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The Risk Management within European Equity Asset Managers

By

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Report on research presented in fulfilment of the

Requirements of the examination for the

Doctor in Philosophy in Finance

at City University London in April 2017



Cass Business School
CITY UNIVERSITY LONDON

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Abstract

The objective of this research is to understand what risk management processes are currently in place amongst active European equity asset managers, and to determine which practises are most effective. The focus of this research is on active equity portfolios within the European markets. The thesis is divided in five chapters: 1) Introduction, 2) Introduction and literature of risk management in financial institutions, 3) How risk management is currently used in European funds; a survey of 200 asset managers and hedge funds is undertaken to identify current approaches to risk management, and identify what might need to be improved, chapter, 4) using a unique survey, a comprehensive analysis of the level of risk that pension fund clients (Board Members, Chief Financial Officers, and upper management of organisations with pension funds under third-party management), family offices that invest in hedge funds and Intermediate Financial Advisors (IFAs in UK) are willing to accept, and 5) Conclusions. This will cover the financial crisis and the on-going subsequent recovery. The key findings from Chapter 2 are that there is limited literature in this subject, from Chapter 3 that there is significant issues within the risk management systems utilized by the various asset managers and that there is a need to improve considerably these systems and from Chapter 4 using a unique survey we gather a comprehensive analysis of the level of risk that pension fund clients (Board Members, Chief Financial Officers, and upper management of organisations with pension funds under third-party management), family offices that invest in hedge funds and Intermediate Financial Advisors (IFAs in UK) are willing to accept.

To the best of our knowledge, this is the first comprehensive study of current risk management practices within active European equity asset managers.

Chapter 1: Introduction

The motivation for this study is to understand the involvement between the active European equity asset managers and the risk management processes and systems. After the last two crises in the financial markets, the dotcom bubble (2000-2003) and the credit crisis (2008-2009), the last few years were marked by a deep change in fundamental paradigms and beliefs of the industry and investors. In the most recent credit crisis, there was a lack of transparency and feasibility in the quantitative tools used to compute the value of portfolios and risk management within the asset management industry. Questions were raised about the effectiveness of risk management and economic uncertainty, the convergence of risk factors and regulations boosted the complexity of risk management. The motivation for this research comes from the lack of comprehensive study on the current state of risk management within the European equity portfolios and the findings that there is a clear need to understand and improve the area under discussion.

This research will focus on three different subjects and is structured as follows. In Chapter 2, it will answer broad questions regarding risk management within portfolio management, such as:

- What is risk and what is the role of risk management?
- Why is risk management important and what are current and historical attitudes to risk management in the asset management industry?

To answer these questions the researcher will review many of the key theories and discuss important papers and the most up-to-date research on these matters. This

section will aim to give a taste of current thinking about risk and risk management and will provide an exhaustive study of most relevant literature. It will attempt to highlight key theories and thinkers and shed some insight into risk and risk management rather than giving a chronological history of the whole debate surrounding risk.

The main conclusion from Chapter 2 is that it clearly shows the gaps in the available literature within the subject. We identify that the definition of risk management is not clear and that little is known about the current state of risk management within the active European equity asset managers.

In Chapter 3, the researcher will analyze how risk management is currently used in European funds, through a survey of 200 asset managers and hedge funds in order to identify the current approaches to risk management, how it has changed, the areas that might need to be improved and expectations of how it will change in the immediate future. Moreover, in Chapter 3, the researcher analyzes the influence of risk measure in each fund's performance. The questions in the survey try to answer several key themes in order to reveal many important issues for the industry:

- What are the consequences of past financial crises?
- Is risk management taken seriously inside financial organizations?
- Are funds with fewer assets under management expected to spend (proportionally) less on risk management?

In Chapter 3, we find that there are significant issues within the risk management systems utilized by the various asset managers (traditional asset managers with a bias towards long only products and hedge fund managers with an absolute bias) and that there is a need to improve these systems. Moreover, we identify that change is now being considered: companies are currently more aware of problems regarding the lack of risk processing and monitoring and they are taking risk more seriously. Asset managers are willing to spend more on resources and give risk departments more power inside their organizations.

In Chapter 4, the researcher will make a comprehensive analysis of the level of risk that different managers are willing to accept, namely Pension Fund clients (Board Members, Chief Financial Officers, and upper management of organizations with pension funds under third-party management), Family Offices that invest in Hedge Funds and Intermediate Financial Advisors (IFAs in the UK). In Chapter 4 we find evidence suggesting that there are different levels of risk acceptance between pension fund clients, family offices and IFAs.

Finally, Chapter 5 summarizes the results and concludes the study.

To the best of our knowledge, this is the first comprehensive study of current risk management practices within active European equity asset managers.

Chapter 2: Literature review and introduction to risk management in portfolio management

1. Introduction

In Chapter 2 we will review the literature within risk management in portfolio management. The objective is to answer broad questions regarding risk management such as what are the various definitions of risk and the role of the risk management within the portfolio management.

2. Risk Management Literature Review

In order to investigate risk management within the European asset management industry, we must first assess and review relevant literature to answer a number of questions: What is risk and the role of risk management? Why is risk management important and what are current and historical attitudes to risk management in the asset management industry?

To answer these points, in the first sections below, I will review many of the key theories regarding these questions and I will discuss important papers and the most up-to-date research on these matters. These sections will aim to give a taste of current thinking about risk and risk management and will provide an exhaustive survey of most relevant literature. It will also not be an attempt to give a chronological history of the whole debate surrounding risk, but rather, it will attempt to highlight key theories and thinkers and shed some insight into risk and risk management. In the first of these sections below, I will ask what risk is, in fact, and highlight some of the key issues as highlighted by the experts in the field.

2.1. What is risk?

While there are many sources of financial risk, within this chapter we concentrate on market risk or price risk, i.e. the risk of unexpected changes in prices or rates (Duffie and Pan, 1997). The reason why we focus on market risk is that we believe it to be the most relevant to equity portfolios. According to Kuriyan and Rossi (2010), there are various risk factors: market risk, credit risk, operational risk, macroeconomic risk, strategic risk and integrated risk. There are specific risk challenges when trying to model these specific risk factors, i.e.:

Table 1 – Risk Factors / Challenges

Risk Factor	Challenges
Market Risk	<ul style="list-style-type: none">• Impact of market valuation factors across all assets• Accounting for correlation across risk portfolios• Integrating credit risk in the trading book (i.e. counterparty risk)
Credit Risk	<ul style="list-style-type: none">• Default probabilities and expected loss assumptions• Valuation impact of macroeconomic factors on credit risk (accrual book)
Operational Risk	<ul style="list-style-type: none">• Historical scenario data to model operational risk• Quantifying economic impact of operational risk• Integrating operational risk in aggregate stress test risk reporting
Macroeconomic Risk	<ul style="list-style-type: none">• Defining appropriate macroeconomic factors• Algorithms to translate macroeconomic changes into specific risk factors
Strategic Risk	<ul style="list-style-type: none">• Developing pro-forma financials to model impact of strategic assumptions• Integrating results in stress test reporting
Integrated Risk	<ul style="list-style-type: none">• Methodology to account for liquidity risk (funding vs. trading)• Feedback loops

Source: Kuriyan, Vikram; Rossi, Cliff, GARP Leadership Series – Stress Testing and Scenario Analysis, May 2010

In this research chapter we will focus on market risk as defined by Resti and Sironi (2007) - i.e. the risk of changes in the market value of an instrument or portfolio of financial instruments, connected with unexpected changes in market conditions (stock prices, interest rates, exchange rates, and volatility of these variables).

Interestingly, much of what we know about risk in finance comes from the ground breaking work done by Harry Markowitz and others studying portfolio theory as far back as in the 1950s and 1960s. In the process of considering how diversification affects portfolio risk, they considered the relationship between expected returns on investments and their risk and their work is still seen as being seminal despite it being put together decades ago.

Another interesting point about this debate is that when we try to quantify risk in equity portfolios, we are quickly drawn to statistical measures of risk (Damodaran, 2003). The standard deviation or variance of actual returns around an expected return has become the most widely accepted measure of risk within the asset management industry. Here, expected returns measure reward and the standard deviation measures risk and, therefore, equity portfolios that generate higher expected returns with lower standard deviations are the investors optimal choice, or on the “Efficient Frontier” as defined by Markowitz (1952). Damodaran (2003) points out that there are limitations when using variance as the only measure of risk - the first is that it is calculated using variations from the mean and is thus a function of both upside and downside variations - i.e. a stock that went up significantly in the recent past can therefore look just as risky, based upon standard deviation, as a stock that has gone down significantly. Additionally, when investors are assessing the desirability of investments, they may consider more than just the expected return and variance (Damodaran, 2003).

According to Elton et. al. (2007), Portfolio Theory tells us that “risk” in the sense of expected volatility of returns, can be reduced by adding more securities to a portfolio provided that the returns of new securities are:

a) less than perfectly correlated with the returns of the original holdings

If an investor's entire portfolio is invested in just one stock, they are not only highly vulnerable to the firm specific risk, and they take on market risk as well. As mentioned above, by expanding our portfolio to include other assets or stocks, one is diversifying, and by doing so, there is a reduction of firm specific risk. There are two main reasons why diversification reduces, or, at the limit, eliminates firm specific risk. The first is that each investment in a diversified portfolio is a much smaller percentage of that portfolio than would be the case if the portfolio were not diversified. Therefore, any action that increases or decreases the value of only that investment or small group of investments will have only a small impact on your overall portfolio. The second reason is that the effects of a firm specific action on the prices of individual assets in a portfolio can be either positive or negative for each asset for any period (Damodaran, 2003). DeMiguel et al (2010) state that portfolio performance is measured in terms of four metrics: volatility, Sharpe ratio, certainty-equivalent return, and turnover. They determined that prices of stock options contain information that can be used to improve the out-of-sample performance of portfolios.

Although it is commonly believed financial markets are becoming increasingly sophisticated in pricing, isolating, repackaging, and transferring risks it is worth examining such assumptions in light of the recent financial crisis. Tools such as derivatives and securitization contribute to this process, but they pose their own risks. The failure of accounting and regulation to keep abreast of developments introduces yet more risks, with occasionally significant consequences (Holton,

2004). One can quickly see how difficult it is to assess the risk of investing in, for instance, the equity of a bank which is a significant player in securitisation and derivatives, when even their auditors and regulators have difficulty quantifying the risk within the firm.

According to Holton (2004), practical applications (including risk limits, trader performance-based compensation, portfolio optimization, capital calculations) all depend on the measurement of risk, but it is unclear exactly what these measurements reflect. Due to this lack of clarity, debates are arising on trading floors, asset management companies, in academia and in industry journals about meaningful risk measurement. A search of financial literature yields many discussions of risk but few definitions accepted and agreed on by all. To understand risk one needs to consider two main streams - one is subjective probability, the other is operationalism. Where these two main factors meet, according to Holton (2004) we can understand risk.

The most common definition of risk is that provided by Frank Knight (1921), who wrote during the period of active research into the foundations of probability. His research really touched upon the concepts of “known unknowns” and “unknown unknowns” in the field of risk, which would seem well ahead of his time. Other research in the same period includes well-known pieces by John Maynard Keynes (1921), Richard von Mises (1928), and Andrew Kolmogorov (1933). One key debate from this period relates to subjective versus objective interpretation of probability. According to objective interpretations, probabilities are real. We may discover them by logic or estimate them through statistical analyses. According to

subjective interpretations, probabilities are human beliefs. Holton (2004) argues that Knight's definition is, in fact, not a definition of risk. Holton details how risk entails both uncertainty and exposure and possible consequences. Knight's distinction addresses only uncertainty. His definition is based on a particular objectivist interpretation of probability. To Knight, probability is intrinsic to a proposition and depends only on necessary ignorance. It is interesting to compare Knight's (1921) and Keynes' (1921) theories regarding probabilities. According to Keynes, probabilities apply not to propositions but to pairs of propositions:

- One proposition is not known to be true or false,
- The other is the evidence for the first.

A probability, then, is a relationship between two propositions.

For economists, Knight's distinction parallels divisions between types of economic activity. His notion of risk (measurable uncertainty) conforms to many contingencies that are used by insurers. His notion of uncertainty (un-measurable uncertainty) conforms to many contingencies that confront entrepreneurs or speculators. Accordingly, economists have found it useful to embrace some form of distinction between measurable and un-measurable uncertainty. The validity or usefulness of such a distinction continues to be a topic of debate among economists. In another context, however, Knight's distinction is less relevant. In finance, according to Holton 2004, it has essentially played no role.

Portfolio theory is generally perceived as a body of models that described how investors might balance risk and reward in constructing investment portfolios. Interestingly, in his famous model for investment portfolios in 1952, Markowitz offered no definition of risk; he simply proposed the following rule: "... that the investor does (or should) consider expected return a desirable thing and variance of return an undesirable thing..." That is, in short, the highlight of Markowitz's views regarding risk. He simply stated that it is an "undesirable thing". Only toward the end of the paper did he note: "the concepts "yield" and "risk" appear frequently in financial writings".

Any general definition of risk may firstly consider outcomes and personal interest, and secondly, that people do not know what will happen - therefore in both situations the outcome is uncertain. It seems, according to most definitions therefore, that risk entails two essentials components:

- exposure;
- uncertainty.

Risk, then, is exposure to a proportion of which one is uncertain. In a generic definition (Holton, 2004) mentions, "risk is a condition of individuals - humans and animals - that are self-aware". Organizations, companies, and governments are not self-aware, so they are incapable of being at risk. Rather, they are conduits through which individuals - members, investors, employees, voters, and such - take risk. This fact of the input of human and non-human variables is rarely acknowledged in today's literature on financial risk management, which tends to

treat abstract things, such as companies as risk takers. Looking through a company to see who ultimately bears specific risks can be enlightening. The author comments that the subjective probability, utility, and state preferences are tools for characterizing the uncertainty and exposure components of risk. Such tools are limited by the fact that they apply only to those aspects of risk that are perceived.

Another important body of research in the field of risk and risk perception is that of behavioural finance. Paul Slovic's (2000) definition states that "*Risk is inherently subjective...human beings have invested the concept risk to help them understand and cope with the dangers and uncertainties of life... Even the simplest, most straightforward risk assessments are based on theoretical models, whose structure is subjective and assumption-laden and whose inputs are dependent upon judgement*". This links to Holton's (2004) point that risk is a condition of human beings that are self-aware. Therefore, it is important to consider human behaviour when studying, monitoring and managing risk. The Decision Research organisation demonstrates that a wide range of risk indicators may be reduced to two main risk constructs; these are "dread risk" and "unknown risk". Behavioural finance scholars find that people have a substantial anxiety or dread of risks whose severity, they judge, cannot be controlled - (consider people's attitudes towards the risks of terrorism, versus the risk of smoking). Unknown risk separates out between hazardous activities that are familiar, have been around longer and have immediate consequences, versus those risky actions that are unfamiliar, new and have belated causes. When humans make investment decisions, they perceive familiar scenarios to be less risky. Finucane (2002) commented, "perceived risk

was judged as greater to the extent that the advisor would worry about the investments, that the investments had greater variance in market value over time and how knowledgeable the advisor was about the investment option". Girgerenzer & Todd (1999) define familiarity as "to denote a *degree* of knowledge or experience a person has respect to a task or object". Therefore, familiarity bias is an inclination or prejudice that alters an individual's perception of risk. Gilovich (1981) finds that familiarity bias is found in the world of equity investing. For example, investors demonstrate a preference for investing in domestic stocks (familiar assets) rather than international stocks (unfamiliar assets). Gilovich (1981) also finds that portfolio managers have also demonstrated a tendency to invest money in local companies or stocks with recognizable brand names or reputations. Gilovich (1981) refers to this tendency as "home bias", and the recent IMA survey (2009) says that UK equity portfolios have 47% of assets is invested in the UK and a further 17% in Europe (so at home or close to home).

Ricciardi (2008) finds that various demographic characteristics can affect an individual's decision making towards risk. Well-established research finds that:

- Gender: men tend to be more risk seeking than women;
- Marital status: Single individuals tend to make riskier decisions than married persons;
- Age: Younger persons are inclined to be more risk seeking than older individuals;
- Level of education: A person with higher levels of education display a greater risk propensity or tendency to take risks;

- Financial Knowledge (Experience/Expertise): Individuals who believe they have more knowledge of risk and risky situations, tend to undertake greater financial risks.

For a review of the impact of manager characteristics on performance see, for instance, Chevalier and Ellison (1999). Importantly, behavioural finance literature on risk reminds us that risk would not exist without a human element. The failures of risk management in the recent financial crisis were down to humans, but humans must also fix them and therefore this needs to be taken into account for any meaningful risk measurement.

2.1.1 Common Measures of Risk

One cannot thoroughly discuss risk without discussing how it is measured and again, just as there is no absolute and agreed definition of risk, there is much debate on aspects of risk measurement. However, the two key measures of risk are VaR (“Value-at-Risk”) and Volatility. Both measures will be discussed in much more detail in the following chapters, however, it is necessary to include a brief introduction before we can continue to discuss risk management.

Volatility can be defined as the standard deviation of the returns of a portfolio over a given timeframe, and in practice, the words volatility and risk are often interchangeable (Litterman 2003). When, for example, we interchange volatility for the beta in the CAPM model, one can make assumptions about return based on the volatility of that stock/investment. However, Boguth and Kuehn (2009) find that “under the CAPM, individual stocks returns can exhibit non-trivial unconditional

skewness. Higher-than-expected volatility in times of high returns leads to a fatter right tail, or positive ex-ante skewness, while a negative covariance between shocks to asset volatility and returns leads to negative skewness". Munenzon (2010) in his analysis of the VIX (volatility index) finds that different VIX states result in very different risk-adjusted performance for all investment strategies. Herein lies the problem, or difficulty with volatility as a measure of risk; its value changes when the value of the investment changes, and it is only a retrospective measure.

DeMiguel et al (2010) investigate how information implied in prices of stock options can be used to forecast volatilities of stock returns. For example, they find that stocks with high volatility risk premia tend to outperform those with low volatility risk premia when using option implied information to estimate historical volatilities. Their empirical evidence shows that the portfolios where volatilities have been scaled using the volatility risk premium outperform the traditional portfolios in terms of Sharpe ratio and certainty-equivalent return, but with an increase in turnover.

Hsu & Li (2010) find that stock market volatility is not consistent over time, and that equity market volatility is time varying, as is the equity risk premium. Hsu & Li (2010) and Schwert (1989) note that volatilities for various risky asset classes tend to be lower in bull markets and higher in bear markets. This illustrates another problem with volatility as a measurement of risk Bear market returns generally exhibit up and down days, as investors tend to be eternally optimistic, which is often proved wrong. Indeed, swings are often larger in percentage terms too (given the reduced value of assets) leading to a higher volatility measure. Conversely, during bull markets, because the up and down price movements on a

daily basis become an ever smaller percentage of the asset value, volatility is lower. David and Veronesi (2009) state that “the relation between the volatility of stocks and bonds and their price valuations is strongly time varying”. David and Veronesi (2009) argue that the relationship between volatility and the macro economy is much more complex than the simple boom-bust business cycle variation. They find that volatility changes when the state of the economy changes, whether for the better or for the worse. Investors learn about the current state of the economy in terms of earnings and inflation, and act accordingly. When earnings or inflation change in a way they did not expect, their attitude to investments would change, which in turn causes an increase in volatility. Zhou and Zhu (2010) examine both the long-run and short-run volatilities in their model; their two-factor volatility model better captures macroeconomic volatility.

Engle and Rangel (2008) illustrate that despite our assumptions about volatilities and returns, there is still little examination of the relationship between the state of the economy and financial market volatility:

“After more than 25 years of research on volatility the central unsolved problem is the relation between the state of the economy and aggregate financial volatility. The number of models that have been developed to predict volatility based on time series information is astronomical, but the models that incorporate economic variables are hard to find. Using various methodologies, links are found but they are generally much weaker than seems reasonable.

For example, it is widely recognised that volatility is higher during recessions and following announcements but these effects turn out to be a small part of measured volatility” [Engle and Rangel (2008)].

According to Rossi and Timmerman (2010), despite over 20 years of empirical research, there is little consensus on the basic properties of the relationship between the equity premium and conditional stock market volatility. Breeden (1979) and Merton (1971) in the consumption and intertemporal CAPMs respectively, propose different measures of risk. Rossi and Timmerman (2010) build on these models to create a new measure of covariance risk that is based on the high-frequency business activity index developed by Aruoba, Diebold and Scotti (2009). Rossi and Timmerman (2010) find in their analysis using US stock return data that there is a positive trade-off between conditional volatility and expected returns at low or medium levels of conditional volatility, but that the relation becomes flat or even inverted during periods with high volatility. Put simply, the risk return trade-off does not hold true in periods of high market volatility.

Another measure of risk commonly used is Value-at-Risk; VaR.

VaR has proven very popular because the concept is so simple (Li , 2004), and indeed it is one of the most common ways to measure risk (Resti, Sironi, 2007). However, there has recently been an increasing call for the development of techniques to evaluate the quality of these models. The academic world and the financial community have thus started to wonder as to the quality of the risk measures generated by VaR models and their ability to correctly predict trading portfolio losses. Such questions are beginning to be of great interest to regulatory authorities. For example, the Basel Committee requires that VaR model should be

regularly back-tested to determine its relevant predictive ability as a pre-condition for using that same model to determine the market risk capital requirement.

VaR is an estimate of how much a certain portfolio can lose within a given time period and at a given confidence level. More precisely VaR is defined so that the probability that a portfolio will lose more than its VaR over a particular time horizon is equal to α , a pre-specified number. Put mathematically: X denotes a random variable with density function $f(x)$ and cumulative distribution function (cdf) $F(X)$.

Define the quantile $X(P)$ of X as the maximum value of X for which there is a probability of P to be below this value under the cdf of $F(X)$. Formally, the definition of $X(P)$ is: $\Pr(X \leq X(P)) = P$.

Value-at-Risk at $1 - \hat{P}$ confidence interval, $\text{VaR}(\hat{P})$, can be defined as the loss below some reference target, $\eta(F(X))$, over a given period of time, where there exists a confidence interval of $1 - \hat{P}$ of incurring this loss or a smaller one.

If $\eta(F(X)) = E(X) \equiv \mu X$, where μX is the expected mean of X , then the VaR is the loss below the expected mean, μX , and is denoted as VaRe. If a constant reference point, such as the risk free return or zero is selected, then it is denoted as VaRt.

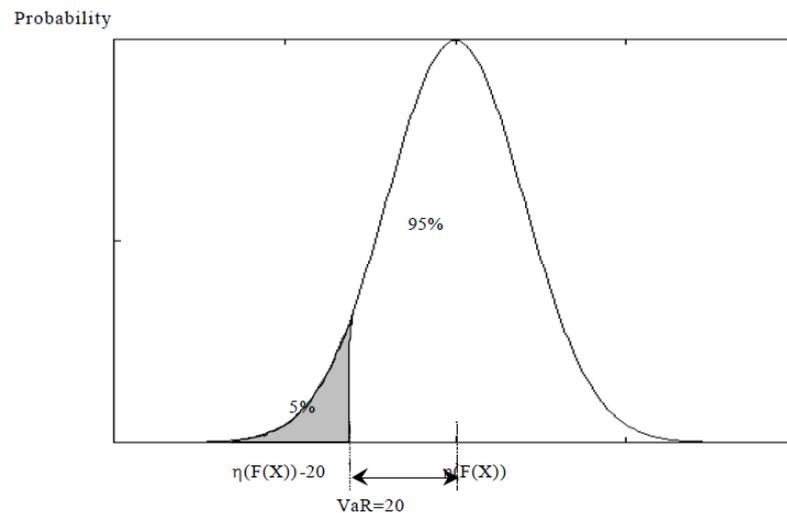
For example, a weekly $\text{VaR}_{t=0}$ of \$5 million at the 99 percent confidence interval means that there is a 1 percent probability of having a loss greater than \$5 million within the next week.

In terms of the quantile function, $\text{VaR}(\hat{P})$ can be written simply as:

$$\text{VaR}(\hat{P}) = \eta(F(X)) - X(\hat{P}) \quad (1)$$

VaR calculation involves two primary steps: First, derive the forward distribution of returns¹. Second, calculate the first \hat{P} percent of this distribution. Figure 1 illustrates this process.

Figure 1 – VaR process



Source: (Li, 2004)

In simple terms, VaR is an estimate of how much a certain portfolio can lose within a given time period and at a given confidence level. Because VaR is defined so that the probability that a portfolio will lose more than its VaR over a particular time

¹ In order to prove it is sufficient to provide an example. Suppose that X takes a value of either 10 or 20, each with a probability of 0.5. Similarly, Y takes a value of either 0 or 5, each with a probability of 0.5. It can easily be seen that any rational investor would prefer alternative X over Y ($\text{Min}(X) > \text{Max}(Y)$) $\Rightarrow Y \text{ D } X$. However, at a 50 percent or higher confidence interval ($\hat{P} < 0.5$), the VaRs of X and Y are given by: $\text{VaR}(X)=5$ and $\text{VaR}(Y)=2.5$, respectively. Hence, both the mean and the VaR of X are higher than the mean and the VaR of Y and according to the mean-VaR rule there is no dominance between the two alternatives.

horizon is equal to α , a pre-specified number, VaR plays in the tails of the distribution of returns. Danielsson et al (2006) reminds us that financial returns tend to exhibit fat tails, which makes preparation for those tail events even more pressing. Therefore, the best VaR models are those that model a realistic distribution of portfolio returns, exhibiting fat tails.

VaR estimates can be used for many purposes. The natural first field of application is risk management within portfolios. Setting position limits in terms of VaR can help management estimate the cost of its positions in terms of risk. This allows managers allocate risk in a more efficient way. Second, VaR can be applied to evaluate the performance of the risk takers on a risk/return basis. Rewarding risk takers only on a return basis can bias their behaviour toward taking excessive risk. Hence, if the performance (in terms of returns) of the risk takers is not properly adjusted for the amount of risk effectively taken, the overall risk of the firm may exceed its optimal level.

Most VaR models follow a similar structure: **1)** the portfolio is marking-to-market daily; **2)** the distribution of the portfolio's returns is estimated; **3)** the VaR of the portfolio is computed.

The ensuing portfolio models construct historical returns that mimic past performance of the current portfolio. From these historical returns, the current VaR is constructed based on a statistical model. Thus changes in the risk of a particular portfolio are associated with historical experience of this portfolio. Despite methodologies being similar they come up with varying results: Beder

(1995) applies eight common VaR methodologies to three hypothetical portfolios. The results show the differences among these methods can be very large, with VaR estimates varying by more than 14 times for the same portfolio. Clearly, there is a need for a statistical approach to estimation and model selection.

Extending from the simple measure of VaR are a number of variations that try to answer VaR's shortcomings. An extension of VaR is found when we consider VaRe (VaR with expected mean as a reference point) and VaRt (VaR with a constant reference point). Li (2004) discusses these VaR measures, which are summarised briefly below:

VaRe, is the VaR with expected mean as a reference point. This measure is appealing to investors as it simply quantifies the maximum loss below an expected mean value. Baumol's (1963) claim that "Investment with a relatively high standard deviation will be relatively safe if its expected value is sufficiently high" illustrates this point. Thus, he identifies the mean less k times the standard deviation as the subjective "confidence level" for the risk taken by the individual. Nevertheless, the main drawback of VaRe (as well as any other risk measure which is based on results below the mean) is that it is unaffected by a constant shift of the whole distribution (Atkinson, 1970). Because of this shortcoming, the Basel (1996) Amendment recommends calculating the VaR as the potential loss below the current value, i.e. VaRt.

AVaR (The Accumulate VaR), which is also known as Conditional-VaR or Mean-Shortfall, was introduced by Embrechts, Klueppelberg & Mikosch (1997), Artzner et

al. (1997, 1999), Basak & Shapiro (2001) and Longin (2001) and was further investigated by Uryasev (2000) and others.

According to Li (2004) “VaR measures assume that investors assess risk in a completely different process, in that the attitude toward risk is determined not only by the size of the loss but also by the probability of this loss to occur”. It is worth summarising other measures of risk in order to understand the complexity of the subject. The fact that there are so many different measures of risk also shows that there is a long way to go in finding the optimal risk management strategy for equity portfolios. Not only is there debate over how best to manage risk, but there are also many debates in academic literature on how best to measure risk. The following table by Kaplanski and Kroll, 2001 presents the mathematical expression for each measure, discusses their main properties and summarizes the main differences between them.

Figure 2 – Types of measures of risk

Type of measure	Index	The arbitrary elements	Main Drawback	*SD⇒ mean-risk		
Probability Dispersion	$SD = \sqrt{\int_{-\infty}^{\infty} f(x)(x-\mu_x)^2 dx}$		Accounts for positive dispersion	none		
	Entropy = $-\int_{-\infty}^{\infty} f(x) \ln(f(x)) dx$			none		
	Abs' Dev' = $\int_{-\infty}^{\infty} f(x) x-\mu_x dx$			none		
	Gini = $\frac{1}{2} \int_a^b \int_a^b R-r f(r) f(R) dr dR$			SSD		
	Co. Variation = σ/μ			none		
Probability of Dispersion Below a Target	Fishburn = $\int_{-\infty}^t (t-x)^\alpha dF(x)$	$\alpha \rightarrow 0$	Roy = $P(X \leq t) \leq \sigma^2 / (\mu - t)^2$	t	Ignores the size of loss	FSD
		$\alpha = 1$	D&M = $\int_{-\infty}^t (x-t) f(x) dx$	t	Prospects over a changing range of probabilities	SSD
		$\alpha = 2$	S-Variance = $\int_{-\infty}^t f(x)(x-t)^2 dx$	t		TSD
		$\alpha \rightarrow \infty$	WCS = $t - X(0)$	t	Ignores $0 < P \leq \hat{P}$ Ignores $P < \hat{P}$	TSD
	VaR	$VaR_t = t - X(\hat{P})$	\hat{P}, t	FSD		
		$VaR_\mu = \mu - X(\hat{P})$	\hat{P}, t	none		
		$AVaR = \int_0^{\hat{P}} VaR(p) dp$	\hat{P}, t	SSD		
		$AAVaR = \int_0^{\hat{P}} AVaR(p) dp$	\hat{P}, t		TSD	
	Baumol	Baumol = $\mu - k\sigma$	k	Ignores $X < \mu - k\sigma$	none	

Table 1: Summary of the most common risk measures, their main drawbacks and the relations in the general case between the mean-risk criterion using these risk measures and the Stochastic Dominance approach.

*The efficient set of the mean-risk criterion is a subset of the SD criterion (note that for the SD rules the following holds: FSD⇒SSD⇒TSD).

Source: Kaplanski and Krol (2000)

The majority of risk measures discussed so far assume a normal, symmetrical distribution of returns. However, in the general case positive deviations cannot be considered a source of risk. In the second group, risk is measured only by results below some reference point. Below we review the most common measures in each group.

The Standard Deviation Risk Measure is the most common risk measure in the dispersion group and is given by:

$$\sigma_x = \sqrt{\int_{-\infty}^{\infty} f(x)(x - \mu_x)^2 dx} \quad (17)$$

Many criticisms of the standard deviation as a risk measure have been published, mostly relating to its inadequacy with regard to the expected utility theorem (see for example Markowitz (1959), Mao (1970) and many others). Other dispersion measures include the coefficient of variation, which is simply the standard deviation divided by the mean and The Expected Absolute Deviations Risk Measure, which is given by:

$$AD = \int_{-\infty}^{\infty} f(x)|x - \mu_x|dx \quad (18)$$

Atkinson (1970) discussed this dispersion measure as a measure of inequality. More recently, Konno & Yamazaki (1991) developed a mean-Absolute Deviation optimization model, which utilized this risk measure.

The Gini Mean Difference measures the expected value of the absolute difference between every pair of realizations of the random variable and is given by:

$$\Gamma = \frac{1}{2} \int_a^b \int_a^b |X - x| f(X) f(x) dX dx \quad (19)$$

The mathematical complexity of this measure obscured the intuition behind it and discouraged its use.

An alternative to the dispersion measures of risk are the “below a reference point” risk measures. These only consider results in the lower part of the distribution, and are thus more appealing as risk measures to investors. This is because investors consider risk as what they could lose, rather than return that they hope to gain. In Fishburn's (1977) paper, he states that their attractiveness in the framework of the mean-Risk analysis is their ability to "recognize the desire to come out well in the long run while avoiding potentially disastrous setbacks or embarrassing failures to perform up to standard in the short run".

Most of the traditional important measures in this group are specific cases of Fishburn's α -t model, which is defined as:

$$\int_{-\infty}^t (t - x)^\alpha f(x) dx \quad (20)$$

where α describes different attitudes toward risk. Other risk measures in this group include Roy's (1952) Safety first Risk measure, Domar & Musgrave (1944) Markowitz's (1959) Semi-Variance (SV) Risk Measure, Boudoukh, et al's (1995) Worst-Case-Scenario measure, which can be written approximately as: $WCS=t-X(0)$, and: Baumol's (1963) measure, which is given by the expected return minus k times the standard deviation. This is when the parameter, k , is an arbitrary number which is supposed to reflect the subjective level of risk aversion. The larger k is, the higher this level is and the larger the Baumol efficient set is.

Despite the acceptance that there are several measures of risk, each with their own advantages and disadvantages, one must be aware that VaR risk measures are currently used for risk management purposes, and VaR measures of risk are at

least as good as other risk measures for decision-making purposes. However, VaR did not save portfolio managers from significant losses in the recent financial crisis. Using instruments that allowed them to trade volatility, another measure of risk, may have been the solution, as we discuss in the following chapters.

2.1.2 Types of Risk in the Portfolios

There are various types of risks within equity portfolios and factor models seek to explain risk by building on the variance/co-variance approach and adding explanatory structure in the form of different factors (Ross, 1986). There is great choice of explanatory variables, but they fall into two broad categories. The factors are typically either macro-economic or fundamental.

Macro-economic factors essentially try to model the sensitivity of equities and other assets as a function of economic factors. The most common factors are usually:

- interest rates (short-term, long-term, shape of the yield curve);
- currencies;
- inflation (consumer prices, producer prices, unit labor costs);
- commodity prices (oil, gold, indices); and
- output (gross domestic product, industrial production, retail sales, survey data, etc.).

Fundamental factors are generally based upon data derived from corporate accounts, and are felt by the investment community to be important factors that drive equity prices from time to time. Fundamental factor models express the riskiness of assets as a function of various styles and indices. The most common factors are usually:

- value vs. growth (price/earnings ratio, price-to-book, yield);
- the size (log market capitalization, 'blue-chip' effect);
- momentum/success (index out-performance, moving averages);
- forecasts/surprises (I/B/E/S expectations, earnings revisions); and
- the country or economic/industry sector effects.

Despite its undoubted popularity, this type of model is fraught with a number of serious problems. The models intrinsically lack flexibility; they do not respond well to changes in market conditions or to new variables that may drive prices. In most cases the factors simply do not match up to those that are used by the portfolio managers. There are a limited numbers of factors; different factors would require a completely new re-estimation of the model that often renders the exercise impractical. The factors are correlated, and therefore interpretation of the results, whilst it appears to be quite simple, is, in fact, extremely difficult. In the case of economic series, most economic series are highly correlated, and one runs into severe problems when including many factors. Frequently, meaningful data are not available on a consistent basis either across or within markets. Lately use of "big data" has been included in the analysis of risk within the portfolios.

2.2. What is risk management?

After studying the available literature regarding the concept and definition of risk, I will introduce the reader to what risk management is, taking into consideration the research and information available about the subject. Afterwards, in Chapter 3, I will analyse the risk management within the active European Equity Asset Managers.

According to Rebonato (2007) risk management is the discipline concerned with assessing the probability of and, most importantly, reacting and planning for uncertain events. By being aware of what could happen, one can be prepared for what action to take in that event. Having experienced the past couple of years in the financial markets, it is fair to say that many market participants were not particularly prepared and therefore their risk management was not as robust as many thought. In this thesis, we will focus on risk management with the objective of risk reduction and eventually with the possibility of trading risk to enhance portfolio returns. Risk reduction is only part of risk management; risk management has to be defined far more broadly to include actions that are taken by firms to exploit uncertainty (Damodaran, 2003). It is a complex and challenging concept as it implies much more than risk reduction. It is to identify and measure the risks taken, aggregate these risks in a measure of total risk, enable to eliminate, mitigate and avoid bad risks as well as to ensure that the risk level is consistent with its risk appetite (In any financial services' company, guaranteeing the risk management function plays an efficient and correct role is challenging because there are still many limitations in measuring risk). Limitations of risk measurement imply that setting appropriate incentives for risk takers and promoting an appropriate risk culture are essential. (Economic Policy Review, 2016)

In traditional portfolio theory, risk management is very straightforward, as the portfolio manager only has to choose the relative weights to be allocated to the tangency portfolio and to the riskless asset, respectively. However, reality is more complex and there are several frictions that do not allow the traditional portfolio theory to model risk. Therefore, risk management in Asset Management is a much

more central and complex part of Asset Management companies and is frequently independent from the management divisions of an Asset Management (Dangl, T., Randl, O. and Zechner, J., 2014).

Active and passive portfolio managers have different models to manage risk. Passive portfolio managers can follow the traditional portfolio theory where each asset's risk will be measured by a constant beta for each of the risk systematic factors while for an active portfolio manager the position's marginal risk contribution depends on the portfolio weights in addition to the covariance matrix. (Dangl, T., Randl, O. and Zechner, J., 2014).

The Asset Management has a strong influence over the financial markets and the populations' wealth due to the increasingly amount of savings for retirement as pension funds or mutual funds. Therefore, it is of the utmost importance that Portfolio Managers monitor and control their risks in order to guarantee the welfare of the societies. (Dangl, T., Randl, O. and Zechner, J., 2014).

The recent financial crisis and the following sovereign debt crisis have demonstrated the limitations of the risk management in the Asset Management Industry. These market events lead to an enhancement of risk monitoring and controlling within all industry. Downside protection's strategies that were used until the recent years ended up being too expensive during volatile periods and there was a clear need to develop risk management concepts. However, according to Dangl, T., Randl, O. and Zechner, J., 2014, risk management for long-term investor is still in an early stage, supporting this research's findings.

This agrees with my findings from Chapter 3, making them relevant in current risk climate. The researcher found that only 20% of the Portfolio Managers in the sample use their risk management system on a daily basis and there are still 22% that only use their risk systems quarterly. Furthermore, the survey proved the lack of commitment that most Portfolio Managers had with the risk department. Generally, the conducted survey shows that the hedge fund industry is better prepared and more diligent in terms of risk management.

While most risk models agree that risk comes from the distribution of actual returns around the expected return and that risk should be measured from the perspective of a marginal investor, who by definition should be well diversified, they part ways when it comes to measuring non-diversifiable or market risk. The risk and return model that has been in use the longest, and is still the standard in the practitioners' world, is the capital asset pricing model (CAPM) (Sharpe, 1964; Lintner, 1965; Mossin 1966). It assumes that there are no transaction costs, that all assets are traded, investments are infinitely divisible (i.e. you can buy any fraction of a unit of the asset) and that everyone has access to the same information. Making these assumptions allows investors to keep diversifying without additional cost. At the limit, their portfolios will not include every traded asset in the market but will have identical weights on risk assets - which then would be called the market portfolio. The risk of a stock becomes the risk that it adds on to the portfolio. This, in turn, is measured with a beta, measured against this portfolio:

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f)$$

where,

$E(R_i)$ = Expected Return on asset i

R_f = Risk-free rate

$E(R_m)$ = Expected Return on market portfolio

β_i = Beta of investment i

In the CAPM, all market risk is captured in the beta, measured relative to a market portfolio, which, at least in theory, should include all traded assets in the market place held in the proportion to their market value.

The restrictive assumptions on transactions costs, private information in the capital asset pricing model and the model's dependence on the market portfolio have long been viewed with scepticism by both academics and practitioners.

Like the CAPM, the arbitrage-pricing model begins by breaking risk down into firm specific and market risk components. As in the CAPM, firm specific risk covers information that affects primarily the firm. Market risk affects many or all firms and would include unanticipated changes in a number of economic variables. Unlike CAPM, the arbitrage-pricing model allows for multiple sources of market-wide risk and measures the sensitivity of investments to changes in each source. Therefore, with n market risk factors, the expected return on an asset can be written as:

$$E(R_i) = R_f + \beta_1[E(R_1) - R_f] + \beta_2[E(R_2) - R_f] + \dots + \beta_n[E(R_n) - R_f]$$

where:

R_f = Expected return on a zero-beta portfolio

β_j = Sensitivity of the asset to market risk j (j=1,2,...n)

$E(R_j)$ = Expected return on a portfolio with a factor beta of 1 for a factor j and zero for all other factors.

A major downfall of the CAPM model is that it assumes stock returns exhibit a smooth variation typical of a Gaussian distribution.

The terms in the brackets can be considered the risk premium for each of the factors in the model. However, several authors (Chernov et al (2003), Eraker et al (2003) and Huang and Tauchen (2005)) observe that stock returns exhibit jumps. These jumps arise for a number of different reasons. If jumps are broadly systematic, unpredictable, and highly correlated, as in the recent crisis, diversification provides little solace for even the most-diversified portfolio (Pukthuanthong and Roll (2009)). It is in this area that the researcher wishes to examine ways for ameliorating losses in equity portfolios.

Multi-factor models are estimated using historical data, rather than economic modelling (Damodaran, 2003). Once the numbers of factors has been identified in the arbitrage-pricing model, their behaviour over time can be extracted from the data. The behaviour of unnamed factors over time can be compared to the behaviour of macroeconomic variables over the same period to see whether any of the variables is correlated with the identified factors (Chen, Roll and Ross 1986).

Basak, Shapiro and Tepla (2005) mentioned that portfolio theory must address the fact that in reality portfolio managers are evaluated relative to a benchmark and, therefore, adopt risk management practices to account for the benchmark performance. The authors capture this risk management consideration by allowing a pre-specified shortfall from a target benchmark-linked return, consistent with growing interest in such practice. In a dynamic setting, the authors demonstrate how a risk averse portfolio manager optimally under or over performs a target

benchmark. Risk management with benchmarking, when shortfall is allowed, leads to a rich variety of investment behaviours. In the absence of benchmarking, a normal manager's optimal policy is driven by his risk tolerance, which reflects the sensitivity of the normal policy to changing economic conditions.

2.2.1 Factor Models in Practice

There are different kinds of BARRA models, and it should be noted that most pension/mutual fund managers will have an equity benchmark against which their risk and performance is measured.

The expected deviation in returns from such a benchmark is expressed as a volatility number, and termed tracking error or active risk. Benchmarked long-only funds will typically hold somewhere around 30-70 stocks from an investment universe based on the benchmark. Their active risk will be estimated as a percent, for example, 4%, suggesting that the expected deviation (within 95% probability band) is +/-8%. This will be different to the portfolio's total risk, which may be around 20% (similar to that of the benchmark).

In the case of benchmarked portfolios, almost all attributes are measured relative to the benchmark, with a term 'active' preceding the name. For example, an 'active beta' of 0.1, will denote a portfolio with a beta of 1.1. An 'active exposure of +5% to Germany' will denote a portfolio that holds 5% more in German stocks than the benchmark.

The pattern of stock price movements is affected by many fundamental factors, which are common across a broad set of securities. Barra multi-factor risk models measure asset's sensitivities to these factors, e.g. market conditions and fundamental data, in order to forecast risk and segregate its common factors from the sources of asset-specific risk. Barra Models enable fund managers to rank securities and find trends in the marketplace, according to the quantified ex-ante

risk. They can also represent a valid instrument when running pre-trade “what if” scenarios and simulations to evaluate the trade-off between risk and return. In addition to this, “tilt” active strategies may be developed using the common factors identified by the Barra models.

The first multi factor risk models have been launched in 1970s, followed in 1990s by the launch of Barra Aegis and GICS®, a standardized classification system for equities. In the 2000s Barra and Morgan Stanley Capital International (MSCI)² merged their operations. Actually, MSCI is a leading provider of support tools for investment decisions worldwide and the first provider of multi-factor risk models. Multiple-factor models have become primary tools for forecasting and analysing portfolios’ risk. Today, Barra models are one of the most powerful tools of risk management in the world.

The standard form of a multi-factor model is the following:

$$r_j = x_1 f_1 + x_2 f_2 + x_3 f_3 \dots + x_k f_k + u_j$$

where x_i with $i=1, 2\dots k$ measures the asset’s exposure to the relative factor i whose return is denoted as f_i . The error term of the regression measures the asset’s specific return. As mentioned, the fundamental risk model will assume some ex-ante structure to forecast volatility. It will do so by setting the exposures of securities (x_i) to the systematic risk factors (f_i). It will also determine the number of factors (x_i) ex-ante. So for example, X may be a matrix of exposures to

² “MSCI is a leading provider of world-class, mission-critical investment decision support tools to financial institutions worldwide, with over 40 years of experience, 2000 employees, in 19 countries and around 5800 clients worldwide”. Manghani R., Ruban O., (2013), “Best Practices in Risk Management”, MSCI.

Industry, Country, and the security's liquidity, size or status as a value stock for example.

Given the factor structure X , and the exposures, the cross-sectional regression is estimated on a regular basis (daily usually) to estimate f_i . Clearly, the f_i , or factor returns, are highly dependent on the regression structure, estimation, and potential bias. Once the factor returns are estimated daily, they are cumulated into a time-series to create the factor returns of the model. The stock-specific returns (u_j) are also saved, and used later to calculate the stock-specific volatility of an individual security.

These returns are subsequently used to estimate the factor covariance matrix as denoted by:

$$F_{k,m} = Cov [f_k, f_m]$$

where k, m are the common factors. This variance-covariance matrix is at the heart of the fundamental factor model. It is calculated with some care, as usually the half-life for the volatility estimates (the diagonal of the matrix) will differ from the correlation (off-diagonal) elements, to reflect the faster changing volatility structure versus the 'long-term' correlation that the model is hoping to capture. The correlations (and covariance) between factors are the only mechanism that individual securities can achieve correlated returns. It is also the key vulnerability in the model for when market are in distress, and correlations change rapidly.

An important component of the Barra risk models is the amount of data cleaning and servicing that must take place. Firstly, a model must identify a relevant investment universe. This is particularly important, as a very broad investment

universe will have different kinds of firms (usually smaller cap) that may affect the regression based factor returns. Secondly, the model must identify the X, or the ex-ante exposures that it thinks drive the risk of securities.³ The objective of this step is to identify the variables, “descriptors”, which most effectively can partition risk. A test for their statistical significance is made in order to best capture the assets’ risk profile. Descriptors are then standardized and collected into relevant combinations. The standardisation itself is fraught with danger, including missing data, outliers, and the need to normalise across what is usually an extremely broad investment universe. Finally, risk-models by design choose those descriptions for which they have many data across the entire investment universe. While some factors may be particularly good at describing risk, if the data is sparse across all stocks, they will often not be used, instead replaced by those where data is readily available. In the past, models have used composites (across 3-4 different metrics) to get around this problem.

Once the statistical estimation is done, the model is back-tested against alternative models and continuously updated to reflect changing trends and new information with the most recent fundamental and market data. The final model released will often be ‘fitted’ to historical data, and be the best forecaster of risk for a historical time-range. This itself is a kind of ‘model-selection’ bias.

There is clear evidence that Barra Equity Models play a relevant role in supporting managers' investment decisions. The wide range of products offered allows investors to create optimal portfolios and select assets, choosing the desired

³ MSCI, “Barra Risk Model. Handbook”, Sect. 2, Ch. 3 “Barra Equity Risk Modeling”.

investment risk profile. Managers and investors' requests, together with their remarks and feedback, allow the MSCI to better tailor the most recent versions of their Barra Equity Models to any particular investment mandate.

The MSCI, notwithstanding the accuracy and the explanatory power of the models, provides constant improvements in order to enhance their efficiency and flexibility. One of the last notable examples has been the enlargement of the MSCI products to Stochastic Multifactor Models, which adopt non-fundamental analysis as a base for their estimates.

2.2.2 Risk Management Process

In Chapter 3, I will be reviewing the adequacy of risk management process in the active European Equity Funds. In this section, I will introduce the reader to what is considered a good risk management process to help my further analysis in Chapter 3.

According to Martellini (2010) investors require risk management. The *raison d'être* of the investment industry is not to generate alpha or design complex structured products, but is to serve investors' needs by helping them find solutions to their problems. This involves meeting long-term objectives in the presence of short-term constraints.

Risk management can provide:

- Diversification: design improved performance-seeking portfolios;
- Hedging: neutralizing impact of risk factors in liability streams;

- Insurance: maximizing upside subject to short-term constraints.

According to Bender and Nielsen (2009) a successful investment process requires a risk management structure that addresses multiple aspects of risk. The authors mentioned that the latest recession (2008/2009) brought risk management to the forefront and highlighted the need for guidance on best practice for investors. Asset managers were surprised by the violent market moves during this period. Some have argued that risk management practices failed when they were needed most, and with multi-sigma events extending across formerly uncorrelated asset classes, investors have questioned the very meaning of the term “well diversified portfolio” (Bender, Nielsen, 2009). Bender and Nielsen (2009) mention that there are 3 main guiding principles when considering best practices in risk management:

1) “Risk management is not limited to the risk manager”. Anyone involved in the investment process, from CIO to the portfolio managers, should be thinking about risk. It should become part of the firm’s culture, especially when managing investment decisions;

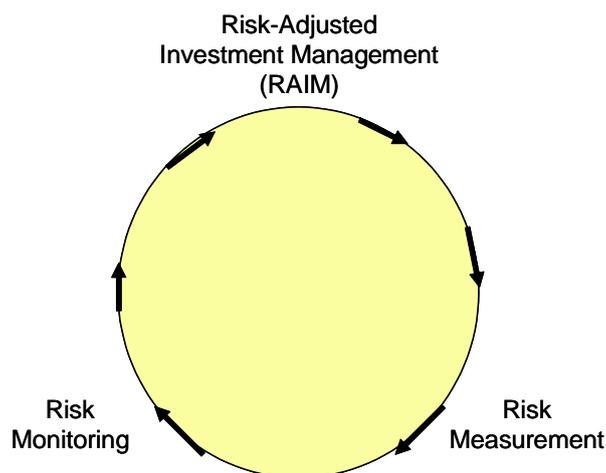
2) “If you can’t assess the risk of an asset, maybe you shouldn’t invest in it”. For institutions invested in alternative asset classes, such as private equity and hedge funds, or those who have exposure to complex instruments, such as derivatives and structured products, the risk management requirements have greatly increased. These investors need a framework for managing risk that far exceed what was required for the plain vanilla stock and bond investing that prevailed only ten years ago. Bender and Nielsen (2009) argue that one should assess one’s risk

management capabilities before making the decision to invest in certain asset types;

3) “Proactive risk management is better than reactive risk management”. Being prepared for unlikely events is perhaps the most important lesson learned from the recent crisis. This applies to both market risk and non-market risks such as counterparty, operational, leverage, and liquidity. This relates again to point 1); A risk management culture should run through the veins of each member of the firm so they can identify non-market risks as well.

The authors mention 3 main pillars of Risk Management:

Figure 3 – 3 main pillars of risk management



Source: “Best Practices for Investment Risk Management” - Jennifer Bender and Frank Nielsen, June 2009

Bender and Nielsen (2009) lay out a best practice framework, as illustrated in the above exhibit, that rests on 3 pillars: risk measurement (using the right tools accurately to quantify risk from various perspectives), risk monitoring (tracking the output from the tools and flagging anomalies on a regular and timely basis) and risk-adjusted investment management (uses the information from measurement

and monitoring to align the portfolio with expectations and risk tolerance). All three are critical.

In the figure below, we see examples of stress tests that can uncover potential weaknesses within a portfolio. If we incorporate these stress tests into our risk scenario analyses, we may be able to prevent losses should these shocks occur.

Figure 4 – Stress Tests Uncover Possible Weaknesses in the Portfolio:

I. Systemic Shock: <ul style="list-style-type: none">- liquidity shock- leverage shock
II. Macro shock: <ul style="list-style-type: none">- interest rate shock- oil price shock
III. Market wide shock: <ul style="list-style-type: none">- market wide decline in equity prices
IV. Target shock <ul style="list-style-type: none">- U.S. value stocks hit- Japan Growth stocks hit

Source: "Best Practices for Investment Risk Management" - Jennifer Bender and Frank Nielsen, June 2009

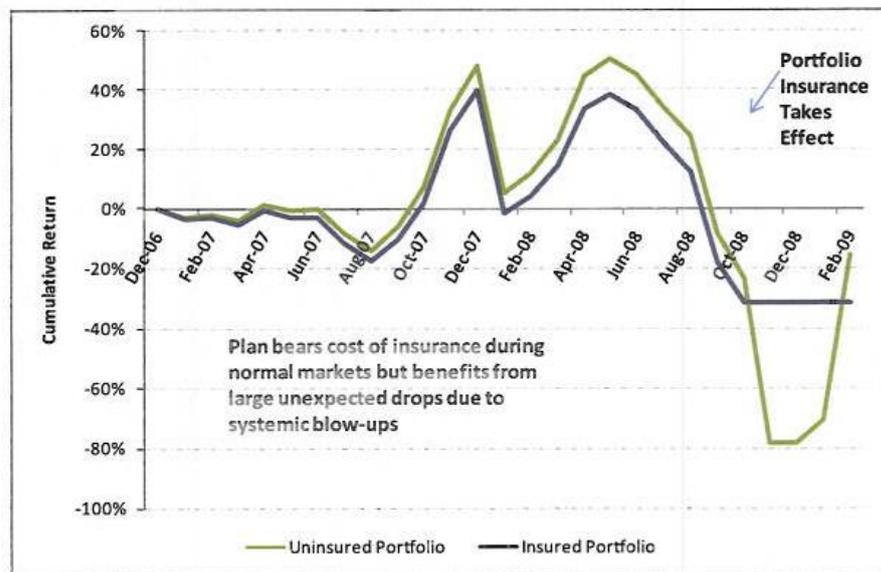
Bender and Nielsen (2009) state that a thorough analysis of the sources of risk, which may include market risk, sector risk, credit risk and interest rate risk amongst others, requires portfolio decomposition along various characteristics or exposures via a factor model. This model can stress test the portfolio to assess the impact of large and rare events.

In their explanation of Risk-Adjusted Investment Management (RAIM), Bender and Nielsen (2009) point out that risk monitoring requires the necessary IT and infrastructure resources for support and that “Delays in a risk manager’s ability to view changes in holdings, prices, or characteristics are often caused by infrastructure limitations”. In sum, institutions should consider the costs of implementing the necessary risk management systems when they decide in which assets to invest.

RAIM, when implemented firm wide, may have prevented losses seen across the board in equity portfolios. It would have allowed hedges to be implemented well ahead of the crisis. Admittedly, this would have dampened returns pre-crisis, but one only has to glance at the figure below to see the losses it could have eliminated.

Figure 5 illustrates a successful market hedge that includes just a simple stop-loss strategy plan at a point when assets drop below a specified level.

Figure 5 – Risk-adjusted investment management to protect against downside risk



Source: Bender, Jennifer; Nielsen Frank; “Best practices for investment risk management”, 2009 – MSCI Barra Research Insights

All three pillars - Risk Measurement, Risk Monitoring, and RAIM - are indispensable to a complete risk management structure. Figure 6 summarizes the three pillars, illustrated with specific examples. The chart uses the same idea presented before, namely, that risk measures can be categorized by normal and extreme times and relative versus absolute investment objectives. The objective of our first empirical chapter is to test if asset management firms during crisis period really stick to those three principals outlined by Bender and Nielsen (2009).

Figure 6 – Three pillars of the risk management

	Risk Measurement	Risk Monitoring	RAIM
N o r m a l	Volatility	Monitor sources of volatility	Limited exposure to biggest sources of volatility
	Tracking Error	Monitor sources of tracking error	Limited exposure to biggest sources of tracking error
E x t r e m e	Stress tests / Tail risk measures	Monitor expected shortfall of the total plan	Implement portfolio insurance plan
	Stress tests / Tail risk measures	Monitor expected shortfall of the total plan	Ask managers to limit exposures to certain sources of risk

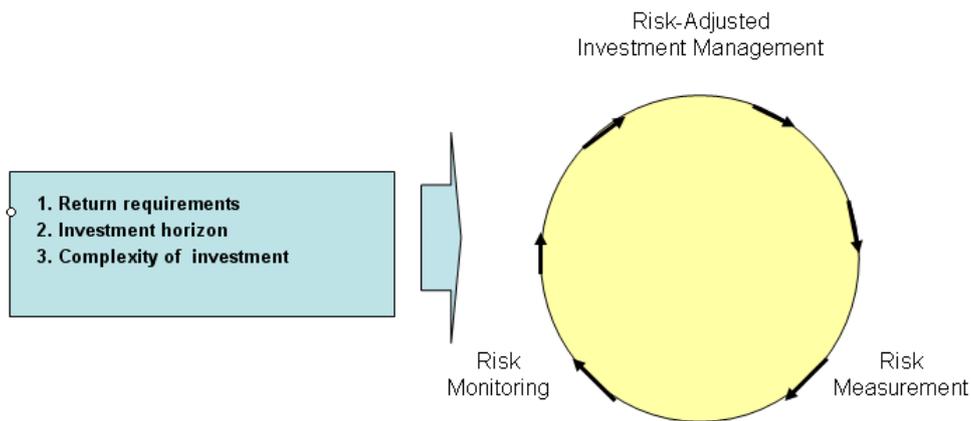
Source: Bender, Jennifer; Nielsen Frank; "Best practices for investment risk management", 2009 – MSCI Barra Research Insights

2.3. Why is risk management important?

Besides understanding the definitions and concepts, it is quintessential that the reader understands the use and importance of risk management within the companies. Therefore, in this sub-chapter I will introduce the reader to the significance of the subject for the functioning of an Asset Manager.

In practice, the needs of institutional investors and hedge funds can be wide ranging, and their ideal measurement, monitoring, and managing capabilities will differ. (Bender, Nielsen 2009) illustrate the case of a hypothetical but typical US plan sponsor. Although there may be additional criteria, the three critical drivers of risk management requirements are shown in Figure 7.

Figure 7 – Critical drivers of risk management:



Source: Bender, Jennifer; Nielsen Frank; "Best practices for investment risk management", 2009 – MSCI Barra Research Insights

(1) **Return Requirements:** The plan's liabilities or expected payouts will influence not only the assets in which it invests but also which benchmarks are used and how much it can lose over certain periods. The latter, in turn, may drive how much risk it is willing to take and with how much exposure to certain sources of return/risk it is comfortable taking.

(2) **Investment Horizon:** The plan's investment horizon, or willingness to sustain shorter-term shocks, will influence which risk measures are appropriate and how frequently they need to be monitored.

(3) **Complexity of Investments:** Plans that invest in difficult-to-value assets with potentially non-normal return distributions or unusually high exposure to tail events require additional risk measures, higher monitoring frequencies and advanced RAIM capabilities.

The importance of risk management can be wide spread across different aspects of the overall business. However, within asset management the importance of managing the risk becomes evident when equity portfolios returns are maximized by using different hedging strategies.

As an example, Judge (2006) mentions that within the corporate world hedging literature over the last decade has grown rapidly, motivated firstly by the development of a theoretical framework and secondly by the availability of public data. Much of the early research in this area sourced data on hedging practices by surveying corporate risk management practitioners, such as corporate treasurers, finance directors and financial managers. Recent developments in accounting standards regulation resulted in an increase in the quantity of risk management data and an improvement in the quality of data disclosed in financial statements. These developments have acted as a catalyst and facilitated the recent growth in empirical studies (e.g. Goto and Xu 2010). However, within corporate finance the existing evidence provides mixed support for the theories of hedging. The author argues that the lack of a general consensus might be due to biases in the samples of some studies or that country specific institutional factors play an important role. Whichever it is, one thing is certain, existing research has only touched the surface and many unresolved issues remain. To support the case for why risk management is important one has to support the case of why hedging is important. As such, we need to define and measure hedging: hedging can be defined as putting in place measures that actively modify your potential losses, should the risk event we fear happening take place. Put simply, hedging is insurance against potential loss. The ability to identify which firms hedge and which do not, and for those that hedge, the extent to which they hedge, is vital if reliable tests of hedging theories are to be undertaken. The empirical examination of hedging theories has been hindered by the general unavailability of data on hedging activities. Until recently, information on a firm's exact position in hedging and its methods of hedging (for example, use of derivatives) was closely guarded because it was

deemed to be of strategic importance to that firm. It is only in the last few years that firms have been encouraged to disclose information on their hedging policies and their methods of hedging in their annual reports. In the absence of this information, most of the earlier empirical studies used survey data to examine the determinants of corporate hedging (Nance, Smith and Smithson (1993) and Dolde (1995)). In these studies, authors surveyed firms, asking respondents whether their firm used derivative instruments. As disclosure of hedging practices in financial reports improved, several studies began to search reports for qualitative disclosures. They then defined hedgers as firms whose reports included references to terms such as “hedging” or “risk management” or “derivatives” or to particular derivative instruments such as “interest rate swaps” or foreign currency derivatives” (Francis and Stephan (1993), Wysocki (1996), Mian (1996)).

Parallels can be analyzed when comparing why firms hedge and why portfolio managers hedge. One of the main reasons why risk management is important is a consequence of an incorrect assumption by the majority of investors that the purpose of risk management is to minimize risk (Litterman, 2003). In fact, many investors even go so far as to worry that too much focus on risk management will constrain their portfolio managers and inhibit their ability to generate positive returns. According to Litterman (2003), in an equity portfolio risk is necessary to drive return. The purpose of the risk management function is not to minimize risk, but rather to monitor the level and sources of risk in order to make sure that they match expectations. In fact, an investor with strong risk management controls ought to feel comfortable targeting and maintaining a higher overall level of risk, thus leading to higher, rather than lower, returns over time. According to Litterman

(2003), portfolio managers need to address three main considerations within their risk components: **1)** country/sector/large, mid, small capitalization/high, low beta **2)** risk objectives and **3)** the long-run rate of return of the portfolio. These components are critical in defining its risk profile. Nonetheless, risk created the capacity for losses, and along the path to long-run returns, there will be painful bumps and losses of capital that will cause any investor to question the plan. One critical role that risk management can play in generating long-run returns is to provide comfort in such situations that a portfolio remains in adherence to the long-run plan. This could mean that an investor does not lose confidence and overreact to short-term market fluctuations. The importance of risk management is paramount for the performance of equity portfolios; a useful way of thinking of risk in a portfolio (Litterman, 2003) is to view it as a scarce resource. Just as a family must budget its expenditures against income, a portfolio manager must budget the risk within the portfolio relative to his/her ability to accommodate losses. As consequence of the characteristics/objectives of the equity portfolio, some investors in these portfolios must budget their ability to take losses and volatility within the returns and then not overreact to short-term market fluctuations. If we compare portfolios within different asset management companies, but within the same family of funds, we see substantial differences in the average risk taken, expressed by different levels of tracking errors. If we now compare the risk within equity portfolios to risk within a typical retail investor we can observe that over the course of their lives, many investors show a typical pattern of increasing ability to take risk as they increase their level of savings, followed by decreasing risk as they retire and draw down those savings (Chai et al 2010; Marekwica et al 2010). However, after accounting for differences in circumstances, age, country, taxes,

and other measurable characteristics, there is a strong component of tolerance for risk taking that simply depends on the preference of each individual.

Additionally, according to “Top issues facing asset managers” by Price Waterhouse Coopers in April 2012, risk management has been gaining significance in the last decade. As corporate culture is an important factor in financial failure/error/misunderstandings, when risk management becomes a relevant part of a company’s culture, it can help unmask the company’s weak spots, no matter the types. Since no corporation has the sufficient resources to manage risk perfectly, risk priorities work as a mirror of corporate values (Economic Policy Review, 2016).

The volatile markets of this century had a strong impact on asset management governance, with risk management programs subject to increased scrutiny by all the stakeholders. The most recent financial crises caused deep reflection on the effectiveness of risk management in the asset management industry: the economic uncertainty, the correlation between the different markets and the convergence of many risk factors resulted in the need for a more proactive, transparent and adaptive approach to risk management. Besides the new regulatory requirements, investors became more risk averse, expecting quality governance, processes and controls, as well as a greater transparency about the institutional risk management practices. There is a growing pressure for transparency and disclosure of information, which led the asset managers’ directors to have a greater insight of the compliance programs as well as guarantee the independence of the risk management and compliance teams within their firms. Risk management is

becoming an increasing concern and requires a continuing effort to identify, assess and monitor risk. In accordance with PwC's study, we will show in Chapters 3 and 4 that both traditional and alternative asset managers are adapting and refining controls and risk management strategies in response to investors and regulatory needs. Asset managers are increasingly looking to improve their risk management programs in order to extend their analysis to emerging or improbable risks. They are also monitoring internal and external risk factors to plan appropriately risk mitigation strategies. PwC adds that asset managers will maintain the focus on strengthening the links between risk, regulation and business strategies (Price Waterhouse Coopers, 2012⁴).

2.4 Utility Theory

Chapter 4 of this thesis investigates the degree of risk aversion of different investors (Pension Funds, Family Offices and Intermediate Financial Advisors). Hence, in this section I will introduce the reader to the concept of utility theory from which the concept of risk aversion is derived.

2.4.1 The Importance of Utility Theory

Modern utility theory is considered the “workhorse of modern economics” (Levin, 2006) because it measures the satisfaction (or *utility*) that one gains from consuming one more unit of a good or service. The utility concept is important because it allows economists to determine how much of an item one will consume and this is directly linked to the behaviour of the investors.

⁴ <http://www.pwc.com/us/assetmanagement>

Among the Asset Managers, many Portfolio Managers deal with the utility concept on a daily basis when evaluating potential investments, either by computing expected values with scenario analysis or by weighting the risk budget. For professional investors, risk aversion is more than a theoretical concept, it is a practical reality that contains much information and insight. This concept was visible during the results of the surveys in Chapter 3 and 4 in which we found the perception towards risk similar by the investors similar to the Utility concept. The original Expected Utility of Von Neumann-Morgenstern (VNM) has obvious limitations and it has been often criticized. In the last part of this section, we will underline some of the critics and alternative approaches in response to the VNM model. However, it is important to underline here that the work of Von Neumann-Morgenstern still remains the base of modern utility theory.

2.5 Utility Theory vs. Expected Value: The Saint Petersburg Paradox

Historically, the first concept of utility function goes back to 1783 with Daniel Bernoulli. Bernoulli proposed a utility model to overcome the classic Saint Petersburg paradox and the simplicity of the expected value approach (Schoemaker, 1982). The paradox is as follows: In a casino with unlimited resources, the decision maker pays a fixed amount of money to enter a game where a fair coin is tossed repeatedly until the first tail appears, ending the game. The pot starts at 1\$ and is doubled every time a head appears. When the first tail appears, the game ends and the decision maker wins whatever is in the pot. If we apply the expected value (EV) calculation:

$$\begin{aligned}
E &= 12 * 1 + 14 * 2 + 18 * 4 + 116 * 8 + \dots \\
&= 12 + 12 + 12 + 12 \dots \\
&= K = 1 \text{ ¥ } 12 = \text{ ¥ }
\end{aligned}$$

The expected value is infinite and has no upper limits. According to pure EV maximization, the decision maker should be ready to pay any fixed fee to play the game, but reality is different and very few people will pay any amount of money to participate in the game. To solve the problem, Bernoulli introduced an expected utility formula that takes into account risk preferences of the decision makers to correct the limitless expected value. Bernoulli's initial utility function is a strictly concave $\ln(x)$ where x is the expected payoff. The function gives a finite number and assumes decreasing marginal returns. As such, a rational person will refuse to play the lottery after a certain limited fee as the marginal utility of winning the game decreases even as the money payoff increases (Schoemaker, 1982).

2.6 Expected Utility Theory

Expected Utility Theory forms the basis of modern financial theory. It is critical therefore to have a broad view of the topic in its original form and relate this theory to the results gathered in both empirical chapters. The way utility functions measure individual preferences in uncertain decisions under wealth constraints is cardinal to portfolio optimization problems. Indeed, Expected Utility had a major impact on Markowitz modern portfolio theory (Levy and Markowitz, 1979) and his work starts from the approximation of a Von Neumann-Morgenstern utility function by a function of mean and variance.

John Von Neumann and Oscar Morgenstern formally developed modern utility theory in 1944. In their classic book *Theory of Games and Economic Behaviour*,

they develop the expected utility model as a side note to games theory. The approach of the Von Neumann and Morgenstern model is axiomatic. If an individual satisfies 4 axioms of rationality then the outcomes of a game of choices can be ranked accordingly to a utility function $u(x)$ based on the individual's preferences under uncertainty.

The model starts out with a set of possible prizes (monetary or otherwise). The prizes are associated with uncertainty and a set of lotteries/probability distributions. To rank the possible outcomes of a lottery P we need a utility function (Levin, 2006):

A utility function $U: P \rightarrow R$ has an expected utility form (a Von Neumann-Morgenstern utility function) if there are numbers (u_1, \dots, u_n) for each of the N outcomes (x_1, \dots, x_n) that for every $p \in P: U(p) = \sum_{i=1}^n p_i * u_i$. The VNM utility function U is based on mathematical expectations (Norsworthy et al, 2003).

2.6.1 The Von Neumann-Morgenstern axioms

The VNM model specifies 4 axioms that set limits to an individual's preferences over pairs of uncertain lottery outcomes.

1st Axiom: Completeness

For any choice of probability distributions p_1 and p_2 , either p_1 is preferred to p_2 ($p_1 \succ p_2$), p_2 is preferred to p_1 ($p_2 \succ p_1$), or the individual is indifferent between p_1 and p_2 ($p_1 \sim p_2$). This is considered the basis of rationality assumption.

2nd Axiom: Transitivity

For any choice of probability distributions p_1 , p_2 and p_3 , if $p_1 \geq p_2$ and $p_2 \geq p_3$, then $p_1 \geq p_3$.

3rd Axiom: Continuity

A preference relation \geq in the set of lotteries P is continuous if for any p_1 , p_2 and $p_3 \in P$ with $p_1 \geq p_2 \geq p_3$ there exists some $\alpha \in [0, 1]$ such that: $\alpha * p_1 + (1 - \alpha) * p_3 \sim p_2$. If the first three axioms are valid and preferences are complete, transitive and continuous, then the set of choices for each individual can be represented by a utility function $U: P \rightarrow R$ where $p_1 \geq p_2$ if and only if $U(p_1) \geq U(p_2)$.

4th Axiom: Independence

While the first 3 axioms can be accepted as reasonable, the axiom that really defines the VNM original theory and has been the centre of many critics is the 4th axiom of independence. It states that preferences hold independently of the probability of a different outcome:

A preference relation \geq in the set of lotteries P is independent if for any p_1 , p_2 and $p_3 \in P$ and some $\alpha \in [0, 1]$, the following relationship is true: $p_1 \geq p_2$ and $\alpha * p_1 + (1 - \alpha) * p_3 \geq \alpha * p_2 + (1 - \alpha) * p_3$. Therefore, if I prefer p_1 to p_2 then I will also prefer the possibility of p_1 to p_2 given that the other possibility in both cases is some p_3 . This axiom is also called the “substitution axiom: The idea that if p_3 is substituted for part of p_1 and p_2 , this shouldn't change my ranking” (Levin, 2006).

Interestingly, in standard consumer theory, there is no independence axiom. If I prefer {2 oranges, 0 apples} to {0 oranges, 2 apples}, this doesn't mean that I prefer {2 oranges, 1 apple} to {1 orange, 2 apples}, even though the last two are averages of the first two choices with {2 oranges, 2 apples} (Levin, 2006).

Many authors have documented systematic violations of this axiom, which are listed at the conclusion of this chapter. Von Neumann and Morgenstern responded to these critiques with: *"Many economists will feel that we are assuming far too much ... Have we not shown too much? ... As far as we can see, our postulates [are] plausible ... We have practically defined numerical utility as being that thing for which the calculus of mathematical expectations is legitimate."* (Von Neumann and Morgenstern, 1953).

As a result of the axioms, the VNM theory implies "the existence of numerical utilities for outcomes whose expectations for lotteries preserve the preference order over lotteries" which means greater expected utility equals to higher preference (Schoemaker, 1982).

The utility function of the outcomes are unique and up to positive linear transformations: For any rational decision maker in the model (satisfying the axioms) exists a function U of utility assigning to each outcome of a lottery a real number $U(p)$ such that for any two lotteries, we can always rank the outcomes according to the decision maker's preferences. Specifically, the linearity of the utility function means that: $U(\alpha^* p_1 + (1 - \alpha)^* p_2) = \alpha^* U(p_1) + (1 - \alpha)^* U(p_2)$

The linearity is the most critical and defining property of the VNM model. In investment decisions, for instance, the VNM model values compound lotteries as the aggregation of their components.

2.6.2. Implication of the Utility Theory for Investment Decision Making

Let's consider lotteries where the outcomes for the decision makers are dollars. According to **Von** Neumann-Morgenstern, a rational decision maker will always try to choose the lottery that maximizes its expected utility and the 4 axioms guarantee there is a utility function that ranks lotteries by their expected utility (Schoemaker, 1982). As utility functions can be linearly transformed, the scale and the measures of utility can be set accordingly to the cases.

Within finance, an investment can be easily seen as a lottery where the cost of the investment is the value of the bet and the possible gains or losses of the investment are the outcomes of a lottery with a certain probability distribution. The VNM formula, therefore, becomes very powerful as every investment decision can be represented by a utility function up to a linear transformation.

$U(x)$, the form of the utility function in the VNM model, is twice differentiable and normally assumes the following two properties (Gerber and Pafumi, 1998):

$$\text{Non-satiation: } u'(x) > 0$$

$$\text{Risk aversion: } u''(x) < 0$$

The non-satiation rule means that "more is better" and that $U(x)$ is an increasing function of x . Utility increases with wealth and decision makers are never satiation - always preferring more dollars to fewer, even if the value of one dollar more is just slightly more desirable (Norstad, 1999).

Norstad (1999) explores other properties of utility theory. Firstly, the non-satiation property states that utility increases with wealth, however, the risk aversion property states that the utility function is concave. In other words, the marginal utility of wealth decreases as wealth increases. If you start with one dollar and this is increased by one dollar, your increase in utility is greater than if you started with one hundred dollars, and this was increased by one dollar. Because of the risk aversion property within utility theory, we find that investors attach greater weight to losses than they do to gains of equal magnitude similar to the behaviour gathered in the answers to the surveys in Chapter 4.

The second rule of risk aversion requires more attention and is covered latter on in this literature review. If a decision maker is always risk averse, then $U(x)$ will always be a concave curve as its second derivative is negative. If this is the case, the marginal utility of wealth decreases as the wealth of an individual rises (Norstad, 1999).

In summary, the literature reviewed outlined that utility of wealth curves or mean and standard deviation data can be used to measure investors' risk aversion, an aversion that tends to decrease as wealth increases, consistent with the data gathered in the surveys in Chapter 4. While modern portfolio theory overall supports the risk aversion hypothesis, researchers have highlighted that the sensitivity of the investors to risk will affect the determination of the optimal portfolio.

3. Risk Aversion

Having reviewed the development of utility theory and how it can be used to examine and frame investors' behaviour in the market place, as well as the concept that investors have an interest in separating the risks of their portfolio from the risks of the general market through different concepts of neutrality, we now turn to behaviour of investors with regards to risk aversion. One of the main objectives of the surveys in Chapter 3 and 4 was gathering their perception/attitude towards risk aversion.

Risk aversion is defined as a preference for receiving the actuarial value of a gamble with certainty, rather than the gamble itself (Copeland and Weston, 1983). The level of risk aversion can be measured in a number of ways. Arrow and Pratt (1965) proposes that an individual's level of risk aversion is reflected in the curvature of an investor's utility for wealth curve (Miller, 1975), while others claim that risk aversion can be determined by the mean and standard deviation provided by combinations of assets (Copeland, Weston., 1983). Whether risk aversion is an increasing or decreasing function of wealth is also debated. Arrow and Pratt's (1965) conclusion that as wealth increases risk aversion also increases (Graves, 1979) is inconsistent with the decreasing relative risk aversion behaviour demonstrated by a typical investor (Graves, 1979). Regardless of the multiple available literatures on the subject, in the next chapter of this paper it becomes clear that in the European Asset Managers' risk aversion decreases with wealth.

Arrow-Pratt Risk Aversion

In 1965, Kenneth Arrow and John Pratt proposed another way to measure risk aversion (Schoemaker, 1982). For any utility function $u(x)$ that follows the VNM model, the Arrow-Pratt absolute risk aversion function $A(x) = -\frac{u''(x)}{u'(x)}$ is based on the curvature of the utility function. It provides a quick measure of the decision maker's absolute risk aversion as a function of his wealth. In addition, this measure is invariant for linear transformations as the VNM model. If we maintain the initial assumption on risk aversion and decreasing returns, then A will always be a positive number.

The risk aversion hypothesis is supported by modern portfolio theory, which shows that portfolios with higher returns demonstrate greater volatility (Sharp, 1964). Investors are increasingly searching for long only portfolios that are able to provide higher returns than a reference benchmark with lower volatility in those returns (Baker, Bradley and Wurgler, 2011). When considering asset allocation, a static asset mix is optimal for a constant relative risk averse investor (Merton, 1971), while the greater the risk aversion, the greater the sensitivity to changes in asset allocation (Jones and Stone, 1969). Some risk averse investors advocate the risk parity (RP) approach when constructing portfolios, which proposes that investors should take similar amounts of risk in different asset classes. However, this approach fails to deliver optimal portfolios unless leverage is employed, as investors also balance off return and risk (Asness, Frazzini and Pedersen, 2012). Finally, an examination of risk aversion at a market level shows that the market price of risk approaches zero as the number of investors continues to increase (Lintner, 1972), and higher risk premiums are required in a market consisting of

risk adverse investors, than in one consisting of risk seeking investors (Ang and Schwarz, 1985).

Risk aversion measurement based on the utility for wealth curve

Arrow and Pratt (1965) define measures of risk aversion based on the curvature of an investor's utility for wealth curve (Miller, 1975). In a gamble, an investor is risk adverse if his expected utility of wealth is less than his utility of expected wealth (Copland and Weston, 1983). Alternatively, an investor would be considered risk loving if his expected utility of wealth is more than his utility of expected wealth (Copland and Weston, 1983). Specifically, Arrow and Pratt (1965) defined risk aversion, risk neutral and risk loving as follows:

$$U(e(w)) > E(U(W)) \text{ risk aversion}$$

$$U(E(W)) = E(U(W)) \text{ risk neutral}$$

$$U(E(W)) < E(U(W)) \text{ risk loving}$$

where $E(W)$ is the expected wealth, $U(W)$ is the utility of expected wealth, $U(E(W))$ is the utility of the expected wealth and $E(U(W))$ is the expected utility of wealth (Copland T. and Weston F., 1983).

Arrow and Pratt (1965) developed their definition of risk aversion further by deriving an absolute and relative measure of risk aversion for a given level of wealth, and these measures are used to provide insight to an investor's change in attitude to changing risk (Copland and Weston, 1983). These measures are as follows:

$$\text{Absolute ARA} = -U''(W)/U'(W)$$

$$\text{Relative RRA} = -WU''(W)/U'(W)$$

where $U'(W)$ is the first derivative of marginal utility and $U''(W)$ is the second derivative (change in marginal utility with respect to changes in wealth) (Copland and Weston, 1983). Relative risk aversion (RRA) is defined by Arrow and Pratt as the absolute level of risk aversion (ARA) multiplied by the level of wealth (Miller, 1975).

An investor shows increasing, constant, and decreasing relative risk aversion when RRA is greater than 0, RRA is equal to 0, and RRA is less than 0 respectively (Miller, 1975). These measures of risk aversion assume that risk is small, more wealth is always positive (i.e. $U'(W) > 0$) and $U''(W)$ is negative for risk averse investors. The greater the RRA, the more the investor is risk averse (Graves, 1979).

Risk aversion measurement using mean and standard deviation combinations

Other prominent measures of risk aversion assume that investors' measure of expected utility of risky assets can be examined by looking at the mean and standard deviation provided by combinations of these assets (Copland and Weston, 1983). Such a measure, advocated by Tobin (1958), proposes that indifference utility curves can represent an investor's preferences between return and risk. Indifference curves show for each level of expected utility of wealth, all combinations of risk and return. The assumption is made that an investor would

prefer a greatest return available for a given level of risk (Tobin, 1958). Tobin's measure of absolute and relative risk aversion are defined as:

$$\text{Absolute } (-U' / U'' w)$$

$$\text{Relative } :(-U' / W U'' w)$$

where W is mean wealth and σ is standard deviation (Miller S, 1975).

The slope of the indifference curve relating W and σ corresponds to the measure of absolute risk aversion (Miller, 1975). In other words, an investor shows decreasing absolute risk aversion about expected wealth as wealth increases for each level of risk, if the slope of the indifference loci decreases (Miller, 1975).

Risk averse investors have positive indifference slopes, as in they will only accept more risk if they earn more return, while risk lovers have negative slopes as they will accept lower expected return in order to have a chance to earn higher capital gains at each level of risk (Tobin, 1958).

Risk aversion is an increasing or decreasing function of wealth

According to Arrow and Pratt (1965), as wealth increases risk aversion also increases, and an incremental proportion of wealth is put into safe assets (Graves, 1979). In addition, if the size of the bet and the wealth of an investor were to increase by the same amount, an investor would be less willing to engage in the bet. In order for an investor's preference towards the bet to remain the same, it would be necessary for the probability of winning the bet to increase (Graves, 1979). Furthermore, Pyle and Turnovsky (1971) claim that if a risk averse investor tries to minimise the probability of falling below a particular level of wealth, in other words

employing the safety-first principle, he will also show increasing relative risk aversion behaviour (Graves, 1979).

However, not all researchers agree that increasing wealth leads to risk aversion behaviour. The strict safety-first principle claims that as wealth increases, an investor will show decreasing relative risk aversion (Graves, 1979). This principle proposes that an investor is expected to try to maximise his expected wealth, subject to a constraint on the probability of not falling below a particular level of wealth (Graves, 1979). This type of investor demonstrates decreasing relative risk aversion, challenging both Arrow and Pratt's and Pyle and Turnovsky's research (Graves, 1979).

Further questions over the assumptions made in Arrow and Pratt's model were raised by researchers such as Agnew (1969) and Graves, (1979). Agnew demonstrated that a portfolio selected on the basis of the strict safety-first principle reflects the fact that greater variance is not always undesirable, if the expected return is allowed to vary (Graves, 1979). Baumol's (1963) research supported Agnew's study by outlining that an investor is not just focused on the standard deviation of the investment options, but also on the expected return. For example, an investor would prefer to lose \$10 on a bet that has an expected return of \$100, than lose \$8 on a bet that could deliver a \$50 expected return (Baumol, 1963). According to Graves (1979), the most plausible behaviour by an investor is that if the bet and wealth level doubled it is likely he will engage in the bet, as the probability of going below the disaster level will be lower. In other words, the strict

safety-first principle where an investor shows decreasing relative risk aversion is the more likely behaviour (Graves, 1979).

Pyle and Turnovsky (1971) also examined the impact of changes in the amount of available investable wealth on an investor's behaviour under three different specifications of the safety-first criterion. They established that if the investor defines a minimum required rate of return, the relative riskiness of her portfolio will not change due to changes in investable wealth (Pyle and Turnovsky, 1971). However, if the investor specifies a minimum required level of revenue, and behaves according to the maximising total revenue version of the safety-first principle, the relative riskiness of her portfolio will decrease with increases in investable wealth (Pyle and Turnovsky, 1971).

In re-examining Arrow and Pratt's model, Graves (1979) claimed that an investor's reaction to an increase in wealth is not independent of the amount of wealth owned by others. On this basis, Graves suggested that it is appropriate to use cross-sectional data in which higher levels of wealth imply a high level of relative wealth (Graves, 1979). The hypothesis of decreasing relative risk aversion is strongly supported when this data is used (Graves, 1979).

In Chapter 4 it is visible that for Active European Equity Asset Managers as the assets under management/wealth increase, the portfolio managers will be less risk averse: family offices are in general more risk aware than pension funds. For instance, 71% of the pension funds surveyed were comfortable with potential drawdowns between 5% and 20% while only 35% of the family offices were willing to accept drawdowns greater than 15%.

Rubinstein's measure of risk aversion is similar to Arrow and Pratt's

The most straightforward implications of increasing or decreasing absolute or relative risk aversion occur in the context of a portfolio with one risky and one risk-free asset, which is the portfolio model on which Arrow and Pratt's (1965) measures of absolute and relative risk aversion are based (Li and Ziemba, 1987). However, in light of some of the ambiguous results derived from Arrow and Pratt's model concerning attitudes toward risk, Li and Ziemba (1987) derived Rubinstein's measure of absolute and relative risk aversion. These researchers used approximations of risk premiums with correlated risks and showed that their measure was similar to the Arrow and Pratt measure of risk aversion.

The Rubinstein's measures are:

$$\text{Absolute } R(X) = -E(U''(X))/E(U'(X))$$

$$\text{Relative } R^*(W, X) = -W E(U''(X))/E(U'(X))$$

Assuming that the returns from the two investments have a bivariate normal distribution, and the allocation between the two risk investments is proportional, an investor's risk preference can be determined. According to Li and Ziemba (1987), the investor with the highest measure of Rubinstein's risk aversion will choose the portfolio with the least risk, similar to how an investor would invest a portfolio consisting of a risk-free and a risky investment. In addition, the weight of the higher return investment in the portfolio is an increasing, constant, or decreasing function of initial wealth, in line with the investor's decreasing, constant, or increasing Rubinstein's measure of risk aversion. These results are similar to the conclusion about risk aversion derived from the Arrow and Pratt model.

Furthermore, according to Kallberg and Ziemba (1983) when the time period is small (e.g. daily, monthly, or quarterly returns), Arrow's and Pratt's measure of relative risk aversion can be used to approximate Rubinstein's relative risk aversion measure (Li and Ziemba, 1987). Therefore optimal portfolios weights and utility curves with the same increasing, constant, or decreasing properties of risk aversion can be derived (Li and Ziemba, 1987). Li and Ziemba's (1987) research went further to show that Rubinstein's measure of risk aversion can be presented as multivariate. For example, a number of factors can influence the real value of an investor's wealth.

Risk aversion hypothesis supported by volatility of high return portfolios

Sharpe (1964) tested the validity of the statement that the prices of capital assets will adjust so that:

$$E1 = P + b \sigma$$

for all efficient portfolios where $E1$ is the expected value of the distribution, P is the riskless interest rate, and b is the risk premium, which is greater than zero. Sharpe used the ex-post values of the means and standard deviations of return as proxies for investors' expectations (Sharpe, 1964). His model incorporated the annual returns of 34 mutual funds over the period from 1954 to 1963, assigning the average rate of return for each fund over a ten year period as an expected rate of return ($E1$) while using the standard deviations of the actual returns over the same period as estimates for the risk. The results were in line with the risk aversion hypothesis, showing that high return portfolios exhibited greater volatility. Although the relationship between the average return and standard deviation was not perfectly linear, it did show generally linearity (Sharpe, 1964). Overall, the

portfolios' returns showed a high level of correlation with the overall market in line with the risk aversion hypothesis.

A static asset mix is optimal for a constant relative risk aversion investor

Merton (1971) studies established that there were certain conditions which ensured that a constant asset mix in a portfolio across multi-time periods was optimal (Jones and Stone, 1969). A central proposition is that rebalancing is required continuously, otherwise drift will lower the investor's utility (Merton, 1971). Merton measures drift by the difference between the level of risk that would rebalance a portfolio back to its optimal asset mix, and to the investors' actual level of risk (Jones and Stone, 1969). With continual rebalancing, an investor with constant relative risk aversion will have an optimal portfolio if the constant weights between the risk-free and risky assets are maintained (Jones and Stone, 1969).

Risk aversion causes sensitivity to portfolio's asset allocation changes

Jones and Stone (1969) claimed that the greater the amount invested in risk-free assets, (i.e. the more risk adverse the investor is), the greater the sensitivity of the investor to a change in asset allocation within a portfolio. The same conclusion was reached by Hawawini (1986) who proposed that an investor's sensitivity to asset mix can be determined by the curvature of his utility curve. Hawawini defines an investor's absolute level of risk aversion by the rate of change of the curvature of his utility curve in response to a change in the riskiness of his portfolio. As a result, it follows that the frequently rebalancing of a portfolio is necessary if the investor is risk averse (Jones and Stone, 1969).

Leverage changes the relationship between risk/return in CAPM

According to research undertaken by Asness, Frazzini and Pedersen (2012), the introduction of leverage changes the predictions of modern portfolio theory. The capital asset pricing model (CAPM) proposes that investors should hold the market portfolio levered in line with the investor's risk preference. However, Risk Parity (RP) investing has become a well-known alternative approach to asset allocation (Asness, Frazzini and Pedersen, 2012). RP advocates propose that one should take a similar amount of risk in different asset classes (Asness, Frazzini and Pedersen, 2012). The RP approach uses an asset allocation heuristic where the justification is not theoretical but intuitive. Given the different risk profiles of different asset classes, an investor is required to invest more investable wealth in low risk assets than high-risk assets in order to diversify risk. The attractiveness of the RP theory centres on the appeal of risk diversification as the objective of the asset allocation decisions, thus RP does not depend on expected returns which investors have less confidence in predicting (Schachter and Thiagarajan, 2011).

Despite this intuitive appeal, diversifying risk as an investment approach is not sufficient due to the fact that if the expected return from investing in a risky asset class is high enough, an investor would (intuitively) be content to place all his assets in that market (Asness, Frazzini and Pedersen, 2012). In other words, equalising risk across asset classes is not necessarily the optimal approach to portfolio construction, unless the expected return from these asset classes are also equal.

Asness, Frazzini and Pedersen (2012), demonstrate that leverage aversion might be the link which could result in RP portfolios being optimal. Their proposition is that some investors, such as pension funds, are not in a position to use leverage (Asness, Frazzini and Pedersen, 2012). In order to meet their return targets, therefore, they hold riskier assets instead of using leverage to increase the return of the lower risk assets and that is in line with the results gathered in Chapter 3 survey results. As demand for riskier assets pushes up valuations the expected return is reduced. The lower risk underweighted assets trade at lower valuation and hence their expected return is higher (Asness, Frazzini & Pedersen, 2012). Those investors who are able to use leverage should do so in low risk return assets to achieve a higher return (Black, 1972). The research undertaken by Black and colleagues demonstrated that a RP portfolio over 1926-2010 achieved a Sharpe ratio which was 0.27 higher than that of the market portfolio, implying that an investor in the RP portfolio earned 2.7 per cent more per annum than a market portfolio investor (Asness, Frazzini and Pedersen, 2012). The research done by Asness and colleagues (2010) and Black (1972) is robust across many asset classes. Hence, leaving aside investors with high leverage costs or aversion to leverage, investors can benefit from using leverage (Asness and colleagues, 2010).

Relationship between the market price of risk and the market risk aversion

Given the assumptions of stable expectations and variances of rates of return, John Lintner (1972) established that the market price of risk varies inversely with the market size as measured by the number of investors and their total investable wealth. Lintner (1972) established this proposition in a number of ways. Firstly, by

showing that market risk aversion is equal to the market price of risk. He defined the market's risk aversion as being equal to the mean of the individual risk aversion parameters, divided by the number of investors in the market. Secondly, Lintner (1972) claimed that the market price of risk and risk aversion is the sum of the risks of all the shares in the market. The individual's risk aversion, on the other hand, is the sum of the risks of the shares that the individual holds (Lintner, 1972). Thirdly, Lintner (1972) showed that the sum of all the risks of all investors is less than the sum of all risks being "priced out" by the market price of risk. The latter risk is equal to the total of all the variances and covariances between all shares of different stocks and all the different shares of the same stock. However, no investors are holding the risks involved when different shares of the same security are held by different investors (Lintner, 1972). As the market size increases this has an eliminating effect, which explains why the market price of risk falls, even when the average risk aversion of the investors is constant (Lintner, 1972). Lintner concludes that the market price of risk approaches zero as the number of investors continues to increase.

Investor's risk aversion behaviour causes price variability in markets

Ang and Schwarz (1985) examined whether the risk aversion behaviour of investors causes price variability in markets. In a study based in two experimental markets with two sets of traders, it was established that risk averse investors required higher risk premiums and were slow to make changes to their portfolio (Ang and Schwarz, 1985). In contrast, in a market place consisting of risk preferred investors, there was greater price variability and prices tended to converge to the prior equilibrium price quickly (Ang and Schwarz, 1985).

3.1 Certainty Equivalent and Risk Aversion

An important implication of expected utility is the Certainty Equivalent (CE), or the guaranteed amount that someone would accept, rather than taking a chance on a higher but uncertain alternative amount (Norstad, 1999). An equivalent term for CE is selling price. There is a specific certainty equivalent for any specific expected utility. In formula, the CE $c(X,u)$ is the amount of money for which:

$$U(c) = E(U(X))$$

The difference between the EV and CE of the investment is called the Risk Premium (RP), and in the case of a risk-averse individual, the CE will always then be less than the EV of a lottery (Norstad, 1999). According to Bodily (1981), many risky opportunities are evaluated solely by the average of the possible financial outcomes or Expected Monetary Value (EMV). For example, a risk-averse individual will prefer to sell a \$500 lottery ticket with a 50% chance of winning \$1000 for less than its \$500 sale price. Besides EMV and probability, Bodily identifies a third factor in evaluating risk as our willingness to face risk, or the Risk Premium (RP). The risk premium is the amount of money an individual is willing to give up to avoid the risk of loss. Individuals who have positive risk premiums are risk-averse individuals. Risk-averse utility functions display a concave shape.

CE is particularly important in that it gives a broad measure of how risk-averse investors and decision makers behave. Given two decision makers with different utility functions $u(x)$ and $v(x)$, if $c(X,u) \leq c(X,v)$ for every X , then the decision maker with utility u will be more risk averse than the decision maker with utility v (Levin, 2006).

In the case where an investor has an exponential utility function: $U(x) = 1 - e^{-ax}$ with $a > 0$ and $-\infty < x < +\infty$ (note: $u'(x) > 0$ and $u''(x) < 0$), then $C = E[u^{-1}(u(x))]$.

3.2 Application of Expected Utility Theory in a Portfolio Problem

Up to now, we have considered only two options: invest (participate in the lottery) or do not invest. Applying the Expected Utility Theory to a portfolio problem, the decision maker can invest a certain amount of dollars in a risk-free investment with a return r or in a risky investment with a random return z with a probability distribution F . We maintain the assumptions that the utility function of the decision maker is double differentiable, concave and with decreasing marginal returns. The decision maker invests a certain amount of wealth a in the risky assets and the remaining amount of wealth $(w-a)$ in the risk-free assets. For the non-satiation assumption, the risk-free investment return r is always preferable to nothing. Ultimately, the investor's wealth will equal $a * z + (w - a) * r$.

According to the utility theory, the decision maker will allocate his resources according to the optimisation equation: $\max_a \int u(a * z + (w - a) * r) dF(z)$

The first order condition of the maximisation problem is:

$$\int u'(a * (z - r) + wr) * (z - r) dF(z) = 0$$

If the investor is risk neutral, it is easy to calculate the asset allocation because $u(x) = \alpha * x$ where α is a constant. Therefore, the marginal return of the allocation problem is $a * w * r + a * a * (E(z) - r)$ which means that the risk-averse individual put all his wealth in the asset class with the highest expected returns.

If the investor, however, is risk averse ($u'' < 0$), the implications are different. As the optimisation curve is concave, then the first-order condition is the solution of the investment, and if the risky asset has a rate of return greater than that of the risk-free asset $z > r$, the investor will still invest a part of his wealth in the risky asset (Levin, 2006). To demonstrate this, if $a=0$, then $u'(wr) > (z-r) \int dF(z) > 0$, which doesn't maximise the solution of the portfolio. As a result, the optimal investment in the risky asset is some amount where $a > 0$. The investor will not invest all his wealth in risk-free assets because his utility will remain the same no matter the outcome of the lottery. In insurance, for instance, if insurance prices are close to their actuarial fair value, then the risk-averse decision maker will never insure 100% since being fully insured is like completely investing in risk-free assets. Similarly, in any portfolio problem, even the most conservative (risk-averse) investor will invest some of his wealth in risky assets as a portfolio of only risk-free assets does not optimise utility.

3.3 Limitations of the Expected Utility Theory

The strong assumptions of the VNM model have been tested in the last half-century with empirical studies and theoretical critiques. While the model is still regarded as a valuable normative description of how people behave under uncertainty in terms of descriptive power, it has several limitations (Machina, 1982).

Most criticisms of the VNM model focus on its independence axiom. One of the best-known critiques is by Tversky and Kahneman (1979) in the formalisation of

their prospect theory. Starting from an experiment of Maurice Allias in 1953, they use a series of counter examples against the VNM utility theory.

3.3.1. The Certainty Effect

The certainty effect is the psychological effect resulting from the reduction of probability from certainty to probable.

The assumption of independence means that if Lottery B is preferred to Lottery A, then any probability mixture of B (B, p) must be preferred to A (A, p). The reduction of probability from certain to uncertain has a greater effect than from more probable to less probable. People overweight certain outcomes to probable ones. Kahneman and Tversky (1979) call this violation the certainty effect. Similar results have been found with non-monetary outcomes such as weeklong trips to England. Kahneman and Tversky (1979) experimental results mean that people tend to overvalue a sure thing in the context of investments – certain profit. This experiment and similar others do not respect the linearity in the probability constraint of the VNM (Machina, 1982). Similar outcomes were visible on the surveys we elaborated in which investors would prefer a certain outcome on the underperformance of the portfolio understanding that would have a cost on the potential outperformance of the portfolio.

3.3.2. The Reflection Effect

Kahneman and Tversky (1979) studied a second violation of the independence axiom called the reflection effect. Decision makers are risk averse in the face of gains and risk seeking in the face of loss. Together with the reflection effect, the certainty effect still holds valid for gains, but in the opposite way for losses: Individuals prefer a larger potential loss that is uncertain to a smaller loss that is certain.

3.3.3. The Framing Effect

Outside the validity of the independence axiom, Kahneman and Tversky (1979) found another problematic aspect in the way lotteries are framed. Framing can change people's behaviours from risk averse (if lotteries are presented as gains) to risk taking (when lotteries are presented as losses). Schoemaker called this the context effect and explains several other similar psychological biases of the VNM model (1982).

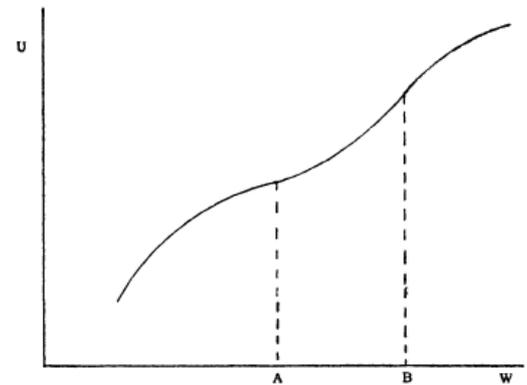
3.4 Variations on the Classical Utility Model

Although it has limitations, "expected utility analysis remains quite robust to failure of the independence axiom" (Machina, 1982). The basic concepts and tools of the utility model remain mainly valid if we make some variations to the VNM axioms according to Machina (1982). Many authors have been trying to explain their own version of the utility model in order to increase its descriptive efficacy (Machina, 1982).

3.4.1 Friedman and Savage Critique

One of the first variations to VNM came from Friedman and Savage (1948). Starting from the empirical fact that people buy both insurance and lotteries, Friedman and Savage proposed a utility function shaped without the assumptions of VNM, which holds constant the utility function among

Figure 8 - Friedman and Savage's Utility Function



levels of wealth. Friedman and Savage's function changes according to different levels of wealth and is concave where $w < A$, convex from A to B , and concave again where $B > w$. This means that in the interval between A and B , a bet is preferred to its CE. Even in the case of slightly unfair lotteries, individuals will play the lottery rather than do nothing (Friedman and Savage, 1948). The authors go as far as to interpret the different concavity and convexity of the function among different socioeconomic levels and classes (Friedman and Savage, 1948). According to Markowitz (1952), another implication of their utility curve is that "individuals with such a curve will prefer "positively skewed distribution (with large right tails) more than negatively skewed ones (with large left tails)" (Machina, 1982). In the results of the Surveys in Chapter 2 and 3 we were confronted with similar behaviour from the investors, i.e. the need to limit the downside (the portfolio drawdown) but interested capturing the potential upside, understanding that potential upside could be limited by the cost of the constant hedging of part of the portfolio.

3.4.2. Markowitz's Critique

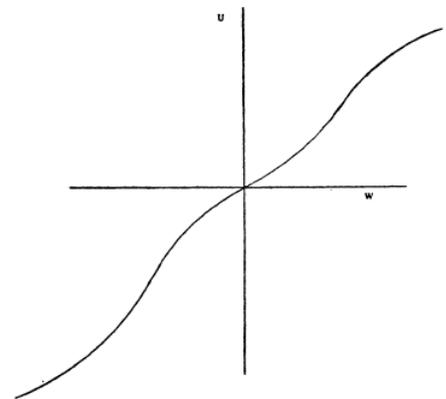
One problem with Savage and Friedman's (1948)

hypothesis is that their utility function remains defined over ultimate wealth levels. Stability of preferences remains as in the VNM model.

"Fixed utility functions are fixed to ultimate levels of wealth" (Machina, 1982). However, this characteristic empirically contradicts the fact that

people of every possible wealth actually buy both a lottery ticket and an insurance policy, sometimes at the same time. In his article "The Utility of Wealth" (1952), Markowitz sustains that changes in wealth cause the utility function to shift horizontally. Starting from similar examples to Kahneman and Tversky (1979), Markowitz expresses a utility function that does not respect the independence axiom of the VNM theory. Markowitz's hypothesis is that utility theory has 3 inflections points with alternating convexity and concavity. The second inflection point corresponds to "customary wealth" (Markowitz 1952). The utility function does not change according to the level of wealth, but according to deviations from present wealth. The curve is monotonically increasing, but bounded. Individuals will buy both an insurance policy and a lottery ticket, and the behaviour of the investor will be the same whether he is rich or poor. What changes is the meaning of small or large gains or losses for each decision maker and, accordingly, the position of the inflection points.

Figure 9 - Markowitz's Utility Function



Markowitz explains that decision makers will tend to act more conservatively when they are moderately losing and more aggressively when they are moderately

winning (during our surveys we were able to confirm this behaviour from both the portfolio managers as well as the investors). If one game concludes and the individual decides to play again, both his customary wealth and utility function shift. If the individual has recently lost a lot, he will continue to play as a risk seeker (from the lower part of the utility curve). If the individual has won a lot, however, he will continue to play conservatively (from the upper part of the utility curve). According to Markowitz, the decision maker's preferences cannot be defined independently from his current consumption point.

3.4.3 Prospect Theory

In their seminal paper "Prospect Theory: An Analysis of Decision under Risk", Kahneman and Tversky (1981) studied the inconsistencies of expected utility theory and developed the most important critique of the VNM model. Prospect theory is particularly useful in the case of investor behaviour and asset allocation and was visible in the results obtained in the surveys of Chapter 2 and 3.

According to prospect theory, "people perceive outcomes as gains and losses rather than final stage of wealth fare." Similar to Markowitz's studies, prospect theory is centred on the evaluation of gains and losses rather than the absolute level of wealth. The decision process, however, involves two stages: editing and evaluation. In the editing phase, the individual takes into account the framing effect, and in the evaluation phase, the individual formulates a decision (value) based on the potential outcomes and their respective probabilities, and then

chooses the alternative, which has a higher utility. Kahneman and Tversky formulation of the value function comes from the modification of the VNM utility function as:

$$U = \sum_{i=1}^n w(p_i)v(x_i) = w(p_1)v(x_1) + w(p_2)v(x_2) + \dots + w(p_n)v(x_n)$$

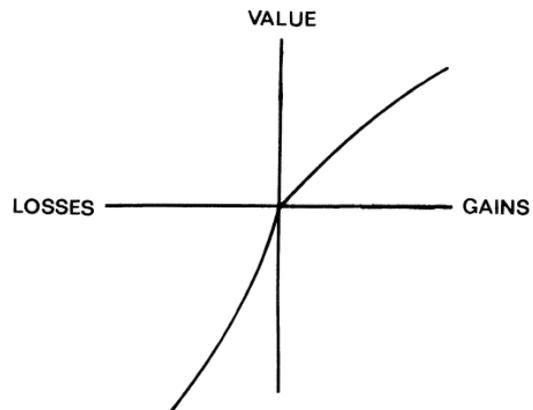
where x_1, x_2, x_n are the potential gains and losses from a certain reference point of the decision maker and p_1, p_2, p_n their respective probabilities.

Gains and losses are the variables of the value function and they are related to a certain reference point, which can be to the status quo, but can also deviate in response to framing factors in the editing phase.

Another aspect of the theory is w , the decision weight. The weights are not probabilities but they moderate probabilities according to the decision makers' expectations. However, they do not follow any utility maximization rule and the weighting establishes a nonlinear effect independent from the underlying probability. Weights highlight how the individuals interpret personally the possible outcomes of the prospect and they can be affected by factors such as ambiguity, in a sort of "psychological weighting".

As a result of the subjective expectations of the decision makers, the weighting function tends to overweight small probability while underweight medium and high probability. This is in line empirically with the certainty effect that was previously discussed.

Figure 10 - Kahneman and Tversky's Value Function



The value function of Kahneman and Tversky's prospect theory is therefore s-shaped, asymmetrical, and centered according to a reference point. The curve is concave for gains and convex for losses and the function is steepest near the reference point.

Their theory is obviously very different from the VNM theory as losses are valued differently from gains and the decision makers do not make decisions according to absolute wealth but to gains and losses. In addition, the theory leaves the possibility to account for psychological effects including for instance ambiguity in the formulation of weights or the editing phase.

Prospect theory and portfolio problems

The three main implications of prospect theory are loss aversion (the function is asymmetric in the valuation of losses or gains), diminishing sensitivity (the marginal value of gains and losses decreases with increasing size) and reference

dependence (gains and losses are depended according to a reference point). All behaviours that were gathered in the surveys collected in Chapter 2 and 3.

Each of these effects has particularly important implications in behavioural finance. Whether investors value gains and losses symmetrically (VNM model) or asymmetrically (Kahneman and Tversky, 1981) changes the way assets should be priced. Similarly, while VNM predicts that the valuation of large gains or losses of an investment should be proportional to the mathematical expectations, in the case of Kahneman and Tversky, investors' valuation of large gains and losses can decline as the prospective gain or losses increases (Norsworthy et Al., 2003).

Norsworthy et Al. (2003) test these effects across the stock returns of 100 companies with significant results. Firstly, through a partitioning of CAPM model, he demonstrates that investors' expectations are heavily influenced by frames of reference (Norsworthy et Al., 2003). For Norsworthy et Al. (2003) the CAPM model with single values of beta and alpha is unstable and less descriptive than a model which includes reference points of investors which influence the perception of current market conditions. Furthermore, across their experiment, symmetrical valuation of gains and losses was rejected and non-proportional marginal sensitivity accepted (although they do not demonstrate decreasing sensitivity). Norsworthy et Al. (2003) test the characteristics of Prospect Theory across three different time periods: although some periods show stronger results than others do, in all of them the investor behaviours hold the same effects. These experiments concisely demonstrated that market behaviours of investors are strongly influenced

by reference frames according to the behavioural assumptions of the prospect theory. Of course, the concept of subjective reference is an obvious contradiction of the efficient market hypothesis where current investor behaviour should solely relate to the currently available information on the state of the markets.

More recently, Norsworthy et al (2003) point to Kahneman and Tversky's (1979) Prospect Theory as an even better description of reality. Put simply, it states that a person's decision in a risky situation is dependent on their current frame of reference. This would partially explain Ricciardi's (2008) findings mentioned in chapter 2 of this research, that:

- Gender: men tend to be more risk seeking than women;
- Marital status: Single individuals tend to make riskier decisions than married persons;
- Age: Younger persons are inclined to be more risk seeking than older individuals;
- Level of education: A person with higher levels of education display a greater risk propensity or tendency to take risks;
- Financial Knowledge (Experience/Expertise): Individuals who believe they have more knowledge of risk and risky situations tend to undertake greater financial risks.

The marital status and age differences are of particular relevance, as a person is more likely to take the riskier decision if they have more time to fix it if it goes wrong, or they have less to lose if it goes wrong. However, there is a slight conflict as Bodily (1981) states that we tend to become more tolerant to risk as we become

wealthier. Increasing wealth is usually partially a factor of age, so we must read Ricciardi's (2008) findings as younger people are likely to take more risk if they have the same wealth as the older people. Nornworthy et al (2003) state the most important element of Kahneman & Tversky's (1979) prospect theory is the dependence of expected returns on the current frame of reference. Similarly, we found similar results in our initial surveys in Chapter 2 and 3 that support the above conclusions.

Probability vs. Uncertainty

One of the important implications for Utility Theory is in options pricing which is vastly used by the hedge funds that were interviewed in Chapter 2 and the family office clients that invest in hedge funds. Miao and Wang (2004) state that "Many economic decisions can be described as an option exercise or optimal stopping problem under uncertainty...many economic decisions can be described as binary choices". Miao and Wang (2004) use a Knightian (1921) definition and distinguish risk from uncertainty. In this case, ambiguity may accelerate or delay option exercise.

When positing that most economic decisions are binary choices, Miao and Wang (2004) extend their explanation:

"First, the decision is irreversible to some extent. Second, there is uncertainty about future rewards. Third, agents have some flexibility in choosing the timing of the decisions. These three characteristics imply that waiting has positive value.

Importantly, all the preceding problems can be viewed as a problem where agents decide when to exercise an “option” analogous to a financial call option”.

Miao and Wang (2004) make a clear distinction between risk as a probability problem, and risk as an uncertainty problem. This distinction is more important in the researcher’s opinion. The Ellsberg Paradox suggests that people prefer to act on known rather than unknown, or ambiguous probabilities.

4. Portfolio Insurance Strategies

In Chapter 4, I will investigate the degree of risk aversion for different investors. Therefore, in this section I will introduce the reader to different portfolio insurance strategies that help investors protect their portfolios. Investors have different levels of utility, exhibit different levels of risk tolerance, and have an interest in isolating the different types of risks that their portfolios encounter. Therefore, investment strategies that could provide protection against losses, while preserving some upward potential, would likely be attractive for a wide range of investors. We now take a look at a specific set of strategies through which investors seek to manage the trade-offs between risks and maximising their level of utility. That is through the explicit use of portfolio insurance techniques to mitigate the risks on their overall portfolios.

4.1 Tail Risk Management

Advancements in portfolio management have made it possible for investors to be more flexible in the approach they take towards maximizing their utility by

balancing their risk/reward calculations and their risk aversion across a wide array of asset classes (Weng and Sullivan 2012). As previously discussed, investors have different levels of risk aversion and utility, and that the risk premiums on assets cycle over time within a given market as investors' appetites change (Xiong and Idzorek, 2010). Traditional portfolio theory has looked at managing risk aversion by considering standard (normal) distributions of potential portfolio risk, generating much interest in what the exact nature of the curve looks like (fat tail, standard, shifted etc.). However, in light of recent events such as the 2008 financial crisis, and the 2011 European debt crisis, there has been an increase of interest in the potential for high-risk events at the tail of the distribution (Vrecko and Branger, 2009). The detrimental effects of these high-risk events, has created interest from investors for ways of hedging their portfolios against them. This type of hedging is called tail-risk management.

Tail risk, is by its own nature an elusive quantity, and therefore presents economists with the difficult task of explaining market behaviour with relatively few (and rarely observed) actual situations. However, the mere potential for infrequent events of extreme magnitude can have important effects on asset prices. Previous reviews of these phenomena such as peso problems (Krasker (1980)) or the rare disaster hypothesis (Rietz (1987), Barro (2006)) have developed to try and make sense of impact of this risk on asset prices.

Nassim Nicholas Taleb (2011) challenged popular understandings of tail risks, pointing out that the frequency of high impact events in the financial markets has far exceeded mathematical expectations build on standard models. Interest in tail-

risk management has increased following the financial crises of 2007-2008 and the subsequent European debt crisis, and financial institutions have responded to the demand, offering new tail-risk management solutions for investors (Vrecko and Branger 2009). Examining the returns of over 6000 hedge funds following the financial crises of 1998 and 2007-2008, Jiang and Kelly (2012) found that tail-risks play a significant role in driving hedge fund returns. Given the apparent propensity of tail-risk events, it has become clear that investors need to think more carefully about managing the full distribution of potential risks to their portfolio. The following section takes a look at some of the basic ways in which investors attempt to limit the downside of their portfolios while preserving the upside, which is in line with the concerns expressed by the investors that answered our surveys.

Why Investors Buy Portfolio Insurance

Leyland (1980) concluded that investors who purchase portfolios should fall into two categories: either they are investors with average risk tolerance but have expectations that are above average or they are investors with average expectations but whose risk tolerance increases with wealth faster than the average. As we have discussed with regards to Tvserky's (1979, 1991) Prospect Theory, risk (tolerance) aversion is a key driver of investor behaviour. Following on from Tvserky's work, Benninga and Blume (1985) demonstrated that the optimality of a portfolio insurance strategy depends on an investor's utility function. Therefore, we can build on the previous examination of the behavioural finance concepts of Utility Theory, Risk Aversion and Neutrality in this paper to determine how portfolio insurance strategies can satisfy investor preferences for returns. Furthermore, the perceived increase in extreme, but unlikely events, has given rise

to renewed interest the tail-risk management strategies offered through portfolio insurance techniques.

Portfolio Insurance

The term portfolio insurance is a generic way of describing a set of investment strategies that attempt to limit downside risk to the value of an investor's portfolio while retaining the portfolio's exposure to higher returns (Pain, 2008). Alternatively, Grossman and Villa (1989) and Basak (2002) define a portfolio insurance trading strategy as a strategy which guarantees a minimum level of wealth at a specified time horizon, but also participates in the potential gains of a reference portfolio. Ideally, these strategies allow investors to tailor their investment portfolios more closely to their risk preferences by allowing the separation of different types of underlying risk within the portfolio. The concept of portfolio insurance (and the academic literature examining it) is not new, and in fact UK based firms offered actual insurance contracts on investment portfolios as early as the 1950's. The modern conceptualizations of portfolio insurance however, are generally viewed as having developed shortly after the emergence of the Black-Scholes-Merton option pricing theory in the early 1970s.

Despite this extended timeframe, portfolio insurance strategies have experienced resurgence over the past few years in terms of both investor and academic interest (Vrecko and Branger 2009). The enhanced interest in portfolio insurance has generally been attributed to lower structuring and trading costs, a broadening in, and growth of, asset classes on which investors find the idea of principal protection

attractive, and as a reaction to dramatic swings in the market such as following the collapse of Lehman Brothers and the ensuing financial crisis (Pain 2008).

4.2 Types of Portfolio Insurance Strategies

Though portfolio insurance strategies vary widely, they generally fit into two broad categories, option based portfolio insurance (OBPI) and the constant proportion portfolio insurance (CPPI) (Bertrand and Pringent 2005). It should be mentioned that these are not the only types of portfolio insurance, there are also simplistic strategies such as stop-loss or even “buy and hold” approaches, but we will not focus on those for the purposes of this paper, given their relative simplicity and lack of relevance for the professional money management industry. Building on the earlier work of Black and Scholes (1973), OBPI was popularized by Leland and Rubinstein (1976), who introduced the concept of securing a floor for a portfolio by combining a put option and a risky asset. While Black and Scholes proposed a method to create risk-free returns by hedging in a dynamic way an option with a stock, Leland and Rubinstein reversed the process by providing a dynamic strategy through which an option could be created based on an investment.

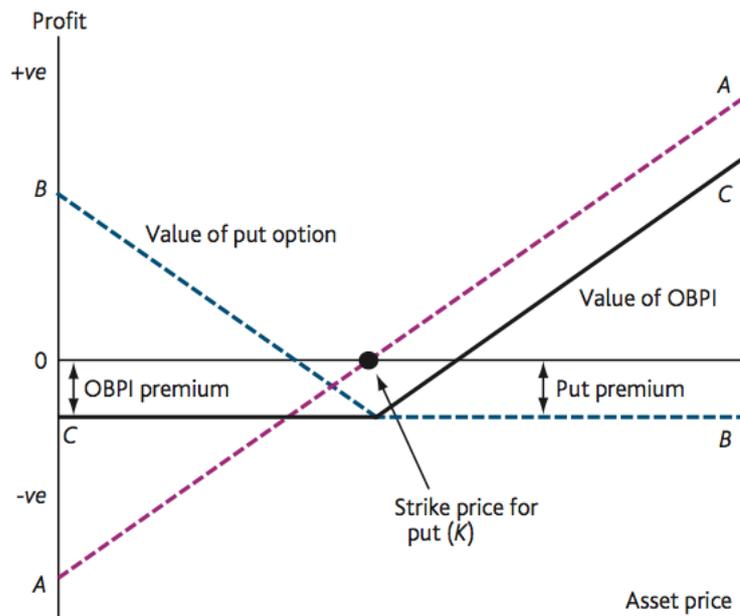
4.2.1. Option Based Portfolio Insurance (OBPI)

OBPI consists of the simultaneous purchase of a risky asset S , and a put option with a strike price of K on the same risky asset. This strategy protects the value of the risky asset at the terminal time T , ensuring that independent of the price movements for S , the value of the portfolio at T will be greater than the strike price of the put K . The strike K is usually set as a proportion of the initial investment.

Basically, the investor is able to put a floor under the value of the portfolio should the value of the risky asset S fall past the strike price.

Figure 11

Figure 1 Profit at expiration to an investor in OBPI



Source: Pain, 2008.

This construction of OBPI can also be inverted, with the investor securing a floor through purchasing a risk free asset, and then purchasing a call option on the risky asset (Pain 2008, Pezier and Scheller 2013). Explaining OBPI in this fashion is preferable for our purposes, as it eases the comparison with CPPI and points to why CPPI strategies have come into favour.

Looking at a simple example of OBPI using a call option, we can write the payoff for this strategy at the terminal moment T as:

Here S^C is the price of the risky asset, F denotes the investment in the risk free asset; by r^f we represent the continuous risk-free rate of return and by N the number of call options bought at a strike K . As mentioned by Joossens and Schoutens (2008), the value of the strike K is related to the value of the initial floor in the CPPI strategy, see below for an explanation of the CPPI approach. Thus, the OBPI strategy insures that at the terminal moment T , the investor will at least have a portfolio of value K .

In these simple constructions, the OBPI approach offers a robust and simple method of providing portfolio insurance, however the theory rests upon many assumptions that make it difficult to perfectly replicate the appropriate option payoffs. Underpinning the theory are key assumptions such as the availability of continuous trading, the complete lack of transaction costs, and the absence of credit constraints on the investor. As these are obviously non-trivial assumptions that do not hold true in the real world, the OBPI strategy is not always a practical methodology for investors. As a result, constant proportion portfolio insurance (CPPI) - has become the more prevalent approach in the market (Pain 2008).

4.2.2. Constant Proportion Portfolio Insurance (CPPI)

Black and Jones (1987) pioneered the CPPI approach for equity portfolios, which was extended to fixed income portfolios by Perold (1986), and more recently to more exotic instruments such as credit default swaps (CDS) by Joossens & Schoutens (2008) and Jessen (2008). This strategy also consists in setting a floor that gives the lowest acceptable value of the portfolio, but instead of using options to attempt to guarantee that value the investor seeks to approximate the payoffs of

a call option on the risky asset by switching the allocation of assets between a risk free asset and a risky one using a discrete, mechanical rule. At each time period, the investor calculates the investment needed in the risk free asset to preserve the lowest value of the portfolio (the floor), as well as the amount left over in excess of that floor. This excess is known as the cushion, and is subsequently invested in the risky asset based on a constant multiple that reflects a mix of risk tolerance and available leverage. Using the notation in Pezier and Scheller (2011), we can formally write:

$$C_{PPIS}(S, T) = F \exp(r_f T) + (\omega(0) - F) S^c(T) \exp(-m \sigma^2 T)$$

Here $\omega(0)$ is the initial wealth; as for the previous equation; F is the investment in the risk free asset and r_f the risk-free rate of return; $S(0)$ is the initial price of the portfolio, σ is the constant diffusion coefficient, $S^c(T)$ is the price of the risky asset at the terminal moment T , finally m stands for the multiplier. Both the floor and the multiplier depend on the choice of an investor. Thus the terminal value of this strategy is a combination of the initial investment in the risk free asset given by F , and the remaining value of the initial wealth ($\omega(0) - F$), called the cushion, invested in the risky asset, whose terminal value depends on the price of the asset at the terminal time, $S^c(T)$, and on the multiplier value m .

To make things more clear we provide a simple example. Let us consider an investor that has an initial portfolio with a value $S(0)$ of £500. For this portfolio, he seeks to recoup the entire £500 value of the portfolio at the end of the period, so sets the floor as the present value (PV) of the £500 or 372 (assuming a risk free rate of 2.5%), and chooses a multiplier m of 3. Thus, he will allocate first $3 * (£500 - £372) = £383.9$ to a risky asset and the remaining £116.1 to a risk free asset.

Following the mechanical rule, the investor then reallocates the sums at the end of the each period as the value of the portfolio change. The example demonstrates the basic principles of the approach, which is that as the value of the risky asset increases, the allocation to it increases, while when it falls, the allocation shifts back to the risk free asset. Interestingly, the model also shows that in year three the risk free asset exposure moves into negative territory as a result of strong performance of the risky asset. This implies that the investor has nothing invested in the risk free asset, and instead is borrowing money to invest in the risky asset.

Table 2 - Example of CPPI Strategy Rebalancing Over 10 years (Pain 2008)

Period	Cost of Guarantee	Risky Asset Price	Cushion	Risky Asset Exposure	Risk-free Asset Exposure	Portfolio Value
	A	B	C = F-A	D=C x Multiple	E = F-D	$F = E_{t-1}(A_t/A_{t-1}) + D_{t-1}(B_t/B_{t-1})$
0	372.0	100.0	128.0	383.9	116.1	500.0
1	383.2	112.0	166.3	499.0	50.5	549.5
2	394.7	125.0	214.3	642.8	(33.9)	609.0
3	406.5	110.0	124.3	372.8	158.0	530.8
4	418.7	98.0	76.2	228.5	266.4	494.9
5	431.3	103.0	83.2	249.7	264.8	514.5
6	444.2	95.0	58.8	176.5	326.5	503.1
7	457.6	90.0	46.0	138.1	365.5	503.6
8	471.3	80.0	27.9	83.8	415.5	499.2
9	485.4	85.0	31.5	94.4	422.5	516.9
10	500.0	87.0	31.8	95.4	436.4	531.8

Investment Horizon 10 years
Multiple 3.0
Risk Free Rate 3.0%

As previously mentioned the OBPI strategy is generally viewed as static once the initial insurance has been set, while the CPPI approach is regarded as a dynamic one, consisting in a continuous reallocation of the portfolio. At the same time, we note that the CPPI emerged as a response to the difficulty of the OBPI strategy to provide options that are sufficiently long-dated or sufficiently match the underlying assets of the portfolio.

Characteristics of CPPI Strategies

The construction of a CPPI strategy has some natural characteristics that are worth exploring. For example, there are some biases inherent to CPPI such as when the underlying asset performs strongly, a CPPI strategy will tend to underperform a pure investment in the risky asset since it does not generally allocate 100% of funds to the risky asset from the start. Obviously, when the underlying assets experience weak performance, CPPI will limit the downside, which is of course the point of using the strategy in the first place.

Another core feature of CPPI strategies is that they are said to be “Path Dependent” because the calculation of the final return to a CPPI strategy depends on the entire history of prices of the underlying asset throughout the term and not just the terminal value (Pain 2008). In other words, at any given time in the investment horizon, the complete history of the investment strategy affects the set of possible choices that the investor can make (Bookstaber and Langsam 2000). The path dependence of CPPI strategies also highlights how these strategies are affected by developments in the risk-free rate, which may change over the investment horizon, and therefore how the investor must take into account the risk-free rate at each rebalancing point not just its initial level (Pain 2008).

The other two core drivers of CPPI strategies are leverage, as defined by the multiple (m), and volatility. Pain 2008, shows that both leverage and volatility have a significant impact on the ultimate returns of the CPPI strategy, with higher levels of leverage increasing the potential upside to a CPPI strategy but also resulting in more frequent underperformance and hence more variable returns. Alternatively

we can express this with the simple notion that the greater the multiple, the higher the convexity of the pay-off profile. Pain (2008) also points out that for higher levels of volatility in the price for the underlying assets result in weaker performances for CPPI strategies. On a practical level, this is easy to understand since CPPI strategies are adjusted to reflect movements in prices and therefore they are always chasing the market. Greater movements in the underlying prices mean that there is a greater potential for the investor to be “knocked out” of the risky asset (shifting completely into the risk-free asset) before having to readjust back into the risky asset once it recovers. On a theoretical level this should be intuitive as well, since CPPI strategies have option like characteristics, and it is well known that options become more expensive when volatility is high, Black and Scholes (1973).

Limitations of CPPI Strategies

Much of the original CPPI theory relies on several assumptions about the market that are fundamentally unworkable in real market conditions. For example, it is well known in the literature that (Balder et. al., 2006) if the dynamic process of the risky asset is a geometric Brownian one, in the continuous CPPI strategy, the value of the portfolio will never fall below the floor. In reality, however, there are constraints that contradict the assumptions of the model. For example, despite globalization, increased and after-hours trading, and the integration of international exchanges there is no such thing as truly continuous trading. Even the simple interruption of trading for the weekend or a public holiday is enough to render this assumption untrue, for events can happen while the markets are closed meaning that asset prices can gap higher or lower without a trader having a chance to react.

Plainly said, fund managers run the risk of not being able to adjust their portfolios quickly enough to market conditions when changes happen outside of normal trading hours. Therefore, CPPI strategies have an inherent “gap risk,” i.e. the risk that the portfolio will have a value lower than the floor, Cont and Tankov (2009) or De Franco and Tankov (2011). The impact of gap risk became particularly apparent around the financial crisis of 2008, and as previously mentioned has increased interest in tail risk management.

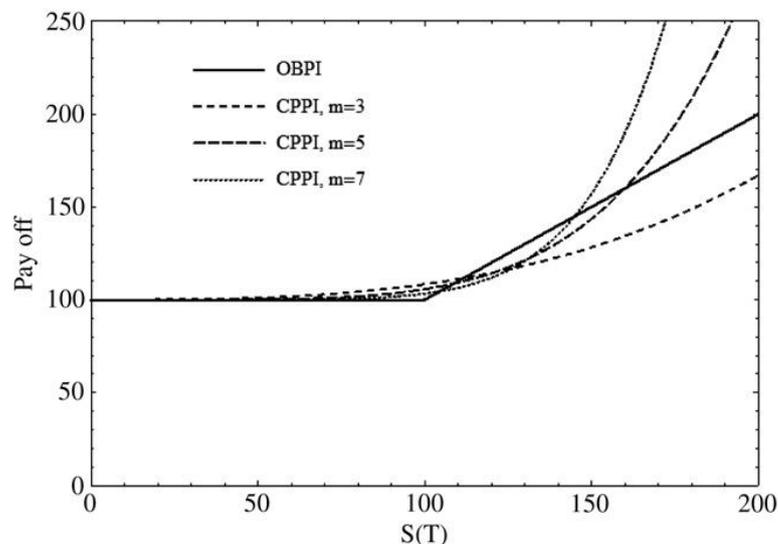
Cont and Tankov (2009) provided a framework to study the gap risk by using a model with jumps. They showed that the jump risk is significant for the CPPI strategies. They were also able to derive expressions for the probability of hitting the floor, as well as for the expected loss and the distribution of losses. The problem of limiting risk exposure has been addressed by De Franco and Tankov (2011), who built on the previous work by Gundel and Weber (2007), provided a solution to the problem of maximizing the utility of a portfolio given the risk of an expected shortfall. They considered the problem of utility maximization of a portfolio only for both positive gains and negative shortfalls.

Comparing OBPI and CPPI Strategies

A primary focus of the academic literature reviewing portfolio insurance looks at the comparison of the two strategies, and/or how closely the theory matches the practical outcomes in the market. Given that the two strategies offer alternative ways to seek protected payoffs, it is natural to examine under what circumstances an investor should prefer one type of protection to the other.

In order to better understand the differences between these strategies, we present the results of a simple simulation following Bertrand and Pringent (2001). While OBPI is a strategy based on the choice of a single parameter, K the strike of the put, the CPPI strategy implies the setting of both the cushion and multiplier. The simulation assumes the same initial amounts and that the two strategies provide the same guarantees. Moreover, the cushion value equals the price of the call. It is further assumed that the terminal date T equal one year, that the initial value of the portfolio is 100, that the risk free rate r^f is 3% in annual terms, and the volatility σ is 0.40%. The results of the simulation can be seen in Figure 1. Different paths of the CPPI strategy are provided for different values of the multiplier m . The intersection of the strategies provides the approximate value of the risk-free return. The graph shows that the higher the multiplier, the higher the payoffs of the CPPI strategy. The OBPI approach outperforms the CPPI one only for moderate values of the multiplier m . At the same time, Bertrand and Pringent (2002) underlined that one should not choose too high values for this multiplier, since the higher the value of the multiplier, the higher the risk for an investor to reach the floor.

Figure 12 - OBPI vs. CPPI for different multipliers



Source: Bertrand and Pringent (2011)

Bertrand and Pringent (2005) extended the previous work by considering the probability distributions of the portfolio values under different strategies. They pointed that when the probability distribution is ignored, one cannot discriminate between OBPI and CPPI. When the probability distribution is taken into account, as the insured amount at maturity rises, the CPPI strategy becomes better than the OBPI one. The reason for this, as they note, is that the OBPI call has a lower probability to be used.

Annaert et al. (2009) extended the work by Bertrand and Pringent (2005), by considering the use of stochastic dominance criteria in comparing the different portfolio insurance strategies (while most of the previous research focused on mean-variance criteria). They argued that the literature up to considered only the standard mean-variance measures of investment performance, but failed to account for the entire distribution, as stochastic dominance does. At the same time, due to the portfolio insurance specifics, which imply possible upward and downward movements, an appropriate approach must take into account the whole distribution. They also considered a comprehensive comparison of the different portfolio insurance among each other and with the buy and hold strategy. Their main results are that the portfolio insurance strategies lead to both better downside protection and lower excess return as compared to the passive buy and hold strategy. However, the portfolio insurance strategies do not stochastically dominate the buy and hold strategy. They also found that when the floor is the highest, the protection against downside movements is the best.

Zagst and Kraus (2011) noticed that the two strategies act in different market environments. Namely, the CPPI strategy is a dynamic one within a certain market characterized by an empirical volatility, while the OBPI strategy uses put options that require implied volatility. However, the implied volatility and the empirical volatility are not necessarily equal. They extended the previous research by considering stochastic dominance criteria up to the third order, as well as by taking into account the spread between the implied and empirical volatility. Their main conclusion was that the higher the implied volatility, the higher the chances that the CPPI strategy stochastically dominates the OBPI strategy in the third order.

Another study that addressed the issue of the hypothesized law of motions of the asset returns is due to Bertrand and Pringent (2011). They introduced the Omega measure in comparing the two portfolio insurance strategies. They considered not only the standard case of Brownian motion with drift but also the sum of Brownian motion and a compound Poisson process with jump. In both cases, for the Omega measure (and Kappa measures in general), the CPPI strategy outperformed the OBPI one (Bertrand and Pringent 2011).

5. Conclusions

Having studied the literature available on the topic of risk management there are a few key themes we can draw out at this stage. Firstly, there are several definitions of “risk” and indeed several types of risks that authors try to define when writing on the topic of risk and this is not always the same thing. Secondly, in general, most authors are in agreement about what risk management is, and most also have suggestions on how it could be better applied on the basis of its failure during the

most recent crisis. Thirdly, there were several papers and articles that have focussed on the asset classes in which it was found their risk profile was incorrectly estimated pre-crisis (Credit Default Swaps, Asset Backed Securities, Mortgage Backed Securities, etc).

In order to expand the first point on the definitions of risk, we looked at some of the multiple definitions/debates. It was stated earlier in this chapter that we would use the definition of market risk as stated by Resti and Sironi (2007) since it assumes portfolios are well diversified and, therefore, is most applicable to active equity portfolios: “the risk of changes in the market value of an investment or portfolio of financial instruments connected with unexpected changes in market conditions”. This is closely related to Markowitz’s (1952) notion of risk as an “undesirable thing” in his description of the perfect portfolio. In his CAPM model, all the market risk is captured in the beta, measured relative to a market portfolio, which should, in theory, include all traded assets in the market place held in proportion to their market value. Damodoran (2003) points out that when trying to address risk in equity portfolios we are often drawn to statistical measures of risk.

As stated above, most authors agree risk management could and should be improved upon. It is important to note the reasons why it has not been improved upon in the past, particularly in equity portfolios. Brandolini et al (2000) identify the key reason when they speak of the third-party portfolio manager who has control over the investments, yet the liability is removed from him. The most he could lose from a risky investment that did not pay off is his job. However, in normal market conditions, if he made a bad stock pick, his performance in other investments

would hopefully far outweigh that one bad bet. Many authors try to blame risk models, and more importantly, our ability to use the risk models. The truth is, models can only produce scenarios from the data that is put into them. Darnell (2009) points to the short volatility bias that caused significant losses across the board. Traditional equity portfolios had little in the way of options hedging in place.

One paper the researcher believes presents a good model to use going forward is that of Bender and Nielsen (2009) which talks about the 3 pillars approach of Risk Measurement, Risk Monitoring and Risk Adjusted Investment Returns.

The focus of the rest of this research is on equity portfolios within Europe. There has been so much focus in the academic literature on alternative and derivative investments, but we cannot ignore the significance of the plain vanilla equity funds. These funds suffered large losses during this crisis, and stock picking was not enough to manage their risk.

With such a significant amount of assets under management in equity portfolios, it is important to investigate the risk management culture that allowed some portfolio managers to take risk without sufficient hedges.

In Chapter 2 upon the review of the literature within risk management in portfolio management we gathered substantial information that helped us answer broad questions regarding risk management such as what are the various definitions of risk and the role of the risk management within the portfolio management – our main conclusion is that it is clear that there is a lack of specific risk management

literature dedicated to this specific topic and to the best of our knowledge the above risk management review literature is the most complete and detailed available.

Chapter 3: First Empirical Chapter

1. Introduction and objectives

To the best of our knowledge, there is no comprehensive study on the current state of risk management within European equity portfolios.

The objective of the first empirical chapter is to research how risk management is currently used. Using a questionnaire survey, we determine to what extent risk management is currently used, how it has changed in recent times and expectations of how it will change in the immediate future.

The questions in the survey try to analyse the state of the art of the Risk Management in the Asset Management Industry. It tries to answer several key questions:

- What are the consequences of past financial crises?
- Is risk management taken seriously inside financial organizations?
- Are funds with fewer assets under management expected to spend (proportionally) less on risk management?

2. Literature review

The last two crises in financial markets, the dotcom bubble which burst (2000-2003) and the credit crisis (2008-2009), have made the industry and investors rethink many of the paradigms and beliefs fundamental to it. In many respects these issues are not wholly new and as far back as 1996 the then US Federal Reserve Chairman, Alan Greenspan, described the behaviour of financial participants as displaying “Irrational Exuberance”, as they simply did not value

companies in a judicious manner (Shiller, 2000) and simply continued to inflate the dotcom bubble that finally blew up in 2000. Furthermore, in the recent credit crisis (2008-2009) there was a lack of transparency and feasibility in the quantitative tools used to compute the value and risk management for the exotic credit derivatives products.

To the best of our knowledge, there are no academic papers which have surveyed risk management practices in financial institutions. Nevertheless, Price Waterhouse Coopers completed a survey on valuation and risk management with regard to 68 US, European, Asian and Canadian hedge funds⁵. They found that for a majority of funds some areas of risk management were not sufficiently considered, in particular, counterparty risk and the risks associated with the approval of new instruments. They also found that hedge funds have a diverse view of who should bear prime responsibility for risk management in the company. This role is variably delegated to the General Partner, the Board of Directors, the Senior Portfolio Manager, and the CFO or to an independent risk manager. Further, almost 70% of the respondents to their survey were found not to have a risk management committee, while only 31% had an independent risk manager. Additionally, a third of respondents believed that tools used for risk management in hedge funds were not that sufficient, while 11% considered that the risk management process was relatively weak. Finally, it was found that the performance of only 50% of portfolio managers is measured on a risk-adjusted basis, taking into account adequate risk measures.

⁵http://www.pwc.com/en_GX/gx/financialservices/pdf/globalhedgefundsurvey.pdf

Ernst and Young's Risk Management for Asset Management Survey (2011)⁶ is based on interviews of a limited sample of around 30 UK and European large, medium, small (by assets under management) and alternative asset management firms. They found that, in general, risk management practices in 2011 were improving relative to previous years. They also found: that managing liquidity risk was a priority for most of the firms; that investment risk (deviation from an expected return, i.e. volatility) was "well managed"; that 65% of respondents used Value at Risk (VaR) to model market risk; and that 45% of respondents had increased the size of their risk management team. Further, the survey also assessed respondents' views on counterparty risk, operational risk, tax risk and various aspects of regulation. They found that although mitigating counterparty risk was viewed as very important, improvements were needed in terms of (intra-daily) monitoring of such risk per counterparty and asset class; that risk managers spend less time relative to previous years on operational risk and that more emphasis should be put on how regulation will affect outsourcing and delegation; and that 42% of respondents believe that tax issues are adequately overseen by the risk team, while an even higher 66% believe that tax inefficiencies are evaluated on a consistent basis. However, the survey confirms that the governance structures of hedge funds have not changed significantly despite the forces of change that have affected public companies and registered investment companies.

Two years later, Ernst and Young repeated the survey by interviewing 54 UK and European large, medium and small traditional and alternative asset managers. The

⁶[http://www.ey.com/Publication/vwLUAssets/Risk_management_for_AM_2011Survey/\\$FILE/Risk_management_for_AM_2011Survey.pdf](http://www.ey.com/Publication/vwLUAssets/Risk_management_for_AM_2011Survey/$FILE/Risk_management_for_AM_2011Survey.pdf)

survey reflected that the pace of regulatory change, the need to mitigate reputational risks and the desire for capital optimization has been motivating the companies to improve the risk management functions. The Risk Management for Asset Management Industry's (2013) results showed a greater appetite among the Asset Managers to hold more risk factors under consideration. In contrast of the 2011 survey's results, in 2013 several asset managers posted improvements in how they were able to determine counterparty risk exposure. Regarding the operational risk, respondents claimed to outsource this service. Above the traditional operational and counterparty credit risks, the risk categories of major concern were regulatory, mandate, conduct and liquidity risks, followed by market and investment risks. 76% of the respondents consider regulatory risk as the top risk category to be monitored. Nonetheless, there was a wide variance in the involvement of the risk management in the investment process among the firms, namely in organization, the key decisions and how tolerances and limits were defined. Only 51% of the respondents confirmed the independence of the investment risk function but 66% claimed intra-day reporting from sophisticated risk metrics. 62% evidenced liquidity metrics for regulated and segregated portfolios on an ongoing basis and 40% claimed an advanced process for risk budgeting. Moreover, 61% of firms could demonstrate the measurement and monitoring of risk at both an aggregate and a factor level while 47% could demonstrate dynamic modelling. Respondents also commented on the need to extract information from interlinked systems, with only 57% of the respondents showing their ability to carry this out.

On the Rethinking Risk Management survey in 2015, Ernst and Young concluded that despite the previous years' enhancement of risk management systems and processes to meet regulatory and market demands, in 2015 companies started a process to re-engineer some aspects of risk management. More than 50% of the respondents reported they aimed to identify non-financial risks by developing more forward-focused and prevention measures as well as risk scenario analysis and tools. 77% of the respondents reported an increase in senior management attention to risk culture in the past 12 months and 75% claimed they were still making changes in the firm's culture. Companies were still facing several challenges to convert the risk culture into the day-to-day business and most of the respondents continue to work to develop stress-testing approaches and improve data systems. Only 43% of the total sample confirmed the risk appetite was successfully linked with the business planning but 57% reported strong progress in the ability to enforce risk management. Another good indicator of the improvements within these companies is that 64% of the respondents guaranteed an increase in the size of the risk function while 60% were expecting such increases to continue in the 2016.

In Chapter 3 our findings are consistent with EY's surveys even though EY uses a smaller sample. We found out that hedge funds are more sensible towards risk management when they look at it and that risk monitoring frequency and factors analysed need to be developed and improved. Furthermore, we observed in the survey from Chapter 3 that both long only and hedge fund managers consider liquidity and volatility risks more frequently compared with other risk factors and

that the Asset Management's risk teams are not sufficiently independent from the investment teams.

To conclude, although practitioners' surveys have addressed some of the issues that the asset management industry is facing in terms of risk management, such as those relating to adjustment to new regulations, issues around the allocation of additional resources to risk management or issues with regard to better communication, we believe that the existing surveys are not comprehensive enough to give a definitive picture of the risk management landscape in turbulent times. They do not investigate whether the amount spent on risk management improves a fund's performance or not. In addition, the surveys are generally conducted with a relatively small sample of respondents, making it more difficult to draw industry-wide conclusions. To overcome this lack of information, in Chapter 3 several questions are asked to a sample of 200 asset managers, regarding the size of the risk teams, the budget they have, who the CRO reports to, the impact of the latest financial events, etc. Afterwards, the researcher will try different approaches to explain the performance of the funds in terms of the survey's questions.

Litterman (2003) mentions that by recognizing that risk is a scarce resource and that different investors have different appetites for risk, each investor needs to develop an individually tailored investment plan with a target level of risk for the portfolio based on their preferences and circumstances. For most investment portfolios, the dominant risk will be a relatively stable exposure to the traditional asset markets, especially equity and bonds. This could be referred to as strategic

asset allocation. The construction and management of an active equity portfolio is somehow similar to the above example, i.e. divided in two steps:

1) first the development of equity allocation (based on the weights of the relative benchmark), and **2)** the implementation and monitoring of portfolio allocations relative to that benchmark. This allocation is designed to be a stable mix of equities that maximizes long run expected return given a targeted level of risk. Today most of the equity mix within an equity portfolio is conditioned to the benchmark of the portfolio. Since this research focuses on risk management within active equity portfolios is necessary to emphasize the distinction between total risk and active risk because it is a key element in the design and overall management of portfolios. Total risk is defined as the overall risk within a portfolio while active risk is the equity weight above the benchmark (Litterman 2003).

2.1. How is Risk Management currently used?

Brandolini et al (2000) identify some key reasons why asset managers have insufficient risk management practices:

1. Institutional investors manage third party funds so eventual liabilities are those of other people - if there is a loss on the fund, it is their clients, not their own liability;
2. Losses, therefore, have no immediate impact on the balance sheet of an institutional investor;
3. Many fund managers are concerned with returns relative to a benchmark instead of absolute returns. Therefore, their analysis of risk in their portfolios ignores broad market downturns like that witnessed in 2008.

“Investment firms have often managed risk in an intuitive manner and risk management systems have been viewed as an avoidable costly investment, which has to demonstrate every time it’s utility” Brandolini et al (2000).

Eppler and Aeschimann (2009) identify that Goldman Sachs Investment Bank, which was relatively better off than other banks, had a strong risk management culture. Buehler et al (2008) identify *daily* risk reports and *weekly* meetings of the firm wide risk committee; this regular communication within the firm on risk, allowed them to weather the crisis relatively better than their competitors. An Article in Pensions and Investments (2006) adds that in risk management we face two issues: one is an issue of risk model structure; another is an issue of economic cycle. There are times when the economic cycle will dwarf the risk model structure. This article would suggest that even if the human relationships aspect of insufficient risk management culture were overcome, we would still have issues of picking the right model for whatever stage in the economic cycle.

Martellini (2010) mentions that “for more than 50 years the investment management industry has focussed on security selection as its greatest single source of added value. Risk management and asset allocation have therefore been largely out of view”.

According to Darnell (2009) most investors look for strategies that have recently provided positive, consistent, risk-adjusted returns. In this approach, however, many risks are ignored, including exposure to beta, interest rates and credit. Darnell (2009) argues that during low probability high-tail risk events such as the

financial crisis of 2008, long volatility positions would have been highly successful. By having limited protection against loss in many portfolios, they were net short volatility. These short volatility biases looked very attractive to investors, as they had experienced positive performance over the prior 20 years. However, it was this growing short volatility bias that created so much pain in the recent downturn.

Rebonato (2007) suggests that risk management should be of major interest in behavioural finance and cognitive psychology. Commentators point to flaws in risk management models prior to the crisis because they only looked at historical data of the last 20 years, an exceptionally good time in the market. Over 10 years prior to this, Greenspan (1999) was quoted in the New York Times as saying “...boards of directors, senior managers, and supervisory authorities need to balance emphasis on risk models that essentially have only dimly perceived sampling characteristics with emphasis on the skills, experience and judgement of the people who have to apply those models. Being able to judge which structural model best describes the forces driving asset pricing in any particular period is itself priceless. To paraphrase my former colleague Jerry Corrigan, the advent of sophisticated risk models has not made people with grey hair, or none, wholly obsolete”.⁷

Risk models by their nature make some simplifying assumptions (Cowell 2009). According to Cowell (2009), the real danger with risk models is treating them as black boxes: accepting, rather than interrogating and dissecting the risk estimates they generate. Cowell (2009) reminds us that a portfolio manager’s main objective

⁷ [Federal Reserve Board Speech 1999 <http://www.federalreserve.gov/boarddocs/speeches/1999/19991014.htm>]

is not only to avoid losing clients' money, but also to add to it progressively. That requires not only picking the best stocks, but also managing risk within the portfolio and being aware of the risk profile of each investment decision. Risk management should be at the forefront of the investment management industry, not just an after thought. Cowell (2009) goes on to state that the following three factors must combine to create the "machine for good investment management":

1. High quality security level return forecasts;
2. Sound risk management;
3. Relevant and credible risk measurement.

According to results from a survey (European Investment Practices Survey, 2008) by Edhec Risk and Asset Management Research Centre, "... investment professionals are often familiar with research findings and new techniques, but that these are rarely used".

Why is this the case? Sandeep Vishnu of Capco in the Cass-Capco Institute Paper Series on Risk (2010) suggests that there is a "silent accusation" within the asset management industry that risk management dampens revenue and puts brakes on innovation. This is a challenge faced by risk managers as they try to put in structures to guard against losses. Vishnu assesses that in the recent crisis, "managing risks was not an embedded element in critical business processes; it was a bolt on activity. When times are good, fund managers do not want to pay attention to risk management because they are too busy making money but when times are bad, fund managers do not want to pay too much attention to risk

management because they are already incurring losses, and do not want to spend more money”. However, after the financial crisis and with the development of online markets and financial services, professional investors became aware of different types of risk. Operational risk, for instance, has turned to be as important as credit risk and market risk. The main consequence is the need to develop new types of model risk in order to improve risk measurement and monitoring (Xu and Pinedo, 2016). My results in Chapter 3 are in line with Xu and Pinedo’s research, as 74.6% of the investors have increased the amount they spend on risk management compared to the pre-crisis period.

Vishnu (2010) states that “organizations that integrate resilience (and risk management in general) into their culture in a granular manner stand a better chance of not only mitigating risks more effectively, but also more cost-effectively”.

Global Investor (September 2001) highlights that the key to success for building a risk management culture within a firm is:

1. The risk management function should provide recognizable and material contributions to the portfolio management teams that lead to improved risk-reward ratios in the performance of portfolios, funds and separate accounts under their care;
2. The risk management function should make a valuable contribution to the asset management company in terms of reducing the probability of significant losses in portfolios, funds and separate accounts managed by the company;

3. The risk management function should be performing its duties in such a manner that it materially helps the asset management company achieve the “brand” recognition for quality risk management, and thus, enhance the efforts of its marketing and client service teams.

Global Investor (2001) states that risk measurement can be about producing reports that few people take seriously and which do little more than allow the asset management company to say that they have a risk management team that provides basic risk management services. Risk management on the other hand, is about actually helping the company manage portfolios in a more measured way, on a risk-adjusted basis. However, there is a danger of investing in risk management departments who build complex models without achieving the desired results, because too much emphasis is placed on the findings of the model.

Darnell (2009), on the other hand, mentions that risk models are helpful in judging risk exposures under typical situations, but no substitute for investment judgement exists when it comes to anticipating how portfolios will respond to tail events. Danielsson et al (2006) reminds us that financial returns tend to exhibit fat tails, which prepares for those tail events even more pressing. Risk models are generally based on a normal distribution but if the distribution is platykurtic, then these tail events are *more* likely to happen. Darnell's (2009) paper asks a number of questions relating to risk models and whether they failed during the crisis. He concludes however, that it was not the risk models that failed, it was:

- a) Not knowing where to go for answers when the limitations of the risk models had been reached and
- b) Investment judgement based on an incomplete assessment of risk.

Another issue to consider is human reaction to risks. Perhaps too much focus has been put on the quantitative side of risk management in the past, without looking at the qualitative issues. According to Blommestein (2010) too much faith was placed in a new generation of complex risk models. Eppler and Aeschimann (2009) identify that one key problem is effective communication of complex financial risk.

Rebonato (2007) identifies 3 key themes relevant to the management of financial risk:

1. Human beings tend to deal with probabilities in qualitatively distinct fashions: a deliberative System II mode, which allows for more accurate, but slower, assessment of risk; and a System I mode, which provides quick responses, heavily influenced by identifiable heuristics.
2. In the medium-to-high probability range, these rules of thumb are far from perfect, but they do not seem to perform too badly. When the most likely outcome of one such medium-to-high probability event must be estimated, heuristics have actually been shown to be surprisingly effective. Some instances of apparent System I “irrationality” can be explained and partially justified.
3. Where the System I mode of operation really breaks down is when the probabilities at stake are very low. When this is the case the heuristics soon

cease to provide useful guidance, and the behavioural responses become very difficult to explain in a “rational” framework.

According to Brown (2008), one in five fund managers who invested in complex financial instruments admitted to having no in-house specialists with relevant experience. His research found that institutional investors who invested in instruments such as derivatives, collateralized debt obligation (CDO) or structured products seem to be at a greater risk skill, with one in three saying they have no in-house experience regarding these investments.

Golub and Crum (2010) observe that risk managers can only be truly effective when they are independent from the risk takers, even if those risk takers are highly risk aware. Further, Golub and Crum (2010) recommend that at a minimum the risk management function must not be subordinate to the investment function, but of equal standing. The head of the risk management department should report directly to the CEO of the company, and not to the CIO. The risk department's incentives should also reflect positive incentives for long-term success of the firm, and not by the short-term performance of investment portfolios. We will show in the questionnaire that 25% of the respondents still report directly to their CIO.

Against this backdrop, financial markets have suffered significant distress in recent years and many commentators have started to question methods used, particularly in the field of risk management. Clearly, risk management was not well understood or used properly by financial companies that operated in this environment during these two latest crises. It is therefore important to assess the

level of commitment that banks and portfolio managers have had in respect to this crucial area of risk management to see if improvements can be made before further financial crises take place.

In the first empirical chapter, we examine the use of risk management practices in the European Asset management industry. Using a questionnaire survey, we determine to what extent risk management is currently used, how it has changed in recent times and expectations of how it will change in the immediate future.

The questions in the survey try to analyse the state of the art of the Risk Management in the Asset Management Industry. It tries to answer several key questions:

- What are the consequences of past financial crises?
- Is risk management taken seriously inside financial organizations?
- Are funds with fewer assets under management expected to spend (proportionally) less on risk management?

The main conclusion of the survey is that risk management functions have been neglected for some time. As we will see in the questionnaire discussion, the role of the risk officer is not always clear. Sometimes the person in charge of the risk function is the Portfolio Manager himself. The survey also highlights the tendency that smaller funds spend less (proportionally) in risk management functions.

One of the most interesting conclusions from the survey is that it seems that change is now being considered: companies are currently more aware of these

problems and they are taking risk more seriously. They are willing to spend more on resources and give risk departments more power inside their organizations. This conclusion is based on specific questions in the survey that refer to the recent past and the near future in terms of risk management spending.

3. Data and Methodology

Data

This dataset is focused on European equity type funds: traditional open-ended equity mutual funds and hedge funds. The source used to get the number and assets under management of companies that manage traditional equity funds is the database FundFile from Lipper Fund Management Information (Lipper FMI). FundFile is a research tool specially designed for the European and Asian fund industry that tracks over 45,000 funds sold throughout Europe and Asia. The data is released on a monthly basis with an approximate lag of six weeks, which allows FundFile to have all groups reporting their assets at the same date. The latest data available for our purposes was to the end of April 2010.

The FundFile database does not have sufficient coverage of traditional hedge funds - its main strength is the collection of data on traditional open-ended mutual funds. Hence, in order to add a list of hedge fund companies to the sample size an alternative source was used - Morningstar Direct.

Designed for institutional use, Morningstar Direct is an Internet-based research platform that enables users to perform in-depth investment analysis. It powers sophisticated holdings - and returns-based style analysis, insightful peer/competitive analysis, thorough manager performance evaluation, and efficient investment monitoring and reporting. Morningstar Direct fully integrates all investment universes to enable cross-universe analysis. Over the last few years,

Morningstar have continued to expand their hedge fund coverage by acquiring businesses and databases. InvestorForce was acquired, which included the Altvest™ hedge fund database, which allows screening of one of the largest proprietary global hedge fund databases available. Hence, these credentials and coverage of the hedge fund universe makes this source suitable for this study.

Assets under management for traditional mutual funds in the industry were extracted from FundFile and consequently aggregated using the field “Master Group” level. The existence of the “Master Group” level makes this database the most suitable source for constructing this dataset. The Master Group level aggregates company subsidiaries to the head company level e.g. some companies have various asset management subsidiaries and these are placed under the overall banner of the head company. This prevents counting separate asset management entities of the same head company multiple times in the final sample. Other data sources show the separate entities within firms which makes it more difficult to summarise the data.

For hedge funds, although company names have been added to the overall number of companies in the marketplace, assets under management have not been included in the total figure. The main reason is due to the lack of up-to-date asset figures for hedge funds within the Morningstar Direct database. To get to a final number of companies in the industry and an overall asset total the following filter criteria were used. In the case of traditional mutual funds, the ten largest European domiciles by equity assets under management were taken. Domicile refers to the country where the fund is legally incorporated. The ten largest domiciles by total number of assets under management are Luxembourg, United Kingdom, France, Ireland, Sweden, Germany, Switzerland, Netherlands, Italy and Norway. Funds that are domiciled in a particular market are primarily sold to that market (i.e. UK domiciled funds are sold primarily in the UK, French domiciled

funds are sold primarily to French based investors etc.). However, the exceptions are Luxembourg and Irish domiciled funds, which are sold cross-border. I.e. fund companies domicile a fund range in Luxembourg and/or Dublin and register the funds for sale throughout Europe (and are hence in competition with funds also domiciled in each local domicile). There are tax advantages for companies domiciling their ranges in such centres. This methodology gives suitable coverage of the largest equity funds in Europe incorporating both funds in “offshore centres” as well as those funds domiciled in each local market. The largest ten domiciles by assets under management specified above account for 93% of total assets domiciled in Europe. Hence, the total sample size covers the majority of the marketplace.

Secondly, only mutual funds that FundFile classify as Investment Type “Equity” were put into the sample. Hence the dataset excludes bond funds, fund of funds (both fettered/unfettered), any funds that FundFile label as “hedge funds”, mixed asset funds (i.e. those investing across multiple asset classes in the same fund), money market, money market enhanced and property funds. Note that property funds that invest in shares of real estate companies are included in the sample. However, funds that invest in physical property i.e. offices, hotels, warehouses etc. are not included in the sample. There has been no further filtering based on where underlying stocks are listed and hence the sample includes funds investing in regions throughout the world (UK, Europe, US, Asia, Japan, Emerging Markets, sector specific funds etc.).

It is worth noting that the funds within the sample include pooled funds i.e. open-ended OEICs/SICAVs that are sold to both institutional and retail investors. For example, institutional OEICs/SICAVs run by both Fidelity and Schroders are included in the sample. These institutional funds often have a higher initial investment requirement than their retail counterparts. However, segregated

mandates that companies run for specific institutional clients are not included in the sample (i.e. funds that are run to the specific requirements of a company pension scheme and hence not available to the wider investing public). Indeed, assets in segregated mandates are not so widely reported on a consistent basis by all fund groups. Closed-ended funds (investment trusts) are also not included in the sample.

The sample also excludes any funds in the database classified as ETFs (Exchange traded funds) or index trackers. The majority of the funds listed are pure long-only funds but the sample does include some funds that peruse full UCITS III powers and hence have the ability to use derivatives to create synthetic shorts or write covered call options to enhance income. I.e. Blackrock UK Absolute Alpha (net equity exposure 15.9%), Fidelity Special Situations (which has some specific stock shorts), Schroder Income Maximiser (writes covered calls to enhance income).

The sample of traditional open-ended equity mutual funds may also contain some funds that are domiciled in Europe but contain assets invested in these funds by Asian based investors (i.e. Hong Kong or Japanese based investors).

The following filter criteria have been applied to the hedge fund dataset from the Morningstar Direct database. Firstly, as the majority of hedge funds are domiciled in offshore centres such as the Cayman Islands, using domicile as per the methodology used to extract the traditional mutual fund dataset from FundFile is not a sufficient filter criterion. Hence, in this instance the city where the managing firm is headquartered was used and limited only to show those companies based in London (actual filter on the Morningstar Direct system is named "Advisor City").

The dataset was then further filtered to display equity based hedge fund strategies only. As specified earlier, Morningstar categorise funds into their own sectors and

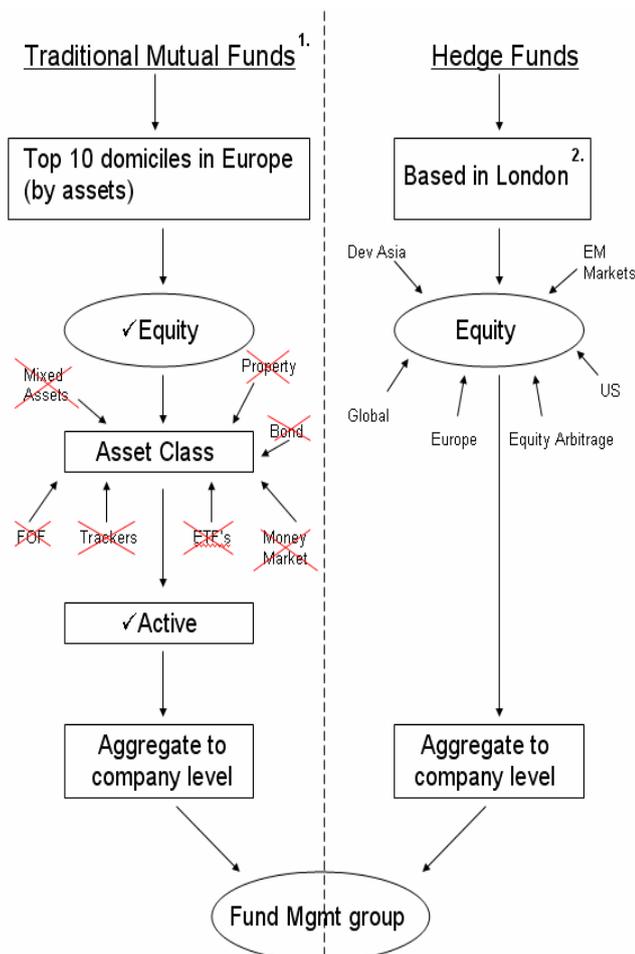
this allows grouping of funds by particular strategy/asset class. Hence, the following Morningstar Categories have been used - Hedge Fund Developed Asia Equity, Hedge Fund Emerging Market Equity, Hedge Fund Equity Arbitrage, Hedge Fund Equity Europe, Hedge Fund Global Equity and Hedge Fund US Equity.

Once the list of hedge funds in these categories was obtained the data was aggregated from the fund level to the company level in order to get a number of hedge fund companies in these specified equity categories where the managing firm was based in London.

The final step in the sample construction meant combining the list of companies obtained from Lipper FundFile to the list of hedge fund companies obtained from Morningstar Direct. Once the list was combined companies that appeared in both the traditional mutual fund list and the hedge fund list were only counted once to avoid double-counting of a company with a hedge fund business and a traditional long only open-ended fund business.

The following graph summarises the filter criteria:

Figure 1 - Filter Criteria



1. Open-end mutual funds in the top 10 domiciles in Europe

2. The city where the managing firm is headquarters

This resulted in a list containing 840 companies with 743 coming from the traditional mutual fund list sourced from Lipper FundFile and 97 coming from the hedge fund list sourced from Morningstar Direct.

The assets under management of this sample total \$1.97 trillion with the largest five equity managers being Fidelity, Blackrock, JP Morgan, Deutsche Bank Group and BNP Paribas. The assets of BNP Paribas include the acquired assets of Fortis. This re-emphasises the importance of aggregating assets to the “Master Group” level as described earlier to avoid counting subsidiaries of groups as

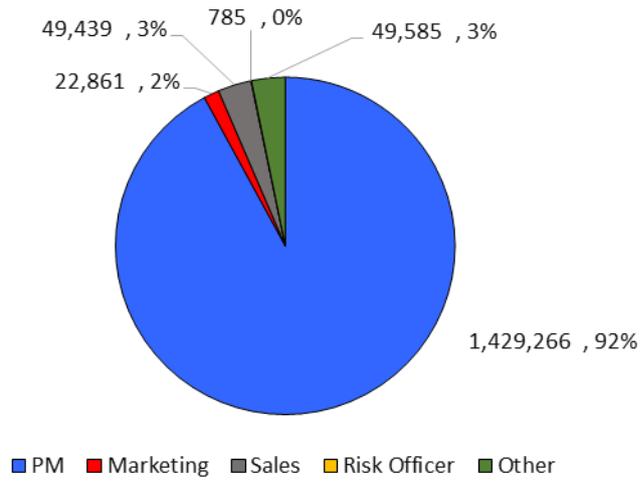
separate entities. The top 10 groups account for 30% of total assets with the top 20 accounting for 48% of the total assets.

Methodology

The survey was carried out by one on one interviews where the interviewer had the question script in front of him and the interviewees were able to respond. This enabled higher response rates than a mailout would have received, for example Levich, Hayt and Ripston (1999) received only a 17.5% response rate from their 1708 surveys mailed during their study of derivatives and risk management practices by U.S. Institutional investors. Interviews were carried out between January and September 2010.

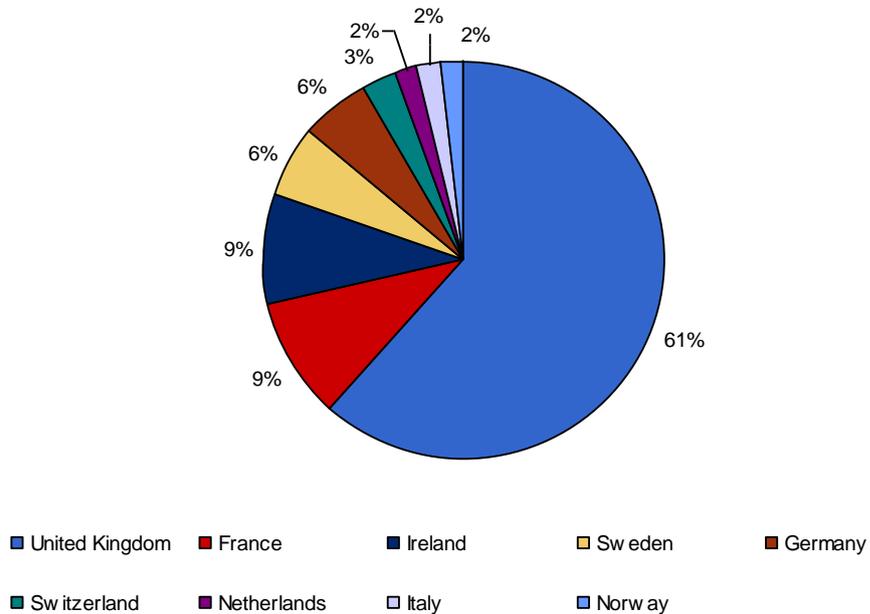
The survey was conducted with 200 subjects whose positions ranged from Portfolio Managers, Marketing Heads, Sales, Risk Officers and others within (the) their asset management firm. 93% of the surveys were completed by Portfolio Managers.

Figure 2
Assets Under Management for Those Surveyed (\$mn)



In terms of geographic breakdown, UK-domiciled assets represented 60% of the Surveys completed.

Figure 3
Domicile of assets for those surveyed (% of AUM)



Spanning the following:

Figure 4

AUM (m\$)	
Total	1,551,935
median	1,126
mean	7,838
max	93,671
min	1

The survey consisted of 24 questions and was designed specifically for the purpose of this research (see appendix 1). Sauner-Leroy (2004) found that using data not designed for the purpose of his specific research hindered the relevance of his results and decided that the relevance of his results could be increased by using indicators that specifically measured the studied phenomena using a specifically designed questionnaire hence the researcher's decision to develop his own questionnaire for this study.

The questionnaire was designed to understand the current importance of risk management within the Asset Management industry in Europe and identify possible areas of improvement. Its purpose is to gather information for two main topic areas: Risk Measurement and Risk Monitoring. Individual questions referred to what risk management system is currently in place, how often Portfolio Managers use the system, the relationship between the PM and risk managers, how often various parameters relating to risk are assessed, who has power when it comes to making decisions to address breaches of risk limits, and how much importance is given to risk management in terms of spend within the institution. The findings can then be used to develop risk-adjusted investment-management strategies.

4. Benefits and limitations of the methodology used

Interviews for data collection can be performed in two essential manners: self-administrated questionnaires, using Internet and mail, or interviews that are conducted by an interviewer, either by phone or face-to-face. All methods can result in high quality data, so the choice for a specific data collection mechanism depends on the research objectives (Leeuw 2008). Due to the nature and detail of the present study, it was decided that interviews would be conducted through a face-to-face method, with the presence of an interviewer.

In order to conduct an in-depth survey, face-to-face interviews are always preferred, since a physical encounter often creates a dynamic and generative environment (Legard, Keegan and Ward 2003). Face-to-face interviews have proved to be the ones with the highest completion rates (Bowling 2005) and to be the most effective to convince reluctant interviewees (Leeuw 2008). Also, they have proved to be an effective data collection method for long and more complex interviews (Leeuw 2008). However, face-to-face interviews also bear some risks and disadvantages. Time and cost can be considered as one of the disadvantages of face-to-face surveys. The cost of selecting, training and overseeing a successful team of surveyors can be extremely high and can take some time to organize. Due to the particular survey situation, the time and financial cost were insignificant factors as the researcher was himself the interviewer and easily got access to the interviewees.

Another important aspect to have in account is anonymity (Sturges and Hanrahan 2016). Face-to-face interviews do not allow for anonymity, as do for example

Internet conducted surveys. This characteristic can potentially have negative consequences and influence interviewees answers, as there are situations in which respondents could be embarrassed to respond to questions that are attached with social or emotional meanings. In the specific situation of the study at hand, anonymity was not a challenge since this survey was not used for evaluating individual behaviors nor implied any type of conflict of interests.

On a face-to-face survey, the impact of the interviewer on the interview always has to be acknowledged. This impact can be positive, motivate interviewees or clarify any question, or negative, it can inhibit socially undesirable answers or influence respondent's behavior in many ways, depending on specific situations. Since the 200 interviews comprising this study were conducted by the researcher who knew the interviewees previously and has a deep expertise in the area, the negative impacts were again not relevant.

For the previous mentioned reasons, the researcher decided to interview the various asset managers in person, as the completion rates are significantly higher and its negative effects were negligible for the results of the present study.

5. Preliminary Results

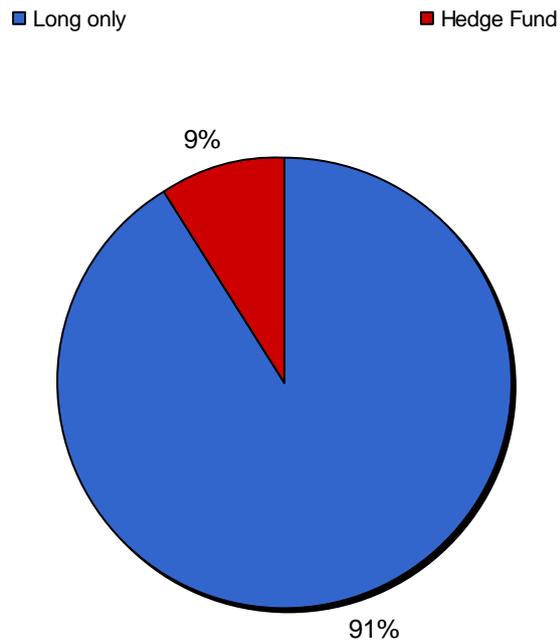
In this section, we discuss the answers to the survey's questions. For each question, we analyse the answers for the all universe of 200 companies. We also provide answers for the long only (182) and hedge funds (18) separately. For each question, the first graph corresponds to the universe, the second to long only funds and finally, the third graph states the answers provided by hedge funds.

Question 1: *How is your institution predominatly characterized?*

This question was introduced in the survey to better understand the universe.

Figure 5.1

Figure 1: Your Institution characterized by being predominantly:



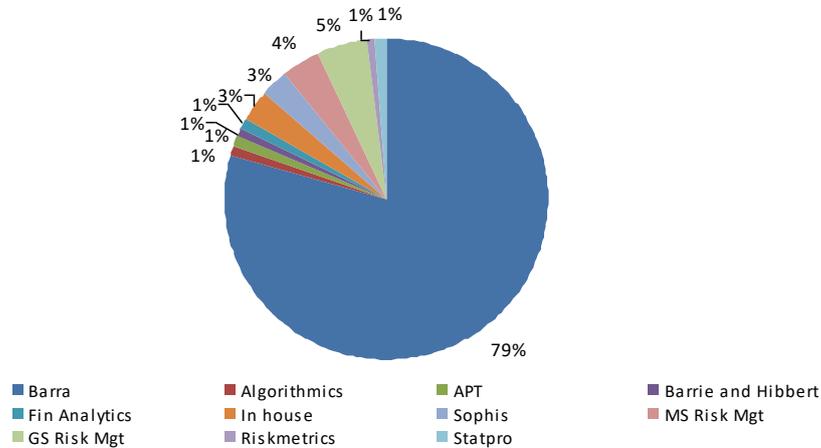
From the sample surveyed, 91% of the respondents claimed their institution was predominantly long only, with 9% representing themselves as hedge funds.

Question 2: *Which Risk Management tool do you currently use?*

The following question has to do with the risk system used by the asset managers. It is interesting to know which risk management tool do asset managers use to measure risk within the portfolios.

Figure 5.2

Figure 2: Which Risk Management tool do you currently use?



The respondents were queried on the risk management tools used at their respective firms. A large majority of those surveyed (79%) use Barra's Risk Management system. Goldman Sachs' (GS) risk management tool was a distant second represented by 5% of respondents.

Different risk systems provide diverse tools for effective risk management. They also differ in terms of assumptions they use. It is therefore important to know what systems are used in the industry. One obvious conclusion from this question is that, once again, the industry seems to be highly correlated in terms of the tools they use. In fact, the great majority of the fund managers questioned uses the Barra's Risk Management system.

When the market is more volatile, portfolio managers have more pressure to scale their positions and measure risks (DeMiguel, 2010). It is precisely their risk system that measures what positions are riskier and which ones should be sold to reduce the portfolio risk. If the great majority of portfolio managers use the same tool to

measure risk, it will create a selling cluster. As mentioned by Boyson, Stahel and Stalz (2008) when using monthly hedge fund style indices representing eight different styles from January 1990 to August 2007, the authors find strong evidence of clustering of worst returns.

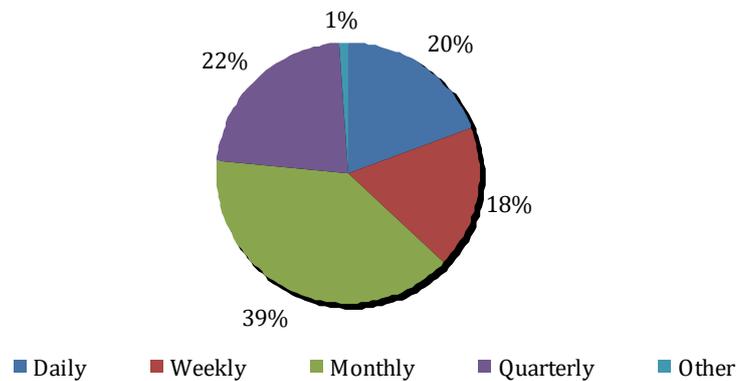
Question 3: How often do your Portfolio Managers use the system?

Having detailed which risk system they use, it is now interesting to know how often they used it. The first question was important to know the sophistication used by asset managers to measure risk. It is also important to see how often the risk models are used.

For all asset managers (all sample):

Figure 5.3

Figure 3: How often do your Portfolio Managers use the system?



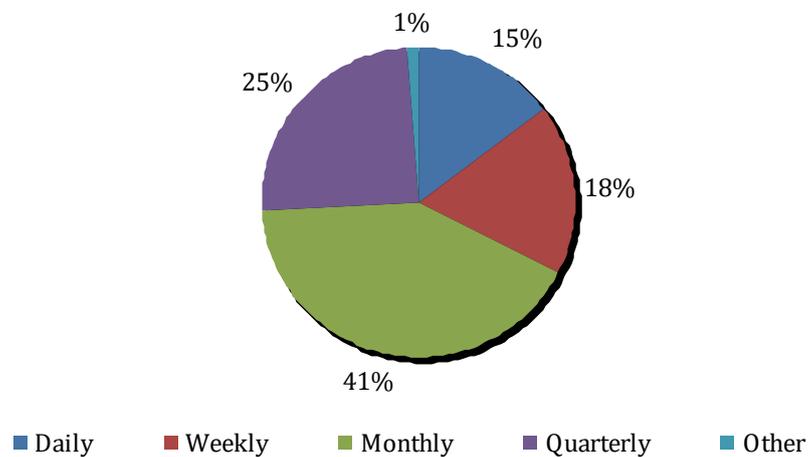
20% of the respondents use their risk management system daily, while 39% use it monthly. While the frequency of use might depend to some degree on the structure of the firm, the survey demonstrates that 77% assess their risk system at least once a month while only 22% use it quarterly.

These findings come in line with Dangl, T., Randl, O. and Zechner, J., 2014 studies, as they state risk management for long-term investor is still in an early stage.

For long only:

Figure 5.3a

Figure 3a: How often do your Portfolio Managers use the system?

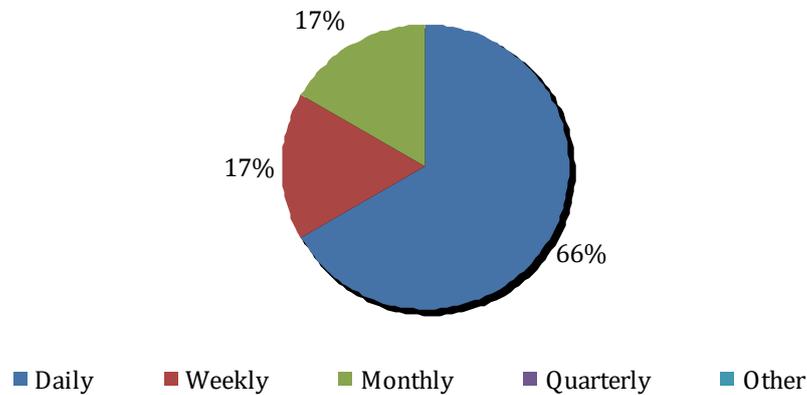


74% of Long-only portfolio managers use their risk system at least once a month with only 15% checking this daily. A quarter of those surveyed look at their risk systems only once per quarter.

For hedge funds:

Figure 5.3b

Figure 3b: How often do your Portfolio Managers use the system?



66% of hedge fund managers check their risk systems on a daily basis, while none of those surveyed use the risk systems available to them less frequently than every month.

We can see by the answers that the systems in place are not used frequently enough by many respondents. Moreover, we clearly see that long only companies use the risk system less often, compared with hedge funds. The majority of hedge fund managers look at their portfolio risk every day, while the majority of long only managers check this only 4 to 12 times per year. This indicates that hedge fund managers are more concerned about understanding their portfolio risk on a more frequent basis.

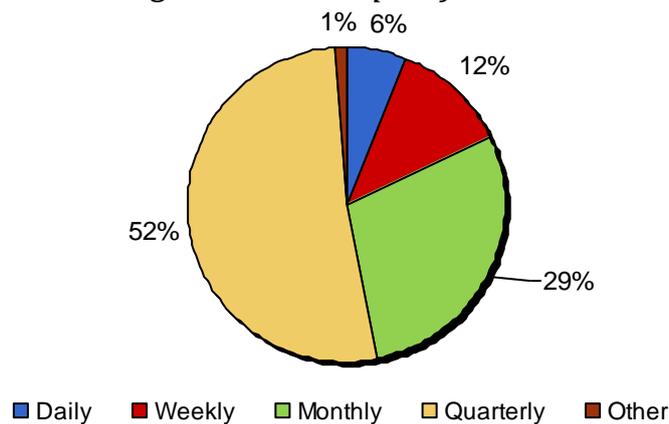
Question 4: How frequently does a Risk Manager meet with the Portfolio Manager to discuss risks within a portfolio?

The risk manager should monitor the risks in the portfolio. This has to be done by discussions between portfolio manager and risk manager. This question is to measure the frequency of these occurrences.

For all asset managers:

Figure 5.4

Figure 4: How frequently does a Risk Manager meet with the Portfolio Manager to discuss portfolio risk?

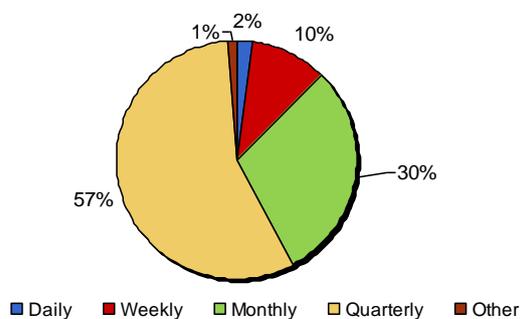


52% of those surveyed said risk managers at their firm met with portfolio managers on a quarterly basis, while 29% of those surveyed said the meetings were held on a monthly basis.

For long only:

Figure 5.4a

Figure 4a: How frequently does a Risk Manager meet with the Portfolio Manager to discuss portfolio risk?



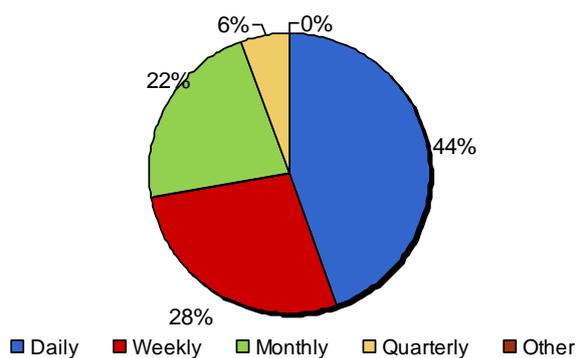
57% of long only managers only meet their risk managers on a quarterly basis.

While only 2% meet their risk managers on a daily basis.

For hedge funds:

Figure 5.4b

Figure 4b: How frequently does a Risk Manager meet with the Portfolio Manager to discuss portfolio risk?



72% of Hedge fund managers meet their risk manager at least once a week, with the majority of these meeting every day. Only 6% meet their risk manager on a less frequent quarterly basis.

These answers point again towards the lack of commitment that portfolio managers have with the risk department, particularly within long only institutions. This clearly shows that hedge funds place a greater emphasis on risk management than long only funds. Overall, we can see that risk monitoring is not frequent enough for all companies and specifically for long only. Hedge Funds are once more shown to be better prepared and are more diligent in terms of risk management.

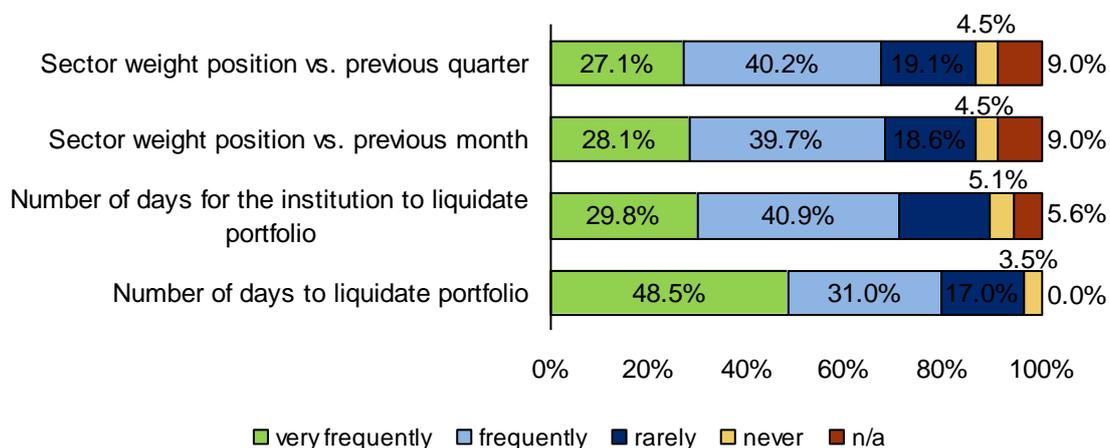
Question 5.1: *Portfolio Liquidity*

Liquidity risk - defined by Jorion (2007) as arising when a forced liquidation of assets creates unfavourable price movements - is a crucial area of risk management and asset management in particular. It is not possible to accurately value portfolios without taking into account the liquidity of its positions. In this question, we tackle liquidity issues.

For all asset managers:

Figure 5.5

Figure 5: Portfolio Liquidity

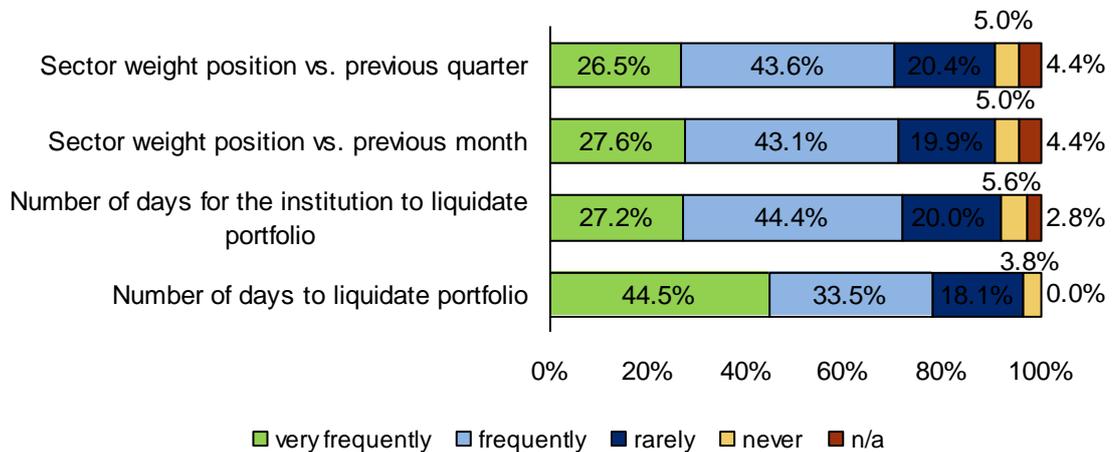


Overall, financial institutions place a greater emphasis on number of days to liquidate the portfolio than any other liquidity related issues, with 79.5% looking at this on at least a frequent basis. Other liquidity issues are also reviewed, but are not look at as frequently.

For long only funds:

Figure 5.5a

Figure 5a: Portfolio Liquidity

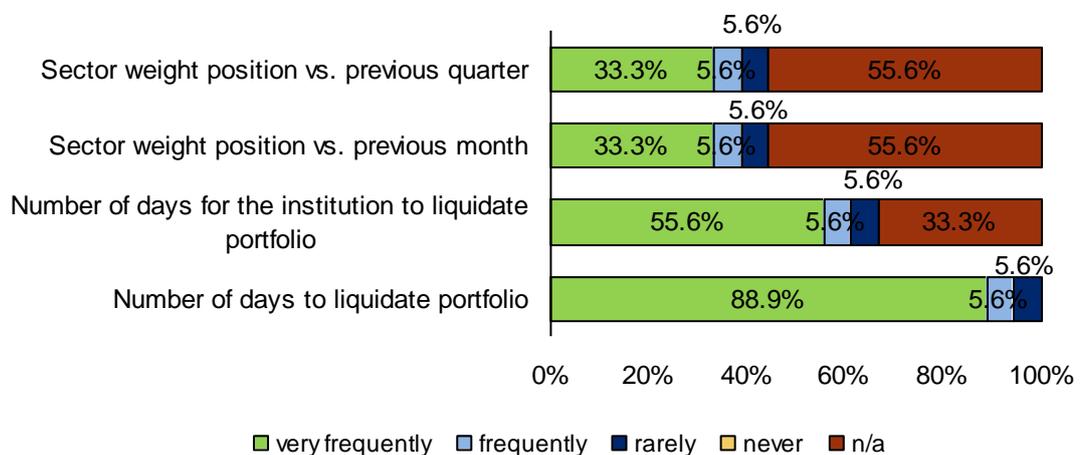


In line with the 'all asset managers' results, long only institutions place a greater emphasis on number of days to liquidate the portfolio than any other liquidity related issues.

For hedge funds:

Figure 5.5b

Figure 5b: Portfolio Liquidity



88.9% of hedge fund managers look very frequently at the number of days it will take to liquidate their portfolios. This is the overriding liquidity concern for hedge funds. Regarding other liquidity issues, hedge funds tend to either very frequently look at this, or not at all.

Comparing long only funds with hedge funds, we again see that the answers for the latter reflect the fact that more attention is dedicated to risk management functions on a more frequent basis, and that hedge funds are much more concerned about portfolio liquidity than their long-only counterparts are. However, despite the differences between long only and hedge fund managers, we found evidence in the literature review that managing liquidity risk has been a priority for most asset managers in the last several years.

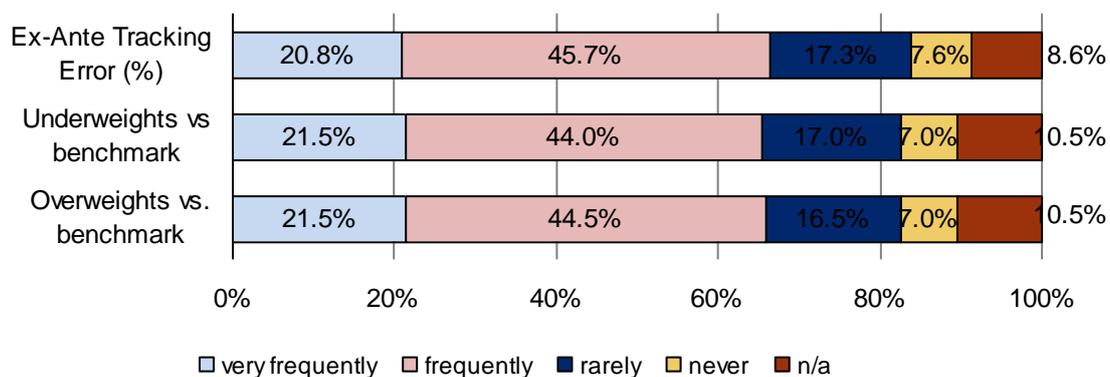
Question 5.2: *Active positions over quarter*

All the funds in our universe defined themselves as active funds. In this question, we are trying to analyse how frequent the participants within the survey analyse the active positions within the quarter in the portfolio.

For all asset managers:

Figure 5.6

Figure 6: Active Positions Over Quarter

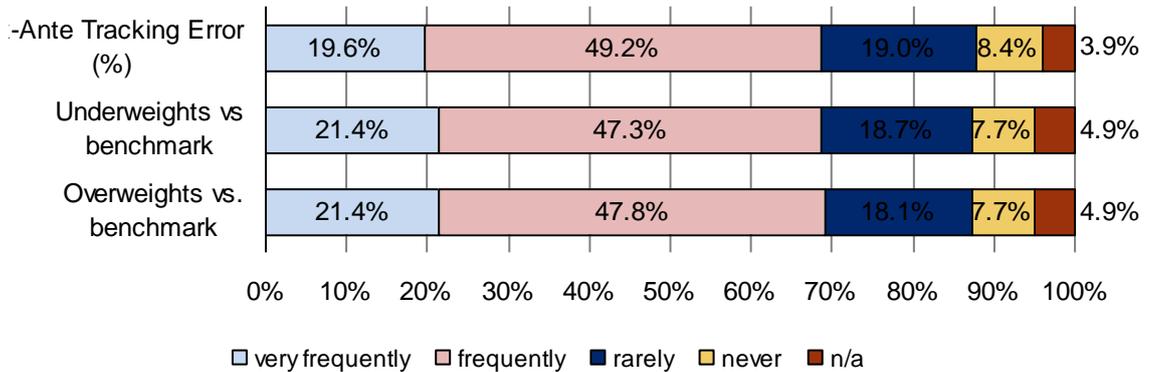


Of those surveyed, 45.7% “frequently” measure their ex-ante tracking error to control and measure portfolio risk rather than “very frequently”. While 44% frequently analyse whether their portfolio is underweight or overweight in comparison to their benchmark, with 21.5% saying they analyse it very frequently. We obtained similar answers for the measurement of portfolios being overweight vs. the benchmark.

For long only firms:

Figure 5.6a

Figure 6a: Active Positions Over Quarter

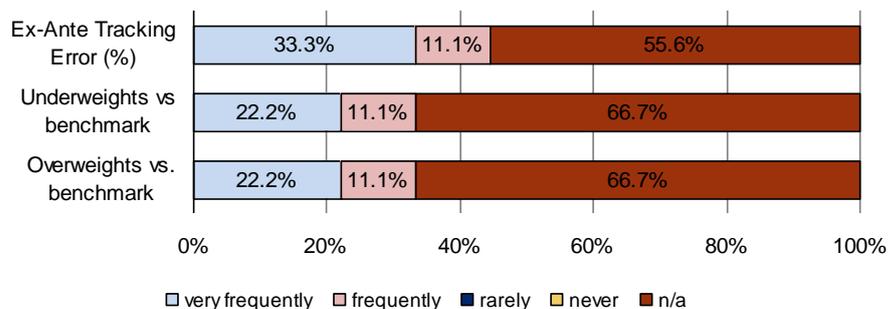


Only about one-fifth of long only portfolio managers looks at their active positions and tracking error on a very frequent basis. This would indicate that long only managers are concerned about these risk factors, but not necessarily over the very short-term.

For hedge funds:

Figure 5.6b

Figure 6b: Active Positions Over Quarter



Hedge fund managers are much more split with regards to looking at tracking error and active positions: they tend to look at them either very frequently, or not at all, with two-thirds of hedge funds saying that they do not consider active benchmark positions. However, this could be because they are not managed against traditional benchmarks, like the S&P500, and are generally judged on absolute, not relative returns.

Once more, although the universe of portfolio managers defined themselves as active managers, they do not analyse their active money as frequently as expected.

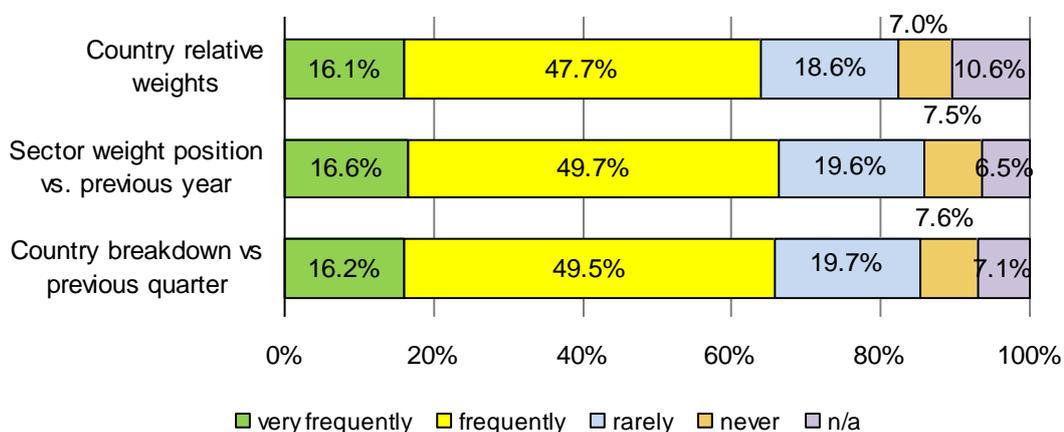
Question 5.3: Country positioning summary

With the recent credit crisis and the actual debt problems in Europe, country and sector exposure are important risk factors to be considered.

For all the asset managers:

Figure 5.7

Figure 7: Country Positioning Summary



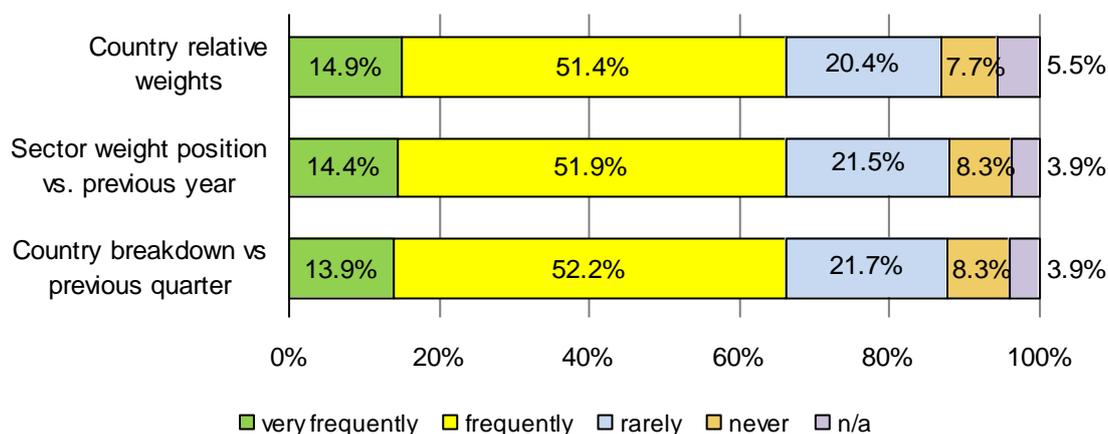
Given the interconnectedness of the global economy and the recent increase in the volatility of sovereign government debt, it is important to consider country exposure with a greater degree of diligence. In terms of relative geographic exposure, only 47.7% of respondents claimed it is considered frequently. Another 18.6% rarely considered country exposure.

With respect to year on year sector weighting positions, 49.7% consider it frequently. The figures are similar for quarter on quarter comparisons for country weightings, with 19.7% saying they “rarely” consider sector weight position.

For long only:

Figure 5.7a

Figure 7a: Country Positioning Summary

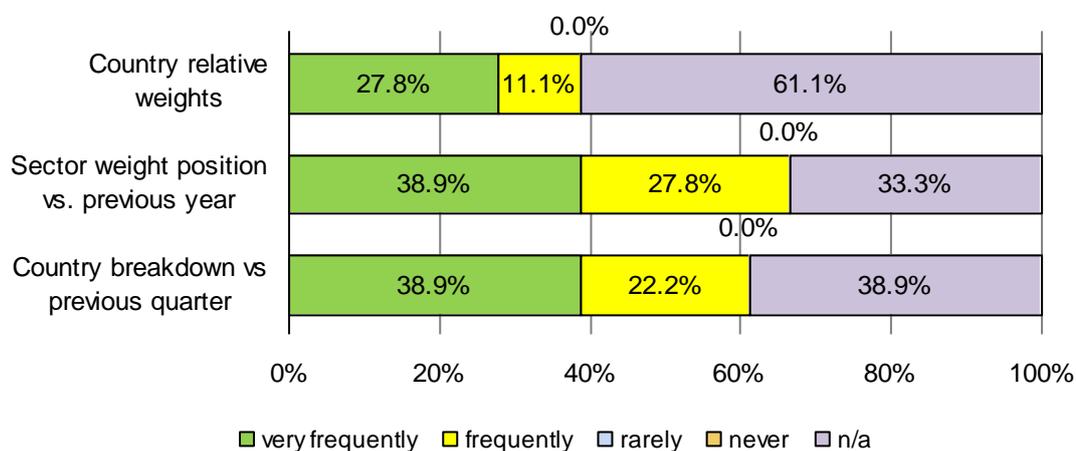


The majority of long only managers frequently look at their relative weights and how they have changed.

For hedge funds:

Figure 5.7b

Figure 7b: Country Positioning Summary



Hedge funds tend to be less concerned about relative weights than long only funds, but again there is a more binary outcome shown from their attitude towards relative weights and how they have changed.

Since the sample is predominantly focused on long only institutions, it is natural that most of these investors consider country when comparing to the benchmark. Once again, these factors are not considered enough.

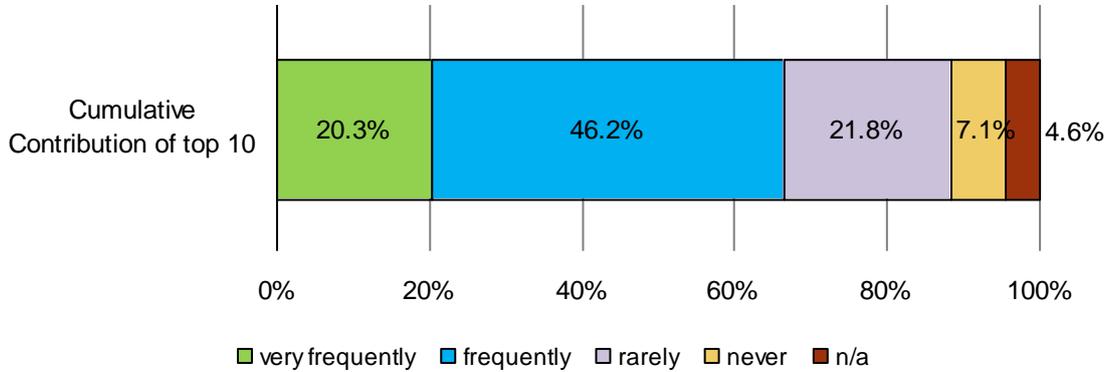
Question 5.4: Top 10 bets since portfolio tenure

It is relevant to analyse the contribution of the top 10 bets within the portfolio since they often count for a substantial portion of the performance of the portfolio (Brandt, Santa Clara and Valkanov, 2009); the contribution of the Top 10 holdings plays a significant role in determining the Portfolio Manager's total contribution.

For all asset managers:

Figure 5.8

Figure 8: Top 10 Bets since Portfolio Tenure

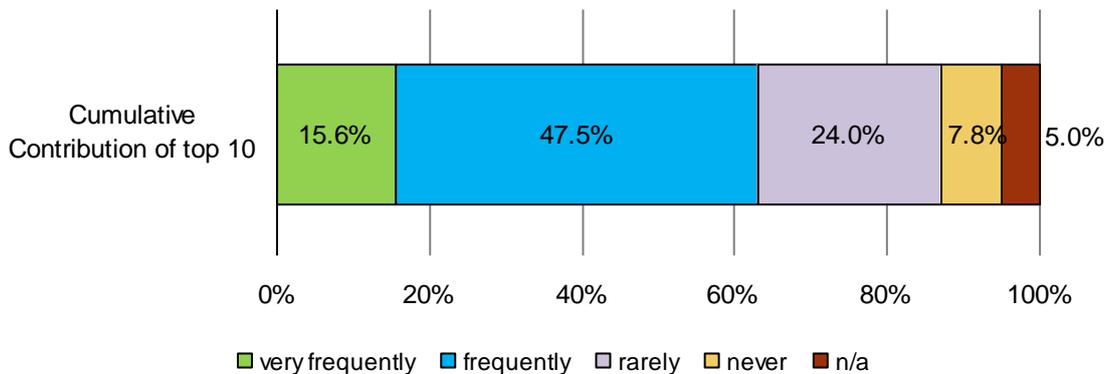


21.8% of the respondents said they rarely considered contribution the top 10 bets. Only 46.2% of those surveyed said they review this performance “frequently” with another 20.3% saying they review it “very frequently”.

For long only:

Figure 5.8a

Figure 8a: Top 10 Bets since Portfolio Tenure

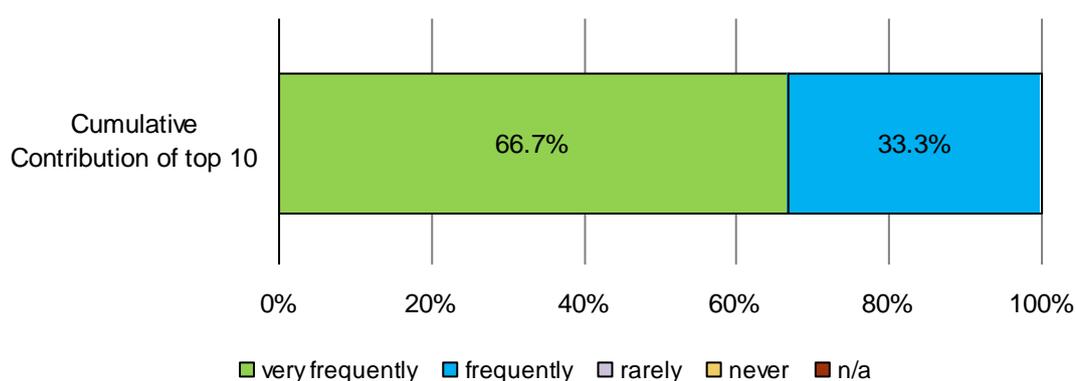


Only 47.5% of long only managers review the contribution to performance from their top 10 bets on a frequent basis, while a fairly large 24% rarely do this.

For hedge funds:

Figure 5.8b

Figure 8b: Top 10 Bets since Portfolio Tenure



Two-thirds of hedge fund managers surveyed said that they look at the contribution of their top 10 bets on a very frequent basis, while the rest look at this frequently.

The top 10 bets count for a significant part of the performance and risk of the portfolio. These answers show that hedge fund managers place more emphasis on their top 10 active positions, and the ensuing results, than long only managers do. This may reflect the fact that long only managers tend to place large bets on 'long-term winners' and are not so concerned with short-term "noise" affecting the performance of their top holdings.

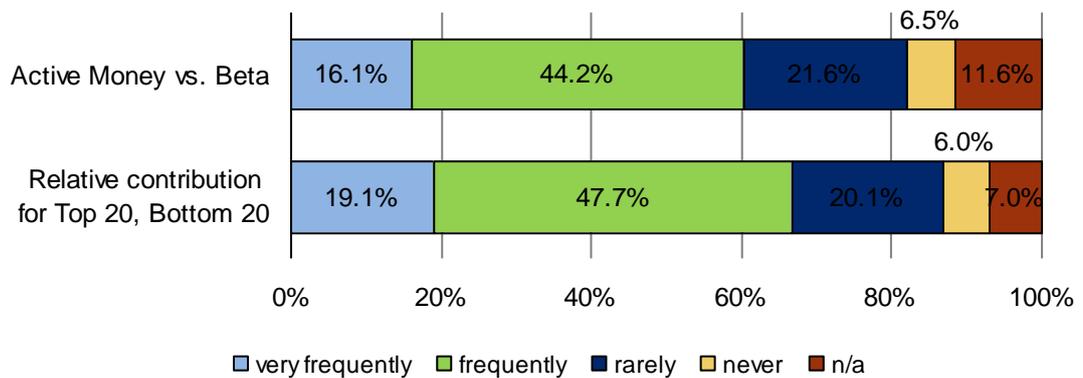
Question 5.5: Quarterly stock contribution

Similar to Tracking Error, it is important to distinguish what is market risk and what is stock specific. It is also important to consider the main contributors towards performance from the Top and Bottom 20 holdings.

For all the asset managers:

Figure 5.9

Figure 9: Quarterly Stock Contribution



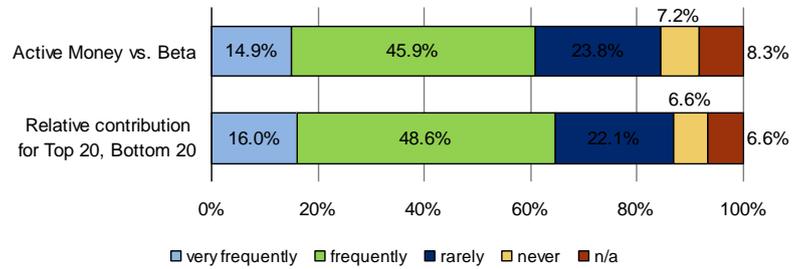
Only a small portion (16.1%) of respondents said they “very frequently” look at their active money vs. portfolio beta, while 44.2% review it “frequently”.

It is important to analyse which of the underlying positions are contributing to the over or underperformance of the portfolio. For the relative contribution of the top 20 and bottom 20 positions, only 19.1% consider it “very frequently” while 47.7% look at it “frequently”.

For long only:

Figure 5.9a

Figure 9a: Quarterly Stock Contribution

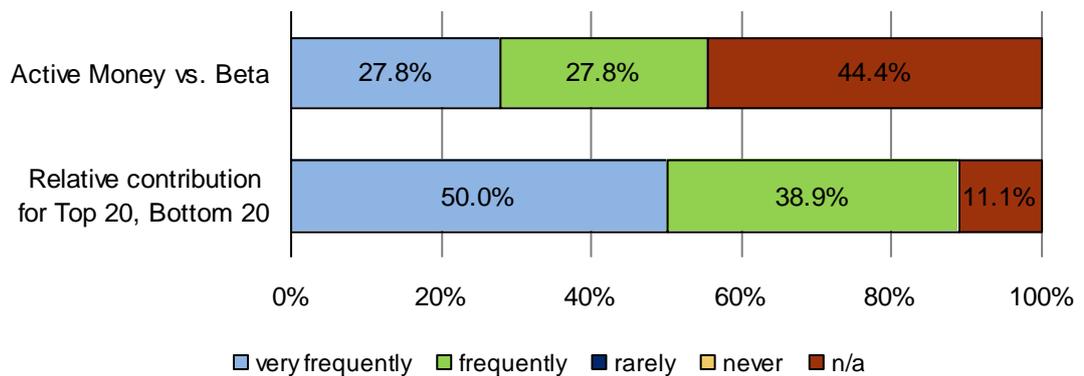


Only 14.9% of long only portfolio managers look at active money versus beta on a very frequent basis and a large 23.8% rarely look at this. A similar pattern is shown towards looking a relative contribution from the top 20 and bottom 20 positions.

For hedge funds:

Figure 5.9b

Figure 9b: Quarterly Stock Contribution



Again, hedge funds show more of a binary outcome when reviewing risk factors, with 44.4% not considering active money versus beta, while the rest look at this at least frequently.

All the portfolio managers are active managers hence they have the benchmark that they need to outperform. The portfolio managers considered in this survey are all active managers. Therefore, it is important to distinguish between stock picking skills and market behaviour (Alpha and Beta). Strangely, few portfolio managers consider this matter. Once more, when hedge funds review these issues, they pay more attention to it than long only managers do.

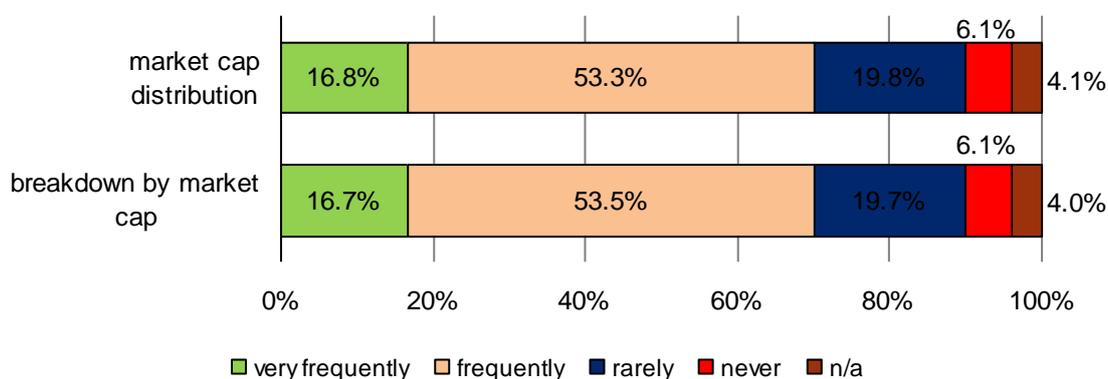
Question 6: Cumulative contribution from stock selection

Market Capitalization is a very important parameter in any portfolio. This question serves to analyse to what extent this value is considered.

For all asset managers:

Figure 5.10

Figure 10: Cumulative Contribution from Stock Selection

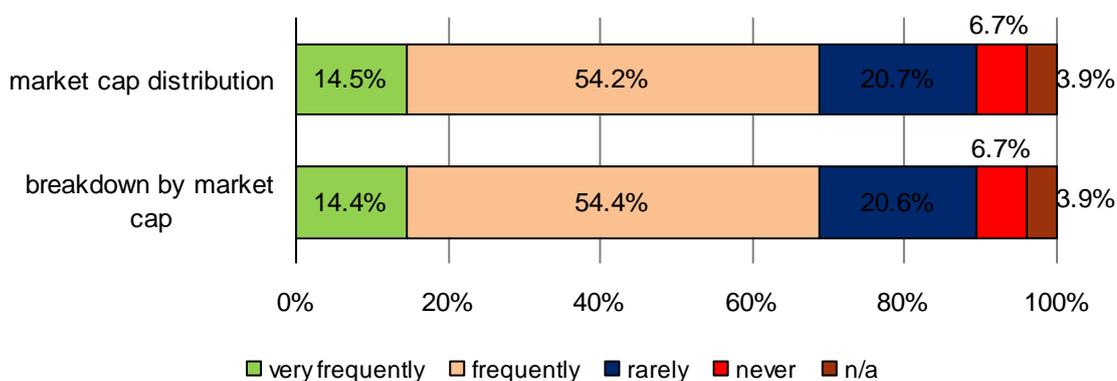


Market capitalization remains an important parameter on the back of liquidity concerns (companies with large market capitalizations tend to exhibit higher liquidity). 53.3% consider the market cap distribution “frequently”, with another 16.8% considering it “very frequently”. The figure is similar for those considering a portfolio’s market-cap breakdown.

For long only:

Figure 5.10a

Figure 10a: Cumulative Contribution from Stock Selection

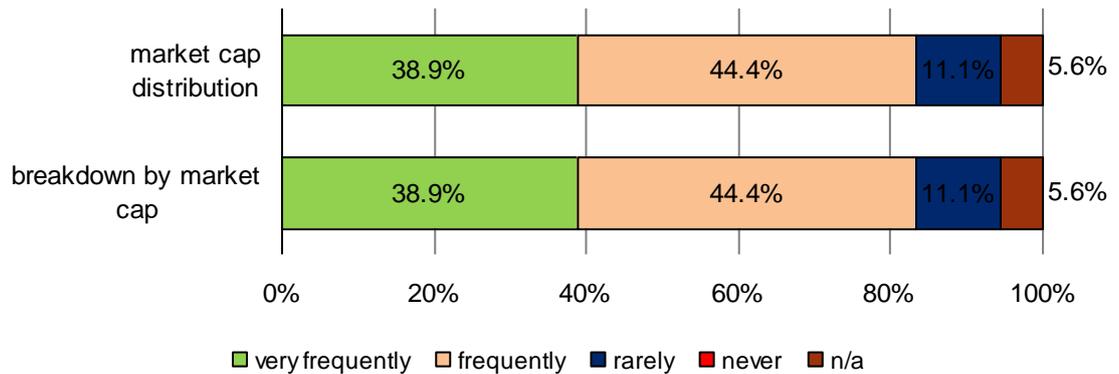


The pattern shown by all asset managers is continued for long only managers, with most frequently looking at their market-cap positioning. However, 20.7% rarely look at this indicator.

For hedge funds:

Figure 5.10b

Figure 10b: Cumulative Contribution from Stock Selection



Hedge funds are more concerned with market-cap distribution than long-only managers, with 83.3% of hedge fund managers looking at this at least frequently.

Market capitalization is considered by many academics to be itself a risk factor (Fama, Banz, 1981). For example, the Carhart (Carhart (1997)) model or Fama and French (Fama and French (1993 and 1996)) three-factor model consider size as a risk factor. Once again, Portfolio Managers do not consider all risks to be wholly important and hedge funds considered this market-cap positioning more than long only funds. This would indicate that hedge funds are more concerned about liquidity.

Question 7: How frequently do you analyse the cash position?

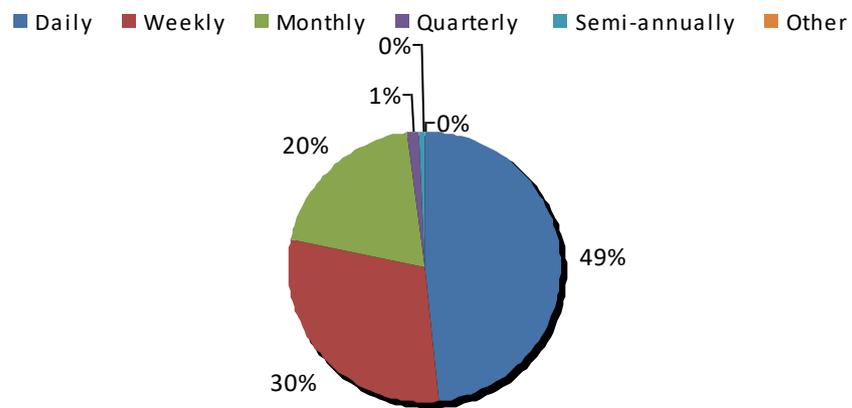
Cash is an important part of a portfolio. On one hand, it reduces risk and offers possibility of new investments. On the other, return on cash is usually lower than on other investments. It is relevant to know what the cash position is within the fund. With the recent increase in emphasis on volatility, the cash cushion provides

the benefit of facilitating redemptions and dampening the effect of volatility (Simutin, 2010). However, the returns on the cash portion tend to be lower than equity, and many portfolio managers are encouraged by their investors to put cash to work.

For all the asset managers:

Figure 5.11

Figure 11: How frequently do you analyse the cash position?

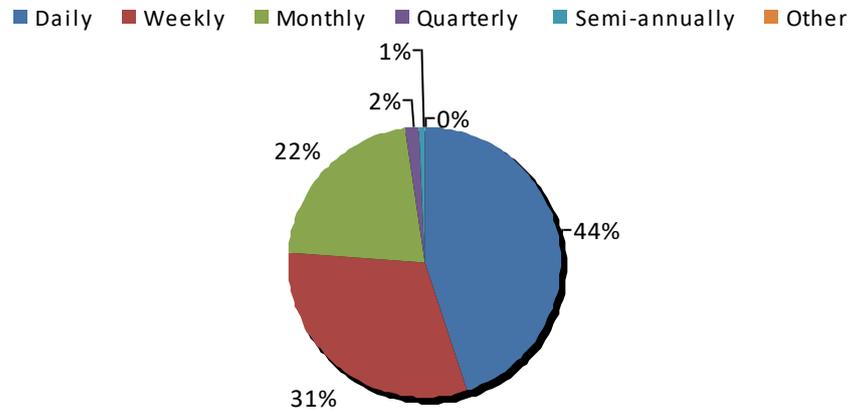


20% respondents consider their cash position monthly, with another 29% analysing it on a weekly basis. 49% analyze it on a daily basis.

For long only:

Figure 5.11a

Figure 11a: How frequently do you analyse the cash position?

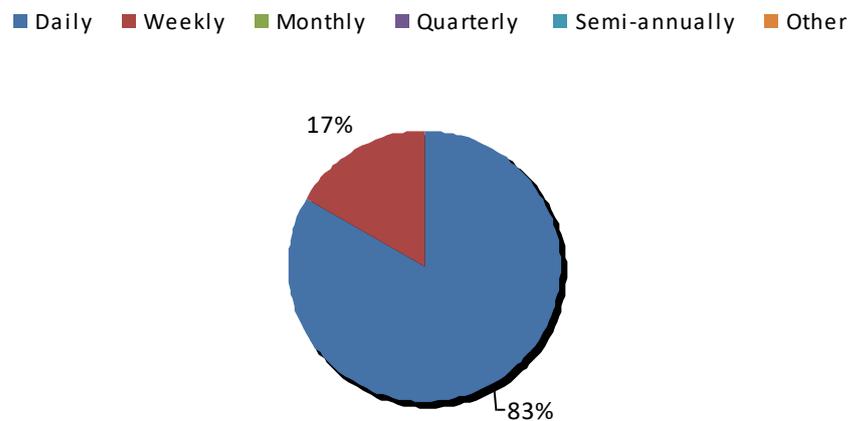


Only 44% of long-only managers analyse their cash position daily, but nearly all do look at this at least once a month.

For hedge funds:

Figure 5.11b

Figure 11b: How frequently do you analyse the cash position?



A massive 83% of hedge fund managers analyse their cash position every day, and none of those surveyed look at this less frequently than every week.

These results indicate that hedge funds look at, and therefore place more emphasis, on the cash position of their portfolios than long only firms place. This again highlights that hedge funds are more concerned about liquidity, and may indicate that they are more concerned about client redemptions.

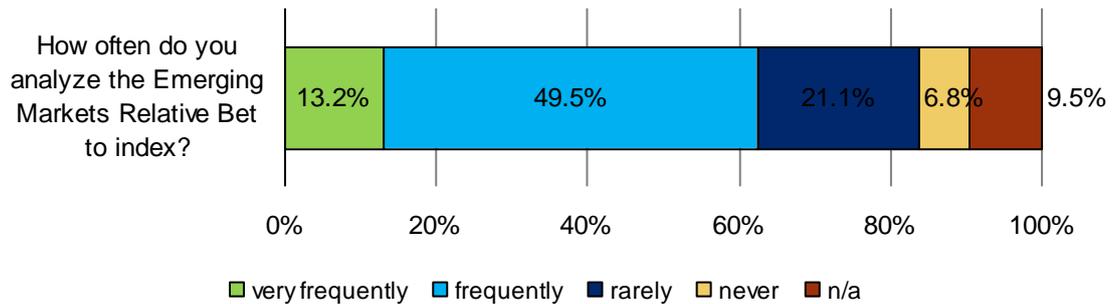
Question 8: How often do you analyse the Emerging Markets relative bet to the index?

Emerging markets played a central role in Equity Allocation in recent years. In fact, their risk premia is larger than for developed markets. It is important to know if this is considered by Fund managers. The Efficient Market Hypothesis (Samuelson,1965 and Fama 1970) says that greater returns imply greater risk. Over the last decade Emerging Markets have had a risk premium over developed markets, while returns have been broadly better than in developed ones. It is important to realize all the risk factors in a portfolio, so we questioned respondents about this area.

For all asset managers:

Figure 5.12

Figure 12: How often do you analyze the Emerging Markets Relative Bet to index?

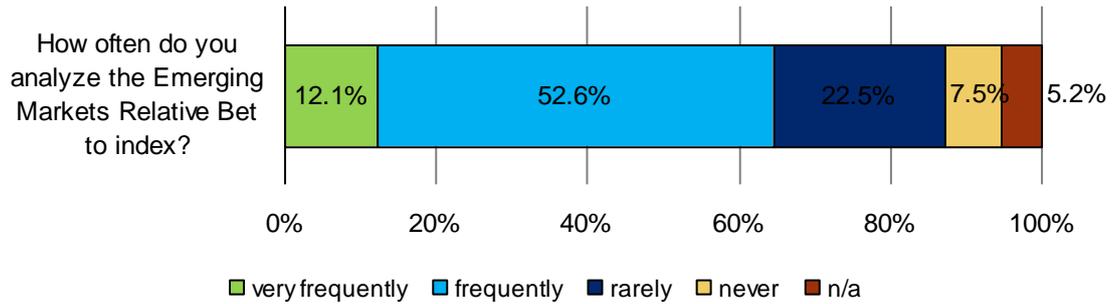


With the importance of emerging markets increasing over the past two decades, and with emerging markets projected to be a major growth driver for future returns in markets, many managers have turned to them to generate returns and provide diversification. 49.5% of respondents say they analyse their emerging markets position “frequently”. It is interesting to see that only 13.2% of the managers analyze their exposure on a “very frequent” basis.

For long only:

Figure 5.12a

Figure 12a: How often do you analyze the Emerging Markets Relative Bet to index?

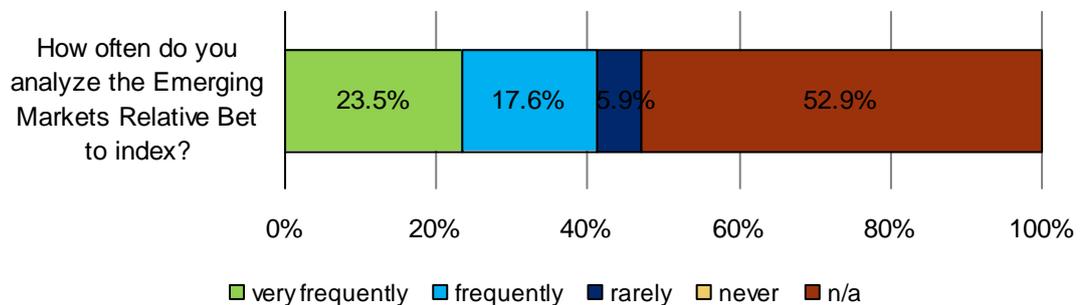


52.6% of long only managers consider their Emerging Market exposure frequently, with 22.5% rarely considering this.

For hedge funds:

Figure 5.12b

Figure 12b: How often do you analyze the Emerging Markets Relative Bet to index?



Once again, hedge fund managers display a binary attitude towards relative exposure, with 52.9% not even considering their Emerging Market exposure.

Overall, long only managers are more concerned with relative exposure to Emerging Markets, yet when hedge funds do consider this, they do so on a more frequent basis.

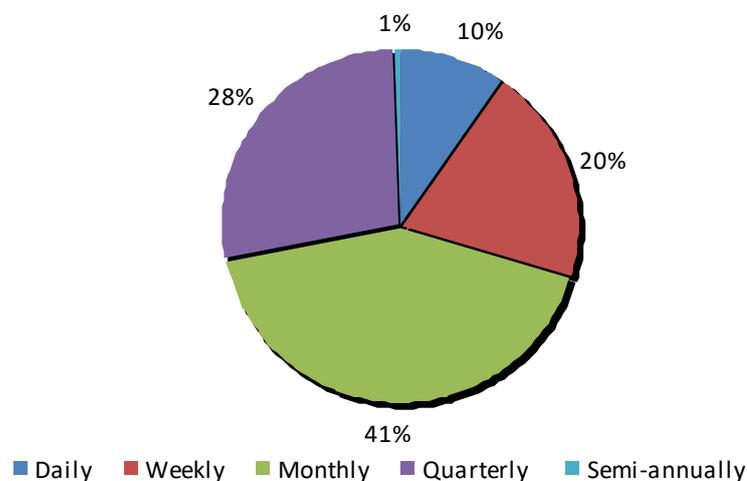
Question 9: *How often do you analyze the portfolio turnover?*

Portfolio turnover is important to assess performance and trading costs. An increase in the frequency of this analysis by asset managers might help to improve portfolio performance, as they would gain a better understanding of their costs.

For all the asset managers:

Figure 5.13

Figure 13: How often do you analyse the portfolio turnover?

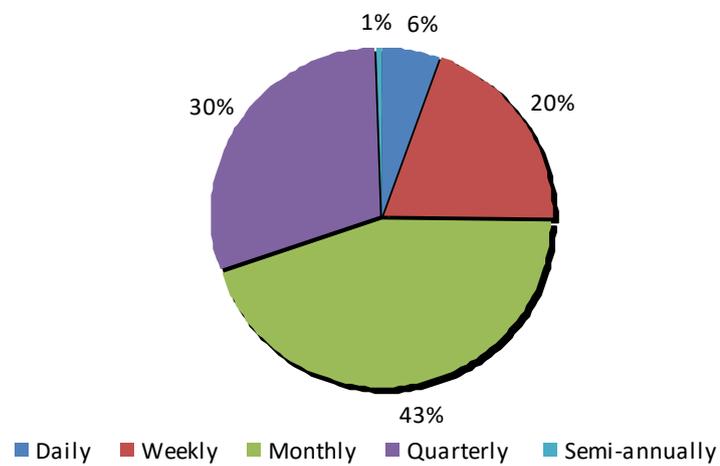


From those surveyed, 71% analyse their turnover at least once a month. Of these responses, 41% review their turnover monthly with another 28% reviewing it only on a quarterly basis.

For long only:

Figure 5.13a

Figure 13a: How often do you analyse the portfolio turnover?

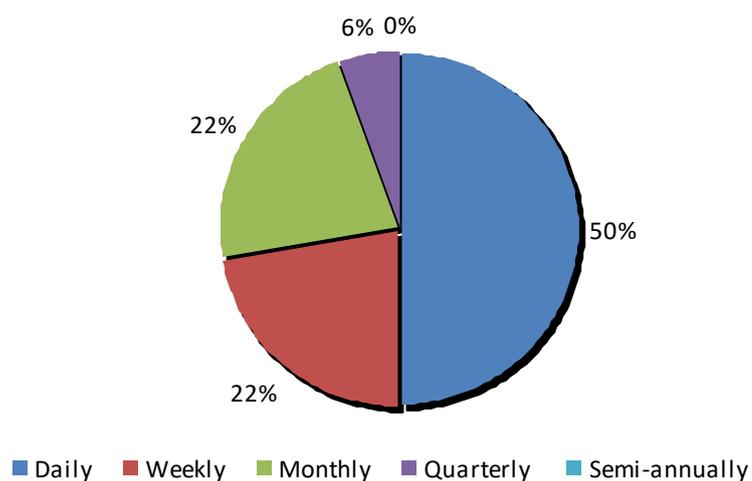


43% of long only managers review portfolio turnover every month, while 30% look at this every quarter.

For hedge funds:

Figure 5.13b

Figure 13b: How often do you analyse the portfolio turnover?



50% of hedge funds analyze portfolio turnover every day, with only 22% and 6% considering this every month and quarter respectively.

There is a stark contrast between these results when comparing long only fund to hedge funds. Most long only funds look at portfolio turnover every month or quarter, while most hedge funds do this at least every week. This may indicate that hedge funds are already much more aware of the effects of the cost of trading on their performance.

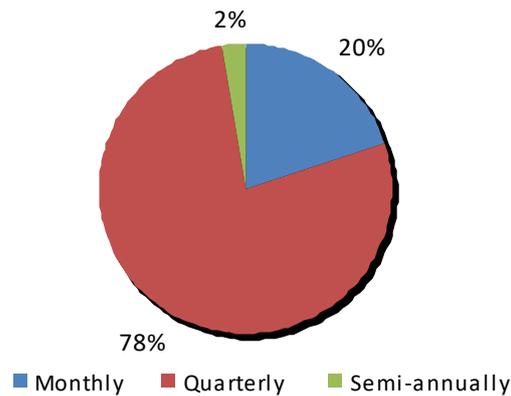
Question 10: How often do you analyse portfolio performance vs. peers?

In this question, we ask how often the fund is compared with its peers. It is a relevant question, particularly for active managers as this is how they are judged, both externally by clients and internally for remuneration.

For all asset managers:

Figure 5.14

Figure 14: How often do you analyse portfolio performance vs. peers?

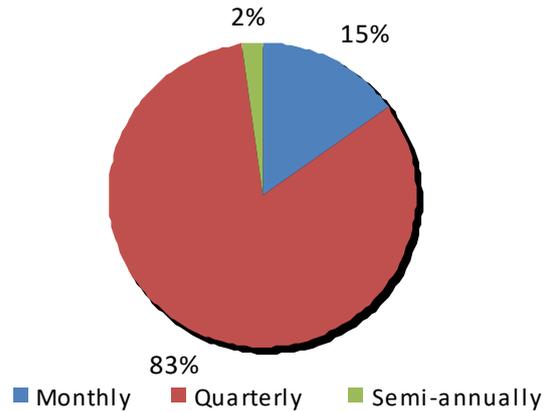


It is interesting to note that even though performance vs. peers is important, only 20% of the 200 sampled analyze the performance on a monthly basis. 78% undertake a quarterly analysis, with 2% analyzing it only twice a year.

For long only:

Figure 5.14a

Figure 14a: How often do you analyse portfolio performance vs. peers?

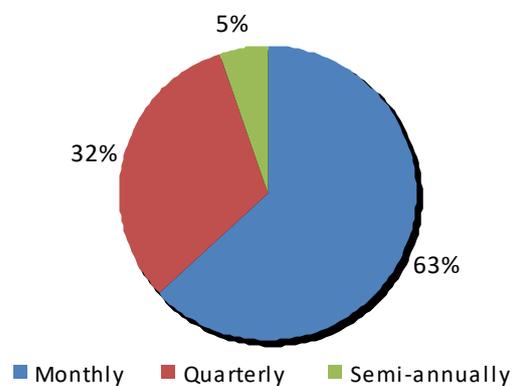


A large 83% of long only managers review their performance versus peers on a quarterly basis.

For hedge funds:

Figure 5.14b

Figure 14b: How often do you analyse portfolio performance vs. peers?



Hedge funds review their performance versus peers on a much more frequent basis than long only funds, with 63% looking at this every month. This could be because hedge funds tend to exhibit a shorter-term investment horizon than long-only funds. Once again, for active portfolio managers, this should be crucial. Analysing performance vs. peers is important to assess skill and risk. Overall, most asset manager's look at performance against peers every quarter, which is still a relatively short investment horizon. This number is heavily skewed by long-only funds.

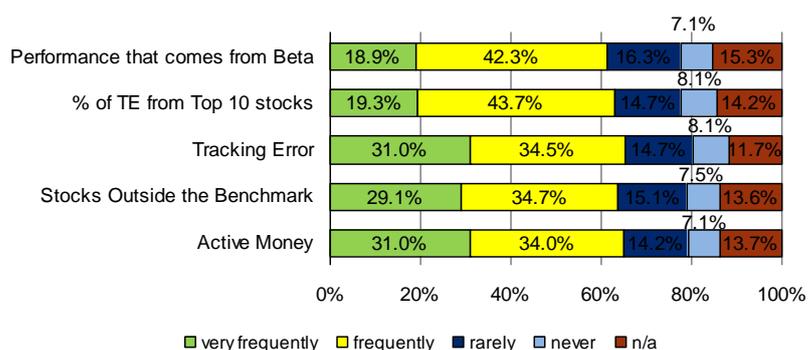
Question 11: How often do you analyze the following parameters to detect the risks within the portfolio?

The next question analyzes several risk factors that should be taken into account when considering portfolio risk.

For all asset managers:

Figure 5.15

Figure 15: How often do you analyse the following parameters to detect the risks within the portfolio?

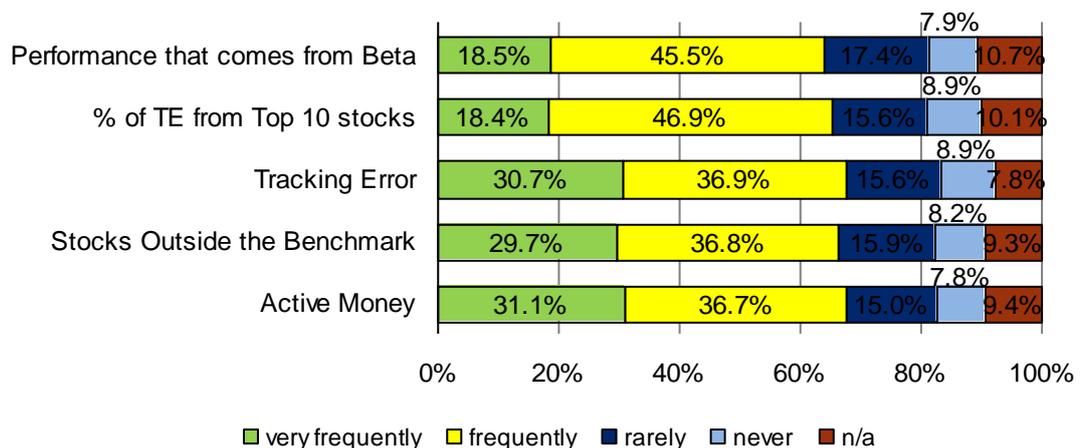


42% of those surveyed measure their performance that comes from beta “frequently” with 18.9% measuring it very frequently. 44% measure the tracking error from the top 10 stocks “frequently” with 19% measuring it “very frequently”. In terms of the tracking error, 31% measure it “frequently”, with 35% measuring it “very frequently”. For stocks outside the benchmark, 35% measure it “frequently” compared to 29% measuring it “very frequently”. 34% measure active money ‘frequently’ with 31% measuring it “very frequently”. It is interesting to see that only 31% of the surveyed analyze the active money on a frequent basis.

For long only:

Figure 5.15a

Figure 15a: How often do you analyse the following parameters to detect the risks within the portfolio?

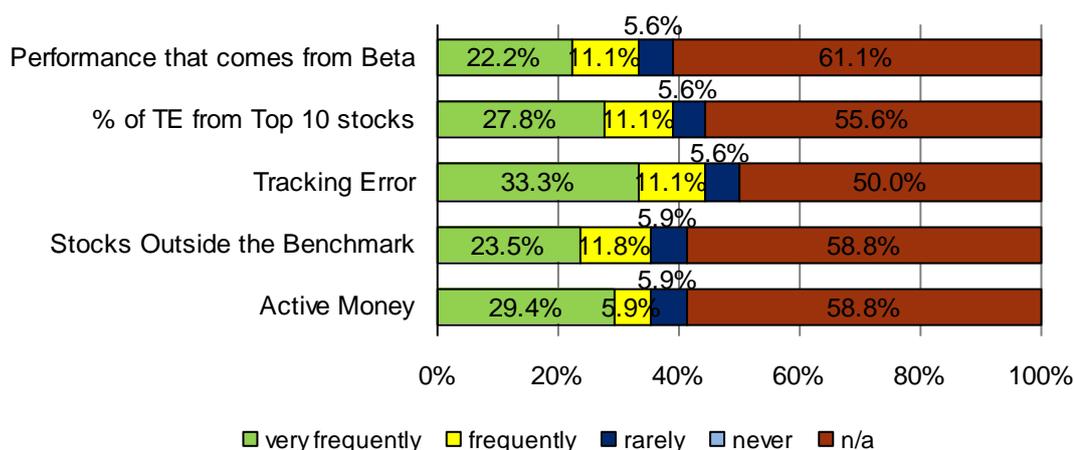


Overall, long only funds place greater emphasis on tracking error, off-benchmark positions and active money, yet other parameters are still considered. Nearly a third of all long only managers rarely or do not ever consider these parameters.

For hedge funds:

Figure 5.15b

Figure 15b: How often do you analyse the following parameters to detect the risks within the portfolio?



Hedge funds continue to exhibit a binary outcome when considering positions on a relative basis. For example, 50% of hedge fund managers do not think about tracking error, yet of those who do, 33% consider this very frequently.

Once again, for portfolio managers that define themselves as active managers, these values are probably not what they should be. While most investment managers look at these parameters, there are a number of hedge funds that do not consider them. This could be because the vast majority of the hedge funds may be judged on absolute, not relative performance, hence they may have cash benchmarks, rather than standard equity market ones.

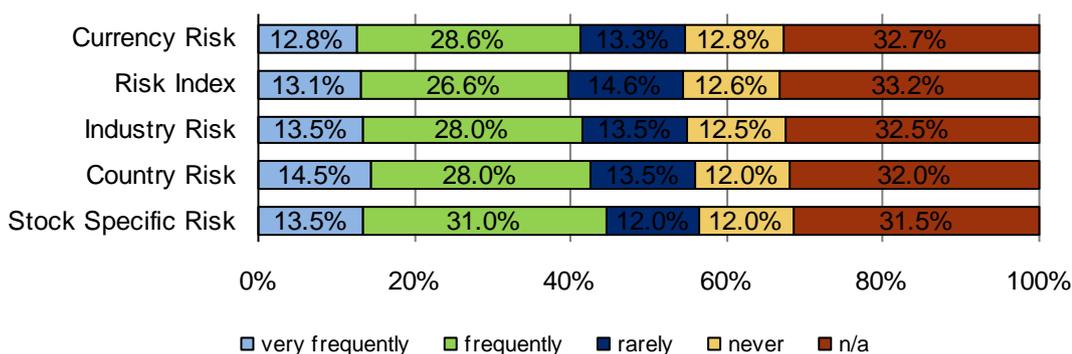
Question 12: How often do you analyze the following risk decomposition parameters?

Once again, the question serves to understand the depth of the risk analysis that is done in investment companies.

For all asset managers:

Figure 5.16

Figure 16: How often do you analyze the following risk decomposition parameters?

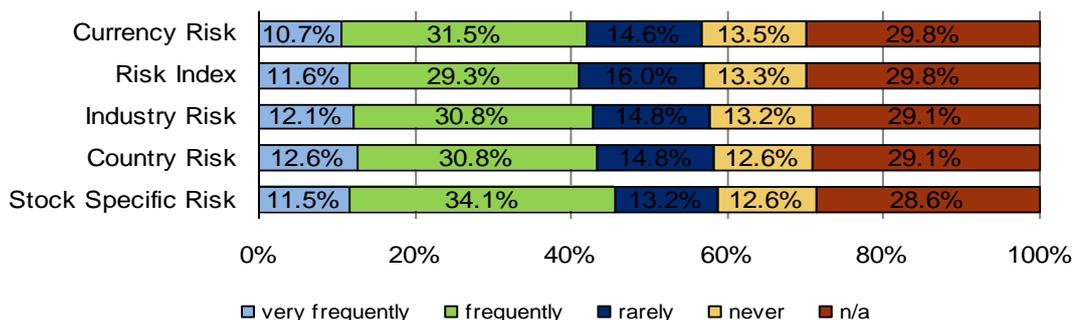


It is clear that these risk parameters are not overly considered by asset managers. Only 13.5% of managers surveyed said that they very frequently look at stock specific risk. This is surprising given that most are active equity market managers.

For long only:

Figure 5.16a

Figure 16a: How often do you analyze the following risk decomposition parameters?

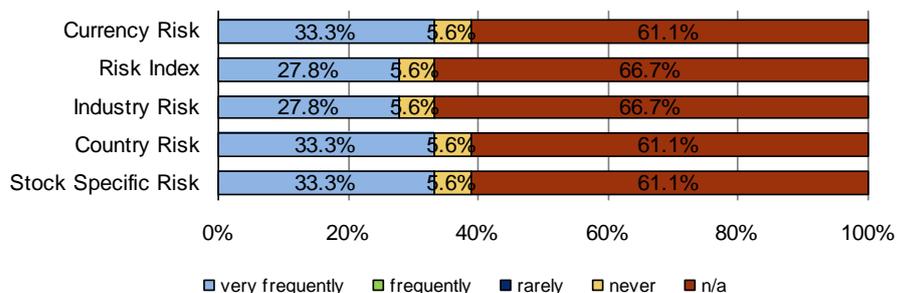


Long only managers tend to follow the same pattern shown by the results for all asset managers. There is a reasonably equal spread of results for all questions asked regarding these risk parameters.

For hedge funds:

Figure 5.16b

Figure 16b: How often do you analyze the following risk decomposition parameters?



Again, hedge funds display an 'all or nothing' approach to assessing risk parameters. All of these risk parameters are either viewed very frequently, or not at all.

This question asks about the analysis frequency of simple risk decomposition parameters. Even with such core and simple risk factors, the frequency is far from reasonable. Once again, for active portfolio managers this analysis should be deeper and more frequent. The typical behaviour appears: hedge funds are more sensible towards risk management, when they actually look at it. These results are meaningful, namely because to the best of our knowledge there is no comprehensive study analysing in such detail, the risk decomposition parameters of the asset managers. As we found out in the literature review (Price Waterhouse Coopers, 2012, Ernst and Young's Risk Management for Asset Management Survey, 2013 and Rethinking Risk Management Survey, 2015), besides the traditional operational and counterparty credit risks, the risk categories of major concern in the last few years have been regulatory, mandate, conduct and liquidity risks, followed by market and investment risks. However, what we conclude with this question's responses is that the risk monitoring frequency and the factors analyzed still need to be developed and improved. This also highlights the previous mentioned problem mentioned by E&Y in 2015, that companies are still facing several challenges to convert the risk culture into the day-to-day business and most of the respondents continue to work to develop stress testing approaches and improve data systems.

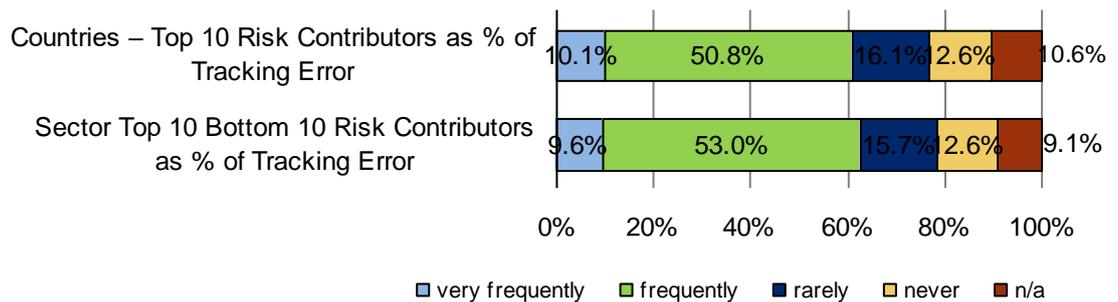
Question 13 and 14: Sector and country: Top 10 /Bottom 10 risk contributors as % of tracking error

This question tries to measure risk for the active part of the portfolio both in terms of sector and country exposure.

For all asset managers:

Figure 5.17

Figure 17: Sector and country: Top 10/Bottom 10 Risk Contributors as % of Tracking Error

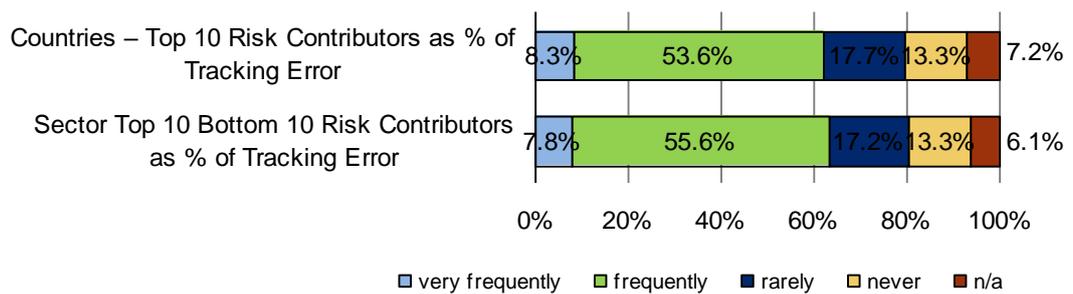


50.8% of those sampled “frequently” analyze the country origin for the top 10 as a risk contributor as a percent of tracking error, with only 10.1% analyzing it “very frequently”.

For long only:

Figure 5.17a

Figure 17a: Sector and country: Top 10/Bottom 10 Risk Contributors as % of Tracking Error

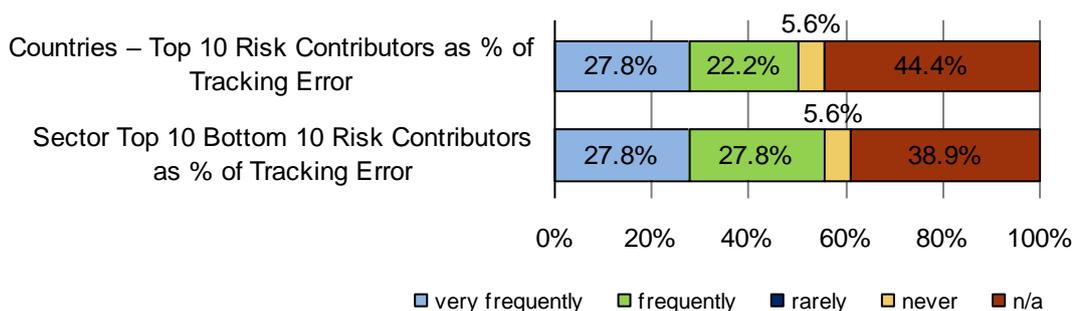


Most long only managers review their country and sector contributions to risk on a frequent basis, recording 53.6% and 55.6% of the reponses respectively. However, 17.7% and 17.2% rarely look at this.

For hedge funds:

Figure 5.17b

Figure 17b: Sector and country: Top 10/Bottom 10 Risk Contributors as % of Tracking Error



Following from the trends we have seen, hedge funds show binary outcome. 27.8% of hedge funds review their country and sector contributions to risk. 50% of hedge funds do not even consider the contribution of country positions to their total tracking error. After the last financial crisis, country risk assumed a crucial importance. It seems that many Portfolio Managers are still yet to consider this new reality. Once again, when considered, hedge funds review these factors more frequently than long only institutions.

53% of those surveyed said they “frequently” analyze the top 10 and bottom 10 sector positions to measure their risk contribution as a percentage of tracking error, with only 9.6% measuring it “very frequently”. Considering that these positions play an important role in the performance of the fund, risk management in this area is, once more, neglected by the Portfolio Manager.

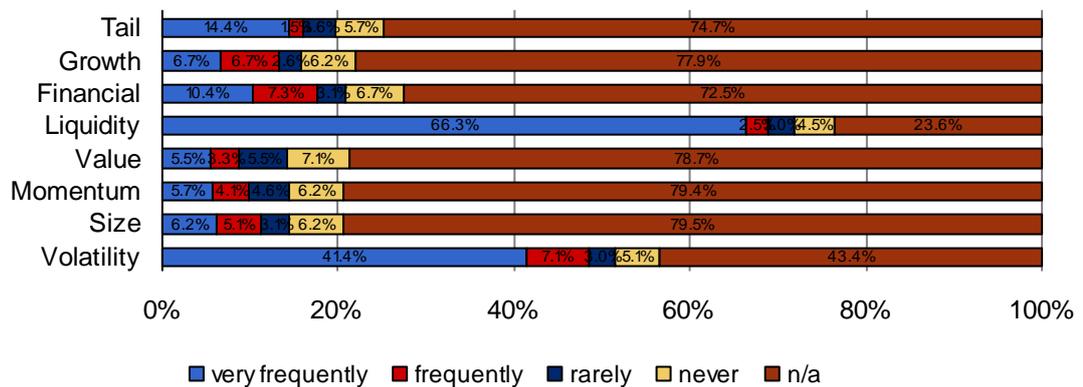
Question 15: *How often do you analyze the following contributors as a percentage of tracking error?*

The following question tries to analyze the risks considered in the portfolio.

For all asset managers:

Figure 5.18

Figure 18: How often do you analyze the following risk contributors as % of tracking error?

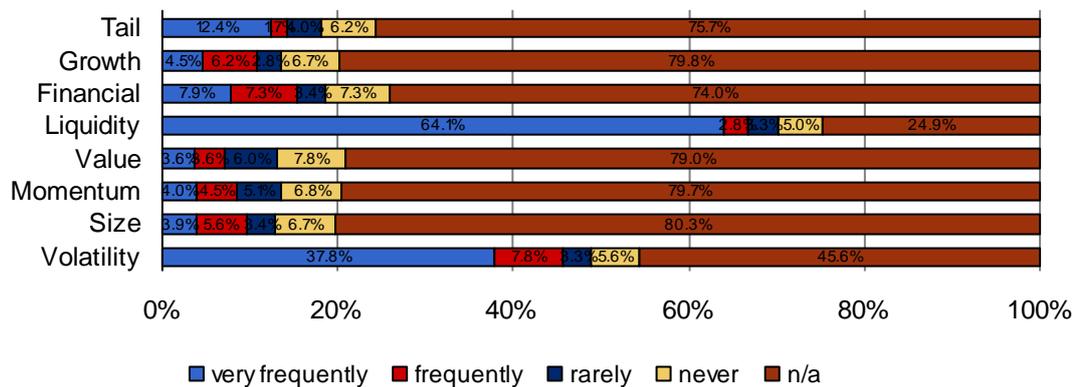


Overall, you can see that liquidity, then volatility, are the most considered when analysing contribution to risk. You can also see that style biases, such as growth or value or momentum, are largely ignored.

For long only:

Figure 5.18a

Figure 18a: How often do you analyze the following risk contributors as % of tracking error?

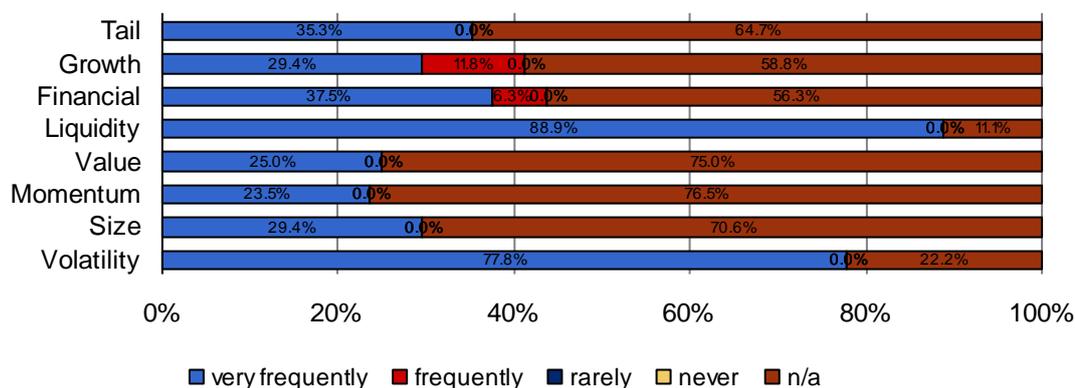


Similarly, you can see that liquidity, then volatility, are the most considered by long only funds when analysing contribution to risk. You can also see that style biases, such as growth or value or momentum, are largely ignored.

For hedge funds:

Figure 5.18b

Figure 18b: How often do you analyze the following risk contributors as % of tracking error?



All factors are given greater consideration by hedge fund managers. For example, a massive 88.9% of hedge fund managers very frequently review the contribution of liquidity to their tracking error, while 77.8% very frequently review volatility.

All the risks considered in the question are very standard risk measures. Both long only and hedge funds consider liquidity and volatility risks more frequently compared with other risk factors. This would support the findings from questions 5.1 and 6, as well as the Ernst & Young's study presented on the literature review, which states that 62% of the asset managers evidenced liquidity metrics for regulated and segregated portfolios on an ongoing basis. Once again, hedge funds seem to be more risk aware than long only firms.

The Carhart (1997) model considered momentum, size, Book to market and beta. This model was discussed in the academic literature. However, portfolio managers

do not seem to take into account simple risks that are known. If risk is not considered, it is not possible to measure performance.

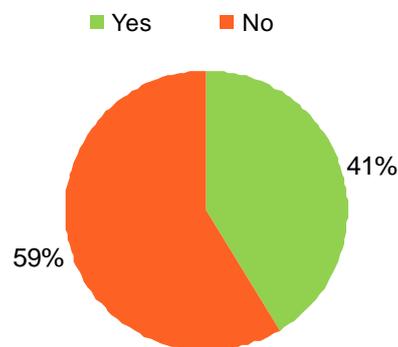
Question 16: *Do you use the Style Research Ltd. tool?*

Style Research is a comprehensive software analysis tool used to assess market risk and style factors in portfolios. This tool is especially used for equity portfolios.

For all the asset managers:

Figure 5.19

Figure 19: Do you use Style Research Ltd. tool?

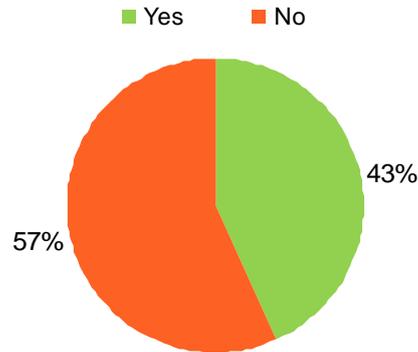


41% of those surveyed said they used the tool, while a majority (59%) does not use this tool.

For long only:

Figure 5.19a

Figure 19a: Do you use Style Research Ltd. tool?

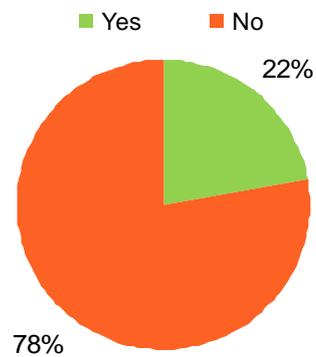


43% of long only managers surveyed said they used the tool, while 57% do not use the tool.

For hedge funds:

Figure 5.19b

Figure 19b: Do you use Style Research Ltd. tool?



22% of hedge funds surveyed said they used the tool, while the vast majority (78%) does not use Style Research.

The Style Research tool is a comprehensive and simple tool to use. This software enables portfolio managers to track different risk behavior, the possible change in risk premium and any style bias in their portfolios. It is a tool that is of particular interest for the equity market. Even so, almost half of the portfolio managers do not use it. In respect to this tool, it is less used by hedge fund industry compared with long only companies. This may indicate that hedge funds prefer other risk measuring software, and are less concerned about style bias.

Question 17: *How often do you use the above system?*

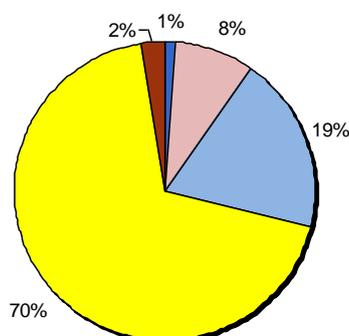
The previous question asked about the usage of the style research. This question asks about how often those who have Style Research use it.

For all the asset managers:

Figure 5.20

Figure 20: How often do you use the above system?

■ Daily ■ Weekly ■ Monthly ■ Quarterly ■ Semi-annually



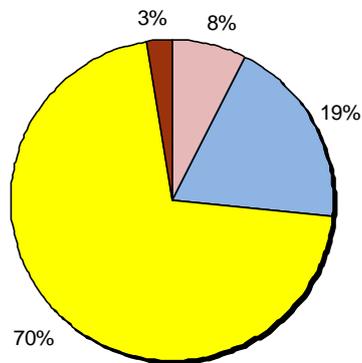
For those respondents who use the Style Research tool, the majority, 70% said they only used it quarterly, while 19% said they used it monthly.

For long only:

Figure 5.20a

Figure 20a: How often do you use the above system?

■ Daily ■ Weekly ■ Monthly ■ Quarterly ■ Semi-annually

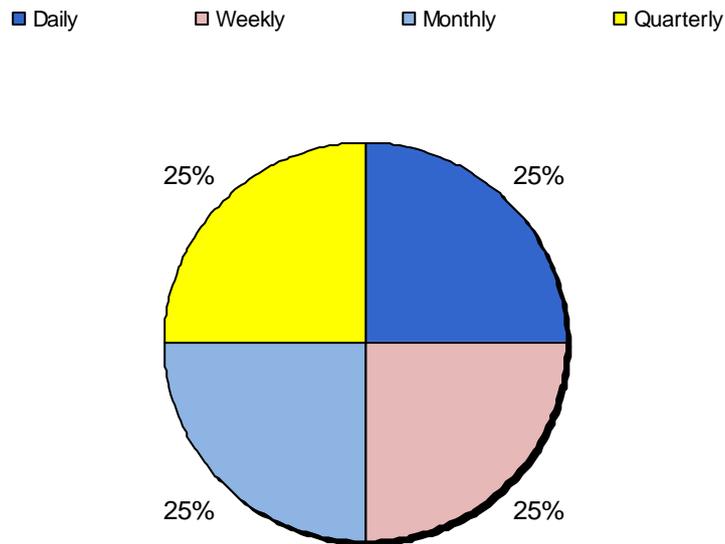


For long only respondents who use the Style Research tool, the majority, 70% said they only used it quarterly, while 19% said they used it monthly.

For hedge funds:

Figure 5.20b

Figure 20b: How often do you use the above system?



For hedge fund respondents who use the Style Research tool, there is an equal split as to the frequency of use.

Considering both answers, portfolio manager's do not use this simple and comprehensive tool for equity risk management often enough. Comparing hedge funds with long only asset managers, hedge funds use the tools less in absolute terms, but, when they do it, is used more often. This could also indicate that long only managers are more aware of style bias present in their portfolios.

Question 18: *Who has the final decision regarding changes to the portfolio when the portfolio is outside the risk parameters?*

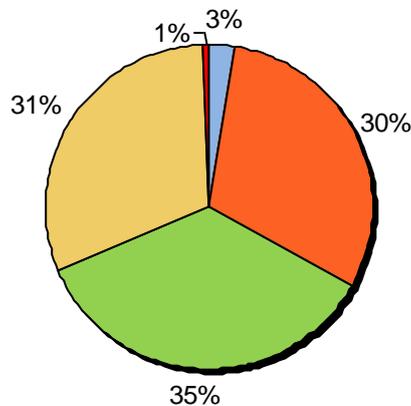
It is important to understand who has the final call when the portfolio deviates outside its risk parameters in order to understand the independence of the risk department.

For all asset managers:

Figure 5.21

Figure 21: Who has the final decision regarding changes to the portfolio when the portfolio is outside the risk parameters?

■ CIO ■ Head of Equities ■ Risk Manager ■ Portfolio Manager ■ Other



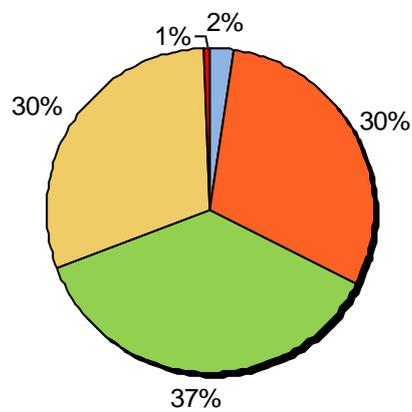
The survey queried respondents regarding the individual who exerted final responsibility when the portfolio fell outside the stated/mandated risk parameters. 30% of those surveyed said the head of equities held final decision-making responsibility, while only 36% said the risk manager made the final decision. 31% of those surveyed responded that the portfolio manager himself had final authority.

For long only:

Figure 5.21a

Figure 21a: Who has the final decision regarding changes to the portfolio when the portfolio is outside the risk parameters?

■ CIO ■ Head of Equities ■ Risk Manager ■ Portfolio Manager ■ Other



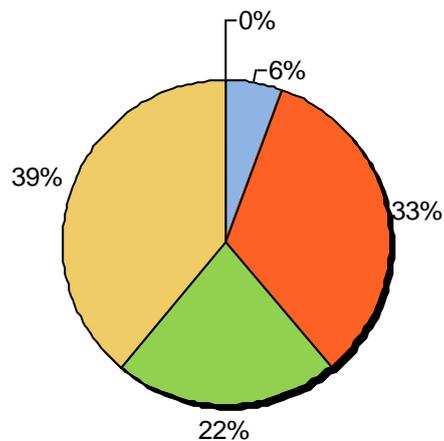
For long only managers the final decision regarding portfolio risk is fairly evenly split between the Head of Equities (30%), the Risk manager (37%) and the Portfolio Manager (30%).

For hedge funds:

Figure 5.21b

Figure 21b: Who has the final decision regarding changes to the portfolio when the portfolio is outside the risk parameters?

■ CIO ■ Head of Equities ■ Risk Manager ■ Portfolio Manager ■ Other



For hedge funds, there is more involvement of the CIO and Portfolio Manager in the final risk decision (6% and 39% respectively) than for long only managers, but the decision-making role of the Risk Manager is reduced.

The answers given raise the question of whether fund management firms provide any separation of responsibility for the risk management function, especially when the risk characteristics deviate from those stated in the fund's mandate. Furthermore, it raises doubts about the portfolio manager's ability to independently separate his risk management from his portfolio management functions. They support the findings from the literature review, that the Asset Management industry

still needs a strong improvement in what concerns the independence of the risk management functions. According to the E&Y reports, in 2013 only 51% of the asset managers confirmed the independence of the investment risk function to the risk decisions.

In this case, hedge fund risk managers have less independence as far as risk is concerned. This can be just a consequence of the size of hedge funds teams and organizations, which are usually smaller than typical asset managers, meaning that there may be shared roles of responsibility.

Question 19: *How many people are in your risk management team?*

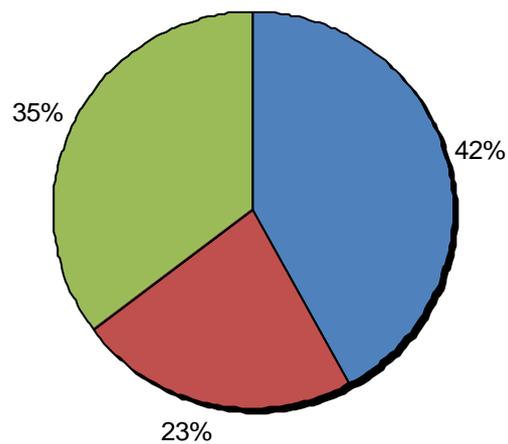
The purpose of this question is to understand the scale of risk management resources used by the investment companies.

For all asset managers:

Figure 5.22

Figure 22: How many people are in your Risk Management Team?

■ 1 - 5 ■ 6 - 10 ■ 10+

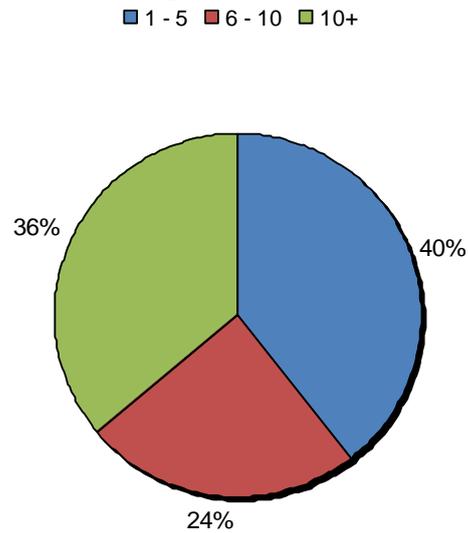


The survey indicated that 42% of firms had 1-5 members on their risk management team, and a further 35% had more than 10 members. 23% had between 6-10 people.

For long only:

Figure 5.22a

Figure 22a: How many people are in your Risk Management Team?

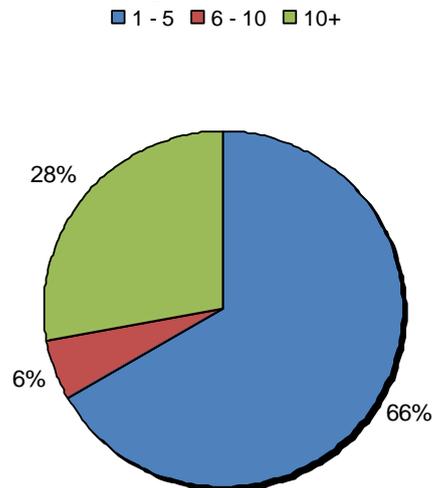


The survey for long only managers indicated that 40% of firms had 1-5 members on their risk management team, and a further 36% had more than 10 members. 24% had between 6-10 people.

For hedge funds:

Figure 5.22b

Figure 22b: How many people are in your Risk Management Team?



The survey indicated that 66% of hedge funds had 1-5 members on their risk management team, and a further 28% had more than 10 members. Only 6% had between 6-10 people.

Again, in line with the findings from the literature review (Rethinking Risk Management Survey, 2015), overall, the number of people financial institutions have working in their risk department seems quite low. However, one would need to consider some sort of assets under management/number of risk management employee's relationship before making a fully informed statement. In general, hedge funds tend to have fewer members on their risk teams. A possible and similar explanation for this has to do with the size of hedge funds companies,

typically smaller than long only ones in terms of assets under management and personnel.

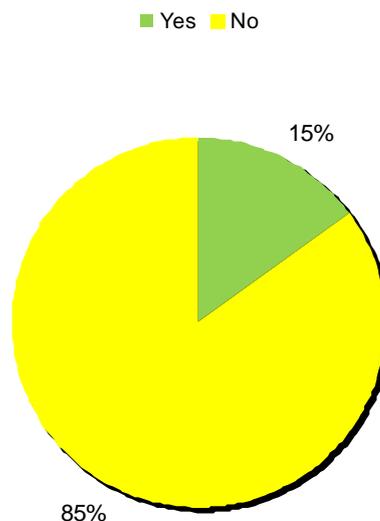
In 2015 E&Y wrote a report in which it claimed that 64% of the Asset Managers guaranteed an increase in the size of the risk function in that year while 60% were expecting such increases to continue in the 2016. Therefore, despite the small number of people in the teams had in 2010, in the last few years they have been growing and gaining relevance and responsibility.

Question 20: *Does your risk manager have other duties?*

This is similar to the previous two questions. The objective is to understand the strength and dedication of the risk department.

Figure 5.23

Figure 23: Does your Risk Manager accumulate other roles

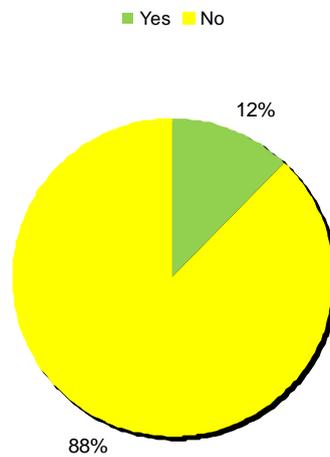


15% of risk managers have other duties apart from their risk management responsibilities, which might preclude them from focusing on and devoting sufficient time and resources to risk management. 85% of fund management firms have dedicated risk managers.

For long only:

Figure 5.23a

Figure 23a: Does your Risk Manager accumulate other roles



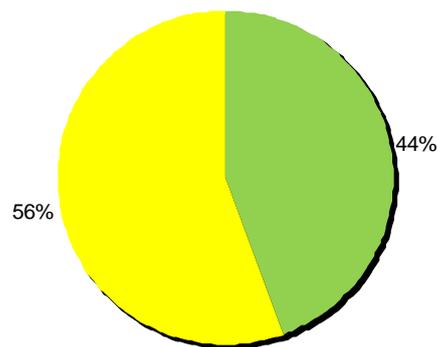
Most long only firms (88%) have a dedicated Risk Management role.

For hedge funds:

Figure 5.23b

Figure 23b: Does your Risk Manager accumulate other roles

■ Yes ■ No



44% of hedge fund risk managers have another role within their company. This additional role could mean that the risk manager dedicates less time to identify risk within portfolios.

As highlighted in questions 18 and 19, hedge funds have less dedicated risk managers. However, a similar argument can be used: the size of hedge fund companies and the need for the risk manager to undertake other duties. It is also important to understand what other roles they execute as this may lead to a conflict of interest.

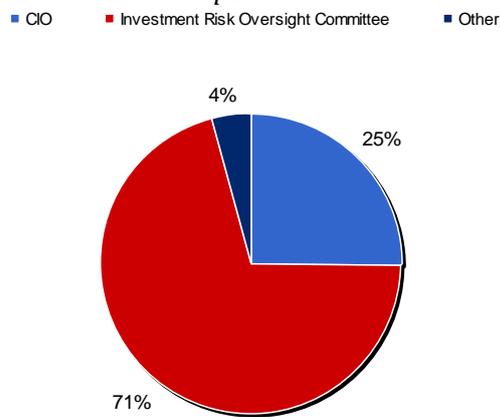
Question 21: Who does your Head of Risk Management report to?

This question also has to do with the independence and strength of the risk department.

For all the asset managers:

Figure 5.24

Figure 24: Who does your Head of Risk Management report to?



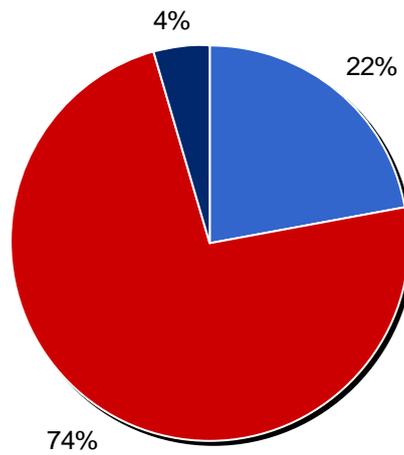
71% of Risk Managers report to their Investment Risk Oversight Committee, while 25% still report direct to their CIO.

For long only:

Figure 5.24a

Figure 24a: Who does your Head of Risk Management report to?

■ CIO ■ Investment Risk Oversight Committee ■ Other

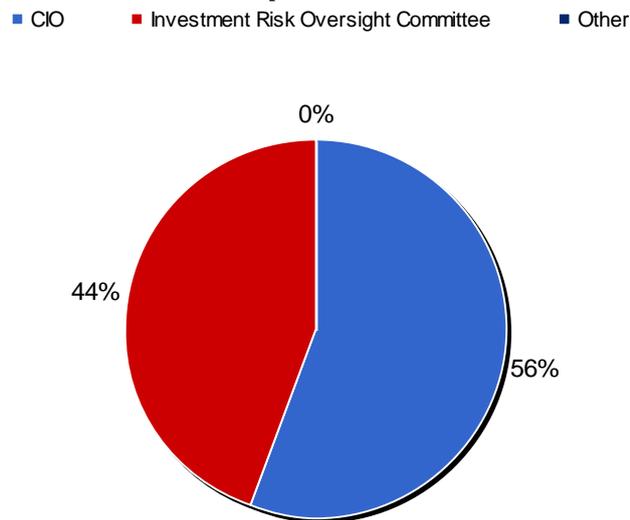


74% of Risk Managers in long only institutions report to their Investment Risk Oversight Committee, while 22% still report direct to their CIO.

For hedge funds:

Figure 5.24b

Figure 24b: Who does your Head of Risk Management report to?



Only 44% of Risk Managers in hedge funds report to their Investment Risk Oversight Committee, while 56% report direct to their CIO.

Overall, 25% of risk managers report to their company CIO, while 71% report to a Risk Oversight Committee. This highlights a potential lack of authority of the Risk Oversight Committee as 25% of PM's still reported to the CIO when regarding risk matters. More importantly, these responses could indicate that there is a conflict of interest when measuring risk, as the CIO may not be as objective when it comes to balancing risk management against reaching performance targets. Clearly, the role of the Chief Investment Officer and the Chief Risk Officer should be different in aims.

Once again, hedge fund risk managers seem to have less independence than long only companies do. A similar justification to the previous questions can be given for this fact.

Question 22: *How much do you spend on Portfolio Asset Risk Management on an annual basis?*

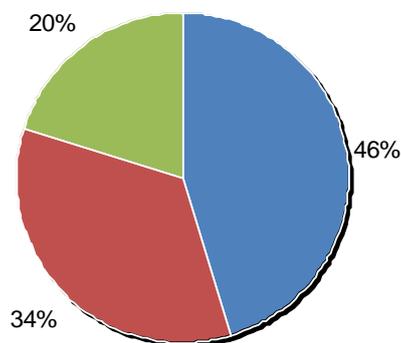
It is interesting to have an absolute value for the expenditure on risk management.

For all the asset managers:

Figure 5.25

Figure 25: How much do you spend on Portfolio Asset Risk Management on an annual basis?

■ Below \$5mn ■ Between \$10 to \$20mn ■ Above \$20mn



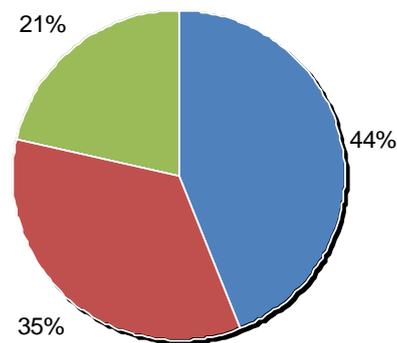
While the size of the firm surveyed may vary, 46% of firms spend only less than \$5million on risk management annually, while 34% spend between \$10million and \$20million. 20% spend more than \$20million.

For long only:

Figure 5.25a

Figure 25a: How much do you spend on Portfolio Asset Risk Management on an annual basis?

■ Below \$5mn ■ Between \$10 to \$20mn ■ Above \$20mn

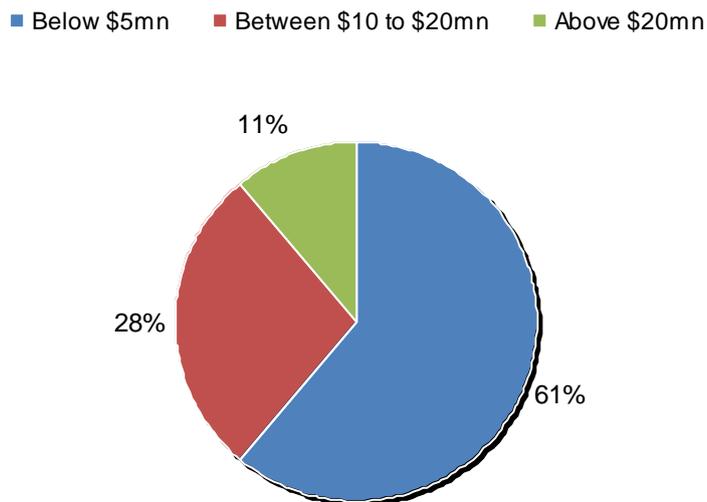


44% of firms spend only less than \$5million on risk management annually, while 35% spend between \$10million and \$20million. 21% spend more than \$20million.

For hedge funds:

Figure 5.25b

Figure 25b: How much do you spend on Portfolio Asset Risk Management on an annual basis?



A large number of hedge funds (61%) spend only less than \$5million on risk management annually, while 28% spend between \$10million and \$20million. Only 11% spend more than \$20million.

The total assets within the sample aggregate to approximately \$503billion, but the money spent on risk management as a percent of assets managed still seems to be very limited. These answers again point towards the lack of commitment of the senior management towards risk management, but this time an angle of financial commitment.

Hedge funds spend less on risk management than long only firms do in absolute terms. However, hedge funds tend to be smaller. It would be interesting to see what the relative spend is of these two type of Asset Management firms in order to determine who takes risk more serious in terms of financial resources.

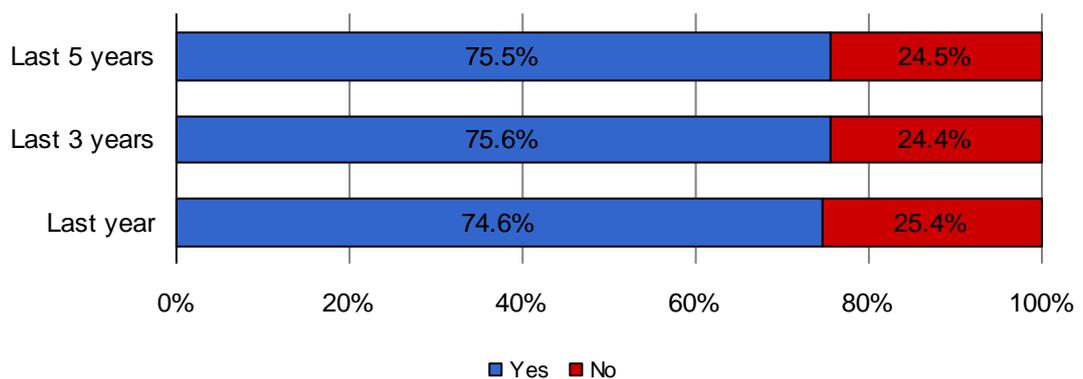
Question 23: *Has this amount increased vs.?*

The recent financial crisis made investors and asset managers rethink their attitude towards risk. This question tries to determine whether the recent financial crisis has led to an immediate consequence, in terms of investment in risk management.

For all asset managers:

Figure 5.26

Figure 26: Has this amount increased vs.

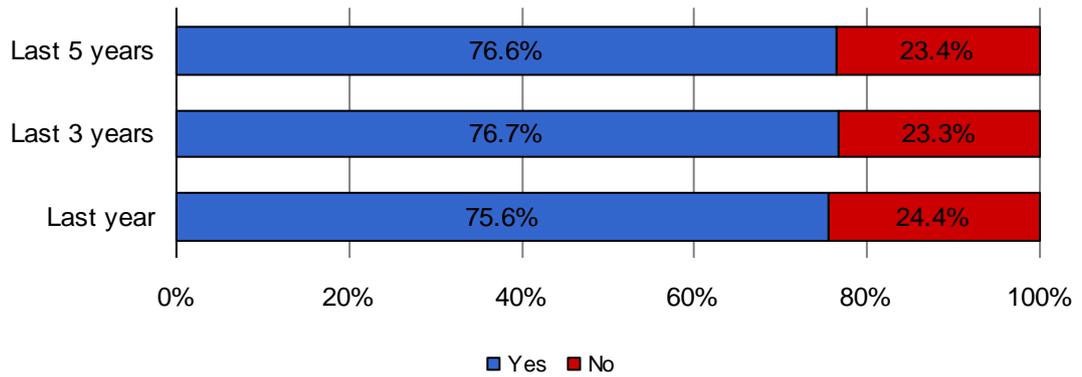


74.6% of firms have increased the amount that they spent on risk management compared to last year. Slightly higher figures are recorded for the last 3 and 5 years.

For long only:

Figure 5.26a

Figure 26a: Has this amount increased vs.

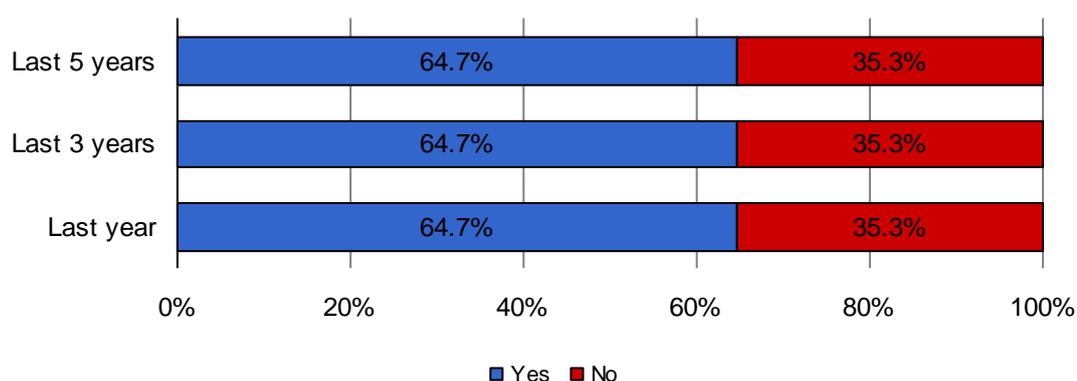


75.6% of firms have increased the amount that they spent on risk management compared to last year. Slightly higher figures are recorded for the last 3 and 5 years.

For hedge funds:

Figure 5.26b

Figure 26b: Has this amount increased vs.



64.7% of hedge funds have increased the amount that they spent on risk management compared to last year. The same figures are recorded for the last 3 and 5 years.

Overall, this trend points to an increasing focus and awareness of the importance of risk management, and indicates that firms have begun to address at least some of the issues regarding additional resources to enhance their risk management capabilities. However, considering all the events from the last couple of years, nearly a quarter has made no increase in investment in risk management.

Hedge funds have not increased the expenditure on risk management as much as long only firms. One possible reason is that they were already more cautious in

terms of risk, finding less need to improve and invest, compared with their long only counterparts.

Observe that the relationship between Assets Under Management (AUM) and risk management will be addressed later in this section.

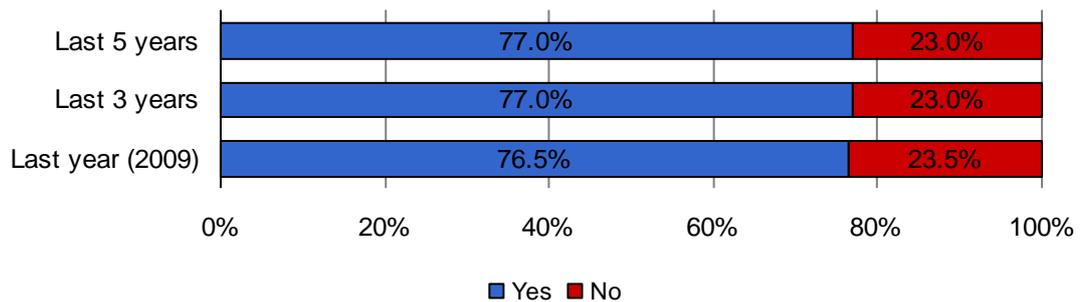
Question 24: Are the above parameters within the survey checked now on a more frequent basis than in the last...?

This question analyses the impact the recent financial crisis had on the frequency of how often the above parameters are observed vs the last 1, 3 and 5 years.

For all asset managers:

Figure 5.27

Figure 27: Are the above parameters within the Survey checked now on a more frequent basis than in the last:

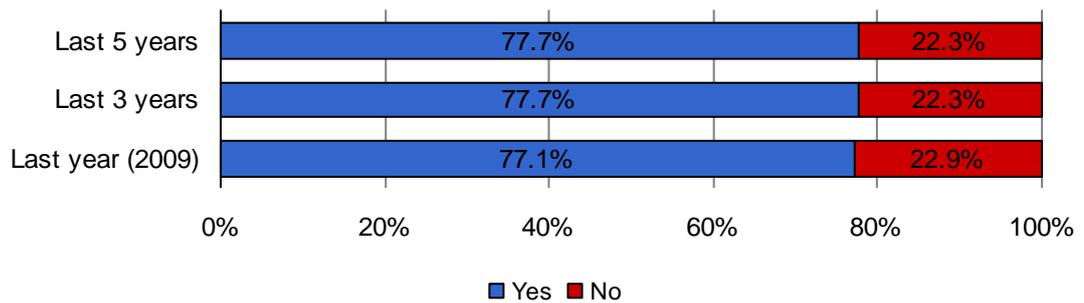


Over three-quarters of those surveyed said that the parameters in the survey were checked with increased frequency compared to last year (2009). A similar number reported an increase in the frequency over the last 3 and 5 years.

For long only:

Figure 5.27a

Figure 27a: Are the above parameters within the Survey checked now on a more frequent basis than in the last:

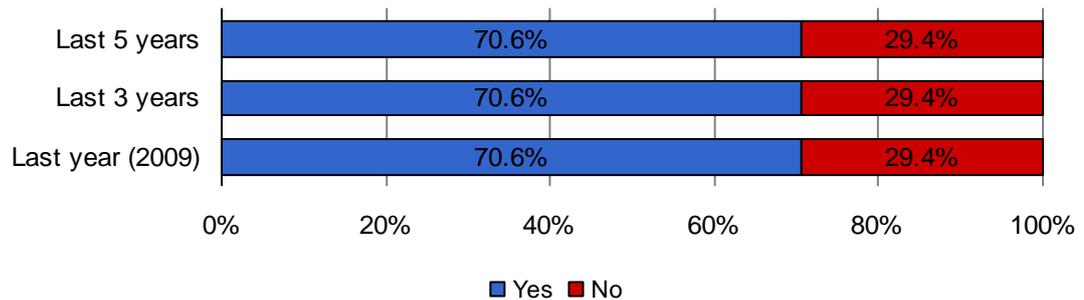


Similarly, over three-quarters of long only firms surveyed said that the parameters in the survey were checked with increased frequency compared to last year (2009). A similar number reported an increase in the frequency over the last 3 and 5 years.

For hedge funds:

Figure 5.27b

Figure 27b: Are the above parameters within the Survey checked now on a more frequent basis than in the last:



Hedge funds surveyed show that while 70.6% of the firms have seen an increase in risk management activity over the last 1, 3 and 5 years, 29.4% of those surveyed have seen no increase.

Overall, even following the financial turmoil, just under a quarter of those surveyed still do not analyze their risk parameters more frequently. In line with the previous question, hedge funds did not change their attitude towards risk management as much as long only asset managers. However, these results do show that risk management is becoming increasingly more important to investment managers.

6. Relationship between performance and level of risk management

The objective of this research is to understand what risk management processes are currently in place amongst active European equity asset managers, and to determine which practises are most effective. After analyzing the results of the primary data survey question by question, our goal is to link 6/w level of risk management (the level of risk management in an asset management) with the funds' performance by measuring the influence that risk management has on a fund's returns.

A 6/w analysis will show the level of risk management within a company. The 6W's can assist in evaluating the risk management within a company, by answering some questions: What is being done? Is it necessary? What useful purposes does it serve?; Where should it be done?; When should it be done?; Who is the best qualified person to do it?; How can it be done better/Easier/Safer?.

This link can be analyzed by two different approaches: multivariate regressions and Principal Component Analysis (PCA). However, as all the questions try to measure risk awareness and focus on the same subject (the size of the risk teams, the budget they have, who the CRO reports to, etc.), they all have a natural correlation between them. Therefore, a multivariate regression per se may not be the best option to our study (Dodge, 2003) as it violates one key assumption of the multivariate regression: that the observations must be independent (Amemiya, Takeshi, 1985).

Regarding the Principal Component Analysis, it is a Statistical tool that makes the different variables orthogonal, and hence, uncorrelated (Jolliffe, 1982). PCA is a procedure used to overcome problems arising when the exploratory variables are close to being collinear (Dodge, 2003 and Jolliffe 1982).

We are going to compare two multivariate regressions results in which the dependent variable is the performance rank as we are trying to measure the impact of the different questions of the survey on the performance of the funds (we computed performance from the available monthly NAV of the Fund in Bloomberg).

In order to do this, we developed the following structure:

- Perform a univariate robust OLS (Reference) for each question in the survey
- Perform a multivariate robust OLS for the questions that were identified as significant in the previous step
- Perform a Principal Components Analysis on the questions
- Perform a univariate robust OLS for each Principal Component
- Perform a multivariate robust OLS for the components that were identified as significant in the previous step
- Compare the results of the different approaches.

1. Univariate Robust OLS

The goal of regression analysis is to find a linear relationship between one or more independent variables and a dependent variable. The simplest regression method is the ordinary least squares regression (OLS). However, this simple method has several limiting assumptions regarding the data (Greene, 2011). If the

assumptions are not true, this simple technique can give misleading results and OLS is said to be not robust to violations of its assumptions. Robust regressions were designed to overcome these problems and are not overly affected by violations of assumptions by the underlying data-generating process (Andersen, 2008).

We are going to do several univariate robust regressions of the type

$$Y_i = \alpha^j + \beta^j X_i^j, j = 1, \dots, 40$$

where 40 are the different questions (variables) of the survey (please refer to appendix for the list of questions). In this regression, the dependent variable is the performance of the Fund and the independent variables are the various questions of the survey. The regressions in questions were performed using Matlab routine *robustfit* of the Statistical Toolpack. The results are presented in the following table

Table 1– Results from the Robust univariate regressions on all the questions in the survey

Question	Intercept	beta	p-value	t stat	R ²
5.1.a	65,79	-0,23	0,96	-0,06	0,00%
5.1.b	66,06	-0,33	0,93	-0,09	0,01%
5.1.c	65,21	0,08	0,98	0,02	0,00%
5.1.d	65,11	0,12	0,97	0,04	0,00%
5.2.a	59,01	2,74	0,38	0,88	0,61%
5.2.b	58,39	2,99	0,34	0,97	0,73%
5.2.c	57,12	3,64	0,25	1,15	1,03%
5.3.a	54,86	4,60	0,18	1,35	1,41%
5.3.b	54,11	4,96	0,17	1,40	1,50%
5.3.c	52,50	5,47	0,08	1,76	2,36%
5.4.a	56,37	4,06	0,24	1,18	1,07%
5.5.a	63,97	0,63	0,85	0,19	0,03%
5.5.b	64,63	0,32	0,92	0,10	0,01%
6.1.a	63,18	1,00	0,80	0,26	0,05%
6.1.b	62,63	1,25	0,74	0,33	0,08%
7	63,34	1,21	0,78	0,28	0,06%
8	58,03	3,16	0,31	1,02	0,81%
9	62,46	1,02	0,79	0,27	0,06%
10	79,95	-7,64	0,18	-1,34	1,38%
11.a	59,95	2,45	0,36	0,92	0,66%
11.b	58,52	3,02	0,27	1,11	0,96%
11.c	61,54	1,78	0,52	0,65	0,33%
11.e	60,87	1,89	0,50	0,68	0,36%
11.f	64,00	0,57	0,83	0,21	0,03%
12.a	72,68	-2,30	0,34	-0,96	0,71%
12.b	74,25	-2,76	0,24	-1,17	1,06%
12.c	73,46	-2,48	0,30	-1,03	0,83%
12.d	70,92	-1,71	0,47	-0,72	0,40%
12.e	77,19	-3,73	0,10	-1,68	2,15%
13	72,32	-2,87	0,39	-0,86	0,58%
14	71,32	-2,38	0,45	-0,75	0,44%
15.a	64,88	0,16	0,93	0,09	0,01%
15.b	74,08	-2,00	0,44	-0,77	0,47%
15.c	61,52	0,87	0,76	0,31	0,08%
15.d	58,83	1,59	0,46	0,75	0,44%
15.e	64,88	0,23	0,91	0,11	0,01%
15.f	62,41	0,74	0,73	0,34	0,09%
15.g	73,15	-1,81	0,47	-0,72	0,40%
15.h	64,17	0,29	0,90	0,13	0,01%
Q22	72,46	-2,40	0,26	-1,13	0,98%

As we can see by the results, only questions 5.3.c and 12.e are significant at 10%.

These questions are the following:

5.3.c) Country Positioning Summary, Country relative weights

12.e) How often do you analyse the following risk decomposition parameters?

Country Risk

Analysing the last regression results, the portfolio manager's main concern seems to be country risk exposure. In fact, the two most significant variables are the country risk and how often they analyse it.

It would have been interesting to explore potential significance between country risk analysis and performance of the Funds, which is something that will be explored in future research.

In order to have more independent variables, we are going to analyse the multivariate regression results using statistically significant variables at 10% and secondly we are going to allow the introduction of variables with t-statistics greater than 1.

2. Multivariate Robust OLS

a. 90% Confidence Intervals

We are now going to perform a multivariate robust regression on the two variables identified as significant in the previous section. In this analysis, the independent variables (X_i) are questions 5.3.c and 12.e, and the output (Y_i) is the performance of the Fund. The regression is

$$Y_i = \alpha + \beta_1 X_i^1 + \beta_2 X_i^2$$

The results are:

Table 2 – Results from the multivariate Robust regression on questions

5.3.c and 12.e

	Intercept	p-value	t stat	
	64,23	0,00	6,82	
Question	beta			Description
Q5.3c)	7,67	0,02	2,41	Country Positioning Summary, Country relative weights
Q12.e)	-5,34	0,02	-2,34	How often do you analyze the following risk decomposition parameters?, Currency Risk
	R ²			
	6,43%			

An interesting point is that the questions have a stronger significance in the multivariate regression than in the corresponding univariate regressions. This is due to the high collinearity between the variables.

b. T-stat greater than 1

It would have been interesting to explore potential significance between country risk analysis and performance of the Funds, which is something that will be explored in future research.

We are now going to perform a multivariate robust regression on the seven variables identified with a t-statistic greater than 1 (Xi) in the previous section. The regression is

$$Y_i = \alpha + \sum_{j=1}^7 \beta_j X_i^j$$

The results are

Table 3 – Results from the multivariate Robust regression on questions with t-stat greater than one

	Intercept	p-value	t stat	
	82,02	0,00	4,53	
Questions	beta			Description
5.2.c)	0,26	0,96	0,04	Active Positions Over quarter, Ex-Ante Tracking Error (%)
5.3.a)	3,20	0,81	0,24	Country Positioning Summary, Country breakdown vs previous quarter
5.3.b)	-9,17	0,46	-0,75	Country Positioning Summary, Sector weight position vs. previous year
5.3.c)	11,30	0,16	1,42	Country Positioning Summary, Country relative weights
5.4.a)	6,51	0,13	1,53	Top 10 / Bottom 10 Bets since Portfolio Tenure, Cumulative Contribution of top 10
8)	-3,61	0,41	-0,82	How often do you analyze the Emerging Markets Relative Bet to index
10)	-10,13	0,12	-1,55	How often do you analyze the portfolio performance vs. peers?
11.b)	1,92	0,62	0,50	How often do you analyse the following parameters to detect the risks within the portfolio?, Stocks Outside the Benchmark
12.b)	-9,74	0,22	-1,24	How often do you analyze the following risk decomposition parameters?, Country Risk
12.c)	14,33	0,13	1,52	How often do you analyze the following risk decomposition parameters?, Industry Risk
12.e)	-10,34	0,07	-1,83	How often do you analyze the following risk decomposition parameters?, Currency Risk
22)	-1,33	0,55	-0,60	How much do you spend on Portfolio Asset Risk Management on an annual basis?
	R ²			
	12,25%			

The questions used to perform this regression are questions 5.2.c), 5.3.a), 5.3.b), 5.3.c), 5.4.a), 8), 10), 11.b), 12.b), 12.c), 12.e) and 22). There are some differences in using more variables. Firstly, the R2 is bigger. Secondly, instead of just considering questions regarding the geographical and diversification of the portfolio, more risk variables come in place, highlighting the importance of the different questions in the survey. The country risk continues to appear as significant for the funds' performance but considering t-stats greater than 1, the currency risk, Industry risk and the analysis of peers' performance plays also an important role.

3. PCA – Principle Component Analysis

PCA is a statistical tool that has been used in several financial studies. For a tutorial on PCA see Smith (2002). Avellaneda and Lee (2008) developed a statistical arbitrage strategy for the US equity market using PCA. Itzhaki and Infantino (2010) developed a high frequency trading system also for the US market using PCA techniques. Sopipan, Kanjanavajee and Sattayatham (2012) used Principal Components Regression to predict the SET50 Index. The studies show the power and usefulness of PCA when dealing with financial data.

We are going to do a Principle Components Regression and to proceed in the same way as we did for the multivariate OLS regression. First, we compute the principal components. The first component, C1, corresponds to the one with the largest eigenvalue, C2 with the second higher eigenvalue, and so on. Second, we do a univariate robust regression for each one of them to identify those, which are significant. Finally, we do a robust OLS on these principal components. The objective of this analysis is to assess the relationship between the survey's questions and performance. The results for the univariate regressions are:

Table 4 – Results from the Robust univariate regressions on all Principal Components

Component	Intercept	beta	p-value	t stat	R ²
C1	65,40	-0,48	0,63	-0,48	0,18%
C2	65,38	-0,19	0,91	-0,11	0,01%
C3	65,45	3,31	0,07	1,85	2,60%
C4	65,34	-0,62	0,78	-0,28	0,06%
C5	65,38	-0,88	0,72	-0,35	0,10%
C6	65,37	1,09	0,70	0,39	0,12%
C7	65,40	1,78	0,56	0,58	0,26%
C8	65,44	-2,58	0,42	-0,81	0,51%
C9	65,34	4,16	0,21	1,25	1,20%
C10	65,38	-0,68	0,85	-0,18	0,03%
C11	65,38	6,64	0,08	1,75	2,34%
C12	65,38	1,57	0,69	0,39	0,12%
C13	65,37	-0,18	0,97	-0,04	0,00%
C14	65,40	-6,39	0,13	-1,53	1,79%
C15	65,44	2,90	0,52	0,64	0,32%
C16	65,37	-0,76	0,88	-0,15	0,02%
C17	65,37	2,69	0,61	0,51	0,20%
C18	65,45	7,07	0,19	1,33	1,36%
C19	65,37	3,80	0,53	0,63	0,31%
C20	65,39	1,69	0,79	0,27	0,06%
C21	65,44	11,02	0,11	1,60	1,96%
C22	65,35	7,97	0,26	1,12	0,97%
C23	65,36	-5,32	0,49	-0,70	0,38%
C24	65,41	-4,33	0,59	-0,54	0,23%
C25	65,38	1,95	0,83	0,22	0,04%
C26	65,43	7,01	0,47	0,72	0,41%
C27	65,34	22,57	0,04	2,10	3,34%
C28	65,27	22,25	0,05	2,01	3,07%
C29	65,31	-16,79	0,16	-1,40	1,51%
C30	65,36	25,64	0,06	1,89	2,72%
C31	65,37	-15,84	0,35	-0,93	0,68%
C32	65,47	-19,13	0,31	-1,03	0,82%
C33	65,42	-35,59	0,13	-1,54	1,81%
C34	65,45	-30,25	0,21	-1,25	1,21%
C35	65,36	22,28	0,46	0,74	0,42%
C36	65,41	29,12	0,41	0,82	0,53%
C37	65,35	22,14	0,59	0,54	0,23%
C38	65,40	89,80	0,04	2,07	3,25%
C39	65,43	-85,39	0,22	-1,22	1,15%
C40	65,35	-109,67	0,61	-0,51	0,21%

Observe that there are six components with a p-value less than 10%: Components C3, C11, C27, C28, C30, and C38.

Finally, the results for the multivariate OLS for these components are

Table 5 – Results for the multivariate OLS for a p-value less than 10%

Intercept	p-value	t stat
65,55861	3,98E-40	19,83193
beta		
92,25957	0,025403	2,262788
23,16576	0,07228	1,812941
20,66697	0,042447	2,050429
21,9169	0,037027	2,108381
-3,356091	0,048647	-1,991452
-6,198491	0,082789	-1,748982
R²		
17,15%		

Considering Table 4, there are 16 components with a t-stat greater than 1. The results for a multivariate OLS on these 16 components are the following

Table 6 – Results for the variables with a t-stat greater than 1

Intercept	p-value	t stat
66,067	0,000	21,030
beta		
3,359	0,039	2,089
3,729	0,212	1,256
6,276	0,066	1,856
-6,588	0,080	-1,765
7,611	0,111	1,606
10,919	0,078	1,781
8,645	0,175	1,365
17,852	0,066	1,857
20,491	0,041	2,066
-16,308	0,129	-1,528
26,167	0,034	2,147
-19,197	0,246	-1,167
-31,946	0,123	-1,556
-31,610	0,142	-1,480
88,071	0,025	2,264
-87,821	0,159	-1,419
R ²		
31,24%		

7. Conclusions

Chapter 3 had the objective of analysing how risk management is currently used in European funds. The questions we developed tried to analyse the state of the art of the Risk Management in the Asset Management Industry. The survey tried to answer several key questions:

- What are the consequences of past financial crises?
- Is risk management taken seriously inside financial organizations?
- Are funds with fewer assets under management expected to spend (proportionally) less on risk management?

A survey of 200 asset managers and hedge funds was implemented to identify current approaches to risk management, and what might need to be improved. The findings highlighted that there are significant issues within the risk management systems utilized by the various asset managers that need to improve considerably. In this chapter, we tried different approaches to explain the performance of the funds in terms of the survey's questions. We did robust regressions on the questions and on their principal components. Due to the high collinearity of the questions, we were expecting the PCA approach to deliver better results and it proved to be correct. The R^2 , which measures the capability of the regression to explain the problem, is greater for the PCA than the robust OLS (17.15% and 6.43%, respectively). To further understand the impact of choosing more variables, we chose variables with t-stat greater than one. Not surprisingly, the PCA results improved. As the variables are uncorrelated, each one brings different information. For the opposite reasons, the multivariate OLS results were worse.

The main conclusion from Chapter 3 is that there are significant issues within the risk management systems utilized by the various asset managers (traditional asset managers with a bias towards long only products and hedge fund managers with an absolute bias) and that there is a need to improve these systems.

Chapter 4: Second Empirical Chapter

1. Introduction

In Chapter 2 we provided a comprehensive analysis of the current risk management practices (literature review) of active European equity long only and hedge funds. Using a unique survey (Chapter 3) we revealed many important issues for the industry. In particular, we find: evidence to suggest that there is an insufficient financial commitment to risk management; that risk managers may not be independent enough; that important risk types may be being ignored; and that portfolio holdings are assessed on an infrequent basis. However, we also find that efforts have been made by funds to allocate more resources to risk management since the start of the recent financial crisis. Further, we find that hedge funds tend to be more 'risk aware' than their long only counterparts and finally that spending more on risk management is likely to improve fund performance rankings.

This chapter provides, using a unique survey, a comprehensive analysis of the level of risk that pension fund clients (Board Members, Chief Financial Officers, and upper management of organisations with pension funds under third-party management), family offices that invest in hedge funds and Intermediate Financial Advisors (IFAs in UK) are willing to accept. By pension funds we mean a fund that was stabilised by an employer to facilitate and organise the investment of employees' retirement funds contributed by the employer and the employees. By family offices we consider private wealth management and advisory firms that serve ultra-high net worth investors. By IFAs we mean professionals who offer independent advice on financial matters to their clients and recommend suitable financial products. In particular, we found evidence suggesting that there are

different levels of risk acceptance between pension fund clients, family offices and IFAs. Family offices are more risk aware than pension fund clients since pension fund clients use traditional asset managers (long only) following a benchmark, and their main concern is not to deviate significantly from the benchmark. On the other hand, family offices are typically invested in hedge funds, and hence, their main task is capital preservation trading in more liquid markets, have higher cash levels and are more concerned with tail risk. Finally, Independent Financial Advisor clients are more concerned with capital preservation, unwilling to take significant drawdowns and volatility on the returns and less sophisticated in terms of understanding financial instruments but with a more absolute attitude towards returns.

To the best of our knowledge, this is the first comprehensive analysis of the level of risk that pension fund clients (Board Members, Chief Financial Officers, and upper management of organisations with pension funds under third-party management), family offices that invest in hedge funds and Intermediate Financial Advisors (IFAs in UK) are willing to accept.

2. Literature Review

Expected Utility Theory

John Von Neumann and Oscar Morgenstern formally developed modern utility theory in their classic book *Theory of Games and Economic Behaviour* in 1944. The approach of the Von Neumann and Morgenstern model is axiomatic. If an individual satisfies four axioms of rationality they are completeness, transitivity, continuity and independence - then the outcomes of a game of choices can be

ranked accordingly to a utility function based on the individual's preferences under uncertainty.

Schoemaker (1982) showed that a rational decision maker will always try to choose the lottery that maximizes its expected utility and the four axioms guarantee there is a utility function that ranks lotteries by their expected utility. As utility functions can be linearly transformed, the scale and the measures of utility can be set accordingly to the cases.

Norstad (1999) noted the non-satiation property states that utility increases with wealth, however, the risk aversion property states that the utility function is concave. In other words, the marginal utility of wealth decreases as wealth increases.

Kenneth Arrow and John Pratt (1965) absolute risk aversion function is based on the curvature of the utility function. It provides a quick measure of the decision maker's absolute risk aversion as a function of his wealth. In addition, this measure is invariant for linear transformations as the VNM model.

Most criticisms of the VNM model focus on its independence axiom. Tversky and Kahneman (1979) use experiential results to show that people tend to overvalue a sure thing. People overweight certain outcomes to probable ones. Kahneman and Tversky (1979) call this violation the certainty effect. Kahneman and Tversky (1979) noted a second violation of the independence axiom called the reflection

effect. Decision makers are risk averse in the face of gains and risk seeking in the face of loss. Together with the reflection effect, the certainty effect still holds valid for gains, but in the opposite way for losses: Individuals prefer a larger potential loss that is uncertain to a smaller loss that is certain.

Friedman and Savage (1948) starting from the empirical fact that people buy both insurance and lotteries, proposed a utility function shaped without the assumptions of VNM, which holds constant the utility function among levels of wealth. Even in the case of slightly unfair lotteries, individuals will play the lottery rather than do nothing. According to Markowitz (1952), another implication of their utility curve is that individuals with such a curve will prefer “positively skewed distribution (with large right tails) more than negatively skewed ones (with large left tails)” (Machina, 1982).

Markowitz (1952) sustains that changes in wealth cause the utility function to shift horizontally. The utility function does not change according to the level of wealth, but according to deviations from present wealth. Decision makers tend to act more conservatively when they are moderately losing and more aggressively when they are moderately winning. According to Markowitz, the decision maker’s preferences cannot be defined independently from his current consumption point.

According to Kahneman and Tversky (1979) prospect theory, “people perceive outcomes as gains and losses rather than final stage of wealth fare”. The decision process involves an editing phase, in which the individual takes into account the framing effect, and an evaluation phase, in which the individual formulates a

decision (value), based on the potential outcomes and their respective probabilities, and then chooses the alternative which has a higher utility. Another aspect of the theory is the decision weight. The weights are not probabilities but they moderate probabilities according to the decision makers' expectations. However, they do not follow any utility maximization rule and the weighting establishes a nonlinear effect independent from the underlying probability. As a result of the subjective expectations of the decision makers, the weighting function tends to overweight small probability while underweight medium and high probability. The value function of Kahneman and Tversky's prospect theory is therefore s-shaped, asymmetrical, and centered according to a reference. The three main implications of prospect theory are loss aversion (the function is asymmetric in the valuation of losses or gains), diminishing sensitivity (the marginal value of gains and losses decreases with increasing size) and reference dependence (gains and losses are depended according to a reference point).

Norsworthy et Al. (2003) test the characteristics of Prospect Theory across three different time periods: although some periods show stronger results than others do, in all of them the investor behaviours hold the same effects. The experiments concisely demonstrated that market behaviours of investors are strongly influenced by reference frames according to the behavioural assumptions of the prospect theory. Norsworthy et al (2003) state that a person's decision in a risky situation is dependent on their current frame of reference.

Neutrality and risk aversion

Buchan, Bruce and Levy (2005) showed security selection and weighting decisions will be determined with a view to maximising return for a target risk level. Alexander and Dimitriu (2002) noted that in order for these securities to offset each other, they need to have an element of proven inter-dependence. This inter-dependence can take the form of an expectation that a relative price convergence between these securities will take place within a certain time period. Historical price behaviour will form the basis of this expectation (Ineichen, 2001). The investment opportunity is provided by the level of pricing before the convergence takes place, and is independent of market conditions. This approach can be employed within a sector exposure. Inter-dependence between investments is also found across a wide variety of market strategies, such as option arbitrage, merger arbitrage and convertible securities arbitrage (Alexander and Dimitriu, 2002).

Asness, Frazzini and Pedersen (2012) noted the introduction of leverage changes the predictions of modern portfolio theory. The capital asset pricing model (CAPM) proposes that investors should hold the market portfolio levered in line with the investor's risk preference. However, Risk Parity (RP) proposes that one should take a similar amount of risk in different asset classes. The RP approach uses an asset allocation heuristic where the justification is not theoretical but intuitive. Given the different risk profiles of different asset classes, an investor is required to invest more investable wealth in low risk assets than high-risk assets in order to diversify risk. The attractiveness of the RP theory centres on the appeal of risk diversification as the objective of the asset allocation decisions, thus RP does not

depend on expected returns which investors have less confidence in predicting (Schachter and Thiagarajan, 2011).

Assess, Frazzini & Pedersen (2010) demonstrate that leverage aversion might be the link which could result in RP portfolios being optimal. Their proposition is that some investors, such as pension funds, are not in a position to use leverage (Asness, Frazzini and Pedersen, 2012). In order to meet their return targets, therefore, they hold riskier asserts instead of using leverage to increase the return of the lower risk assets.

Tail risk management

Wang and Sullivan (2012) noted that modern portfolio management have made it possible for investors to be more flexible in the approach they take towards maximizing their utility by balancing their risk/reward calculations and their risk aversion across a wide array of asset classes. Xiong and Idzorek (2010) showed investors having different levels of risk aversion and utility, and that the risk premiums on assets cycle over time within a given market as investors' appetites change. Vrecko and Branger (2009) highlighted that Interest in tail-risk management has increased following the financial crises of 2007-2008 and the subsequent European debt crisis, and financial institutions have responded to the demand, offering new tail-risk management solutions for investors.

Nassim Nicholas Taleb, 2011 challenged popular understandings of tail risks, pointing out that the frequency of high impact events in the financial markets has far exceeded mathematical expectations build on standard models. Jiang and

Kelly (2012) when examining the returns of over 6000 hedge funds following the financial crises of 1998 and 2007-2008 found that tail-risks play a significant role in driving hedge fund returns. The studies made evident the need for investors to consider more carefully the managing of the potential risks to their portfolio while still trying to preserve the upside.

3. Objectives of the Second Empirical Chapter

3.1. Second Empirical Chapter

To the best of our knowledge there is no comprehensive study on the levels of risk acceptance on pension fund clients, family offices that allocate into hedge funds and investors that use IFAs as way to gather exposure to the market. The objective of the second empirical chapter is to research risk acceptance levels of the above market participants.

The main conclusion of the survey is that each market participant has different tolerance levels of risk and different interpretations of risk, as we will see in the questionnaire discussion.

3.2. Data

This dataset is focused on European equity type asset managers: Pension funds clients, family offices that invest in hedge funds and investors that use IFAs as a way to manage their money. The source used to get the number and assets under management of companies that manage traditional equity funds is the database FundFile from Lipper Fund Management Information (Lipper FMI). FundFile is a research tool specially designed for the European and Asian fund industry tracking over 45,000 funds sold throughout Europe and Asia. The data is released on a

monthly basis with an approximate lag of six weeks, which allows FundFile to have all groups reporting their assets at the same date.

The FundFile database does not have sufficient coverage of traditional hedge funds - its main strength is the collection of data on traditional open-ended mutual funds. Hence, in order to add a list of hedge fund companies to the sample size an alternative source was used - Morningstar Direct as a way to gather the family offices IP Publication (2011) that combines a comprehensive list of family offices based in UK. Finally, the list of clients that invest in IFAs was provided directly by several IFAs based in London.

3.3. Methodology

The survey was carried out by one to one interviews where the interviewer had the question script in front of him and the interviewees were able to respond. This enabled higher response rates than a mailout would have received, for example Levich, Hayt and Ripston (1999) received only a 17.5% response rate from their 1708 surveys mailed during their study of derivatives and risk management practices by U.S. Institutional investors. Interviews were carried out between January and September 2011.

The survey was conducted with 40 Pension Fund clients, 40 Family Offices and 1000 clients that use IFAs all based in UK

The survey consisted of 24 questions for Pension Funds, 23 questions for Family Offices and 18 questions for the IFAs.

4. Results

4.1 Pension Fund Survey Results

This study is based on input from 40 investment management industry participants. This input was obtained through surveys of Board Members, Chief Financial Officers, and upper management of organisations with pension funds under third-party management.

Types of Funds

The investment community members who completed the survey managed the following types of funds:

68% **Corporate pension funds** – Defined contribution or defined benefit plans for corporate employees

18% **Public pension schemes** – Defined benefit plans (and some defined contribution plans) for public sector employees

12% **Endowments** - Funds set up by an institution (often non-profit, universities, hospitals, etc.) and funded by donations.

Regular withdrawals from the invested capital are used for ongoing operations or other specified purposes.

2% **Foundations** – Funds managed by the trustees or directors of a non-profit organization usually created via a single primary donation from an individual or business. A foundation generates income by investing its initial donation, often disbursing bulk of its investment income each year to desired charitable activities.

Charts displaying providers' view

“Overall” results are equally weighted across asset managers to give participants an equal voice.

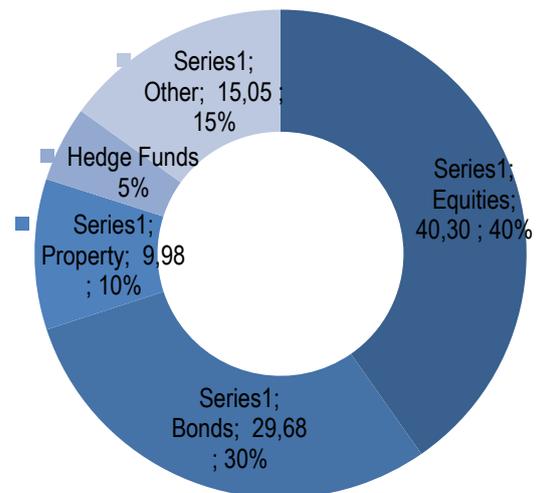
AUM breakdown

All survey participants managed assets greater than USD1bn, with 33% managing more than USD10bn.

Asset Allocation

The participants surveyed indicated that 40% of their current total assets were allocated to equities, 30% to fixed income, and the remainder to hedge funds and alternative investments.

Figure 1
Asset Allocation
(Percentage of Total Assets)



Investment Strategy

40% of the participants surveyed “follow the median manager” as an investment strategy, 25% employ a mean variance optimisation strategy and 5% use a liability driven (LD) investment strategy.

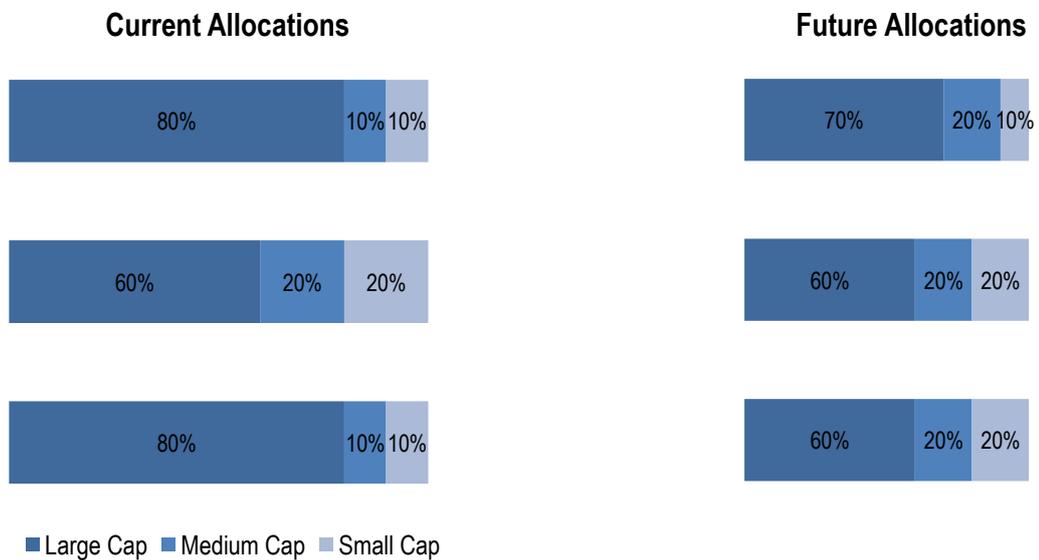
Figure 2 – Investment Strategy



Market Cap Bias

As corporate pension funds, public pension schemes and endowments typically have considerable assets under management, they tend to have a bias towards large cap companies because of their constant need to hold liquid assets.

Figure 3 – Market Cap Bias



According to survey results, future allocations of corporate pension funds, public pension schemes and endowments will not change significantly from current allocations, maintaining a bias towards large cap stocks.

The Importance of Risk Management

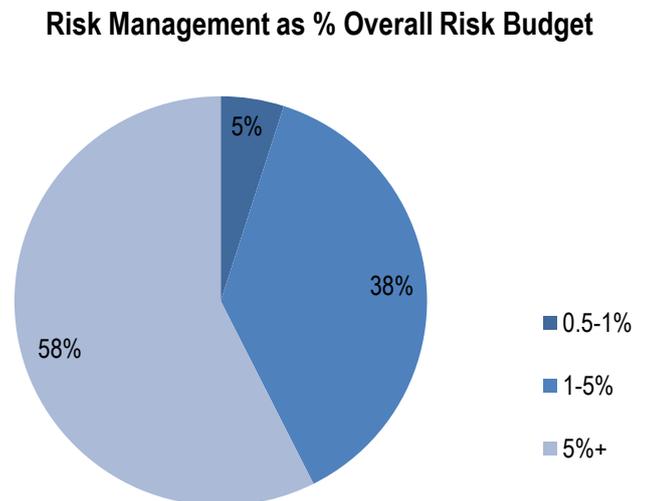
Overall, survey participants were proactive in implementing risk management strategies.

- 80% were unwilling to make an investment if it did not meet their risk criteria.
- 15% believed risk management and reduction were very important and had a risk committee meeting regularly to review each investment over a 5% threshold.
- 3% managed risk “naturally” by the investment made in each fund.
- 2% managed risk on an investment-by-investment basis.

Willingness to Spend on Risk Management

Accordingly, participants were willing to allocate some of their overall risk budget towards risk management (in terms of people, data and analytics). Every participant was willing to spend $\geq 0.5\%$ of their overall risk budget on risk management, with 58% willing to spend more than 5%.

Figure 4



Investment Performance: Absolute or Relative?

Unlike hedge fund managers, the pension fund managers surveyed were overwhelmingly more concerned about relative performance to a benchmark than absolute returns. 88% of participants responded they

Figure 5

Hedging Strategies utilised

- Equity Option strategies
- Options
- Credit strategies
- Commodities
- Managed Futures
- Treasuries
- Inflation options
- Variance swaps
- Tail risk protection indices
- Longevity
- VIX/VSTOXX Futures
- V-stock/Variance swaps

typically sought performance relative to a specific benchmark, tending to be more constrained in their investment process.

Little Concern for Tail Risk

Also divergent from hedge fund managers, the majority (88%) of pension fund managers surveyed were not concerned about tail risk and 92% did not even consider the contribution of tail risk to their overall portfolio (Q#22). Given the investment time horizon for pension funds is longer than that for hedge funds, pension funds are less susceptible to the impacts (e.g., redemptions) of major events that fall into the 'tail-risk' category.

Hedging tail risk

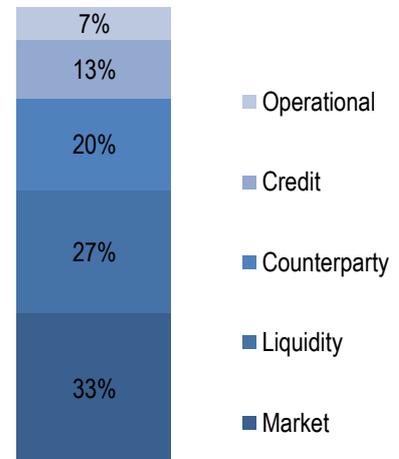
To assess hedging levels, survey participants were asked which instruments they use to hedge tail risk. 61% of participants did not hedge their portfolios, and the 39% who did used a variety of instruments. No single hedging strategy was widely used.

Prioritising different types of risks

Participants ranked market risk the most important risk to consider when investing, with liquidity and counterparty risk also highly relevant.

Figure 6

Most Important Risks



The increasing role of risk management

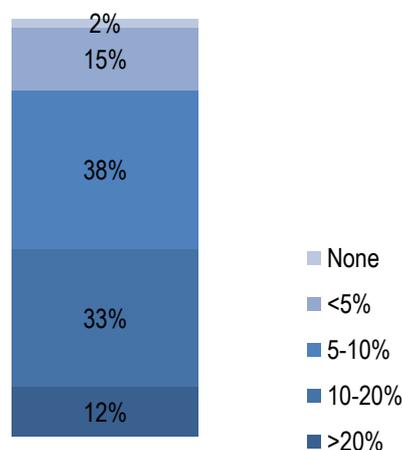
All participants responded that overall investment risk management has increased in importance since the 2008 financial crisis.

Comfort levels with Portfolio Loss

The corporate pension funds were aware of the volatility of long equity portfolios, and 71% of those surveyed were comfortable with potential drawdowns between 5% and 20%.

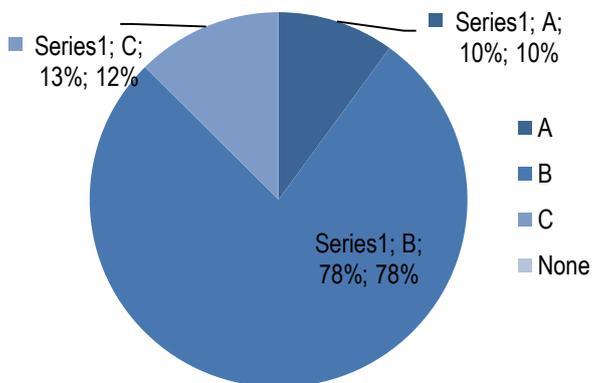
Figure 7

How much portfolio loss are you comfortable with?



This information was corroborated when survey participants were offered a choice of investment portfolios to allocate part of their money to. 78% of participants indicated they would prefer Portfolio B, corresponding to a partially hedged portfolio and reflecting some risk aversion of the clients.

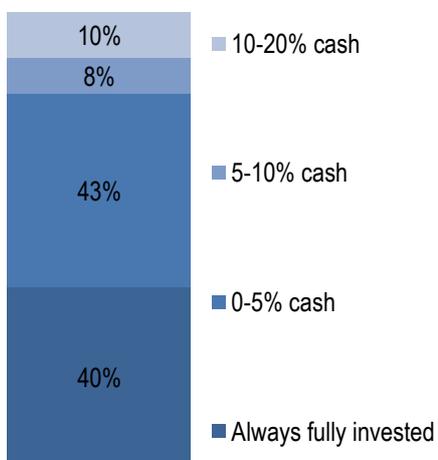
Figure 8



Which portfolio would you invest in?

Figure 9

Cash Position



Cash Management

83% of corporate pension funds surveyed were nearly or fully invested.

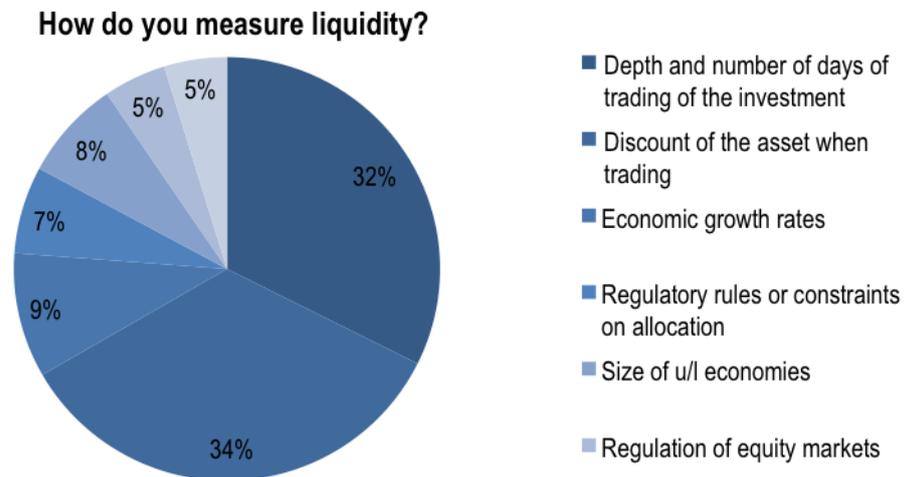
88% of survey participants were more aware of liquidity issues in the assets they invested in, a consequence of the 2008 global financial crisis.

Since 2008, 65% of survey participants have not changed the way they invest in cash, 25% have implemented new technology for cash management, and 10% have increased cash limits.

Measuring liquidity

Almost 65% of the sample interviewed measure liquidity in one of two traditional ways: 1) depth and number of days of trading the investment or 2) the discount of the asset when trading

Figure 10



Investing in private equity

When investing in private equity, all survey participants were concerned with valuation sensitivity analysis, liquidity of the investment, and exit strategy.

Strength of pension schemes

80% of the clients of the corporate pension funds, public pension schemes and endowments surveyed considered their pension schemes on average well provisioned with no significant shortfalls in the potential liabilities to the pensioners.

4.2 Family Offices Survey Results

This study is based on input from 40 investment management industry participants who run family offices that invest in hedge funds.

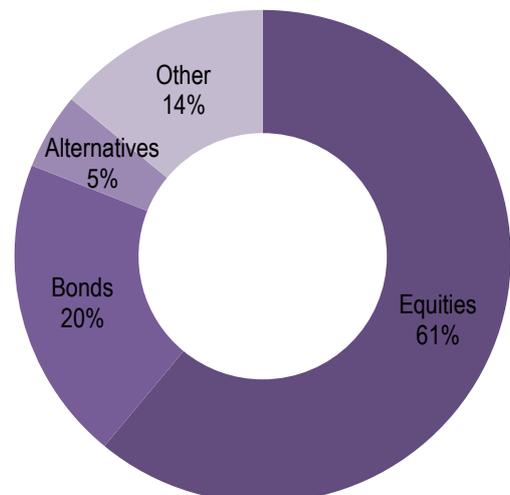
AUM breakdown

All survey participants managed assets less than USD500mm, with 30% managing less than USD200mm.

Asset Allocation

The participants surveyed indicated that 60% of their current total assets were allocated to equities, 20% to fixed income, 5% to alternative investments and the remainder in other.

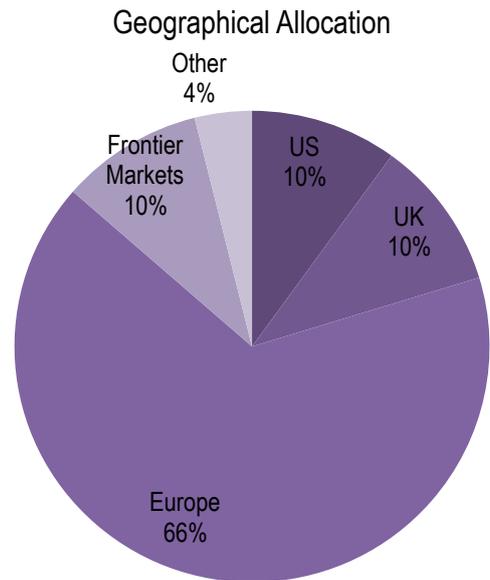
Figure 11
Asset Allocation



Geographical Allocation

The family offices surveyed showed a bias towards local investments. 66% of assets were invested within Europe, 10% were invested in the US, 10% in the UK, 10% in frontier markets (e.g., Africa), and 4% in the remaining markets including China, India, Japan, South America and Asia ex-Japan.

Figure 12

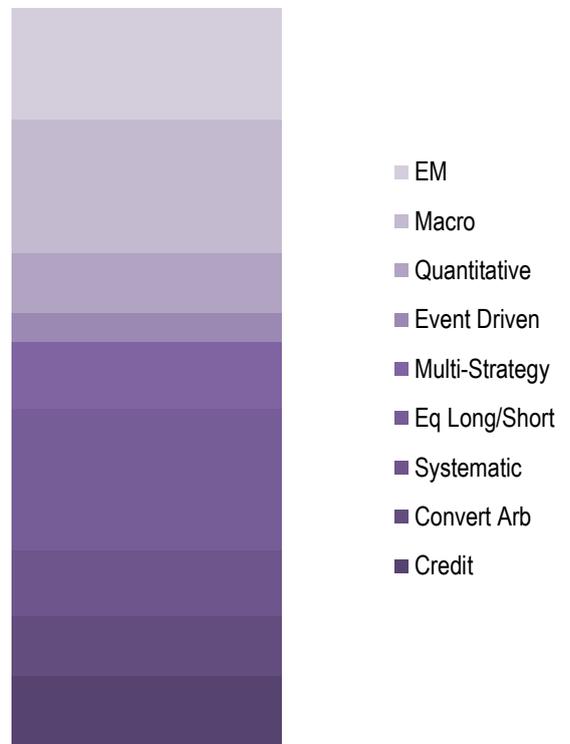


Investment Strategy

The family offices surveyed used a plethora of investment strategy, showing the level of commitment family offices have on improving their portfolio diversification. The most popular investment strategy was Eq Long/Short with 19%. Macro was a close second with 18%, and Systematic third with 15%.

Figure 13

Investment Strategy



The Importance of Risk Management

The family offices surveyed were generally proactive in their approach to risk management.

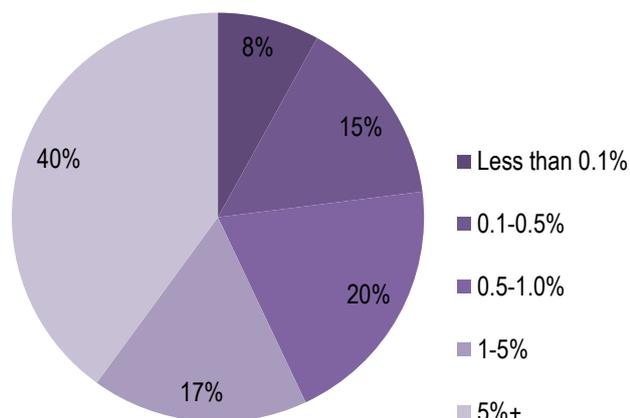
- 43% were unwilling to make an investment if it did not meet their risk criteria.
- 18% believed risk management and reduction were very important and had a risk committee meeting regularly to review each investment over a 5% threshold.
- 17% managed risk “naturally” with each investment made.
- 12% managed risk on an investment-by-investment basis.
- 10% only did the minimum necessary to comply with regulations.

Willingness to Spend on Risk Management

Family offices surveyed were willing to allocate more than 5% of their risk budget towards risk management (in terms of people, data and analytics).

Figure 14

Risk Management as % Overall Risk Budget



Investment Performance: Absolute or Relative?

Unlike pension fund managers, the majority of family offices surveyed were most concerned about absolute return with only 28% concerned about relative performance to a benchmark.

Increasing importance on Asset Allocation

Asset allocation has been considered more seriously in recent years. Although the main driver of asset allocation within family offices' portfolios tends to be absolute return today, asset allocation within different asset classes will play an important role in the future. Looking forward 5 to 10 years, 25% of the family offices surveyed anticipated an asset allocation move towards long only, 42% towards absolute return.

Significant Concern for Tail Risk

58% of family offices surveyed expressed concern about tail risk, indicating a sophisticated level of family offices' technical knowledge and significant concern around portfolio drawdowns.

Hedging Tail Risk

Of the family offices who hedged tail risk, 30% applied hedging strategies to the whole portfolio, 30% to alternative investments, 23% to fixed income, 10% to equities, and 8% to other investments.

Figure 15

Instruments to Hedge Tail Risk

- Equity Option strategies
- Options
- Credit strategies
- Commodities
- Managed Futures
- Treasuries
- Inflation options
- Variance swaps
- Tail risk protection indices
- Longevity
- VIX/VSTOXX Futures
- V-stock/Variance swaps

To hedge tail risk, the family offices surveyed used a variety of financial instruments with no single hedging strategy widely used.

Prioritising different types of risks

Participants ranked counterparty and operational risk - the more challenging aspects to control - as the most important

risks to consider during the investment process. Credit risk, market risk and liquidity risk were all considered relevant.

The increasing role of risk management

All participants responded that investment risks overall have increased in importance since the 2008 financial crisis, confirming the findings of the first paper.

Figure 16

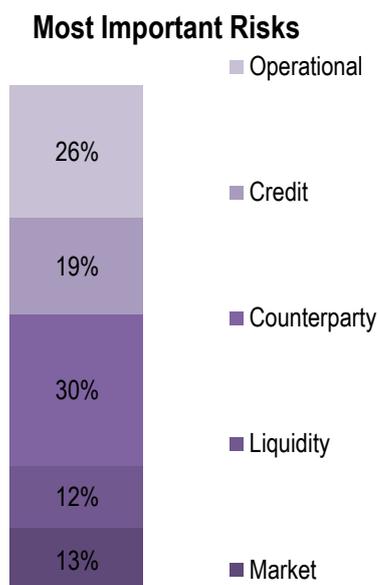
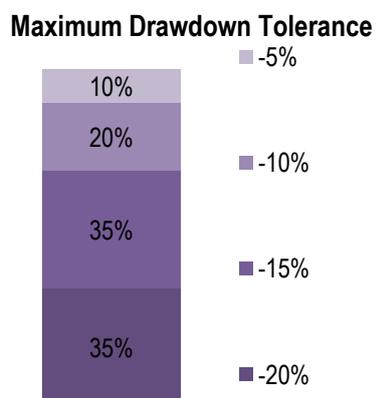


Figure 17



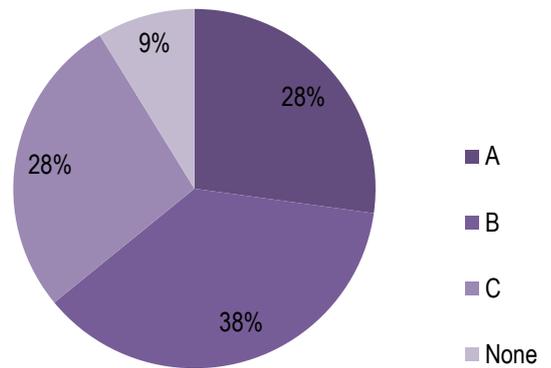
Maximum drawdown tolerance

35% of family offices surveyed were willing to accept drawdowns greater than 15% from peak to trough, demonstrating a relatively low level of risk tolerance.

This information was corroborated when survey participants were offered a choice of investment portfolios to allocate part of their money to. 38% of participants indicated they would prefer Portfolio B, corresponding to a partially hedged portfolio and reflecting some risk aversion of the family offices.

Figure 18

Which portfolio would you invest in?



Volatility

The family offices surveyed demonstrated a willingness to take on risk (in the form of volatility or annualised standard deviation) in order to achieve high returns.

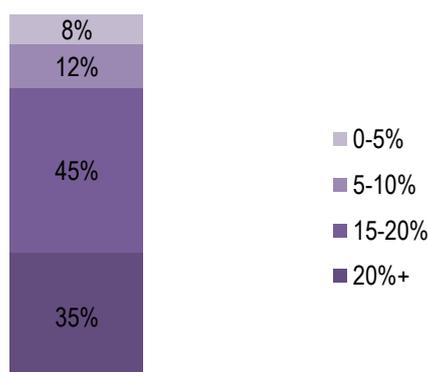
Figure 19

Acceptable Levels of Volatility



Figure 20

Acceptable Levels of Leverage



Leverage

The family offices surveyed also demonstrated a willingness to take on leverage in order to improve returns.

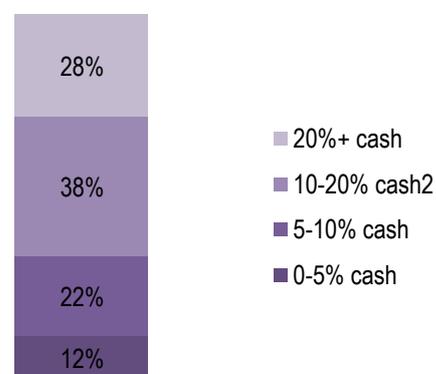
In fact, 90% of all family offices surveyed were considering increasing the leverage within their portfolios in the next 12 months. 53% were considering increasing their leverage by more than 15% and only 10% were not going to increase their leverage.

Cash Management

All the family offices surveyed carried cash, with 66% holding 10% or more of their portfolios in cash. This cash level could be attributed to either risk aversion or cash reserves held for future investments.

Figure 21

Cash Positions



63% of family offices surveyed were more aware of liquidity issues in the assets they invested in, a consequence of the 2008 global financial crisis.

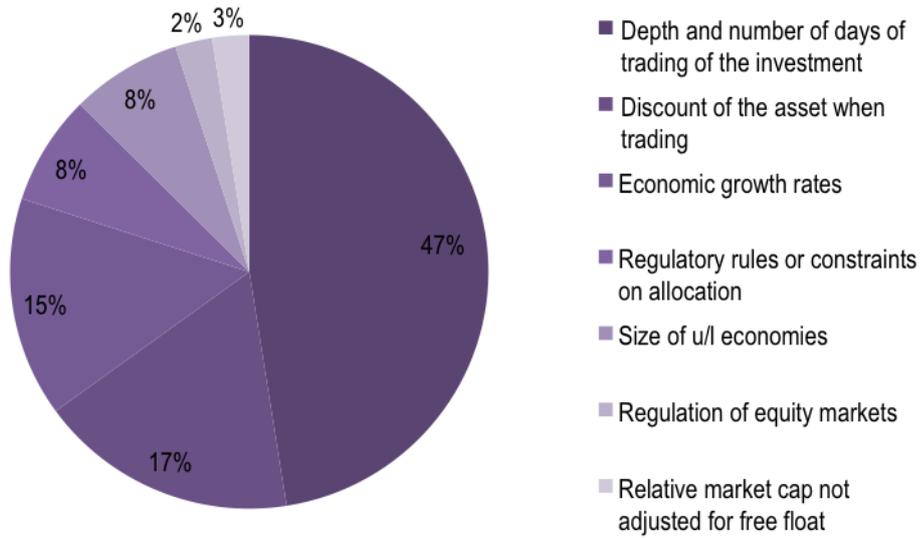
And since 2008, 35% of survey participants have implemented new technology for cash management, 22% have increased cash limits, and 43% have not changed the way they invest in cash.

Measuring liquidity

Almost 64% of the portfolio managers surveyed measure liquidity in one of two traditional ways: 1) depth and number of days of trading the investment or 2) the discount of the asset when trading.

Figure 22

How do you measure liquidity?



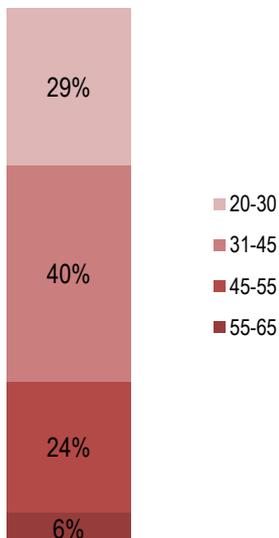
Risk tolerance for hedge fund investments relative to overall portfolio

When asked about their risk tolerance (as measured by drawdowns) for capital allocated to hedge funds relative to their own portfolio investments, 70% of family offices surveyed said they have the same criteria for both.

Figure 23 4.3 IFA Client Survey Results

Age of IFA Clients

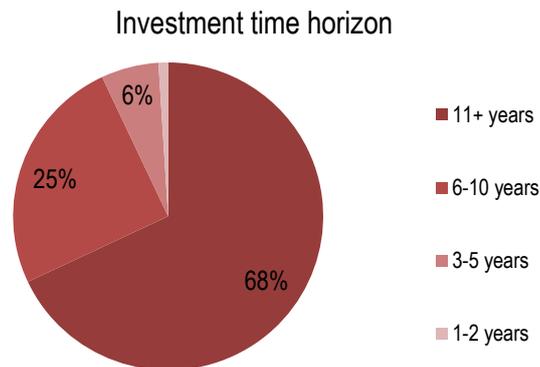
This study is based on input from clients of Intermediate Financial Advisors (IFAs) in the UK. 94% of the IFAs surveyed managed less than US\$100mm.



IFA Client Profiles

Of the IFA clients surveyed, 69% were below the age of 45. Accordingly, 68% had a long investment time horizon (beyond 10 years).

Figure 24



Marital Status

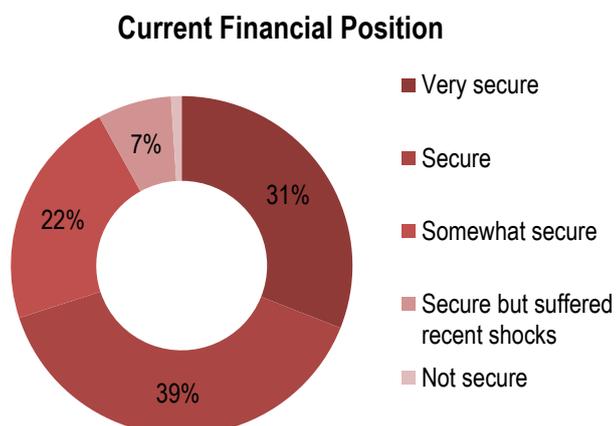
Of the IFA clients surveyed, 67% were married, 25% were living with a partner, and 7% were separated or divorced.

Education

30% of the IFA clients surveyed had a Graduate or Professional degree, 38% had a Bachelor's degree, 25% had an Associate's degree, and 7% had completed

some college, trade or vocational training.

Figure 25

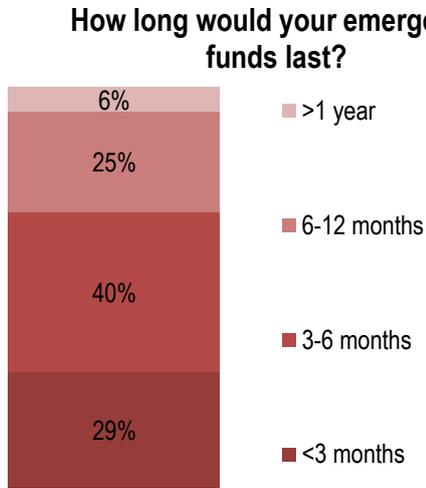


Financial Security

Financially, 92% of the IFA clients surveyed described their financial

situation as somewhat secure or better.

Figure 26



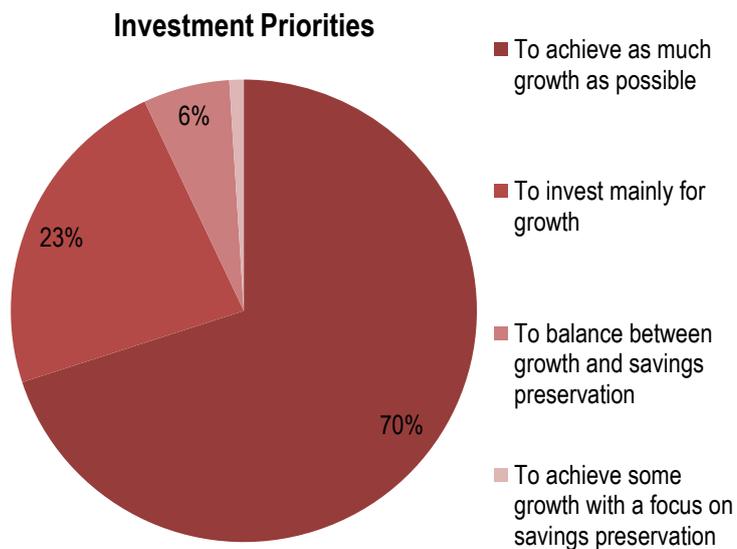
Emergency Funds

When asked about emergency funds, 71% of clients surveyed had emergency funds to cover over 3 months.

Investment Priorities

When asked about investment priorities, 93% of IFA clients were interested in growth rather than preserving savings.

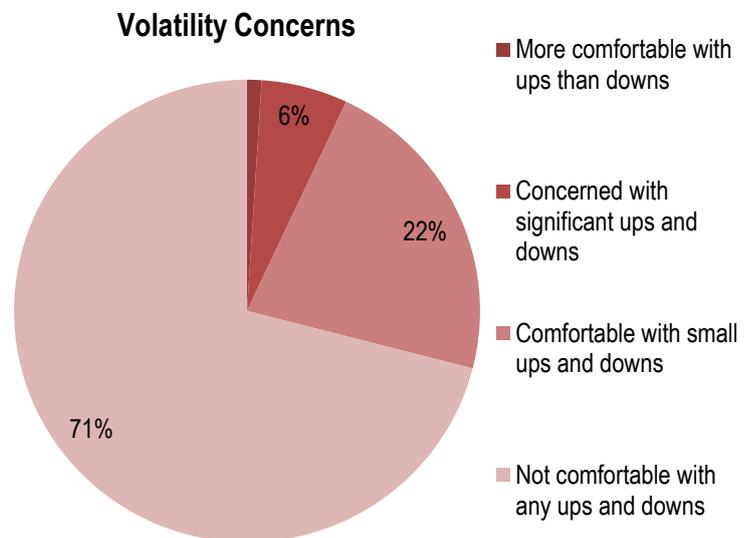
Figure 27



Discomfort with Volatility

Despite their overwhelming appetite for growth, the IFA clients surveyed were actually quite risk averse. 71% were not comfortable with any short-term ups or downs in the value of their investments. Another 22% were only comfortable with small ups and downs.

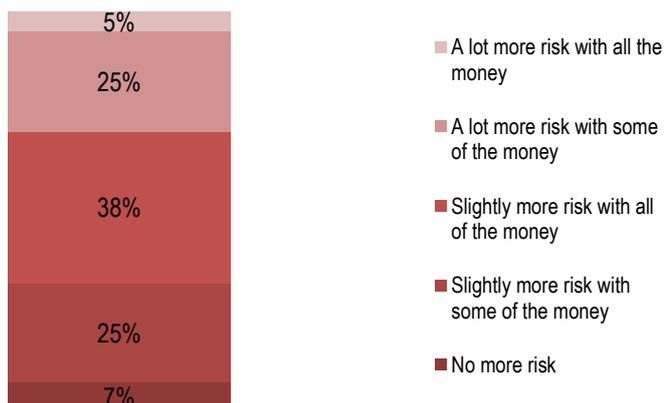
Figure 28



Risk vs. Return

Figure 29

How much risk would you take on to improve returns?



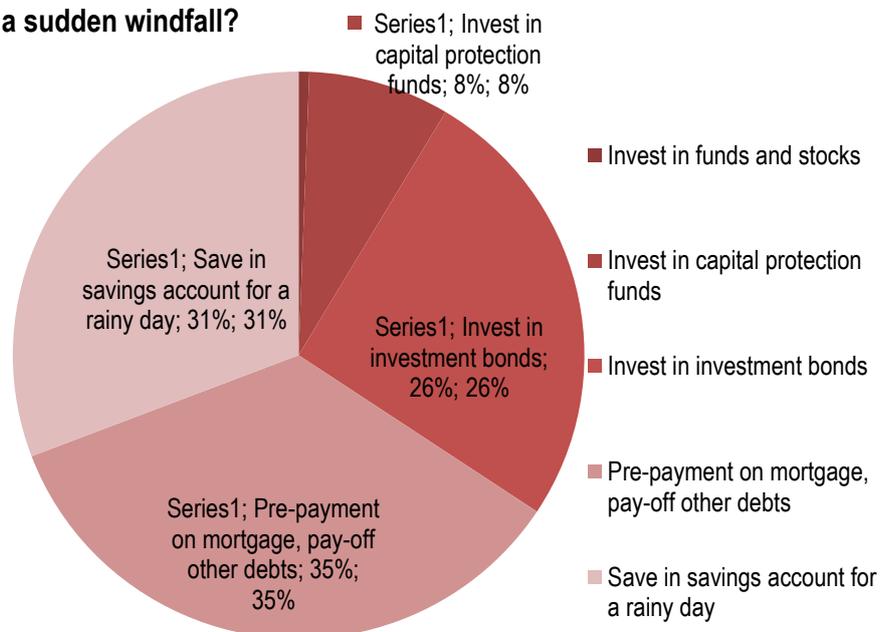
Despite their apparent aversion to loss, the IFA clients surveyed showed a willingness to take on risk to improve their investment returns.

Sudden windfall scenario

Even when posed with the scenario of a sudden windfall (e.g., “you suddenly inherited £20,000”), the IFA clients surveyed were generally risk averse. Two-thirds of respondents took on no risk, choosing to clear their debts and save it as emergency funds. The remaining one-third chose to invest the windfall in bonds and capital protection funds. And no participants chose to invest the windfall in stocks.

Figure 30

How would you spend a sudden windfall?

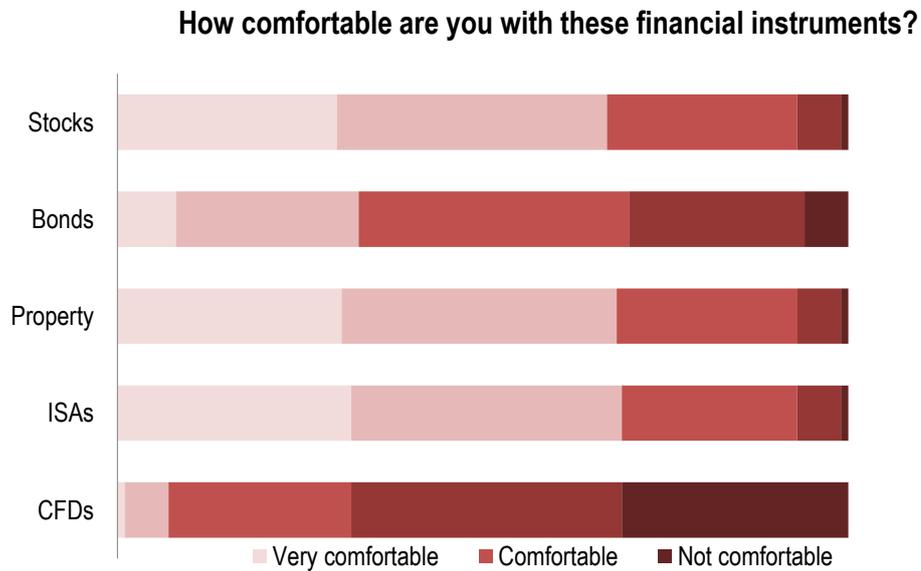


Comfort with Financial Instruments

The IFA clients surveyed were most comfortable with Stocks, Property and Individual Savings Accounts (ISAs), moderately comfortable with Bonds, and downright uncomfortable with Contract for Differences (CFDs) either due to their lack of familiarity with CFDs, the product’s complicated nature, or its use of

leverage. IFA clients' comfort level seemed to depend heavily on familiarity with the financial instrument and recent macro-economic factors.

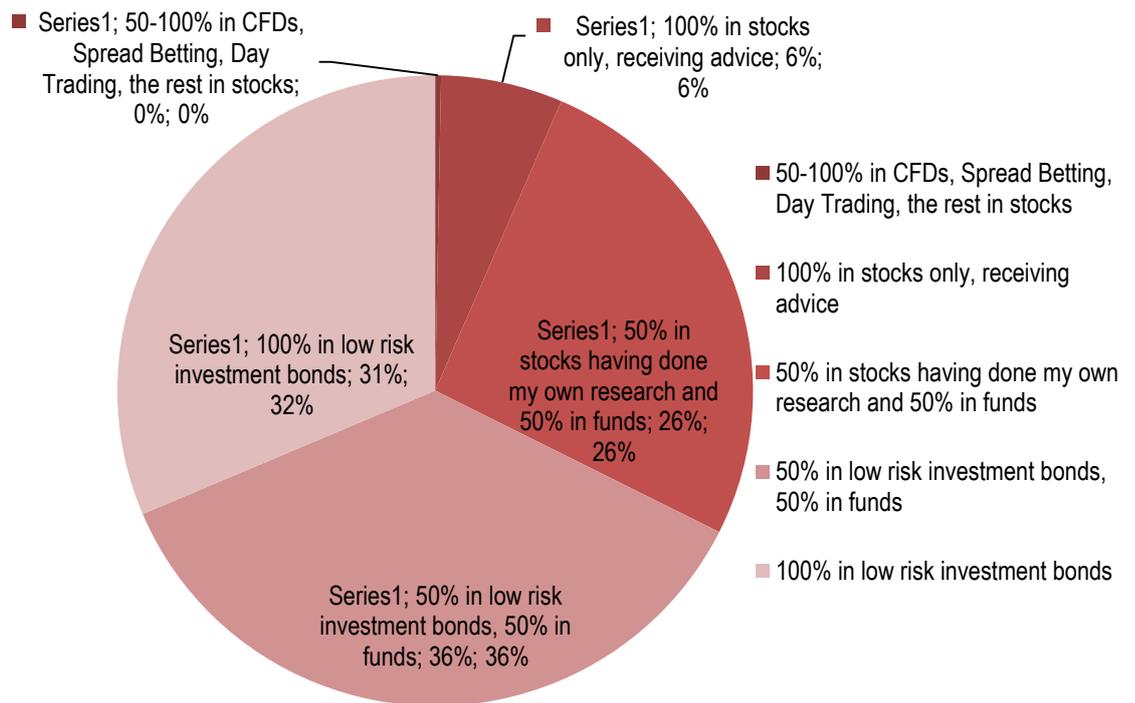
Figure 31



Sudden windfall scenario 2

Again posed with the scenario of a sudden windfall of £20,000, but with the condition that they invest it in one of five portfolios, the IFA clients surveyed again demonstrated risk aversion and a relatively basic knowledge of the different types of financial instruments available. 68% of the IFA clients chose to invest in low-risk bonds and funds.

Figure 32



Which portfolio would you invest a sudden windfall in?

Attitude towards Financial Risk

There was a high level of risk aversion and a lack of understanding of financial instruments among the IFA clients surveyed. Only 1% knew that taking on more risk provided the opportunity to achieve higher returns.

Figure 33

How long would your emergency funds last?

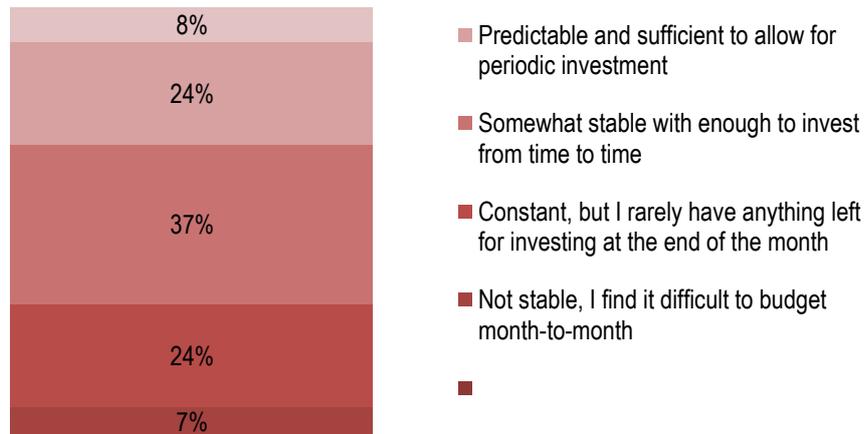


Excess income to invest

The majority of IFA clients surveyed demonstrated a relatively stable source of income to invest (at the very least “from time to time”) allowing for a predictable and sufficient periodic investment.

Figure 34

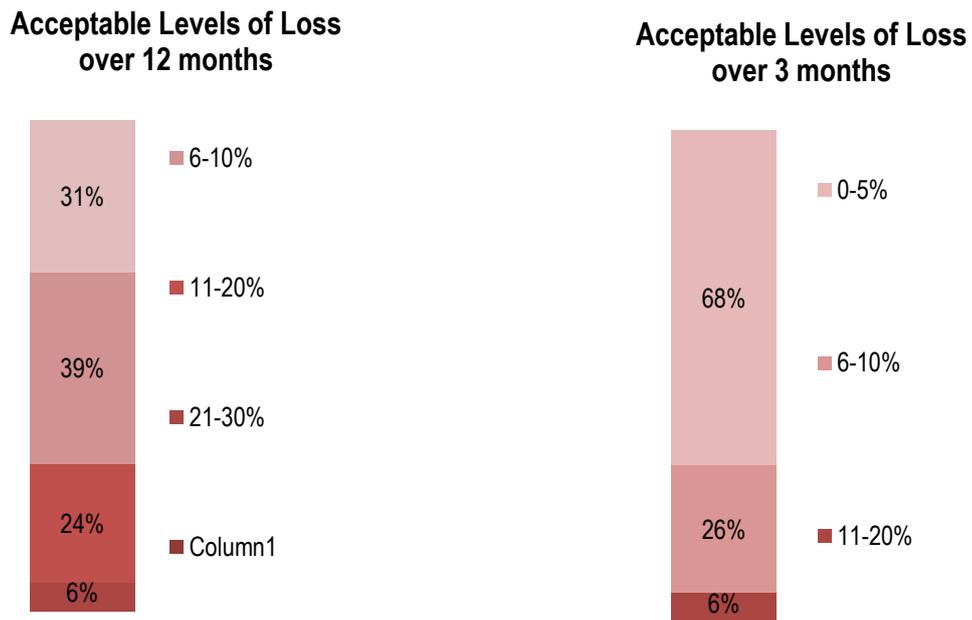
How predictable/stable is your income?



Acceptable Investment Losses

Over a 12-month period, the IFA clients surveyed were not terribly willing to take a loss (in absolute terms) on their investments with only 6% willing to take a loss of more than 20%. Oddly, over a 3-month period, the IFA clients surveyed were even more risk averse with only 6% willing to take a loss of more than 10%.

Figure 35



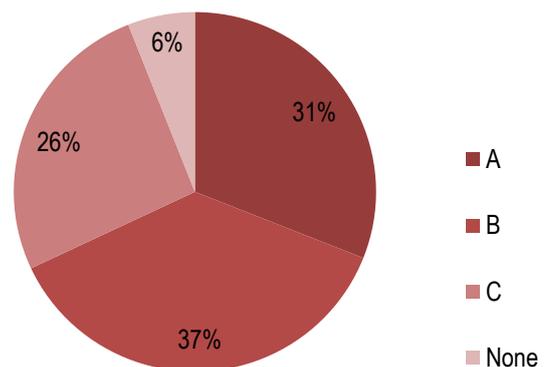
Inflation concerns

71% of IFA clients surveyed were not concerned about inflation when investing.

When survey participants were offered a choice of investment portfolios to allocate part of their money to, they demonstrated risk aversion but with the desire to achieve growth. Less than one-third of the participants chose portfolio A, which was not hedged.

Figure 36

Which portfolio would you invest in?



5. Measuring Risk Tolerance / Preliminary conclusions

Pension Funds and Family Offices Comparison

There are several questions that are common to the Family Offices (FO) and Pension Funds' (PF) surveys. The same cannot be said about the Independent Financial Advisors (IFA) survey. Hence, we are going to compare relevant questions in FO and PF surveys in order to better understand their approach towards risk management.

Question: Do you have a strategy in place to hedge tail risk?

The answer for this question is 0 for yes and 1 for no. The results for the 40 PF clients and for the 40 FO managers surveyed was

	FO	PF
mean	43%	98%
stdev	49%	16%

The results show that PF do not hedge tail risk and the majority of FO uses some hedging tools.

Question: What are your average cash levels?

The different answers for this question are

Always fully invested	0-5% cash	5-10% cash	10-20% cash	20%+ cash
1	2	3	4	5

The answers for the survey were the following

	FO	PF
mean	3,80	1,88
stdev	0,98	0,93

This means that, on average, FO have high cash levels than PF. This is also a natural result: FO are more risk aware and use cash as a hedging lever.

Question: Are you more concerned about absolute returns relative to a benchmark over the next 12 months?

The answer for this question is 0 for absolute and 1 for relative. The results for the 40 PF managers and for the 40 FO managers surveyed was

	FO	PF
mean	28%	88%
stdev	45%	33%

PF are typical investors with a benchmark. On the other contrary, FO trade more like a Hedge Fund, concerned about preservation of capital or absolute returns, which is confirmed by the answers obtained in the surveys.

Question: How important is risk management/risk reduction to you?

The different answers for this question are

5	4	3	2	1
We will do the minimum necessary to comply with regulations	This is managed on an investment by investment basis	Risk is managed naturally by the investments made in each fund	Risk management and reduction is very important; each investment above a threshold of 5% is approved by a risk committee that meets regularly	If an investment does not meet our risk criteria, we will not make the investment.

The answers for the survey were the following

	FO	PF
mean	1,35	1,28
stdev	1,49	0,63

Both PF and FO are on average risk aware. However, the standard deviation of the answers shows that FO have a big variation concerning the answer: some are more risk aware than others.

Question: Since 2008, has your institution

The different answers for this question are

Increased your cash limits	Implemented new technology for cash management	None of the above
1	2	3

The answers for the survey were the following

	FO	PF
mean	2,20	2,55
stdev	0,78	0,67

Once again, the answers are similar. However, FO tend to be more aware of cash management than PF, which was demonstrated on the question regarding the cash levels.

Question: What is your current geographical asset allocation as a percentage of total assets?

The answer for this question is 1 for Developed Markets and 0 for Emerging Markets. The results for the 40 PF managers and for the 40 FO managers surveyed was

	FO	PF
mean	87%	75%
stdev	3%	2%

Both PF and Family Offices are more into Developed markets with a more pronounced bias towards Developed Markets coming from FO. These answers come naturally, as FO are more concerned with liquidity and risk management issues.

Conclusions:

The answers to the survey demonstrated that FO are more risk aware than PF. PF use traditional asset managers, following a benchmark and their main concern is not to deviate from this benchmark. On the other hand, FO are typically hedge fund customers, and hence, their main task is capital preservation. FO trade on more liquid markets, have higher cash levels, are concerned with tail risk events.

We further researched changes in risk aversion during the financial crisis. Ideally, one wants to have the same survey repeated several times before, during and after the financial crisis. This line of work was pursued by several authors (Graham and Harvey, 2006). Unfortunately, we were not able to do a similar research since our survey was conducted once, and hence, we do not have a time variation aspect of the variables in interest. However, there are some questions in the survey that might help us explain and measure the impact of the financial crisis on the risk aversion.

We are going to use the same questions that we analysed in the previous section:

- Do you have a strategy in place to hedge tail risk?
- What are your average cash levels?
- Are you more concerned about absolute returns relative to a benchmark over the next 12 months?
- How important is risk management/risk reduction to you?
- Since 2008, has your institution change your cash limits
- What is your current geographical asset allocation as a percentage of total assets?

The variables in question are discrete and we assume that changing towards risk aversion means for each question:

- Having a strategy to hedge tail risk means more risk aversion: the answer to this question is 0 for yes and 1 for no;
- To have more cash means more risk aversion: the answer to this question is 1 to 5, the largest the value the more cash it has;
- Concerns about absolute returns means more risk aversion: the answer to this question is 0 for absolute and 1 for relative;
- Importance of risk management/risk reduction means more risk aversion: the answer to this question ranges from 1 to 5, the smallest the value the more risk aware it means;
- Since 2008, has your institution increased your cash limits (1), implemented new technology for cash management (2), or none of the above: (1) or (2) means more risk aversion;
- What is your current geographical asset allocation as a percentage of total assets? The answer is 1 to developed markets and 0 for emerging ones: 1 means more risk aversion;

The research is to see the statistically significance of the answers.

Q1: Do you have a strategy in place to hedge tail risk?

Yes	No
0	1

In this case, a statistically significant value that is lower than 0.5 indicates risk aversion.

Q2: What are your average cash levels?

Always fully invested	0-5% cash	5-10% cash	10-20% cash	20%+ cash
1	2	3	4	5

In this case, we are going to assume risk aversion as 3-5. Therefore, we are going to transform the answer in 0 for 1 and 2 and 1 for 3-5. A statistically significant value greater than 0.5 indicates risk aversion

Q3: Are you more concerned about absolute returns relative to a benchmark over the next 12 months?

Absolute	Relative
0	1

In this case, a statistically significant value that is lower than 0.5 indicates risk aversion.

Q4: How important is risk management/risk reduction to you?

5	4	3	2	1
We will do the minimum necessary to comply with regulations	This is managed on an investment by investment basis	Risk is managed naturally through the investments made in the fund	Risk management and reduction is very important; each investment above a threshold of \$500,000 is approved by a risk committee that meets regularly	If an investment does not meet our risk criteria, we will not make the investment.

In this case, we are going to assume risk aversion as 1-2. Therefore, we are going to transform the answer in 1 for 3-5 and 0 for 1 and 2. A statistically significant value lower than 0.5 indicates risk aversion.

Q5: Since 2008, has your institution changed your cash limits

Increased your cash limits	Implemented new technology for management	None of the above
1	2	3

In this case, we are going to assume risk aversion as 1-2. Therefore, we are going to transform the answer in 0 for 3 and 1 for 1 and 2. A statistically significant value greater than 0.5 indicates risk aversion

Q6: What is your current geographical asset allocation as a percentage of total assets?

Developed Markets	Emerging Markets
1	0

In this case, a statistically significant value that is greater than 0.5 indicates risk aversion

Results

We are going to apply a simple t-test for the means of the answers to see if the PF have a different behaviour than FO.

	mean		t-Stat
	FO	PF	
Q1	0,43	0,98	-6,30
Q2	3,80	1,88	8,79
Q3	0,28	0,88	-6,96
Q4	1,35	1,28	0,28
Q5	2,20	2,55	-1,93
Q6	0,87	0,75	19,94

We can clearly see that FO are more risk averse than PF. In fact, excepting for question 5, the results show exactly that. Question 5 has the opposite meaning.

The differences in means are statistically significant (except for question 4), meaning that the behaviour towards risk aversion is different.

6. Conclusions

In Chapter 4 we used a unique survey to gather a comprehensive analysis of the level of risk that pension fund clients (Board Members, Chief Financial Officers, and upper management of organisations with pension funds under third-party management), family offices that invest in hedge funds and Intermediate Financial Advisors (IFAs in UK) are willing to accept. We tried to understand “how much risk are you willing to accept”? In particular, we found evidence suggesting that there are different levels of risk acceptance between pension fund clients, family offices and IFAs. Family offices are more risk aware than pension fund clients since pension fund clients use traditional asset managers (long only) following a benchmark, and their main concern is not to deviate significantly from the benchmark and therefore willing to take higher volatility levels but always with a benchmark as a reference rather than on an absolute bias. On the other hand, family offices are typically invested in hedge funds (alternative asset managers), and hence, their main task is capital preservation trading in more liquid markets, have higher cash levels and are more concerned with tail risk searching for absolute returns and less willing to take higher levels of volatility. Finally, Independent Financial Advisor clients are like Family Offices more concerned with capital preservation, unwilling to take significant drawdowns and volatility on the returns and but less sophisticated in terms of understanding financial instruments but with a more absolute attitude towards returns. From this unique research it was interesting to understand how different the levels of risk that pension fund clients (Board Members, Chief Financial Officers, and

upper management of organisations with pension funds under third-party management), family offices that invest in hedge funds and Intermediate Financial Advisors (IFAs in UK) are willing to accept and the reasons behind that behaviour.

7. Conclusions from Chapter 2, 3 and 4

In Chapter 2 we provided a comprehensive analysis of the current risk management practices (literature review) of active European equity long only and hedge funds which highlighted the limited literature in subject. In Chapter 3 using a unique survey we revealed many important issues for the industry. In particular, we find evidence to suggest that there is an insufficient financial commitment to risk management; that risk managers may not be independent enough; that important risk types may be ignored, that asset managers tend to use the same risk system and therefore analysing similar risk factors and that portfolio holdings are assessed on an infrequent basis. However, we also find that efforts have been made by funds to allocate more resources to risk management since the start of the 2008 financial crisis. Further, we find that hedge funds tend to be more 'risk aware' than their long only counterparts and finally that spending more resources on risk management is likely to improve fund performance rankings.

In Chapter 4 using a unique survey we gather a comprehensive analysis of the level of risk that pension fund clients (Board Members, Chief Financial Officers, and upper management of organisations with pension funds under third-party management), family offices that invest in hedge funds and Intermediate Financial Advisors (IFAs in UK) are willing to accept. We try to understand "how much risk are you willing to

accept”? In particular, we found evidence suggesting that there are different levels of risk acceptance between pension fund clients, family offices and IFAs. Family offices are more risk aware than pension fund clients since pension fund clients use traditional asset managers (long only) following a benchmark, and their main concern is not to deviate significantly from the benchmark. On the other hand, family offices are typically invested in hedge funds, and hence, their main task is capital preservation trading in more liquid markets, have higher cash levels and are more concerned with tail risk, they search for absolute return. Finally, Independent Financial Advisor clients are more concerned with capital preservation, unwilling to take significant drawdowns and volatility on the returns and less sophisticated in terms of understanding financial instruments but with a more absolute attitude towards returns.

To the best of our knowledge, Chapter 2, 3 and 4 are the first comprehensive analysis of the level of risk within portfolio management.

Chapter 5: Conclusions

This research focused on the risk management processes among active European equity asset managers as well as the current most effective practices.

The research was divided in three main parts, which together contribute to the conclusions taken in this section. Firstly, we investigated the available literature of risk management in financial institutions. Considering it, we developed a study about how risk management is currently used in European funds to identify the current approaches and the needs for improvement within the industry. The basis of this analysis was a survey of 200 asset managers and hedge funds, undertaken by face-to-face interviews with key decision makers in the asset managers studied.

Afterwards we used a unique survey to build up a comprehensive analysis of the level of risk that pension fund clients (Board Members, Chief Financial Officers, and upper management of organisations with pension funds under third-party management), family offices that invest in hedge funds and Intermediate Financial Advisors (IFAs in UK) are willing to accept.

The first conclusion of this research is that there is a lack of specific risk management literature dedicated to this specific topic. There is limited literature on this subject and most authors agree risk management could and should be improved upon.

In Chapter 3, a survey of 200 asset managers and hedge funds was implemented to identify current approaches to risk management and what might need to be improved by asking several key questions:

- What are the consequences of past financial crises?
- Is risk management taken seriously inside financial organizations?
- Are funds with fewer assets under management expected to spend (proportionally) less on risk management?

The key findings were that risk management functions have been neglected for some time and smaller funds spend less (proportionally) in risk management functions. Another very interesting conclusion is that companies are currently more aware of risk problems and they are taking risk management more seriously. They are starting to spend more on resources and give risk departments more power inside their organizations. Moreover, considering the risk systems used, one obvious conclusion is that the industry seems to be highly correlated in terms of the tools used by the asset managers. In fact, the great majority of the fund managers in the sample use Barra's Risk Management system.

A conclusion we found from the survey was that, even if all the respondents are considered as active portfolio managers, only one fifth of the long only portfolio managers look at their active positions and tracking error on a very frequent basis. Therefore, although the universe of portfolio managers defines themselves as active managers, they do not analyse their active money as frequently as expected.

Moreover, with the recent credit crisis and the actual debt problems in Europe, country and sector exposure are important risk factors to be considered. Another unexpected conclusion we took from the survey was that only 47.7% of the respondents claimed to consider relative geographical exposure frequently and 18.6% rarely consider country exposure. Therefore, even if it is known that given the

interconnectedness of the global economy and the recent increase in the volatility of sovereign government debt, portfolio managers still need to improve their risk diligence.

In Chapter 4 we developed a unique survey to gather a comprehensive analysis of the level of risk that pension fund clients (Board Members, Chief Financial Officers, and upper management of organisations with pension funds under third-party management), family offices that invest in hedge funds and Intermediate Financial Advisors (IFAs in UK) are willing to accept. The answers demonstrated that family offices are more risk aware than pension funds. To illustrate this, when we asked Pension Funds and Family Offices regarding their strategies to hedge tail risk, the conclusion was that Pension Funds do not have such a strategy while Family Offices use some hedging tools. Pension funds use traditional asset managers following a benchmark, and their main concern is not to deviate from this benchmark. Therefore, they are willing to take higher volatility levels but always with a benchmark as a reference rather than on an absolute bias. On the other hand, family offices are typically hedge fund customers, and hence, their main task is capital preservation. They trade in more liquid markets, have higher cash levels and are concerned with tail risk events. Finally, Independent Financial Advisor clients are like family offices, more concerned with capital preservation, unwilling to take significant drawdowns and volatility on the returns and but less sophisticated in terms of understanding financial instruments but with a more absolute attitude towards returns.

Generally, this research is a strong contributor for understanding the industry as it adds valuable conclusions to the limited available studies on risk management. The original primary data collected from the surveys is a key element, which may have a

meaningful impact on the regulator's vision and action by following the evolution of the industry's main players. After the global economic crisis, the asset management industry has been struggling to cope with the regulatory reform, as dealing with continuous change in regulations is remarkably demanding and uncertain. The main contribution of this research is that the regulator may develop new appropriate policies and promote a most effective industry, avoiding fat tails and conflicts of interest.

To the best of our knowledge, this is the first comprehensive study of current risk management practices within active European equity asset managers.

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Appendix Chapter 3

Questionnaire:

1. Which Risk Management tool do you currently use?

Barra
AllegroDev
Mega
Other: Specify:

2. How often do your Portfolio Managers use the system?

Daily
Weekly
Monthly
Quarterly
Semi-annually
Other: Specify:

3. Is your Institution characterized by being predominantly:

Long only
Hedge Fund
Passive
Other: Specify:

4. How frequently does a Risk Manager meet with the Portfolio Manager to discuss risks within a portfolio?

Daily
Weekly
Monthly
Quarterly
Semi-annually
Other: Specify:

Section – 5.1. to 5.5

How often do you analyse the following parameters to detect the risks within the portfolio?

Please select from:

1= very frequently; 2= frequently; 3= rarely; 4= never; 5= not applicable

5.1. Portfolio Liquidity

Number of days to liquidate portfolio	1 - 2 - 3 - 4 - 5
Number of days for the institution to liquidate portfolio	1 - 2 - 3 - 4 - 5
Sector weight position vs. previous month	1 - 2 - 3 - 4 - 5
Sector weight position vs. previous quarter	1 - 2 - 3 - 4 - 5

5.2. Active Positions Over quarter

Overweights vs. benchmark	1 - 2 - 3 - 4 - 5
Underweights vs benchmark	1 - 2 - 3 - 4 - 5
Ex-Ante Tracking Error (%)	1 - 2 - 3 - 4 - 5

5.3. Country Positioning Summary

Country breakdown vs previous quarter	1 - 2 - 3 - 4 - 5
Sector weight position vs. previous year	1 - 2 - 3 - 4 - 5
Country relative weights	1 - 2 - 3 - 4 - 5

5.4. Top 10 / Bottom 10 Bets since Portfolio Tenure

Cumulative Contribution of top 10	1 - 2 - 3 - 4 - 5
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5.5. Quarterly Stock contribution

Relative contribution for Top 20, Bottom 20	1 - 2 - 3 - 4 - 5
Active Money vs. Beta	1 - 2 - 3 - 4 - 5

6. Cumulative contribution from Stock selection:

Breakdown by market cap	1 - 2 - 3 - 4 - 5
Market cap distribution	1 - 2 - 3 - 4 - 5

7. How frequently do you analyse the cash position?

Daily	1 - 2 - 3 - 4 - 5
Weekly	1 - 2 - 3 - 4 - 5
Monthly	1 - 2 - 3 - 4 - 5

Quarterly	1 - 2 - 3 - 4 - 5
Semi-annually	1 - 2 - 3 - 4 - 5
Other: Specify:	

8. How often do you analyze the Emerging Markets Relative Bet to index

1 - 2 - 3 - 4 - 5

9. How often do you analyze the portfolio turnover?

Daily	1 - 2 - 3 - 4 - 5
Weekly	1 - 2 - 3 - 4 - 5
Monthly	1 - 2 - 3 - 4 - 5
Quarterly	1 - 2 - 3 - 4 - 5
Semi-annually	1 - 2 - 3 - 4 - 5
Other: Specify:	

10. How often do you analyze the portfolio performance vs. peers?

Monthly	1 - 2 - 3 - 4 - 5
Quarterly	1 - 2 - 3 - 4 - 5
Semi-annually	1 - 2 - 3 - 4 - 5
Other: Specify:	

Other questions:

11. How often do you analyse the following parameters to detect the risks within the portfolio?

Active Money	1 - 2 - 3 - 4 - 5
Stocks Outside the Benchmark	1 - 2 - 3 - 4 - 5
Tracking Error	1 - 2 - 3 - 4 - 5
Beta:	
% of TE from Top 10 stocks	1 - 2 - 3 - 4 - 5
How much relative performance comes from Beta	1 - 2 - 3 - 4 - 5

12. How often do you analyze the following risk decomposition parameters?

Stock Specific Risk	1 - 2 - 3 - 4 - 5
Country Risk	1 - 2 - 3 - 4 - 5
Industry Risk	1 - 2 - 3 - 4 - 5
Risk Index	1 - 2 - 3 - 4 - 5
Currency Risk	1 - 2 - 3 - 4 - 5
Other – Specify:	

13. Sector Top 10 Bottom 10 Risk Contributors:

as Percentage of Tracking Error	1 - 2 - 3 - 4 - 5
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14. Countries – Top 10 Risk Contributors:

as Percentage of Tracking Error	1 - 2 - 3 - 4 - 5
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15. How often do you analyze the following risk contributors as % of tracking error:

Volatility	1 - 2 - 3 - 4 - 5
Size	1 - 2 - 3 - 4 - 5
Momentum	1 - 2 - 3 - 4 - 5
Value	1 - 2 - 3 - 4 - 5
Liquidity	1 - 2 - 3 - 4 - 5
Financial Leverage	1 - 2 - 3 - 4 - 5
Growth	1 - 2 - 3 - 4 - 5
Tail Behaviour	1 - 2 - 3 - 4 - 5

16. Do you use Style Research Ltd. tool?

Yes – No
Other – Specify:

If Yes

17. How often do you use the above system?

Daily	1 - 2 - 3 - 4 - 5
Weekly	1 - 2 - 3 - 4 - 5
Monthly	1 - 2 - 3 - 4 - 5
Quarterly	1 - 2 - 3 - 4 - 5
Semi-annually	1 - 2 - 3 - 4 - 5
Other- Specify:	

**18. Who has the final decision regarding changes to the portfolio when the portfolio is outside the risk parameters?
(please tick appropriate box)**

CIO	
Head of Equities	
Risk Manager	
Portfolio Manager	
Other –Specify	

Risk Management Process

**19. How many people are in your Risk Management Team?
(please tick appropriate box)**

1-5	
6-10	
10+	

**20. Does your Risk Manager accumulate other roles?
(please tick appropriate box)**

Yes	
No	

**21. Who does your Head of Risk Management report to?
(please tick appropriate box)**

CIO	
Investment Risk Oversight Committee	
Other – Specify	

**22. How much do you spend on Portfolio Asset Risk Management on an annual basis?
(please tick appropriate box)**

Below \$5mn	
Between \$10 to \$20mn	
Above \$20mn	

**23. Has this amount increased vs:
(please tick appropriate box)**

	YES	NO
Last year		
Last 3 years		
Last 5 years		

**24. Are the above parameters within the Survey checked now on a more frequent basis than in the last:
(please tick appropriate box)**

	YES	NO
Last year (2009)		
Last 3 years		
Last 5 years		

Appendix Chapter 4

Questions for Pension Funds

1. What is your Assets Under Management (AUM)?
2. What is your current asset allocation to equities, bonds, property, hedge funds and other as a percentage of your total assets?
3. What instruments will you use to hedge tail risk?
4. What is your institution type: corporate pension, public pension, endowment or foundation?
5. What type of strategy do you follow: liability-driven, mean variance optimisation, follow the median manager or other?
6. What type of bias do you have in your portfolio in terms of large cap, mid cap and small cap allocations in A) emerging market indices, B) developed market indices, C) thematic?
7. What are your plans for future large cap, mid cap and small cap allocations in A) emerging market indices, B) developed market indices, C) thematic?
8. How much are you willing to spend on risk management in terms of people, data and analytics as a percentage of your risk budget?
9. How important is risk management/risk reduction to you?
10. Are you more concerned about absolute returns or returns relative to a benchmark over the next 12 months?
11. Do you have a strategy in place to hedge tail risk?
12. If you have a strategy in place for hedging tail risk, in which asset classes does it apply?
13. What instruments will you use to hedge tail risk?

14. Rank the following risks in order of importance: operational, credit, counterparty, liquidity and market risks.
15. Have the above risks increased or decreased in importance since 2008?
16. How much loss would you feel comfortable with in your various equity portfolios?
17. What are your average cash levels?
18. Since 2008, has your institution: A) increased your cash limits? B) Implemented new technology for cash management, or C) none of the above?
19. Since 2008, are you more aware of liquidity issues within the assets that you invest?
20. How do you measure the liquidity of your investments?
21. When investing in private equity, do you consider liquidity of the investment, exit strategy, valuation sensitivity, all of the above, or none of the above?
22. Do you consider the contribution of the tail risk to your overall portfolio?
23. If a pension scheme, how would you characterize the strength of your pension scheme?
24. Which of the sample investment portfolios would you feel most comfortable allocating part of your money

Questions for Family Offices

1. What is your Assets Under Management (AUM)?
2. What is your current asset allocation to equities, bonds, property, hedge funds and other as a percentage of your total assets?
3. What is your current geographical asset allocation as a percentage of total assets?

4. In what strategies do you invest: credit, convert arb, systematic, eq long/short, multi-strategy, event driven, quantitative, macro?
5. How much are you willing to spend on risk management in terms of people, data and analytics as a percentage of your risk budget?
6. How important is risk management/risk reduction to you?
7. Are you more concerned about absolute returns or returns relative to a benchmark over the next 12 months?
8. In 5 to 10 years from now, will your asset allocation move towards funds within long only, absolute return or allocation?
9. Do you have a strategy in place to hedge tail risk?
10. If you have a strategy in place for hedging tail risk, in which asset classes does it apply?
11. What instruments will you use to hedge tail risk?
12. Rank the following risks in order of importance: operational, credit, counterparty, liquidity and market risks.
13. Which of the risks mentioned in question 12 increased or decreased the most since 2008?
14. What was your maximum drawdown tolerance from peak to trough?
15. How much volatility (annualised standard deviation) can you take on your investment portfolio?
16. How much leverage are you currently using within the portfolio?
17. Are you considering increasing the leverage within the portfolio during the next 12 months?
18. What are your average cash levels?

19. Since 2008, has your institution: A) increased your cash limits? B) Implemented new technology for cash management, or C) none of the above?
20. Since 2008, are you more aware of liquidity issues within the assets that you invest?
21. How do you measure the liquidity of your investments?
22. When allocating your capital, do you have the same limits on the drawdowns to the hedge funds you invest vs. your own portfolio?
23. Which of the sample investment portfolios would you feel most comfortable allocating part of your money?

Questions for IFA Client

1. How old are you?
2. Approximately how many years until you might want to start using the money you are investing?
3. When investing, what is most important to you: To achieve as much growth as possible, to invest mainly for growth, to balance between preserving savings and growth, to achieve small growth, or to preserve your savings?
4. How would you describe your financial situation?
5. Do you have emergency funds?
6. Are you comfortable experiencing short-term ups and downs in the value of your investments?
7. If you could increase your chances of improving returns by taking more risk, what are you likely to do?

8. If you suddenly inherited £20,000 what are you most likely to do: Invest in funds and stocks, invest in capital protection funds, invest in investment bonds, prepay on mortgage/payoff other debts, or save in savings account for a rainy day?
9. For each of these financial instruments (stocks, bonds, property, ISAs, CFDs), how comfortable are you with how they work?
10. If you were given £20,000 that you HAD to invest in ONE of the following ways, what would you choose? A) 50-100% in CFDs, Spread betting, day trading, the rest in stocks, B) 100% in stocks only, receiving advice, C) 50% in stocks having done my own research and 50% in funds, D) 50% in low risk investment bonds, 50% in funds, E) 100% in low risk investment bonds.
11. Which statement best describes your attitudes towards of financial risk? A) Financial risk means opportunity to achieve higher returns, B) Investing is only risky if you do not rely on research, C) With enough diversification in my portfolio, I can eliminate risk, D) Any investment that does not guarantee capital preservation is not worth it, E) The only safe place for my money is a bank account; I am unwilling to take financial risk.
12. How predictable/stable are your sources of income?
13. What is your marital status?
14. What is the highest level of education you have completed?
15. How much loss (in absolute terms) are you prepared to take on your investment on a 12-month basis?
16. How much loss (in absolute terms) are you prepared to take on your investment on a 3-month basis?
17. When investing your money, is inflation a concern?

18. Which of the sample investment portfolios would you feel most comfortable allocating part of your money?