = 1 + \bar{R}_j$$

where:

- \overline{R}_j is the average mean return;
- \overline{U}_j is the new output that characterizes the returns as the capitalization factor.

Defined in this way, returns cannot turn out to be negative because in the worst of the hypotheses, the investor cannot lose more than the capital he invested.

4.2.3. *Building a measure of ethical engagement*

For an investor concerned not only with the dimension of the returns, but also with the ethical issues deriving from the returns, a model which evaluates the efficiency of the investment from both a financial and an ethical point of view, may be of interest. At this purpose, Basso and Funari (2003) developed three models able to take into consideration the mutual funds' engagement in ethical issues. The models can be conveniently applied to pension funds too.

There is no univocal way to express an ethical measure for an investment, rating agencies provide some ethical indicators and data providers like Morningstar sometimes report sustainability ratings. In this section an effort is done to describe a procedure suggested by Basso and Funari (2005) to create an ethical measure that takes into account three main aspects: negative screening, positive screening and the presence of an ethical committee.

Negative and positive screening were already treated in the previous chapter, the concept of ethical committee is instead something new. It is deputed to oversee the behaviour of the portfolio managers to check if the ethical guidelines are applied effectively in the day-to-day management.

The ethical indicator proposed here is the result of a weighted sum of these three components and is formulated as follows:

$$e_j = w_N N_j + w_P P_j + w_C C_j$$

where:

- $N_j = \frac{N_{jN}}{N_N}$ is the ratio between the negative screening criteria adopted by the fund and the range of negative screening criteria taken into consideration;
- $P_j = \frac{P_{jN}}{P_N}$ is the ratio between the positive screening criteria adopted by the fund and the range of positive screening criteria taken into consideration;
- C_j indicates the presence of an ethical committee according to a scale that assigns 1 point in case of committee with full powers, 0.5 points in case the committee has only partial powers and 0 points in case the fund does not consider the presence of a committee;
- w_N, w_P, w_C are the weights assigned respectively to the negative screening, and positive screening practices and to the presence of an ethical committee.

The ethical indicator ε_j is defined in the real interval $[0, \dots, L]$ where $L = w_N + w_P + w_C$, it takes value 0 if the fund does not take into consideration any kind of SRI practice.

4.2.4. The DEA-SE and the DEA_CE models

The DEA-SE model (Basso and Funari, 2007) is an extension of the I DEA-1 model and also an evolution of the I DEA-E model described before. This new model is able to deal with negative data and to incorporate the described ethical measure too.

Depending on how the ethical measure is treated, the model can be specified in two different ways: if investors want to maximize the returns and the ethical level at the same time the ethical measure acts as an output on the contrary, if the ethical level is chosen a priori it is treated as exogenously fixed.

In the first circumstance the mathematical formulation is as follows:

$$\max \{u_r, v_i\} = \frac{u_1 \bar{U}_{j_0} + u_2 e_{j_0}}{v_1 C_0 + v_2 \sigma_{j_0} + v_3 f_{j_0}^I + v_4 f_{j_0}^E}$$

subject to the following constraints:

$$\frac{u_1 \bar{U}_j + u_2 e_j}{v_1 C_0 + v_2 \sigma_j + v_3 f_j^I + v_4 f_j^E} \leq 1$$

$$u_r \geq \varepsilon \quad r = 1, 2$$

$$v_i \geq \varepsilon \quad i = 1, 2, 3, 4$$

where:

- \bar{U}_j is the measure of return characterized as the capitalization factor;
- e_j is the ethical measure;
- C_0 represents the initial amount of capital invested;
- σ_j is the standard deviation of the rate of return;
- f_j^I are the subscription fees;
- f_j^E the exit fees
- u_r and v_i are the weights assigned respectively to the inputs and to the outputs.

This model introduces the ethical factor and also the factor C_0 .

If the ethical level is fixed a priori by the investor, the formulation of the model (DEA-SEef) is slightly different:

$$\max \{u_r, v_i\} = \frac{u_1 \bar{U}_{j0}}{v_1 C_0 + v_2 \sigma_{j0} + v_3 f_{j0}^I + v_4 f_{j0}^E - u_2 e_{j0}}$$

subject to the following constraints:

$$\frac{u_1 \bar{U}_j}{v_1 C_0 + v_2 \sigma_j + v_3 f_j^I + v_4 f_j^E - u_2 e_j} \leq 1 \quad j = 1, \dots, n$$

$$u_1 \geq \varepsilon, \quad u_2 \geq 0$$

$$v_i \geq \varepsilon \quad i = 1, 2, 3, 4$$

This last model is able to overcome the presence of negative average rates of return and can be used despite the phase of the economic business cycle, moreover it includes a measure of ethical responsibility of the investment.

A slightly different notation can be used applying the DEA-CE model for SRI funds developed by Basso and Funari (2012a). This model poses at the numerator the element:

$$M_j = (1 - c_{Ij})(1 + R_j)^T(1 - c_{Ej}) \quad j = 1, 2, \dots, n$$

which is the amount resulting from the investment of one unit of money at the end of the holding period net of the subscription (c_{Ij}) and exit (c_{Ej}).

The resulting notation of the DEA model is more compact and corresponds to:

$$\max\{u_r, v_i\} = \frac{u_1 M_{j0} + u_2 e_{j0}}{v_1 C_0 + v_2 \sigma_{j0}}$$

subject to the usual constraints:

$$\frac{u_1 M_j + u_2 e_j}{v_1 C + v_2 \sigma_j} \leq 1$$

$$u_r \geq \varepsilon \quad r = 1, 2$$

$$v_i \geq \varepsilon \quad i = 1, 2$$

5. Analysis of SRI and non SRI pension funds with a DEA methodology

This chapter is the conclusive part of this dissertation and constitutes my personal contribution to the research in the field of SRI and non SRI pension funds. The analysis is carried out on a sample of UK-domiciled ethical and non ethical pension funds with the intention of finding whether differences in the performance and in the efficiency of the two categories exist. The aim of this analysis is to seek whether ethical pension funds may represent better investment opportunities than pension funds which operate according to a traditional investment approach.

5.1. Data selection

When talking about ethical pension funds, and more in general about pension funds, the UK market is one of the most developed: the information is well conveyed and is conveniently reported through easily accessible databases.

In this particular case the data were collected from two different sources: for what concerns ethical pension funds, the SriServices database was used. It provides extensive information about ethic funds domiciled in the UK. The user can browse several investment opportunities and, thanks to a combination of filters, one can refine his research to very narrow levels of detail. In this phase the investment opportunities were filtered twice: a first time to include ethical pension funds only, a second time in order to pick only equity pension funds. The final output was a list of 94 equity ethical pension funds domiciled in the UK. Once extracted from the database, the fund list was screened with Morningstar in order to have a better knowledge about each single security; only in a second moment the data were downloaded from Bloomberg. The period of interest for this research is a time window of five years ranging from 30/12/2011 to 30/12/2016 and the data necessary for the analysis are: month end NAV, initial and exit fees, inception date, country of domicile and currency.

A successive step consisted in verifying that all the funds in the sample had at least ten years of data available before 30/12/2016, this was done to allow to be part of this

research only the funds which had already passed the so called “*learning phase*”. The adoption of such a criterion guarantees some reliability in the final results but asks for a sacrifice in terms of sample size.

A final refinement of the data consisted in keeping only the funds which displayed a complete set of data, in fact some of the funds presented discontinuities in the time series which represent an obstacle in the accuracy of the information especially when the data frequency is defined on a monthly interval.

For what concerns non ethical pension funds, the securities were selected from Morningstar, and a set of data with the same characteristics required for the ethical pension funds, was downloaded from Bloomberg. The choice of non ethical pension funds was not random, in fact a preference was given to the pension funds issued by the fund houses offering also some of the ethical funds previously selected.

The final sample used to perform the analysis, consists of 30 ethical equity pension funds and 13 non ethical pension fund domiciled in the UK (see Table 6). Since the analyzed funds are all domiciled in the UK, the month end prices of interest were expressed in GBP currency.

Some issues were encountered when dealing with the subscription and with the exit fees: in fact from the first download of data from Bloomberg almost all the pension funds in the sample did not have any information available to complete these two fields. In order to correct this lack of information, an extensive research was started in order to fill the gap. The Financial Times website together with Morningstar, were helpful and updated source of information and permitted to collect part of the otherwise missing information. Despite of this effort not for all the pension funds it was possible to assess the dimension of the subscription and of the exit fees. What is to be noticed is that a consistent number of the selected funds have zero subscription and exit fees too.

#	Isin Code	Fund Description	Inception Date	Subscription fees	Exit fees
1	GB00B101LQ29	Aviva Alliance Trust Sustainable Future Absolute Growth Pn S6	15/5/2006	0	0
2	GB0030545437	Aviva Alliance Trust Sustainable Future European Growth S3 PF	7/6/2001	0	0
3	GB00B0YMVY23	Aviva Alliance Trust Sustainable Future Global Growth Pn S8	4/7/2006	0,4%	0
4	GB0030545213	Aviva Alliance Trust Sustainable Future UK Growth Pn S3	6/4/2001	0	0
5	GB0006819113	Aviva Alliance Trust UK Ethical NU PF	10/5/1999	0	0
6	GB00B0YLJC34	Aviva Alliance Trust UK Ethical Pn S8	6/4/2006	0,2%	0
7	GB0002042991	Clerical Medical PP Evergreen Pn	28/2/1990	N/A	N/A
8	GB00B0CT0J33	Fidelity F&C Responsible UK Equity Growth Pn 4	30/7/2005	N/A	N/A
9	GB00B0385S33	FL HSBC Amanah Global Equity Index PN	12/2/2004	5%	0
10	GB0003535449	Friend Life Stewardship Acc PF	31/5/1984	N/A	N/A
11	GB00B1407782	Friends Life Jupiter Ecology AP	21/7/2006	5%	0
12	GB00B1NPPR03	Friends Life Jupiter Ecology EP PF	17/11/2003	5%	0
13	GB0009659722	Friends Life Premier Ethical EP PF	30/4/1996	0	0
14	GB00B3KHTH10	L&G (LGIM) Ethical Global Equity Index IF	1/6/2004	N/A	N/A
15	GB0008803545	L&G Ethical Pn G6 Acc	22/10/1999	N/A	N/A
16	GB00B0YTF416	L&G F&C Responsible UK Equity Growth Pn G25	18/4/2006	5%	0
17	GB00B0ZGQ821	L&G Kames Ethical Equity Pn G25	13/3/2006	2,5%	0
18	GB00B0ZQ8978	L&G Pension Jupiter Ecology Fund	18/4/2006	5%	0
19	GB0031675159	M&G PP Ethical PN	8/12/1999	N/A	N/A
20	GB00B17ZZF40	OMW Aberdeen Ethical World SP PF	28/6/2006	0	0

21	GB00B0XQ3T48	OMW Kames Ethical Equity Pn	31/1/2006	2,5%	0
22	GB00B16TCW37	OMW Premier Ethical Pn A	12/6/2006	0	0
23	GB00B032DF83	Scot Wid Ethical PN S3	22/10/2004	N/A	N/A
24	GB0007845422	Scottish Equitable Ethical Pension Fund	31/3/1988	N/A	N/A
25	GB0004319892	Scottish Equitable Socially Responsible Equity PF	1/9/1998	0	0
26	GB0004435862	SJP Ethical Pn Acc	1/11/1998	5%	0
27	GB0002010634	SLFC Green PN	25/6/1992	N/A	N/A
28	GB00B3L4D353	Standard Life Ethical UK Pn S3	18/8/1999	N/A	N/A
29	GB0033822999	Zurich Henderson Global Care Growth ZP PF	17/11/2003	4,5%	3%
30	GB0002970738	Zurich UK Opportunities 1 EP PN	1/1/1991	N/A	N/A
31	GB0001532273	Friends Life/Baillie Gifford International PF	3/11/2000	5%	0
32	GB00B1FRCX99	Friend Life/Henderson Global Growth S3 EP PF	3/7/2000	4,3%	3%
33	GB0009729491	Friends Life/Invesco Perp Glb Smaller Cos EP PF	30/4/1996	5%	0
34	GB00B140QM62	Friends Life/Threadneedle Global Select AP PF	21/7/2006	5%	0
35	GB00B10QPP48	L&G Legg Mason IF Japan Equity G25-PF	19/4/2006	0	0
36	GB00B3KHTM62	L&G Pen PMC(LGIM)World Ex UK Equity Idx	1/6/2004	N/A	N/A
37	GB00B0ZLFM43	L&G/Pen Invesco Perpetual Global Sml Cos	19/4/2006	5%	0
38	GB0008067034	OMW/F&C Glb Sml Cos Inv Tr PF	3/7/1995	N/A	N/A
39	GB0033169862	OMW/Henderson Glb Growth SP PF	1/9/2003	4,3%	3%
40	GB0008100496	OMW/Invesco Perp Gl Sml Cos PF	1/5/1986	5%	0
41	GB00B3K61N85	Stan Life Corporate Overseas 5 PF	15/8/2006	N/A	N/A
42	GB0002964897	Zurich Global Select 2 EP PF	11/12/2000	5%	0
43	GB0033822338	Zurich Global Select ZP PF	17/11/2003	N/A	N/A

Table 6: List of the Ethical and Non Ethical pension funds domiciled in the UK used for the analysis.

5.2. Empirical analysis

This section illustrates the main steps necessary to prepare the data for the assessment of the pension funds' performance and efficiency.

5.2.1. *Return and risk measures*

Before computing the performance measures some preliminary computations became necessary to determine the annual return rate, the standard deviation and the beta of the pension funds in the sample (see Table 8).

The returns and the standard deviation, which were calculated on a monthly basis (coherently with the frequency of the data) were annualized and the beta was computed using the FTSE100 as proxy of the market. The choice of the FTSE100 appeared a reasonable one as the selected pension funds are all domiciled in the UK and have a considerable exposure towards this market.

5.2.2. *The ethical measure*

The ethical measure was calculated according to the model created by Basso and Funari (2005) and explained in Chapter 4.

As explained in the previous chapter, while a negative ethical strategy is somehow a passive approach to socially responsible investment because it simply avoid to consider certain investment opportunities, positive screening strategies require a remarkable effort for the investor because he cannot simply avoid some areas, but he has to actively pick the best ethical investment opportunities present in the market.

The weights assigned to the three components of the equation (Positive screening, Negative screening and presence of an Ethical committee) are illustrated in Table 7 and correspond to the attempt to reflect what stated above, assigning more importance to positive screening strategies rather than to negative screening ones. The presence of an ethical committee was valued positively too. The three weights sum to 4 and consequently the ethical measure ranges between 0 (for non ethical funds) and 4 (for ethical funds).

Symbol	Strategy	Weight
w_P	Positive screening	2
w_N	Negative screening	1,5
w_C	Ethical Committee	1

Table 7: Weights assigned to the ethical measure components

The construction of the ethical indicator required the ethical criteria adopted by each ethical fund to be searched for in more detail, because the database which provided the fund list did not allow to verify explicitly the investment strategies put in place. Of course a first general idea was initially guessed from the SriServices database but then the remaining part of the job was done browsing Morningstar and through the reading of KIIDs and fact sheets, where available.

The results of the ethical measure are displayed in the last column of Table 8 together with the other preparatory calculations performed in this phase.

Isin Code	Fund Description	5-yrs Avg. Return	5-yrs Avg. St. Dev.	5-yrs Beta	Ethical Measure
GB00B101LQ29	Aviva Alliance Trust Sustainable Future Absolute Growth Pn S6	13,46%	10,77%	0,4841	1,62
GB0030545437	Aviva Alliance Trust Sustainable Future European Growth S3 PF	13,87%	12,56%	0,5681	1,62
GB00B0YMVY23	Aviva Alliance Trust Sustainable Future Global Growth Pn S8	13,94%	11,97%	0,5551	1,68
GB0030545213	Aviva Alliance Trust Sustainable Future UK Growth Pn S3	13,01%	11,25%	0,6711	1,68
GB0006819113	Aviva Alliance Trust UK Ethical NU PF	12,95%	11,85%	0,6996	1,55
GB00B0YLJC34	Aviva Alliance Trust UK Ethical Pn S8	13,49%	11,59%	0,6852	1,25
GB0002042991	Clerical Medical PP Evergreen Pn	13,26%	10,96%	0,4519	1,5
GB00B0CT0J33	Fidelity F&C Responsible UK Equity Growth Pn 4	12,60%	10,81%	0,7016	1,5
GB00B0385S33	FL HSBC Amanah Global Equity Index PN	15,02%	11,51%	0,5468	1,55
GB0003535449	Friend Life Stewardship Acc PF	11,42%	11,21%	0,7053	2,5
GB00B1407782	Friends Life Jupiter Ecology AP	12,96%	10,01%	0,3933	1,98
GB00B1NPPR03	Friends Life Jupiter Ecology EP PF	11,40%	10,09%	0,3920	1,92

GB0009659722	Friends Life Premier Ethical EP PF	15,81%	12,19%	0,6855	2,62
GB00B3KHTH10	L&G (LGIM) Ethical Global Equity Index IF	15,98%	10,80%	0,5545	1,68
GB0008803545	L&G Ethical Pn G6 Acc	11,92%	11,58%	0,7615	1,5
GB00B0YTF416	L&G F&C Responsible UK Equity Growth Pn G25	12,66%	11,30%	0,7065	1,62
GB00B0ZGQ821	L&G Kames Ethical Equity Pn G25	13,31%	12,69%	0,7332	1,55
GB00B0ZQ8978	L&G Pension Jupiter Ecology Fund	11,81%	10,66%	0,4135	1,92
GB0031675159	M&G PP Ethical PN	12,64%	10,36%	0,6738	0,5
GB00B17ZZF40	OMW Aberdeen Ethical World SP PF	8,86%	12,43%	0,5687	1,62
GB00B0XQ3T48	OMW Kames Ethical Equity Pn	12,77%	12,75%	0,7376	1,55
GB00B16TCW37	OMW Premier Ethical Pn A	15,41%	13,01%	0,7137	2,62
GB00B032DF83	Scot Wid Ethical PN S3	9,39%	10,75%	0,6222	0,95
GB0007845422	Scottish Equitable Ethical Pension Fund	13,32%	12,04%	0,7057	1,55
GB0004319892	Scottish Equitable Socially Responsible Equity PF	12,58%	11,03%	0,6398	1,5
GB0004435862	SJP Ethical Pn Acc	9,41%	12,84%	0,5927	1,5
GB0002010634	SLFC Green PN	11,50%	10,58%	0,4230	1,5
GB00B3L4D353	Standard Life Ethical UK Pn S3	10,72%	9,04%	0,4953	2,55
GB0033822999	Zurich Henderson Global Care Growth ZP PF	14,81%	11,10%	0,5163	2,62
GB0002970738	Zurich UK Opportunities 1 EP PN	10,66%	10,32%	0,6780	0,95
GB0001532273	Friends Life/Baillie Gifford International PF	16,86%	12,30%	0,5859	0
GB00B1FRCX99	Friend Life/Henderson Global Growth S3 EP PF	16,98%	12,11%	0,5201	0
GB0009729491	Friends Life/Invesco Perp Glb Smaller Cos EP PF	15,91%	10,95%	0,5050	0
GB00B140QM62	Friends Life/Threadneedle Global Select AP PF	15,44%	11,66%	0,5518	0
GB00B10QPP48	L&G Legg Mason IF Japan Equity G25-PF	28,00%	24,08%	0,1212	0

GB00B3KHTM62	L&G Pen PMC(LGIM)World Ex UK Equity Idx	15,80%	11,45%	0,5155	0
GB00B0ZLFM43	L&G/Pen Invesco Perpetual Global Sml Cos	16,00%	11,68%	0,5436	0
GB0008067034	OMW/F&C Glb Sml Cos Inv Tr PF	17,56%	10,92%	0,4937	0
GB0033169862	OMW/Henderson Glb Growth SP PF	17,21%	12,39%	0,4905	0
GB0008100496	OMW/Invesco Perp GI Sml Cos PF	15,51%	11,92%	0,5517	0
GB00B3K61N85	Stan Life Corporate Overseas 5 PF	16,03%	10,99%	0,4982	0
GB0002964897	Zurich Global Select 2 EP PF	15,39%	11,53%	0,5460	0
GB0033822338	Zurich Global Select ZP PF	15,36%	11,63%	0,5509	0

Table 8: Measures of risk, return and ethical level calculated for the funds in the sample. Own elaboration.

5.2.3. Results and final comments

These data are used to compute three performance measures: the Sharpe Ratio, the Treynor Index and the Jensen Alfa. The risk free rate used to calculate the ratios was the UK Gilt 5-Year which is the yield an investor can obtain investing in 5 years government securities issued in the UK. The formulas are already known from Chapter 2, that is why only the results are displayed in Table 9.

Fund Description	Sharpe 5-Yrs	Rank	Treynor 5-Yrs	Rank	Alfa 5-Yrs	Rank
Aviva Alliance Trust Sustainable Future Absolute Growth Pn S6	2,9512	10	0,6568	13	0,2039	21
Aviva Alliance Trust Sustainable Future European Growth S3 PF	2,5639	38	0,5669	25	0,1883	24
Aviva Alliance Trust Sustainable Future Global Growth Pn S8	2,6967	31	0,5814	24	0,1920	23
Aviva Alliance Trust Sustainable Future UK Growth Pn S3	2,7849	28	0,4671	31	0,1554	30
Aviva Alliance Trust UK Ethical NU PF	2,6397	33	0,4471	35	0,1480	33
Aviva Alliance Trust UK Ethical Pn S8	2,7468	29	0,4645	32	0,1569	29
Clerical Medical PP Evergreen Pn	2,8817	18	0,6992	8	0,2095	13

Fidelity F&C Responsible UK Equity Growth Pn 4	2,8611	21	0,4409	37	0,1441	34
FL HSBC Amanah Global Equity Index PN	2,8981	15	0,6099	21	0,2047	19
Friend Life Stewardship Acc PF	2,6546	32	0,4219	41	0,1315	40
Friends Life Jupiter Ecology AP	3,1256	6	0,7956	2	0,2203	7
Friends Life Jupiter Ecology EP PF	2,9455	11	0,7586	3	0,2050	18
Friends Life Premier Ethical EP PF	2,8010	27	0,4981	26	0,1800	25
L&G (LGIM) Ethical Global Equity Index IF	3,1763	3	0,6189	16	0,2126	11
L&G Ethical Pn G6 Acc	2,6128	35	0,3972	43	0,1231	43
L&G F&C Responsible UK Equity Growth Pn G25	2,7425	30	0,4387	38	0,1436	36
L&G Kames Ethical Equity Pn G25	2,4929	39	0,4315	39	0,1437	35
L&G Pension Jupiter Ecology Fund	2,8275	23	0,7289	4	0,2040	20
M&G PP Ethical PN	2,9886	7	0,4596	33	0,1510	31
OMW Aberdeen Ethical World SP PF	2,1874	41	0,4781	28	0,1380	37
OMW Kames Ethical Equity Pn	2,4394	40	0,4216	42	0,1373	39
OMW Premier Ethical Pn A	2,5933	36	0,4727	29	0,1693	27
Scot Wid Ethical PN S3	2,5785	37	0,4456	36	0,1307	41
Scottish Equitable Ethical Pension Fund	2,6287	34	0,4484	34	0,1503	32
Scottish Equitable Socially Responsible Equity PF	2,8042	26	0,4833	27	0,1585	28
SJP Ethical Pn Acc	2,1608	42	0,4682	30	0,1379	38

SLFC Green PN	2,8187	24	0,7054	7	0,1987	22
Standard Life Ethical UK Pn S3	3,2142	2	0,5865	23	0,1739	26
Zurich Henderson Global Care Growth ZP PF	2,9865	8	0,6419	14	0,2098	12
Zurich UK Opportunities 1 EP PN	2,8099	25	0,4277	40	0,1303	42
Friends Life/Baillie Gifford International PF	2,8618	20	0,6006	22	0,2139	10
Friend Life/Henderson Global Growth S3 EP PF	2,9159	14	0,6790	10	0,2307	4
Friends Life/Invesco Perp Glb Smaller Cos EP PF	3,1270	4	0,6780	11	0,2235	6
Friends Life/Threadneedle Global Select AP PF	2,8965	17	0,6121	19	0,2078	16
L&G Legg Mason IF Japan Equity G25-PF	1,9239	43	3,8240	1	0,4347	1
L&G Pen PMC(LGIM)World Ex UK Equity Idx	2,9819	9	0,6622	12	0,2200	8
L&G/Pen Invesco Perpetual Global Sml Cos	2,9407	12	0,6316	15	0,2153	9
OMW/F&C Glb Sml Cos Inv Tr PF	3,2874	1	0,7270	5	0,2427	2
OMW/Henderson Glb Growth SP PF	2,8687	19	0,7246	6	0,2399	3
OMW/Invesco Perp GI Sml Cos PF	2,8397	22	0,6134	18	0,2085	15
Stan Life Corporate Overseas 5 PF	3,1261	5	0,6897	9	0,2263	5
Zurich Global Select 2 EP PF	2,9238	13	0,6176	17	0,2086	14
Zurich Global Select ZP PF	2,8974	16	0,6116	20	0,2072	17

Table 9: Sharpe Ratio, Treynor Index and Alfa Jensen calculated over a time window of five years. Own elaboration

Each fund is ranked three times, once according to the Sharpe ratio, once according to the Treynor Ratio and in the end according to the result obtained from the computation of the Alfa Jensen. Each rank is made easily readable with a conditional formatting rule which assigns a deep green colour to the top performers

and turns red for the funds which obtained the worst results in the comparison. It seems that non ethical funds display slightly better absolute scores even if, looking at the relative differences among the returns the superiority of non ethical funds is not that clear in terms of magnitude and the results are very close one to the other.

Then the same graphical logic is used in Table 10 where the funds are evaluated with the DEA methodology. Two of the explained models are used. The DEA-CE and the DEA-SE models were chosen to see whether incorporating costs in the inputs rather than considering them as part of an output variable had some decisive affects in the measurement of the efficiency.

Fund Description	DEA-CE Score	Rank	DEA-SE Score	Rank
Aviva Alliance Trust Sustainable Future Absolute Growth Pn S6	0,9759	15	0,9788	17
Aviva Alliance Trust Sustainable Future European Growth S3 PF	0,9756	16	0,9708	29
Aviva Alliance Trust Sustainable Future Global Growth Pn S8	0,9691	18	0,9756	23
Aviva Alliance Trust Sustainable Future UK Growth Pn S3	0,9649	19	0,9721	27
Aviva Alliance Trust UK Ethical NU PF	0,9563	24	0,9665	35
Aviva Alliance Trust UK Ethical Pn S8	0,9509	26	0,9704	30
Clerical Medical PP Evergreen Pn	1,0000	1	0,9744	26
Fidelity F&C Responsible UK Equity Growth Pn 4	0,9611	21	0,9698	31
FL HSBC Amanah Global Equity Index PN	0,8858	41	0,9861	12
Friend Life Stewardship Acc PF	0,9823	12	0,9747	25
Friends Life Jupiter Ecology AP	0,9822	13	0,9937	8
Friends Life Jupiter Ecology EP PF	0,9614	20	0,9779	18

Friends Life Premier Ethical EP PF	1,0000	1	1,0000	1
L&G (LGIM) Ethical Global Equity Index IF	1,0000	1	1,0000	1
L&G Ethical Pn G6 Acc	0,9491	27	0,9590	40
L&G F&C Responsible UK Equity Growth Pn G25	0,8712	42	0,9682	34
L&G Kames Ethical Equity Pn G25	0,9109	32	0,9645	37
L&G Pension Jupiter Ecology Fund	0,9397	29	0,9712	28
M&G PP Ethical PN	0,9733	17	0,9749	24
OMW Aberdeen Ethical World SP PF	0,9328	30	0,9295	43
OMW Kames Ethical Equity Pn	0,9067	35	0,9596	39
OMW Premier Ethical Pn A	1,0000	1	1,0000	1
Scot Wid Ethical PN S3	0,9403	28	0,9401	41
Scottish Equitable Ethical Pension Fund	0,9583	23	0,9685	32
Scottish Equitable Socially Responsible Equity PF	0,9594	22	0,9683	33
SJP Ethical Pn Acc	0,8471	43	0,9305	42
SLFC Green PN	0,9813	14	0,9653	36
Standard Life Ethical UK Pn S3	1,0000	1	1,0000	1
Zurich Henderson Global Care Growth ZP PF	1,0000	1	1,0000	1
Zurich UK Opportunities 1 EP PN	0,9541	25	0,9602	38
Friends Life/Baillie Gifford International PF	0,8923	37	0,9849	14

Friend Life/Henderson Global Growth S3 EP PF	0,9100	33	0,9871	10
Friends Life/Invesco Perp Glb Smaller Cos EP PF	0,9085	34	0,9857	13
Friends Life/Threadneedle Global Select AP PF	0,8896	39	0,9771	20
L&G Legg Mason IF Japan Equity G25-PF	1,0000	1	1,0000	1
L&G Pen PMC(LGIM)World Ex UK Equity Idx	0,9983	9	0,9815	16
L&G/Pen Invesco Perpetual Global Sml Cos	0,8940	36	0,9817	15
OMW/F&C Glb Sml Cos Inv Tr PF	1,0000	1	1,0000	1
OMW/Henderson Glb Growth SP PF	0,9117	31	0,9872	9
OMW/Invesco Perp GI Sml Cos PF	0,8882	40	0,9760	22
Stan Life Corporate Overseas 5 PF	0,9963	10	0,9865	11
Zurich Global Select 2 EP PF	0,8908	38	0,9775	19
Zurich Global Select ZP PF	0,9867	11	0,9766	21

Table 10: Efficiency score and ranking reported for the analyzed funds. Own elaboration.

Not surprisingly the two models lead to different rankings which are attributable to the different characterization of the variables. What is interesting to notice is that using the DEA methodology the ethical funds obtain a better ranking than they did with traditional performance measures. Moreover with the DEA-CE model, six out of thirty ethical pension funds report an efficiency score of 1, while only two of the non ethical are able to obtain the same result. Considering factors like the ethical measure allows to give some weight to factors going beyond the risk and return measures and permits to highlight and take into account those peculiarities of the ethical funds which would otherwise be ignored.

The DEA-SE model provides a ranking closer to the ones obtained with the RAPMs; under this measure five ethical pension funds obtain a full efficiency score; for

what concerns the pension funds investing according to non ethical strategies, three out of thirteen obtain an efficiency score of 1.

Under the RAPMs non ethical pension funds obtain better scores while under the DEA measures the comparison results in a situation of equilibrium.

Conclusions

In these pages an effort was made in order to delineate the main differences existing between ethical and non ethical pension funds from both a qualitative and a quantitative point of view.

From a qualitative point of view the two type of investments share exactly the same logic for what concerns the technical aspects related to the organizational structure. The two approaches differ when it is time to define the investment strategy: ethical pension funds put a lot of focus in identifying the best investment opportunities which fit the qualitative criteria required by their investors, while non ethical pension funds can concentrate exclusively on those aspects affecting risk and return.

From a conceptual point of view, the ethical approach to investment seems to be particularly suitable for pension funds because it has a long term view of the investments and because of the so called "*patient money*" managed by the pension funds; that is why it may be a good idea for pension funds to adopt a SRI view as it matches their needs of performing long term and equilibrate investment strategies.

The scepticism surrounding the ability of ethical pension funds (and more in general mutual funds) rests on the supposed *ethical sacrifice* suffered by the investors but, according to the scientific literature on the topic, there is not a decisive evidence that ethical funds represent a worse investment opportunity than the non ethical pension funds.

In the last part of the dissertation this concept is stretched and it seems that, when basing the comparison on purely quantitative basis, non ethical pension funds have a slight advantage. On the contrary, when other aspects kick in the valuation process the difference is very narrow. The analysis carried out with the DEA methodology had precisely this scope. From this analysis there was no decisive evidence of the absolute superiority of the non ethical pension funds over the SRI pension funds.

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