Maslowian Portfolio Theory

Why Goal Based Investing Makes Sense

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Abstract
In this paper we introduce Maslowian Portfolio Theory that postulates that private investors should in the first place adapt investments to investment goals and not to one risk profile. The history of this theory can be summarised as follows:

- *For many centuries, investing was the exclusive domain of the very rich (who did not have to worry about subsistence nor about specific projects).*
- *With this backdrop, Markowitz formulated in 1952 his "Mean Variance Criterion", where money is the unique life goal. This is the foundation of "the investor's risk profile" as today almost all advisers use. This Mean Variance theory concluded that all investments should be put in one optimal portfolio. The problem is that this is both impossible and meaningless (which is my optimal volatility, my unique time horizon, etc.).*
- *However, after World War II, landscape of investing dramatically changed and in a few decades more and more people not only could, but actually had to invest. Those people do have to worry about subsistence and real life-goals!*
- *In 2001, Meir Statman and Hersh Shefrin, described that people have "Behavioural Portfolios": not one optimized portfolio, but rather pockets of separate portfolios for separate goals.*
- *In 2009, De Brouwer formulates his "Maslowian Portfolio Theory". The idea is that for the average investor* should *keep a separate portfolio for each important life-goal. This created a new, normative theory that gave the justification to goal-based investing and on top of that provides a framework to use it in practice (so that no goals are forgotten and all goals are treated in a reasonable order). PhD on the subject defended in 2012.*
- *In 2015, De Brouwer has a proof of concept software that is in line with MiFID and FINRA regulations and that is capable of providing real investment advice on the most important and most elusive aspect in investing: the strategic composition of the portfolio. He also publishes implementation advice (De Brouwer 2016b).*

About Dr. Philippe J.S. De Brouwer

Philippe studied theoretical physics and later acquired a second Master –Business Engineer– while working full time. Doing so, he solved the "fallacy of large numbers puzzle" that was formulated by P.A. Samuelson 38 years earlier. In this Ph.D. he successfully challenged the assumptions of the Noble price winning "Mean Variance Theory" of H. Markovitz that dominated our thinking about suitability of investments for more than 60 years.

In his professional career he moved from insurance to banking focusing on IT, and then found passion in asset management. For Fortis (BNP Paribas) he helped the young investment management company grow, stood at the cradle of the first capital guaranteed funds and got promoted to director in 2000. In 2002 he moved to KBC, merged 4 companies into one and became CEO of the merged entity in 2005. Under his direction the company climbed from number 11 to number 5 on the market. In the aftermath of the crisis he helped creating an investment management company in Ireland that soon accommodated the management of 24 bln. € in ca. 1000 investment funds. In 2012 he widened his scope to quantitative Risk Management. Later he moved on to RBS Group where he was head of Analytics Development. Now he works for a HSBC as head of the Independent Model Review Centre of Excellence.

Philippe also coaches on team leadership and teamwork as well as teaching (mainly for Vlerick Business School and the University of Warsaw).

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1 Introduction

1.1 The Traditional Approach

The most important thing to get right is the strategic asset allocation[1]. However it is also the most elusive and difficult part.

Traditionally one looked for inspiration in utility theory (von Neumann and Morgenstern 1944) and Markowitz' seminal paper (Markowitz 1952a) and concluded that something like an ideal cutoff between risk and return should exist for each investor. Therefore one tries to define something that could be considered as a risk profile – though no theory exists about what this risk profile actually is. Practitioners decided that something like the risk-appetite of the investor should play a major role in this.

The Traditional Approach

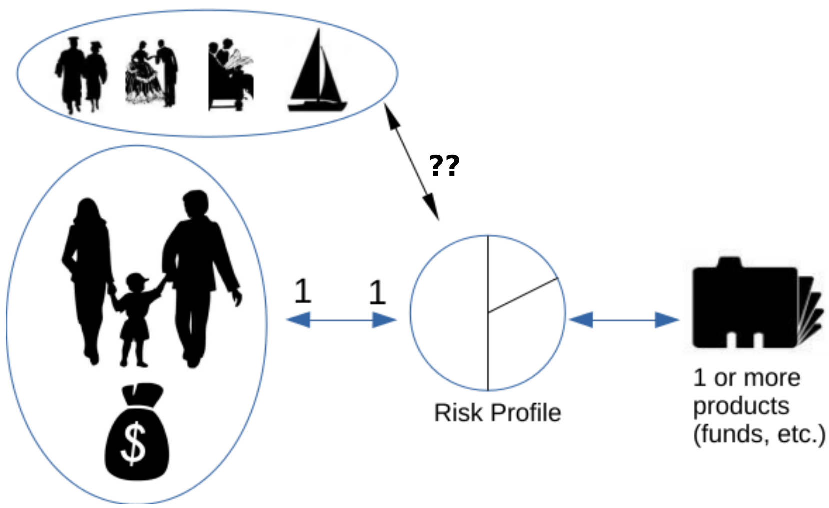


Figure 1: *In the traditional approach to investment advice each investor has* ***one*** *"risk profile". This is based on Markowitz' 1952 theory that implicitly assumes that people have no other goals in life than just "money", because if you get that right all other projects will be covered by this money. This might work for the super-rich who don't have to worry about real life goals.*

It will be clear that this approach of necessarily putting all investments in one basket cannot take separate investment goals into account, is necessarily an average of all goals of that person ... and –unfortunately– in many cases

[1]The strategic asset allocation is the average composition of the portfolio in terms of broad asset classes (such as equities and bonds). In other words it is the framework for all the rest. It is like deciding between a car and a truck, where the stock picking is comparable to the selection of colour and equipment of the car

defined by what the investors understands and desires and not by what he/she needs.

Even without considering this concern it was apparent that this way of thinking did not work for humans. (Shefrin and Statman 2000) described in their landmark paper "Behavioural Portfolio Theory" how investors do actually invest: a separate mental account for each investment goal. This was not a normative theory but only a descriptive theory.[2]

So, what was wrong? The theory or all humans?

This would be a major puzzle. Could it be that all investors were wrong? Or did Markowitz' theory need urgent revision?

This was a hard problem to address, because Markowitz got recently awarded with the Nobel Price (see (Markowitz 1991)), but also the rise of behavioural finance made clear that people did not invest in the way the traditional utility theory would predict.

Cognitive Dissonance Arose

$$\boxed{\boxed{Normative\,Theories}} \Longrightarrow \boxed{All\,Investments\,in\,One\,Portfolio}$$

e.g. Mean-Variance (Markowitz 1952a)

$$\boxed{\boxed{Descriptive\,Theories}} \Longrightarrow \boxed{Many\,Sub-Portfolios}$$

e.g. Behavioural Portfolio Theory (Shefrin and Statman 2000)

So, there were two possibilities

People making choices based on the normative theories

. . . OR . . .

Normative theories that allow for portfolio segmentation(mental accounts)

Maslowian Portfolio Theory addressed this puzzle.

[2] A "normative theory" tells what someone should do as opposed to a "descriptive theory" that describes how something is but without telling that this is good or bad.

2 Maslowian Portfolio Theory—MaPT

As stated before, Maslowian Portfolio Theory (De Brouwer 2009) tries to be a normative theory –it tries to tell how people *should* invest– and doing so it should bridge the gap between the descriptive Behavioural Portfolio Theory and the normative Mean Variance theory.

This mean variance theory might make sense if the investor is so rich that he/she never has to worry about subsistence nor any simple life projects. Indeed only in that case investments can be considered without the investment goal being the most important parameter.

This is something that falls in line with the Behavioural Portfolio Theory where (Shefrin and Statman 2000) described that people do not follow Markowitz theory (and consider all investments in one portfolio), but rather have a few buckets of investments. They described three layers:

- safety layer: safe for your own retirement and have safe investments
- projects layer: sending kids to a good school, buying a new car, etc. projects with medium-risk portfolios
- shot at richness: if all projects are covered and there is still money left one can invest it as risky as one *wants*. It is only here that the psychological risk profile of the investor can be of paramount importance and it is only here that investment portfolio are not to be composed in function of hard parameters related to investment goals.

2.1 The Core Idea

Where Markowitz' approach of considering all investments in one portfolio and optimizing this for an undefined horizon in function of an elusive and abstract "optimal volatility", Maslowian Portfolio Theory solves the investment puzzle by taking an entirely other stance and becomes a universal theory in which Markowitz approach becomes a special case for the investments that serve no concrete purpose.

Maslowian Portfolio Theory – MaPT
The Idea

Core Idea
Investments serve a purpose in life. The life-goals are the purpose of the investments, and money is only a means to attain a life-goal, it is not a goal in itself.

In other words, Maslowian Portfolio Theory starts from human needs and tries to match investments with needs and cover needs one by one.

For example one need to set aside some money for retirement and invest this in function of the investment horizon, relevant risk (inflation), earning potential, etc. A second goal can be to give the kids a good start in life (studies, start company, first apartment, etc. Here we have a concrete investment horizon that will get shorter and shorter.

Maslowian Portfolio Theory (MaPT)
Investments should cater for needs

Human Needs	Investments/MaPT
Physiological Needs	liquid/cash
Safety Needs	insurance, retirement savings
Love Needs	mixed portfolios for projects
Esteem Needs	mixed portfolios for projects
Self Actualization	broker account

Table 1: *Maslowian Portfolio Theory.*

The Maslowian Approach

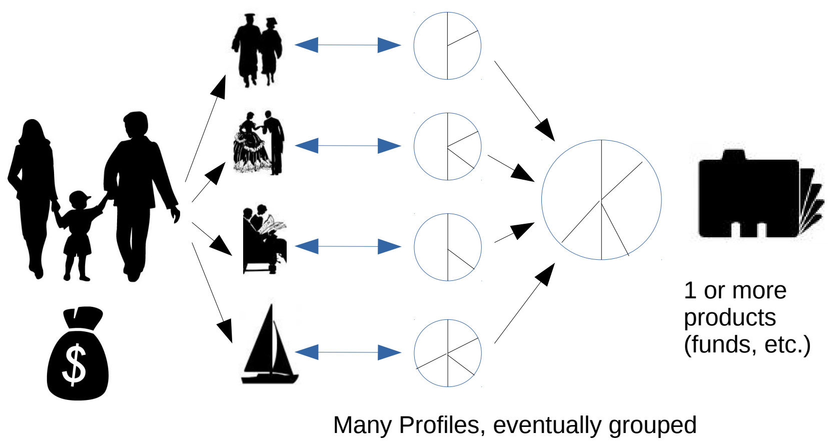


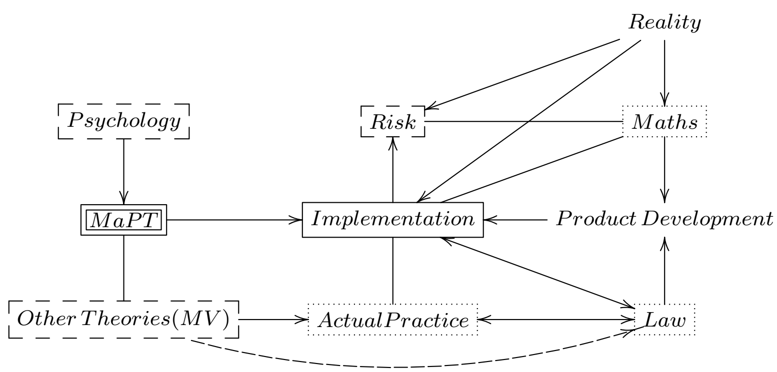
Figure 2: *In the "Maslowian Approach" to investment advice each investor has one risk profile per life-goal. This is not only safer, but also more natural and helps to avoid losses to panic sales (and other behavioural biases), because the investor can see what happens to the underlying life goals. It also helps banks to speak the language of the customer and reduces model risk. It is the only relevant approach to investments that is relevant for people. It is simply the rational thing to do (it is the same as AML –asset-liability matching– used by corporates!).*

2.2 Opening Pandora's Box

Maslowian Portfolio Theory seems simple and compelling, it is in line with how our brain works since our days in the African Savannah, it is how the Roman empire worked, this is how any government is run, this is how insurance companies and pension funds cover their goals (and call it ALM: Asset Liability Matching)[3] it is a logical and safe way of making sure that things are under control and goals are achieved.

However, it is good to look at how things are done now and what changes it would require to the financial advisory landscape.

What else is necessarily involved?
Opening the Box of Pandora . . .



What has been done already?
A Few Steps are Taken

- Problem formulation ca. 2000
- Refereed Publications:
  - investment horizon is relevant: (De Brouwer and Van den Spiegel 2001)
  - analogy (first ideas): (De Brouwer 2006)
  - MaPT: (De Brouwer 2009)
  - TOIA: (De Brouwer 2011)
  - implementation of MaPT & TOIA: (De Brouwer 2016b)
- in the advent of robo-advice and MiFID II the interest in goal-based investment advice if growing.

2.3 Target Oriented Investment Advice—TOIA

Of course, the first issue to solve is the demonstrate that Maslowian Portfolio Theory can lead to reasonable portfolios.

That is where Target Oriented Investment Advice (henceforth TOIA). It is on possible implementation of MaPT.

[3]Actually independent from (De Brouwer 2009) also (Amenc, Martellini, Milhau, and Ziemann 2009) came to similar conclusions and called it "personal asset-liability matching", thought they did not focus on the normative aspect of their propositions.

Target Oriented Investment Advice (TOIA)
The Logic

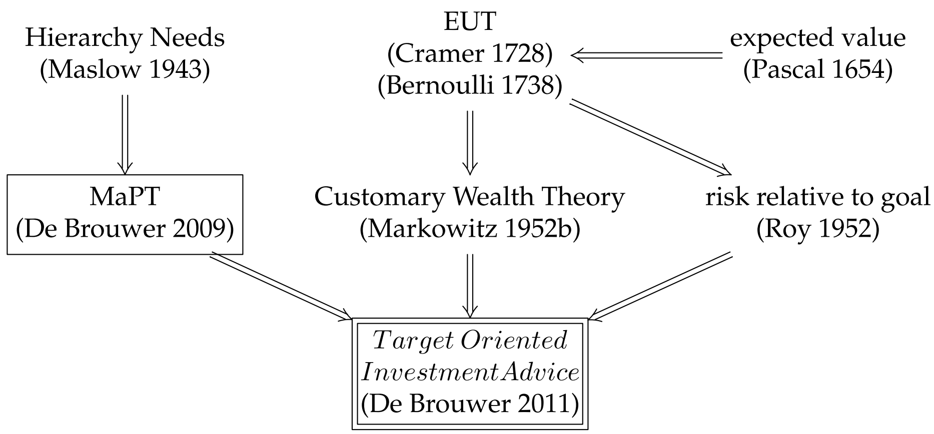


Figure 3: *Milestones for the formulation of TOIA.*

Target Oriented Investment Advice (TOIA)
The Definition

definition 1 (TOIA is the stance where)

1. we subscribe to MaPT (money is not a goal in itself, but serves other purposes) ⇒ mental accounting
2. we optimize portfolios for each goal separately and with the investment goal in mind, so—if we use a risk-reward optimization—then we will use a coherent risk measure that is able to focus on the tail-risk or—if we use a utility function—the utility will depend on the different investment targets separately (as an investment target as in an asset-liability approach);
3. we update financial plans regularly to keep it in line with life goals and resources.
4. we use MaPT as a *guide* to identify the investor's goals

The Steps Within TOIA (I)
Define Projects

The Steps Within TOIA (II)
A correction to the previous: what if the s is not yet pleased

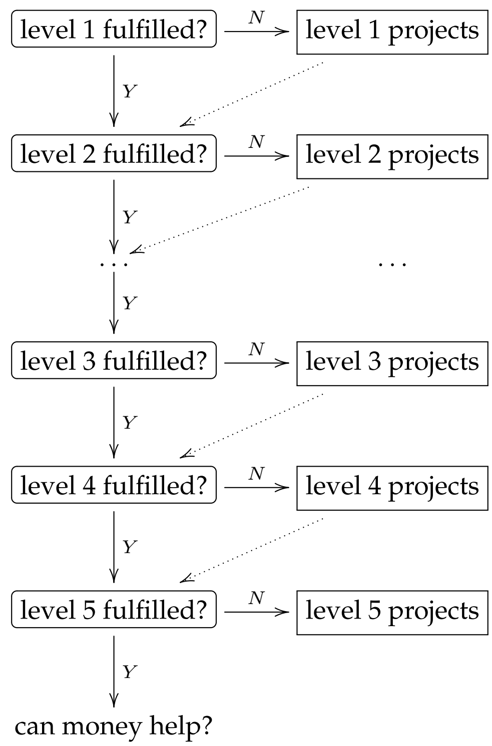


Figure 4: *Define the projects: start with the most urgent needs and if money is left, cater for the next need.*

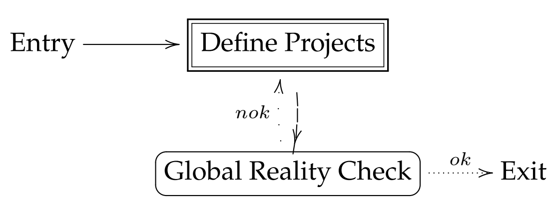


Figure 5: *The basic scheme to get a set of realistic investment projects in appropriate proportions. The important "Define Projects" segment is Figure 4.*

2.4 A Mathematical Implementation

Arguably the most straightforward step of our journey to concrete investment advice is the mathematical implementation: the big decisions are made, now it is a matter of doing what comes logical and fits in a coherent framework. So far TOIA sets a framework but some details still have to be filled in.

The first detailed example provided of such mathematical implementation is (De Brouwer 2012) and we will follow this logic.

The Maths of TOIA
The Logic

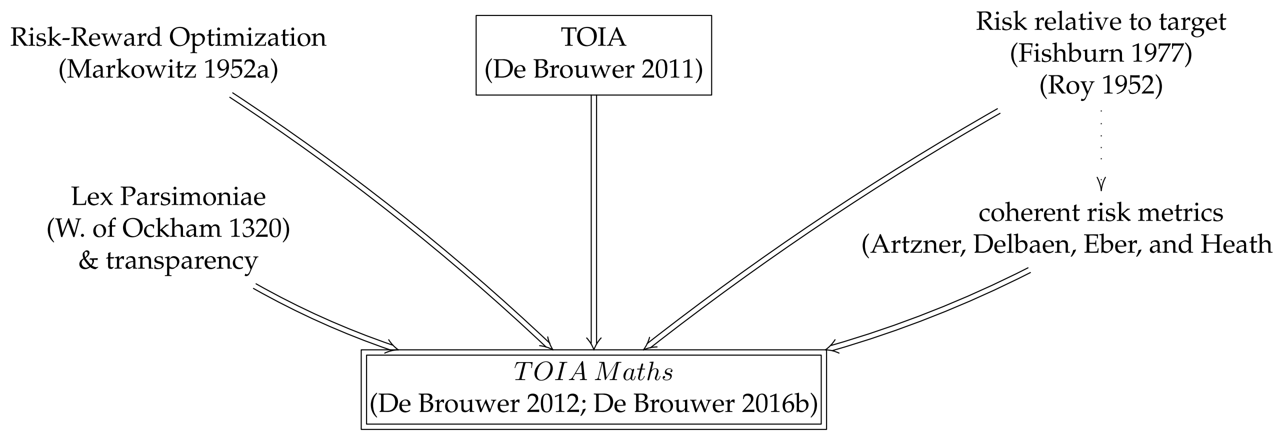


Figure 6: *An Implementation of TOIA – as described in (De Brouwer 2012; De Brouwer 2016b)*

While it would be appealing to invent a completely new theory it usually makes more sense to stand on the shoulders of giants and base one's approach on existing ideas, theories and principles. So also our mathematical implementation. Figure (Amenc, Martellini, Milhau, and Ziemann 2009) illustrates what ideas were added to come to the mathematical implementation.

First we rely on the "Lex Parsimoniae" of William of Ockham (also known as "Ockham's razor") and we will not things more complicated than really necessary, we will not plan more precise than one can expect income to become available, we will not have too much to say about stock picking because it is not too important compared to the strategic asset allocation, etc. In summary this means that we will work goal per goal and just determine the strategic asset allocation.

This will be done by using a risk-reward allocation à la Markowitz. However we will of course not use variance as a risk measure because it is no risk measure. We will of course use a coherent risk measure. This comes in very handy because coherent risk measures tend to have some link with the investment goal (eg. a shortfall when the money is due).[4]. As confirmed by (Acerbi and Tasche 2002) this leads naturally to the choice for Expected Shortfall as a risk measure.

Possible Maths of TOIA
The Concept

definition 2 (Possible Maths of TOIA)

The mathematical implementation of TOIA aims to find a solution for TOIA by adding the following assumptions

- a risk-reward optimization (as opposed to a utility optimization)
- uses a coherent risk measure
- calculates the risk measure relative to the target
- focusses only on the parsimonious aspects (the 93% question[5]: the strategic asset allocation)

The Maths of TOIA
The Risk Metric: Expected Shortfall (ES)
We choose *Expected Shortfall (ES)*, because it

- is coherent in the sense of (**?**), and therefore
  - is logically coherent (intuitive results),
  - has a convex risk surface,
  - can focus on the tail-risk,
  - is compatible with investment goals (translational invariant);
- is the smallest coherent and law-invariant majorant of V@R
- is consistent with second order stochastic dominance (Yamai and Yoshiba 2002) $\rightarrow$ consistent with EUT
- has a rich set of tools in implementation and calculation
  - comonototonic approximations—e.g. (Dhaene, Vanduffel, Goovaerts, Kaas, and Vyncke 2005)

[4]We recommend to reader to have a look at (De Brouwer 2016a) and the appendix to this paper for more information about coherent risk measures and for more theoretical background one can have a look at (De Brouwer 2012; Artzner, Delbaen, Eber, and Heath 1997; Artzner, Delbaen, Eber, and Heath 1999)

[5]93% of the outcome of the investment is defined by the strategic asset allocation (Gary P. Brinson and Beebower 1986); performance of asset managers is not a parsimonious parameter (Annaert, Van Den Broeck, and Vander Vennet 2003), (Annaert, De Ceuster, and Van Hyfte 2005) and others

- convolutions calculated via Fourier transforms—e.g FFT
- simplified formulations of optimizations problems—e.g. (Acerbi 2004)

- is somehow known by practitioners!

. . . but better methods might exist (e.g. efficient investment strategies)

2.5 Risk-Reward Methods

3 Gaussian Assets
Equities, Bonds and Cash

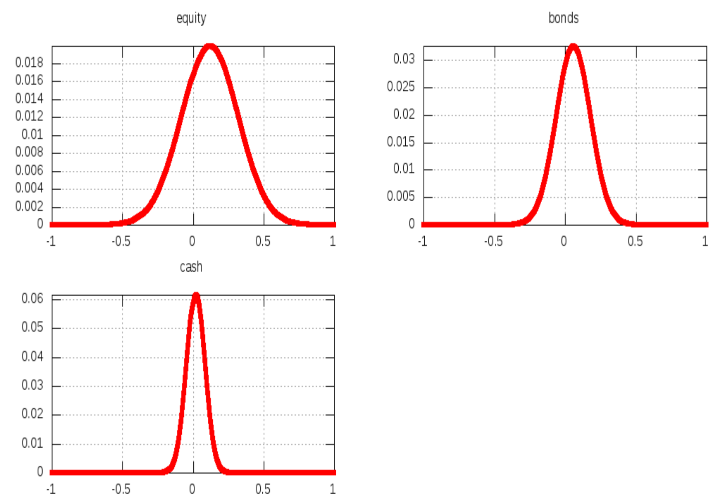


Figure 7: *Equities, bonds and cash (Gaussian distributed).*

The Mechanics of a Risk-Reward Method

Example 1
Gaussian Equities, Bonds and Cash—inflation adjusted

2.6 Coherent Risk Measures

See also (De Brouwer 2012; De Brouwer 2016b).

Some Definitions (1)

definition 3

$\mathcal{P}$ = the absolute return

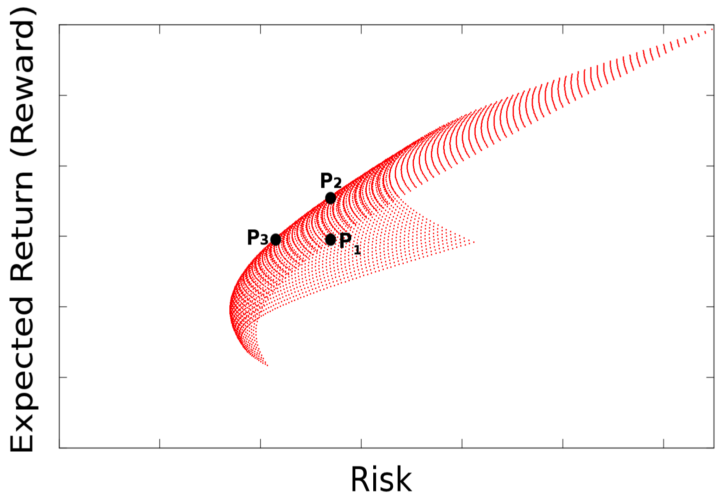


Figure 8: *Portfolios in the risk/reward plane.The risk/reward method is simply "dominance" method in the Multi Criteria Decision Analysis.The portfolio P_1 is not efficient as there are other ones with higher expected returns for similar risks (such as P_2) and there are portfolios with lower risk but similar expected return (such as P_3); but for P_2 and P_3 such argument cannot be made so they are efficient.*

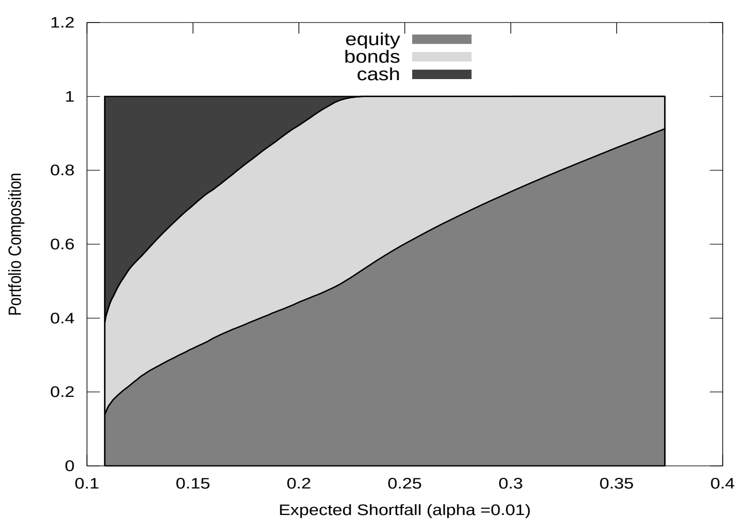


Figure 9: *Recommended portfolios in function of ES.*

definition 4

σ = standard deviation = $\sqrt{VAR}$

definition 5 (Value-at-Risk (V@R))

For the stochastic profit variable, absolute return $\mathcal{P}$, and a probability $\alpha \in [0, 1]$, we define the Value at Risk (V@R):

$$V@R_\alpha(\mathcal{P}) := -Q_\mathcal{P}(\alpha)$$

definition 6

$ES_\alpha(\mathcal{P})$ = the average of the $\alpha 100\%$ worst outcomes of $\mathcal{P}$

Some Definitions (2)

Visualisation of ES, V@R and σ

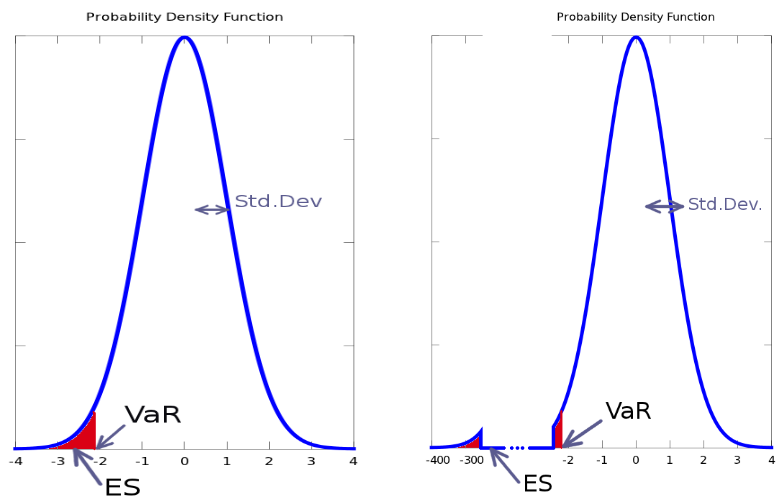


Figure 10: *Interpretation of ES, V@R and σ.*

Thinking Coherently—(I)

The Definition

definition 7 (Coherent Risk Measure)

A function $\rho : \mathbb{V} \mapsto \mathbb{R}$ (where $\mathbb{V}$ is the set of real-valued stochastic variables) is called a **coherent risk measure** if and only if it is

1. **monotonous**: $\forall X, Y \in \mathbb{V} : X \leq Y \Rightarrow \rho(X) \geq \rho(Y)$
2. **sub-additive**: $\forall X, Y, X + Y \in \mathbb{V} : \rho(X + Y) \leq \rho(X) + \rho(Y)$
3. **positively homogeneous**: $\forall a > 0$ and $\forall X, aX \in \mathbb{V} : \rho(aX) = a\rho(X)$

4. **translation invariant**: $\forall a > 0$ and $\forall X \in \mathbb{V} : \rho(X + a) = \rho(X) - a$

After the paper "Thinking Coherently"—(Artzner, Delbaen, Eber, and Heath 1997)

Law-invariance under P: $\forall X, Y \in \mathbb{V}\ and\ \forall t \in \mathbb{R} : P[X \leq t] = P[Y \leq t] \Rightarrow \rho(X) = \rho(Y)$

Thinking Coherently—(II)
Example for (In)Coherence of Risk Meaures

Example 1

Assume one bond with a 0.7% probability to default in one year in all other cases it pays 105% in one year.*The 1% V@R is -5% $\Rightarrow$ V@R spots **no** risk!*

Example 2

Consider two identical bonds with the same parameters, but independently distributed*The 1% V@R of the diversified portfolio is 47.5%!*

Thinking Coherently—(III)
Continuity in α

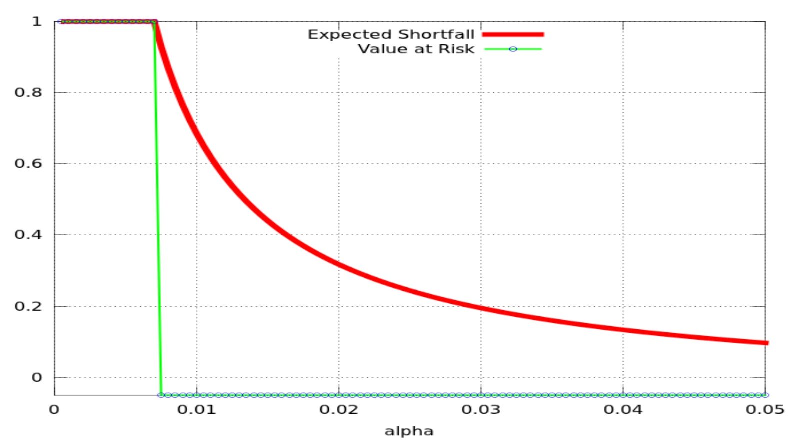


Figure 11: *ES and V@R in function of α for one bond.*

Thinking Coherently—(IV)
Convecity (I)

Thinking Coherently—(V)
Convexity (II)

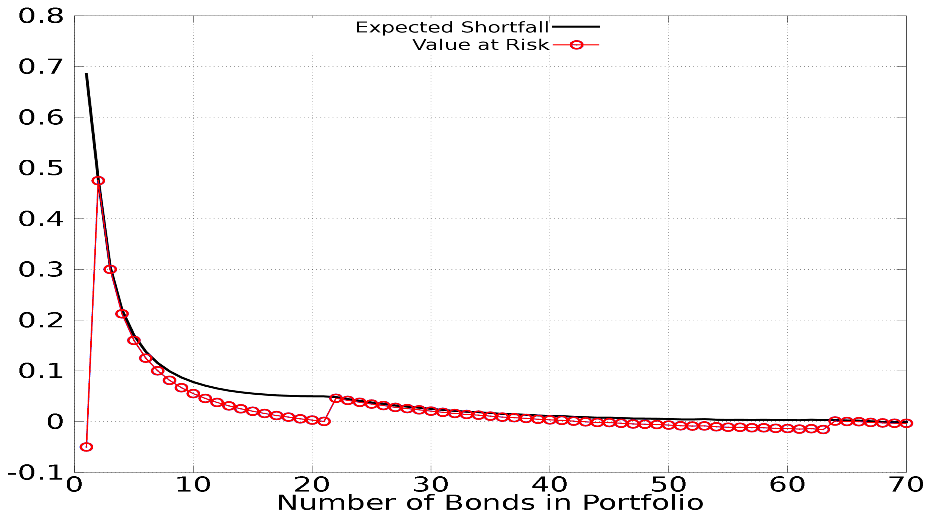


Figure 12: *ES and V@R in function of number of bonds.*

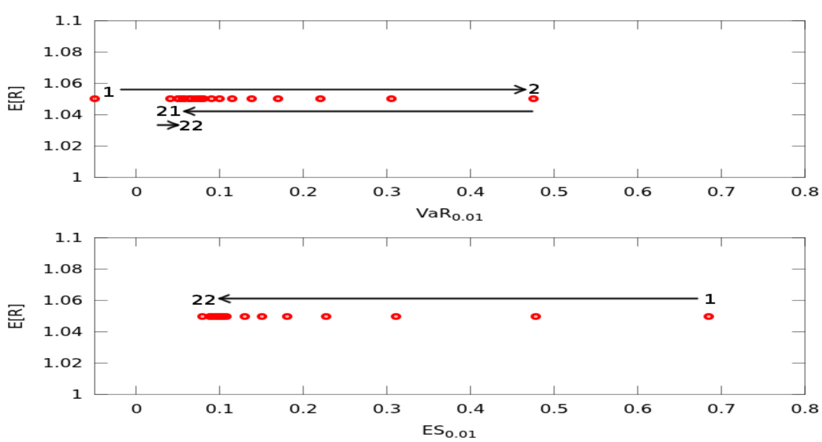


Figure 13: *The result on the risk surface.*

2.7 Criticisms

Different from Markowitz (1952)

1. $ES \neq VAR$
   - ES is a coherent risk measure
2. Mental Accounting is Not Optimal

- How to test? Which T?
- If so: a small price to pay (as a premium for an additional insurance): reduces model risk, diversification in diversification, ring-fencing, framework that counteracts behavioural biases, etc.

2.8 MiFID

The Suitability Requirement
in the Markets in Financial Instruments Directive (MiFID)
Rules for Know-Your-Customer: *suitability requirements* guide the industry to a *one-risk-profile-per-investor* approach based on a *questionnaire*

1. tries to find something that does not exist: a unique risk profile
2. increases model risk (all in one portfolio)
3. focus "risk-tolerance" (not defined, changeable and not the most important)
4. empowers emotions to become decisive ⇒ stimulates bubbles and crashes
5. little understanding of the investor's targets
6. questionnaire = the worst MCDM to find something that does little matter and use it as the only parameter for the only decision, and map this arbitrary parameter in arbitrarily to an arbitrary set of investments.

3 Examples

Example 2: Non-Gaussian Assets
Assume that we have assets that are clearly not distributed according to the Gaussian distribution. Let's assume that the investor can choose between two more common asset classes.

- a hedge fund that can show nice historic returns. However, since these funds do not disclose exactly what they do it is not reasonable to assume that nothing can go wrong. The statistics of historic returns are biased because only the surviving funds appear in them. The funds that have closed down (and where investors lost a lot of money) are not in those statistics. A very crude, maybe even clumsy but in any case handy way to get around is to suppose that there is another "disaster distribution" that is not in the statistics and needs to be added manually. We decided to add a small probability of 2.5% that the investor looses 50% of the investments.

- Further we assume that the investor also can invest in a capital protected structure. These investment funds typically guarantee some payout (here we assume initial capital) and –if the market is up after a certain number of years– something extra. However, if the market is down, there are no further losses. The fund manager can obtain this payout for the investor by investing in a custom-made zero-bond and an OTC option. The pdf of this investment will of course see that the left part is wrapped up in a Dirac-delta function with weight equal to the probability of loss (minus hedging costs). In this example we priced the option using the well-known Black and Scholes formula.

The pdfs of these asset classes are presented in Figure 14.

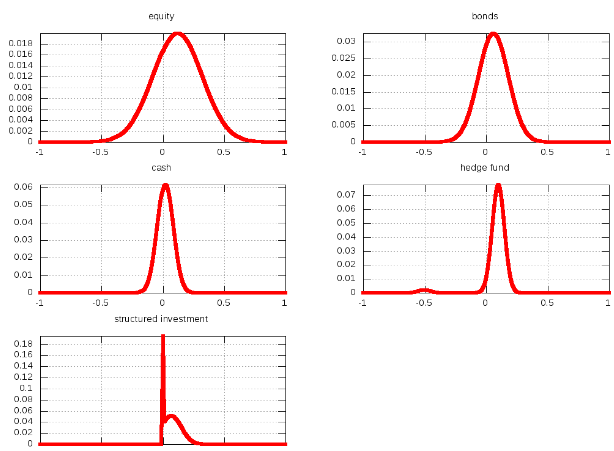


Figure 14: *The pdfs in the example (the y-axis for the structured fund is truncated—this fund is a long call plus a deposit).*

Example 2: Non-Gaussian Assets
Mean-ES and Mean-VAR Optimization
The optimal asset composition of these assets is presented in Figure 15.
Here are some important observations to be made.

The minimum-risk Portfolio When using variance as a risk measure, we notice that the minimum risk portfolio is well-diversified. This is great, but it is also a portfolio that has 17% probability to yield a negative return. When we use Expected Shortfall as a risk measure, we observe that the minimum-risk portfolio is not diversified, but all assets are allocated to the capital protected

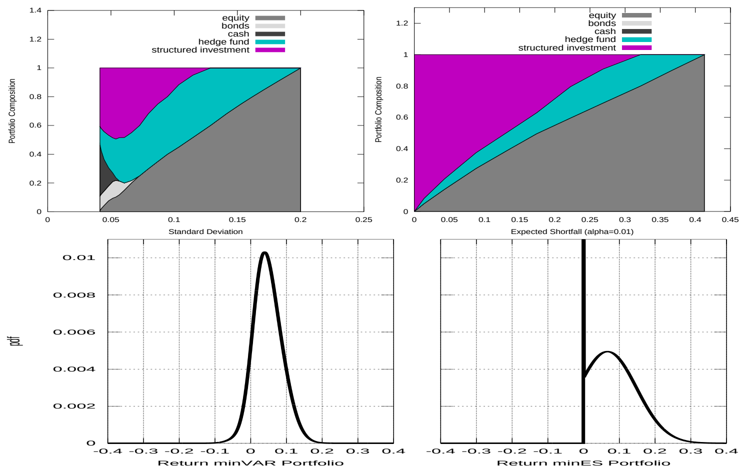


Figure 15: *The min-VAR and min-ES portfolios compared.*

structure[6]. This portfolio has a 0% probability to loose money. What would you consider as the least risky one?

The asset allocation to hedge funds A known paradox in the investment world is that when we use mean-variance to find the optimal portfolio composition that then we inevitably find that a huge amount is allocated to hedge funds. No person that is sound of mind will invest so much in hedge funds. However, with our additional disaster probability and using expected shortfall we seem to get realistic results that might be applied in practice.

Example 3: A Complex Example

In this example we will consider a realistic case: an investor that has multiple life goals.

1. **school**: the investor wants to send his kids to school in one year and needs € 100,000 cash to do so. This goal is important and there is not so much freedom to be satisfied with a lower amount.

2. **yacht**: in five years from now, he would want to buy a yacht, which he hopes to buy for € 120,000. A bigger yacht would be nicer, but a smaller one will also be fine, so we decide to take optimize the portfolio with an expected shortfall of 20%

3. **retirement**: this is still ten years away, but it is a very important goal and we should not allow too much risk that the goal will not be obtained.

[6]we assume the structure to provide capital guarantee on one year and the ES calculation is also on one year.

The investor continues to save for this goal (€ 10,000 per year). This is the only goal where we assume an additional cash flow.

4. **extra**: there is also a portfolio of € 50,000 that is not allocated to any important life goal.

Table 2 shows these investment goals with their relevant parameters.

Goal	τ	T	CF	V_0	α	ES_{max}
school	€ 100,000	1	€ 0	€ 100,000	0.01	10% of τ
yacht	€ 120,000	5	€ 0	€ 100,000	0.1	20% of τ
retirement	€ 200,000	10	€ 10,000	€ 100,000	0.01	minimal
extra	€ 50,000	10	€ 0	€ 50,000	0.05	€ 5,000

Table 2: *The investment parameters for in Example 3. The investor wants to invest V_0 (plus annually CF) and wants it to grow to τ in T years, the expectation of the average of the $\alpha 100\%$ worst outcomes is to be limited to ES_{max}.*

Example 3: Feedback to Investor

With the investment problem formulated in terms of real life goals it becomes possible to provide feedback to the investor that is relevant to him or her.

Goal	Equities	Bonds	Cash	ES	Feedback
school	12.8%	24.4%	62.8%	10.8%	add
yacht	100%	0%	0%	18%	reduce
retirement	21%	30%	49%	€ 3161.20	ES
extra	100%	0%	0%	€ 3836.07	is less
total portfolio	50.46%	16.12%	33.42%	—	

Table 3: *An overview of the ES-optimal portfolio compositions, as well as their proportion of the total portfolio. In the last two columns one finds respectively the percentage of the sub-portfolio at $t = 0$ (i.e. at the moment of writing the financial plan), and the Expected Shortfall as obtained after optimization.*

Example 3: A Complex Example

The portfolios in the mean-variance space. While it is of course very artificial to choose one investment horizon, this is necessary to compare with the results of a mean-variance portfolio. Here we have chosen a one year investment horizon and present the results in Figure 16.

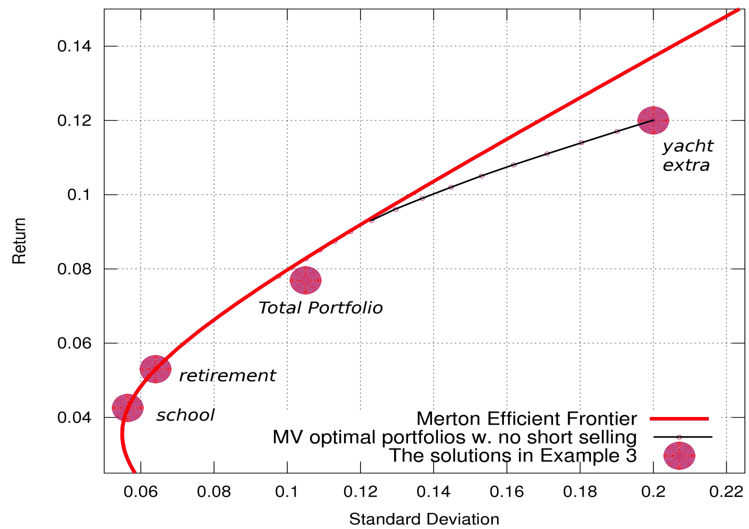


Figure 16: An example with four target portfolios.

4 Conclusions

Disadvantages of TOIA

1. portfolios are not necessarily MV-optimal
   (a) because of **mental accounting** ...however in a *very* abstract way (multiple horizons in MaPT/TOIA!)
   (b) **ES used in stead of VAR** ...however this is much more logical, coherent and intuitive
2. **time consuming** for advisers
3. **computing time intensive** to optimize portfolios
4. **if applied, should be complete** – *all* needs should be covered (facilitated by Maslow's framework)
5. More research is needed (e.g. efficient investment strategies)

Advantages of TOIA

1. creates a **natural language** to guide the investor;
2. investment advice that **serves a purpose**, that makes sense for the investor, helps people to realize goals;

3. **no use of ill-defined concepts** such as “risk tolerance”, no need for magical beliefs about the ability to define, determine and use this parameter;

4. provides a framework to hold onto, to temper emotions

   (a) **portfolio returns are not/less deteriorated** by behavioural biases

   (b) **bubbles and crashes are tempered**—if TOIA is widely used

5. ideal method to **build trust and a long term relationship** between advisor and investor

6. TOIA **reduces model risk** (diversification within diversification)

Conclusions

- MaPT **puts investing in a frame: the frame of life**! Investments not a goal in their own right
- MaPT is **valid**, **normative**, **coherent**, and **applicable in practice** (e.g. TOIA)
- MaPT and its implementation TOIA have distinctive *advantages*: they
  - **answer to real needs** with interpretable parameters
  - Maslow offers a **natural language** in communication with investors + helps not to forget goals
  - are a rational approach **to mitigate some behavioural biases**, while other biases are used to help the investor
  - offers diversification within diversification

Appendices

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B Nomenclature

Nomenclature

ρ a risk measure, page 16

$V@R_\alpha(\mathcal{P})$ Value at Risk, page 15

$E[x]$ the expected value of a stochastic variable x: $E[x] = \int p(x)x\,\mathrm{d}x$, page 15

$ES_\alpha(\mathcal{P})$ Expected Shortfall = the average of the $\alpha 100\%$ worst outcomes of $\mathcal{P}$; aka CVaR, Tail-V@R, etc., page 15

$Q_X(\alpha)$ Quantile Function of the stochastic variable X, page 14

$VAR(x)$ Variance: $VAR(x) = E[x^2] - E[x]^2 = \sigma^2$, page 15

ES Expected Shortfall, the ES_α is the expected value of the $100\alpha\%$ worst outcomes, page 13

EUT Expected Utility Theory, page 13

FFT Fast Fourier Transform, page 13

MaPT Maslowian Portfolio Theory, i.e. the stance where investments should be chosen in function of human needs, page 6

MCDM Multi Criteria Decision Method, page 18

MiFID Markets in Financial Instruments Directive, page 18

MV Mean-Variance criterion, as proposed by (Markowitz 1952a), page 22

pdf probability density function, page 13

TOIA Target Oriented Investment Advice $\equiv$ Goal Based Investing, page 8