

Introduction

Investing in private equity, hedge funds and real assets – such as infrastructure, real estate, forestry and farmland, energy and commodities – has gained considerable momentum in recent years. These assets are often called “alternatives” as their investment history is still relatively short and, unlike traditional asset classes, they are rarely traded in public markets.¹ Investors have been attracted by the superior returns that alternative assets may offer. Moreover, as returns are found to be correlated less with traditional asset classes, alternative assets have been regarded as attractive investments helping asset allocators diversify their portfolios. At the same time, it has been argued that the potential returns of traditional asset classes have diminished. Specifically, public stock markets have become increasingly efficient, limiting investors’ potential to achieve excess returns by investing in undervalued stocks. In the bond market, yields have declined substantially since the 1980s thanks to successful central bank policies aimed at reducing inflation expectations and restoring confidence in monetary policy.

1.1 ALTERNATIVE INVESTING AND THE NEED TO UPGRADE RISK MANAGEMENT SYSTEMS

At the end of 2011, private equity funds, hedge funds and funds investing in real assets were estimated to be managing around USD 4 trillion. This amount may still seem small compared with the size of the global equity and debt securities markets, whose volume totalled almost USD 150 trillion in 2010. However, the market for alternatives has grown much faster than traditional investments. Just three decades ago alternative assets totalled only a few billion US dollars, implying a compound annual growth rate of more than 25%. For some investors, especially endowments, foundations and family offices, alternative investing is no longer considered a niche strategy, but instead is part of their core portfolio. In fact, some asset allocators have invested as much as half their capital in alternatives, a few individual institutions even more. Pension plans, the largest investors in private equity, real assets and hedge funds, generally have a comparatively less pronounced exposure in terms of the total amount of assets under management (AuM). However, some of the largest pension funds worldwide, such as the California Public Employees’ Retirement System (CalPERS), the Canadian Pension Plan Investment Board or the Washington State Investment Board, have invested 20% and more of their assets in alternatives.

The United States has remained the largest market for alternative investing, absorbing more than 50% of the capital deployed in private equity, real assets and hedge funds. At the same time, US investors have been the world’s largest capital source for alternative investments. However, Europe and, more recently, advanced Asia and emerging economies have been playing catch-up, both as a destination and source of capital. As regards the latter, sovereign wealth funds

¹ Note that there is no universally accepted definition of alternative assets. Although often too small for institutional investors, alternatives may also include arts, rare books and maps, vintage cars and wine/vineyards.

(SWFs) have played a particularly important role, helping recycle their countries' current account surpluses and raising foreign exchange reserves by investing in asset classes whose liquidity characteristics make them inaccessible for central banks. Thus, alternative investing has become a global business, with cross-border transactions helping regional markets become increasingly integrated.

However, it appears that the development of investors' risk management capabilities has not always kept pace with their growing exposure to alternative assets. During the global financial crisis in 2008–2009, a significant number of investors, and especially those with a substantial exposure to alternative assets, were faced with an acute lack of liquidity. The sudden shortage of liquidity took investors by surprise. The majority of them had based their liquidity planning on cash flow models whose parameters were essentially static. However, as financial markets shut in the wake of the collapse of Lehman Brothers in the autumn of 2008, the model parameters shifted rapidly due to sharply reduced distributions from private equity funds and similar partnerships investing in real assets, the suspension of redemptions by hedge funds, and increased margin calls and collateral. Many institutional investors thus found that their short-term liabilities either proved to be much more inflexible than they had thought or rose unexpectedly in the face of the crisis.

The financial turmoil that spread rapidly around the globe made a key characteristic of long-term investing in private equity funds and similar structures suddenly highly transparent. Organized as limited partnerships, such funds are designed to shield fledgling portfolio companies in their early stages and those in need of being restructured from disruptive market influences, and to assure these companies' continued financing. This requires patient capital, with long-term investors in limited partnerships essentially locking away their capital for 10 years or even longer. While investors, or limited partners in private equity funds, were aware of the fact that they had to make long-term capital commitments in order to be able to harvest an illiquidity risk premium, during the crisis it turned out that many of them had underestimated liquidity risk in two important ways. First, capital calls, or so-called contributions, of committed capital to private equity funds and similar structures are unknown in terms of their timing and size. Although capital calls slowed substantially during the Great Recession, distributions fell even faster as exit markets essentially closed. Thus, limited partners were exposed to funding risk, which represents a key challenge in terms of liquidity management. Second, investors who had relied on the secondary market as a means to liquidate (parts of) their portfolios found out that transaction volumes fell sharply precisely when liquidity was needed most.

University endowments in the USA were hit particularly hard, and given their payout requirements several of them were forced into distressed sales of assets. However, the problems were by no means confined to university endowments. In fact, as we discuss throughout this book, even some of the largest pension funds were confronted with significant liquidity problems as funding risk and market liquidity risk in the secondary market surged to unprecedented highs. As investors attempted to avoid defaulting on their commitments amid an increasingly illiquid secondary market, they decided to sell liquid parts of their portfolios, such as public stocks, to generate liquidity (Ang *et al.*, 2011). In some cases, the pressure to divest was amplified by a substantially larger-than-expected decline in the mark-to-market value of investors' portfolios, triggering "sell" signals by their asset allocation models. In the event, many investors incurred significant losses (Ang and Kjaer, 2011; whose analysis is summarized in Chapter 6).

To be sure, the crisis did not generally undermine investors' belief in the benefits of alternative investing. While some investors did reduce their allocation to alternatives in an effort

Table 1.1 Allocation of pension funds to alternative asset classes, as a percentage of total assets under management

	2006	2008	2010
Real estate	5.2	6.7	5.6
Private equity	2.7	4.5	4.6
Commodities	0.4	0.6	1.0
Hedge funds	1.5	2.2	2.2
Other	1.0	1.7	2.1
Total	10.9	15.7	15.6

Source: IMF (2011).

to align assets more closely with liabilities and to comply with accounting and regulatory pressures, others maintained their allocations or even raised them, for example, to address underfunded liabilities (WEF, 2011). As far as pension funds are concerned, a recent survey by the International Monetary Fund (IMF, 2011) found that their overall exposure to alternative assets was virtually unchanged between 2008 and 2010 (see Table 1.1), as new investments essentially kept pace with distributions by limited partnership funds or offset other divestments. Importantly, the share of alternative assets in pension funds' total AuM thus remained significantly higher than prior to the crisis, when many investors increased their allocations to alternatives substantially. As a result, pension funds' average exposure to alternative assets in 2010 exceeded their relative allocation in 2006 by more than 40%, with private equity contributing particularly strongly to this increase.

Arguably, the most recent turmoil in Europe's sovereign debt market might have contributed to institutional investors' continuous commitment to alternatives. As the IMF (2012) points out, the debt crisis has reinforced the notion that no asset can be viewed as truly safe. Instead, recent rating downgrades of sovereigns previously considered to be virtually riskless have reaffirmed that even highly rated assets are subject to significant risks. The IMF (2012) estimates that the decline in the number of sovereigns whose debt is considered safe could remove some USD 9 trillion from the supply of safe assets by 2016, or roughly 16% of the projected total. This decline is accentuated by a reduction in the private supply of safe assets as poor securitization in the USA has tainted these securities and more stringent regulation has impaired the ease with which private sector issuers may produce assets that are deemed "safe".

At the same time, heightened uncertainty, regulatory reforms and crisis-related responses by central banks have driven up demand for safe assets. Given the shrinking set of assets perceived to be safe, growing global supply/demand imbalances are feared to increase the price of safety and compel investors to move down the safety scale as they scramble to obtain scarce assets. The IMF (2012) warns that safe asset scarcity could lead to global financial instability resulting from short-term volatility jumps, herding behaviour and runs on sovereign debt. In this environment, where global supply/demand imbalances may seriously distort the benchmark pricing of sovereign debt, investors may be compelled further to invest in alternatives to generate higher returns. Note, in this context, that in the first nine months of 2012 10-year US Treasury bonds averaged around 1.8%, implying significantly negative yields in real terms. Yields on 2-year US Treasuries averaged 0.28% during this period, while strong demand for German and Swiss 2-year bonds drove even nominal yields into negative territory. A third round of quantitative easing in the United States, unconventional monetary policy

measures in the euro area, the United Kingdom and Japan, and further monetary easing in several emerging markets indicate that policy makers are committed to keeping interest rates low in the foreseeable future.

While investors have remained committed to alternatives, their experience in the recent global financial crisis has led many of them to reconsider their investment strategies with regard to private equity, hedge funds and real assets. Generally, this review has focused on two aspects of the allocation process. First, from a top-down perspective investors have revisited their asset allocation models in light of their liability profiles and risk appetite (WEF, 2011). Second, from an asset-specific point of view a growing number of investors have thought about alternative ways to achieve their target exposure to specific asset classes. As a growing number of investors have begun to adjust their asset allocation strategies, they have fostered visible changes in the alternative investment industry.

As far as portfolio construction is concerned, in the pre-crisis era most investors relied on models that were designed to construct efficient portfolios on the basis of historical asset returns, their variance and their correlation with returns in other asset classes. However, in the Great Recession such mean/variance approaches proved to be too static, as systemic risk rapidly pushed correlations upwards. As a result, gains from diversification often proved to be illusive, and investor portfolios turned out to be far less robust than the models had suggested.

Against this background, several investors have begun to implement less granular asset allocation frameworks that focus more on asset-specific risks as differentiating factors generating diversification benefits – as opposed to (less-than-perfect) return correlations that play a key role in the standard mean/variance approach. This applies to both traditional and alternative asset classes. As far as the latter are concerned, the risk factor allocation approach recognizes that private equity, hedge funds and real assets are subject to fundamentally different risks. Private equity, for instance, is subject to liquidity risk, in addition to equity risk. By comparison, investing in hedge funds is generally less illiquid than commitments to private equity funds. At the same time, however, hedge funds tend to be highly leveraged and hence subject to credit risk. As far as real estate is concerned, investors expect to be compensated for the term risk they take – a risk component which is absent in private equity investments. It is this heterogeneity of investment risk and the associated risk premiums that offers diversification gains and hence helps improve risk-adjusted portfolio returns.

1.2 SCOPE OF THE BOOK

Harvesting different risk premiums requires specific risk management approaches. In this book, we focus primarily on the illiquidity risk premium that structurally illiquid asset classes may offer. Two clarifications are in order. First of all, a broad range of asset markets may become illiquid in periods of severe financial stress. In the recent global financial crisis, the markets for corporate debt, collateralized debt obligations and securitization virtually shut down. There is a rapidly expanding literature on cyclical illiquidity, discussing its causes and effects and especially the role of banks (e.g., Shin, 2010; Tirole, 2011 and the literature discussed therein). In contrast to asset classes that may become illiquid thanks to financial turmoil and heightened risk aversion, investors in structurally illiquid asset classes, such as private equity and real assets, are aware *ex ante* of the risk they take. In fact, as we argue in this book, it is precisely this risk, and more specifically the associated risk premium, that

attracts investors to these asset classes. Not all investors are able to harvest this risk premium, however. As a matter of principle, only long-term investors can, whose liability profile allows them to lock capital in for a prolonged period of time, usually 10 years or more. Harvesting the illiquidity risk premium requires specific risk management techniques, however, which are the subject of this book.

Second, we shall not consider hedge funds. While they are generally considered to be part of the alternative investment universe, they show a different risk profile compared with private equity and real assets. Although redemptions may be suspended in certain circumstances, the organization of hedge funds is fundamentally different from private equity funds and limited partnerships investing in real assets, making the former less illiquid. At the same time, hedge funds are subject to risks that are idiosyncratic to this asset class, requiring different risk management tools whose discussion is beyond the scope of this book.

This leaves us with long-term investing in private equity and real assets as two highly illiquid alternative asset classes. But this is still too broad a focus for what this book attempts to achieve. Instead, it is important to recognize that there are different ways to invest in private equity and real assets. As investors have revisited their exposure to alternative assets, and more specifically to private equity and real assets, some of them have decided to pursue alternative routes to fund investing. To begin with, some large investors have engaged in direct investments, essentially competing with partnerships in acquiring assets. Others have put increased emphasis on co-investments alongside funds they have committed capital to. While there is little systematic evidence on the significance of co-investments and direct investments in investors' portfolios, anecdotal evidence suggests that at least in individual cases (notably some Canadian pension funds) these forms play an important role. Yet others (i.e., some sovereign wealth funds) have acquired stakes in the management company of private equity firms. Finally, a rising number of investors have sought to set up managed accounts with asset managers instead of committing capital to limited partnerships.

As investors have looked into alternative ways of investing in private equity and real assets, many fund managers have adjusted their own business models. Several large private equity firms – such as the Blackstone Group, Carlyle Group or Kohlberg Kravis Roberts – have transformed themselves into alternative asset managers, offering their clients a broad range of products, including through managed accounts. A growing number of firms have gone public, enabling shareholders to get exposure to alternative investing without investing in their funds. Meanwhile, there is a range of derivative instruments on listed private equity, including exchange-traded funds (ETFs).

As important as these structural changes in the alternative investment arena are, the most common form of investing in private equity and real assets remains the limited partnership. In a limited partnership, investors serve as limited partners (LPs) committing capital to a fund, which is raised and managed by a general partner (GP). Such limited partnership funds typically have a lifespan of 10 years, with the possible extension of 2 years. For this period, LPs essentially lock in their capital, notwithstanding the emergence of a secondary market in recent years. At any given point in time, LPs have to be in a position to respond to capital calls by the GP, subjecting fund investments to significant funding risk.

Unfortunately, studies on managing illiquidity risk associated with investments in limited partnerships have remained rare. This may seem surprising in light of the growing importance of private equity and real assets in investors' portfolios and the experience of several LPs in the recent global financial crisis. It is therefore the objective of this book to narrow this gap by developing risk management guidelines drawing upon best practices.

1.3 ORGANIZATION OF THE BOOK

This book is organized in three parts. In **Part I**, we discuss illiquid investments in private equity and real assets from a market perspective. In **Part II**, we focus on risk measurement for portfolios of limited partnership funds targeting these asset classes. Finally, in **Part III**, we discuss some techniques for managing this risk and related issues.

1.3.1 Illiquid investments as an asset class

Our discussion starts by defining long-term assets that are subject to structural illiquidity, offering investors a risk premium. These assets constitute the universe of investment opportunities we address in this book, which have to be clearly distinguished from assets that may become temporarily illiquid in periods of financial turmoil. In **Chapter 2**, we provide an estimate of the size of the market for illiquid investments in private equity and real assets. These asset classes can be accessed through alternative routes, which, however, require strategy-specific risk management approaches. In contrast, limited partnerships provide a structural investment framework, which is largely agnostic with regard to the underlying asset class – presumably an important reason why limited partnerships have remained the dominant route for investors seeking exposure to private equity and real assets.

While, as we explain, the market for illiquid investments has grown rapidly over the last few decades, this market expansion has not been linear. Instead, there have been pronounced cycles around the long-term trend, which in part is explained by macroeconomic cycles and in part by asset-specific investment dynamics. Furthermore, we look at the global investor base of private equity, which is representative of the broader universe of illiquid asset classes. While pension funds and insurance firms dominate the investor base in terms of the absolute amount of money invested in private equity funds, endowments, foundations and family offices generally have a larger exposure to the asset class relative to the size of the portfolio they manage. As we will discuss in more detail, relative allocations are generally a function of investors' liability profiles, which vary across different classes of investors. Moreover, asset managers are subject to different regulations and accounting rules. However, even within specific investor classes allocations vary widely, reflecting different degrees of risk appetite.

Looking ahead, we discuss long-term trends in the asset management industry. Of particular importance for long-term investing is the secular shift from defined benefits (DB) pension plans to defined contributions (DC) plans. Given the transferability of claims under DC plans, investments generally require a high degree of liquidity. However, as we discuss in this chapter, this does not necessarily mean that DC plans are unable to invest in illiquid assets. Furthermore, we explore the potential role of emerging economies as suppliers of patient capital. While SWFs have attracted considerable attention as investors in private equity and real assets, we also look at pension funds and insurance firms. Their AuM grow at substantial rates as governments implement important pension reforms and incomes rise. Investments are still often restricted to domestic markets and to specific asset classes. To the extent that such restrictions are lifted and replaced by a prudent investing approach, pension funds and insurance firms in emerging economies could make an increasingly meaningful contribution to the global supply of long-term capital. A precondition for this to happen, however, is the introduction of a comprehensive risk management approach that encompasses illiquid asset classes.

Portfolio diversification is at the core of “prudent investing”, a concept with far-reaching legal consequences. As we point out in **Chapter 3**, the prudent investor rule, as stipulated in the

“Prudent Investor Act” in the United States, has to be clearly distinguished from the “prudent man” rule. Importantly, the former explicitly recognizes that diversification is a key component of prudence, which includes the delegation of investment management to external managers. A portfolio may thus include assets which, on a stand-alone basis, might be considered too risky from the viewpoint of the prudent man rule. Note in this context that US pension funds were allowed to invest in private equity and venture capital funds only in 1979 when the US Department of Labor clarified its prudent man rule in a way that explicitly permitted fund managers to invest in high-risk assets.

As regulators have redefined what constitutes prudent investing, the emphasis has shifted towards the investment process as opposed to specific investments and allocations. As long as the investment process is considered to be prudent, investment managers enjoy considerable flexibility to (re-)design strategies in rapidly changing market environments. Arguably, this flexibility should reduce the risk of herding among investors who have to follow the same rules. But what exactly is a prudent investment process? In Chapter 3, we suggest a number of criteria that are simple and transparent and can be applied across different jurisdictions.

In **Chapter 4**, we discuss the basic structure of limited partnerships as the dominant vehicle through which investments in many alternative asset classes are made. Understanding this structure is critical for investors to measure their risk exposure correctly and manage it appropriately. As we argue, the high degree of illiquidity is not just a by-product of the limited partnership as a legal construct, but instead represents a central feature that enables the GP of a fund to harvest a premium for his LPs. This basic observation remains intact, despite the emergence of a secondary market in recent years. Although the absolute volume of transactions in the secondary market has risen appreciably, it is still very small relative to the total amount of assets managed by private equity funds and partnerships investing in real assets.

Investors have several alternatives to achieve exposure to private equity and real assets, including: through listed vehicles; investments in the management company of private equity firms or alternative asset managers; managed accounts; direct and co-investments. However, none of these alternative routes have seriously challenged the fund structure as the preferred choice for investors who seek exposure to private equity and real assets. In fact, today’s limited partnership as a legal investment framework has precedents that can be traced back to ancient Babylon almost 5000 years ago.

While the limited partnership has a very long history, the key question for investors locking in capital for 10 years or more through such vehicles is whether they are adequately compensated for the illiquidity they accept. To be sure, the illiquidity risk involved in long-term investing in funds is far from trivial, as such commitments make it very difficult, if not impossible, for investors to continuously rebalance their portfolios, a key assumption in standard asset allocation models. In **Chapter 5**, therefore, we discuss recent attempts in the literature to measure risk and returns in private equity to get a better understanding of the illiquidity premium investors may expect.

Generally, the literature finds that GPs have achieved excess returns through a combination of strategic measures, operational measures and financial measures. This does not tell us, however, whether their LPs have actually enjoyed excess returns, given the management fees and the carry paid to the GP. While earlier studies actually raised doubts whether private equity has outperformed public equity net-of-fees, more recent work does suggest that there is a positive illiquidity premium to be earned.

However, it is important to note that the outperformance recent studies find is not adjusted for risk. As we discuss in more detail, the public market equivalent (PME) – a standard measure

to compare returns of investments in private equity funds with similar (cash flow-based) investments in a public market index – implicitly assumes beta to be equal to one, implying the absence of market risk. To the extent that the true beta is under- or overestimated, the true PME is over- or underestimated. Fortunately, we receive some comfort from recent academic research that finds changes in beta have a strongly diminishing effect on the PME: thus, even if the true beta were 1.5 (the upper end of empirical estimates for buyout funds) instead of 1, which is implicitly assumed in PME-based comparisons, there would still be considerable outperformance of private equity. Similarly, it is found that PMEs are remarkably insensitive to the multiple of the public market returns. In fact, even if public market returns had been twice the S&P 500, the median PMEs would still be larger than 1 for the 1990s and 2000s vintages, suggesting that systematic risk does not explain the estimated outperformance of buyout funds.

It remains an open question, however, whether this outperformance is enough for the illiquidity risk investors take when committing capital to private equity and similar funds. Academic research that addresses liquidity risk explicitly in extended approaches of the Capital Asset Pricing Model (CAPM) has just begun to emerge. While this research puts the illiquidity premium in the range of 2–4%, more work is required to say with sufficient confidence whether these estimates provide a reasonable range for the risk illiquid investments in funds entail.

Notwithstanding the remaining uncertainty about the size of the illiquidity premium, a growing number of investors have begun to implement an allocation approach that seeks to generate diversification gains on the basis of a limited number of distinct risks. One risk is illiquidity, a factor that can be accessed through private equity and real assets. This renders private equity and real assets different compared with, say, high-yield bonds, which are primarily subject to term risk and credit risk. As we stress, however, each risk needs to be measured and managed carefully to harvest the premiums associated with the risks in each asset class.

In the final chapter of Part I, we focus on the role of the secondary market, which has sometimes been seen as a panacea for illiquidity in primary fund investments. We caution against such a view. As important as the emergence of a secondary market has been for investors seeking to mitigate the J-curve effect of their primary fund investments programme and improve the risk/return characteristics of their private equity holdings, it is not a game changer in terms of the basic characteristics of illiquid investments. In fact, as we argue in **Chapter 6**, it would be highly dangerous for investors to regard the secondary market as a substitute for proper management of liquidity risk. For starters, as we emphasized before, the secondary market has remained small relative to the overall exposure of investors to private equity and real assets. More importantly, liquidity in the secondary market tends to dry up precisely when sellers need it most. In the recent global financial crisis, transaction volumes fell sharply as buyers demanded huge discounts relative to the net asset value (NAV) of the portfolios the sellers wanted to liquidate. This experience casts doubt on the role of the secondary market in discovering the true price of illiquid investments. Putting in place an adequate risk management system that is designed for the specific risks in illiquid asset classes is therefore a key condition for investors venturing into private equity and real assets.

1.3.2 Risk measurement and modelling

In the second part of the book, we outline the main features of proper risk management based on current best practices. In **Chapter 7**, we set the scene by introducing risk as the potential

deviation from an expected outcome. Risk, as we emphasize, can usefully be distinguished from uncertainty. Whereas risk generally refers to the probability of an event occurring, uncertainty is immeasurable, given that particular events are so infrequent or unique that no probability distribution can be determined. Typically perceived as a negative outcome – not least from a regulatory perspective – risk is usually calculated as the product of the probability of an event and the expected loss if the event occurs. However, investment strategies are generally subject to both downside and upside risks, requiring investors to navigate carefully through the potential losses without ignoring the opportunities that are associated with a particular allocation decision.

While risk is generally predicated on the notion of quantifiability, in practice risk managers often face substantial challenges in measuring risk in a statistically meaningful way. Frequently, we have to accept a considerable degree of subjectivity in quantifying risks. This is not least true in alternative investing where historical data remain rare and market-based valuations are not available. Not surprisingly, therefore, risk models for such assets have remained rare and subject to considerable controversy. Given the nature of investing in private equity and real assets, we argue that a new risk management approach is needed that embraces the lack of high-frequency market data by using all available information, including qualitative assessments.

At the core of any risk management approach lies the definition of the types of risk that need to be managed. From a broader portfolio standpoint, risk is generally seen as market risk and typically estimated in the CAPM framework, to help determine the desired allocation of capital to different asset classes. However, once an allocation to these asset classes is determined, investors have to manage their asset-specific risks. First and foremost, as we explain in **Chapter 8**, investors in limited partnership funds face the risk that the fund manager fails to return the invested capital in full (plus an expected return). Conceptually, this may be considered as a default, and with many practitioners viewing default risk as more relevant than market risk, there have been attempts to apply credit risk models to illiquid assets. However, such attempts are fundamentally flawed as they focus only on the downside, whereas in a portfolio of funds unrealized gains may serve as a buffer, a viewpoint that has long been accepted by the Basel Committee in the context of banks' equity portfolios.

As we emphasize throughout this book, the key differentiating factor between investments through limited partnership funds and investments in marketable assets is the high degree of illiquidity of the former. As far as commitments to funds are concerned, two dimensions of liquidity risk can be distinguished. First, investments are subject to market liquidity risk, in the sense that there might not be enough demand for purchasing assets in the secondary market. Second, investors face the risk of lacking sufficient liquidity to fund their commitments. Capital calls are made at short notice, requiring investors to have sufficient liquidity at any point in time to avoid defaulting on their commitments. However, hoarding cash comes at significant opportunity costs. Related to the illiquidity problem is the absence of market prices as the basis for risk measurement. Instead, we need to base such a measurement on suitable models. Thus, as we discuss further in Chapter 8, investors are well advised to run funding tests by monitoring key liquidity ratios or undertaking more sophisticated scenario analysis for future cash flows. LPs also need to employ such a funding test to confirm that they are able to honour all capital calls or, alternatively, are able to undertake orderly transactions under no duress, which obviously is a critical assumption for modelling the economic substance of investments in limited partnership funds.

In **Chapter 9**, we return to the issue of potential capital losses in fund portfolios. Specifically, we are interested in the maximum loss an investor could suffer within a given confidence interval – a question which can usefully be addressed in the framework of a value-at-risk (VaR) analysis.² Applying VaR analysis to illiquid assets, for which market prices do not exist, raises a number of important conceptual and statistical issues. In addressing these issues, we discuss two alternative approaches. The first approach is a VaR analysis based on (typically quarterly) changes in NAVs as reported by the funds in a portfolio. While this approach appears to be conventional and relatively easy to implement, its simplicity is deceptive and it has important limitations. Chief among these is the fact that changes in reported NAVs do not reflect the lifecycle characteristics of limited partnerships, such as the J-curve phenomenon and the future pattern of undrawn commitments. The second, alternative approach presented focuses on the volatility of cash flows. This approach uses historical cash flow data over the entire lifecycle of funds. These data can be used in a Monte Carlo simulation to generate cash flow scenarios for a portfolio of funds, taking into account correlations between portfolio segments, such as specific vintage years or strategies.

Working with cash flows is more akin to the needs of non-financial firms. While financial institutions employ VaR to determine their capital adequacy and measure tradable risks, real investments in fixed assets by non-financial firms cannot easily be liquidated. Instead, industrial companies tend to focus on the cash-flow-at-risk (CFaR) as a more relevant measure of their investment risk exposure. Specifically, the CFaR measures the maximum deviation of actual cash flows from a given level within a given confidence interval. Contrary to VaR, which is calculated for very short time periods, CFaR relates to longer periods, typically quarters or even years (i.e., intervals that are also relevant for investors in limited partnership funds). Importantly, the CFaR mirrors both cash inflows and cash outflows as key determinants of the funding test limited partners are required to meet at any given point in time.

This leads us to the importance of diversification within fund portfolios across different dimensions. As we discuss in more detail, significant gains are already achieved at relatively low levels of diversification, especially as far as investing over different vintage years is concerned. A key conclusion from this analysis is that continuous monitoring and management of diversification should be an integral part of a LP's risk management. There are two important caveats, however. First, as the degree of diversification increases – in the extreme case, an investor holds the market portfolio – the potential to achieve extraordinary returns declines. Second, in periods of financial turmoil cash flow correlations tend to rise, reducing the potential diversification gains with respect to managing liquidity risk – as opposed to the risk of actual capital losses we also consider in Chapter 9.

The estimation of the true VaR in portfolios of limited partnership funds is inextricably intertwined with the question of how undrawn commitments should be treated in this framework. The answer the standard finance model gives is simple – undrawn commitments can be ignored. According to what represents the main framework of finance theory, different investments and assets can be valued in isolation. Each investment has its own net present value (NPV), which is calculated by discounting future cash flows using an appropriate discount rate. Since undrawn commitments do not represent actual cash flows, they have NPV = 0 and hence should not matter.

² This approach is widely used in financial risk management and regulation, with maximum losses due to adverse movements in asset prices typically determined at the 99% or 99.5% level of confidence (implying an event occurring every 100 or 200 years, respectively).

However, undrawn commitments, which are contractually binding, obviously did matter during the recent financial crisis. In addressing this apparent conundrum, our discussion in **Chapter 10** starts by asking whether overcommitments to funds actually represent leverage. In fact, we find important commonalities between overcommitments and leverage, with both strategies being motivated by the objective to magnify returns. To the extent that overcommitments are used in order to achieve higher returns, they imply higher risk – just as in the case of leverage. Conversely, holding capital in low-yielding Treasury bills to always be in a position to respond to capital calls lowers or even eliminates risk – at the expense of higher returns. Investors may therefore choose a commitment strategy that is consistent with a risk/return profile according to their utility function. However, this suggests that undrawn commitments do play an important role, in contrast to the standard finance model where capital held in highly liquid assets has no economic value as negative cash flows are assumed to be financed through borrowing.

The important role undrawn commitments have played in the losses some investors have suffered during the recent financial crisis will no doubt continue to attract a substantial amount of attention from practitioners and academics alike. A key question that will need to be addressed concerns the treatment of such commitments in the standard finance model. Specifically, how can discount rates be determined in the presence of undrawn commitments? In addressing this question, the accounting view, which treats undrawn commitments as off-balance sheet items, needs to be reconciled with the economic perspective that recognizes the resources dedicated to private equity and the risk from possible overcommitment strategies. Finding a solution to this challenge looks set to rank prominently on the research agenda for years to come. As we argue in the final part of Chapter 10, a first possible step could lie in treating undrawn capital as a loan. Intuitively, one may think of a credit line from a bank used by the LP to fund his commitments. Alternatively, as here, it may be assumed that the GP draws down the capital entirely at the beginning of the fund's life and lends the money to the LP in order for them to respond to their capital calls.

Given the high degree of liquidity risk associated with investments in private equity and real assets, cash flow modelling is a key challenge that needs to be addressed in internal models. Generally, two approaches can be distinguished. Non-probabilistic models use a limited number of parameters and are preferable in cases where the modeller is confronted with important data constraints. A well-known example is the model developed by the Yale endowment's investment team, whose basic structure is presented in **Chapter 11**. While this model and its numerous variants that have been developed in recent years are relatively simple and easy to implement, they are subject to strict limitations. Importantly, non-probabilistic models do not provide for outcome ranges and hence are unable to capture the volatility of cash flows. As a result, they are appropriate only in exceptional circumstances, for instance in the case of large diversified and fully funded portfolios of fund investments.

By contrast, probabilistic models are generally more complex and pose important data challenges. Probabilistic models use extensive cash flow libraries to project the cash flows of a given investment portfolio, taking into account the maturity of the individual funds making up the portfolio. Probabilistic models can usefully be subjected to scenario analysis to determine the sensitivity of cash flows to deviations from the past. Scenarios are particularly useful to stress-test cash flow projections derived from probabilistic models in order to evaluate and quantify the impact of exogenous shocks. The experience that many investors had in the recent financial crisis leaves little doubt about the importance of cash flow modelling under alternative assumptions.

Risk models for funds can be constructed top-down or bottom-up. While probabilistic models using cash flow libraries tend to start with a top-down approach, a bottom-up analysis can refine projections and add considerable granularity. In this analysis, a key ingredient is the distribution waterfall as specified in the limited partnership agreement. The basic structure of the waterfall is presented in **Chapter 12**, on the basis of which we provide different examples of cash inflows and outflows under alternative assumptions about hurdle rates and carried interest. While these parameters determine the profit for the LPs, they are also highly relevant from a risk management perspective. Realistically, however, a bottom-up analysis may be too complex and resource-intensive for most investors, given substantial variations between funds in terms of the key parameters determining profit sharing between the GP and his or her LPs.

As important as quantitative risk measurement is, in illiquid asset classes risk managers often face important data constraints. This does not mean, however, that effective risk management cannot be done. Rather, the risk manager has to work with the set of information that is available to him or her, and this includes qualitative assessments. Understandably, many risk managers feel uncomfortable using qualitative data, as they fear that such information may be inconsistent and hence result in distorted conclusions. However, this discomfort can be mitigated, at least to some degree, by employing classification schemes for limited partnership funds.

As far as mutual funds are concerned, there are several external agencies that provide ratings aiming to provide a forward-looking prognosis based on a standardized valuation. As we argue in **Chapter 13**, independent ratings of limited partnerships are more difficult, as there are few objective criteria that can be used in a standardized fashion. Furthermore, there may be too few potential users, given the still relatively limited number of investors in private equity and real assets, making these asset classes less scalable in terms of external ratings. However, a growing number of LPs are using proprietary fund grading systems that, in an effort to exploit all available information, take into account qualitative assessments. Importantly, funds are benchmarked against their peers in such grading systems. Defining the appropriate peer group is therefore essential for the risk manager to extract information from the grading of funds and as a basis for quantifying risks, as we discuss in **Chapter 14**.

1.3.3 Risk management and its governance

In **Part III** we turn to the question of how the concepts discussed in this book can be applied in practice. The management of securitizations of private equity funds should be seen as a case study where such instruments were successfully used in the market place under the scrutiny of rating agencies. While in the risk-on/risk-off environment in the post-crisis era securitization in general has played a less prominent role, the principle of securitizing portfolios of illiquid funds is highly illustrative for effective risk management. As we discuss in **Chapter 15**, such structured vehicles represent a relatively simple case of asset liability management and are therefore instructive for LPs facing comparable issues, such as pension plans and insurance companies. Securitizations of portfolios of limited partnership funds demonstrate how one risk dimension can be transformed into another and how trade-offs between risk dimensions can be managed – equity versus debt, market risk versus credit risk, illiquidity versus liquidity, liquidity risk versus capital risk.

Focusing on the investment process as a defining criterion of prudent investing could easily lead to confusion over the role of the LP's risk manager versus the role of its compliance officer. In **Chapter 16**, therefore, we clarify the two functions as distinctly different parts of an

investment firm's risk management system. Assuring conformity with regulatory requirements and dealing effectively with operational risk is fundamental for the long-term success of an investment firm. However, compliance has little, if anything, to do with the management of financial risks in the sense of trading off risks versus rewards in asset markets, which falls squarely into the remit of the risk manager. Put differently, compliance has to ensure that specific processes are followed in the way they were intended to work, but it is the role of risk management to help design such processes in the first place.

Ensuring that the risk manager can fulfil his or her role effectively requires appropriate governance structures. This raises a number of important issues. Where in the LP's organization should the risk management function be anchored? To whom should the risk manager report? Who is accountable in case of failures? And how should the risk manager be remunerated within the broader structure of the firm? These are only some of the thorny issues we discuss.

In addressing these and other issues, LPs should have a clear risk management policy in place that sets the framework for coordinating and executing the firm's activities in a risk-sensitive manner. Conceivably, as we examine in the final chapter of this book, this framework may consist of a set of clearly defined rules or may be based on rather general principles. However, while a pure rules-based system may be too rigid, a principles-based framework may be too weak or ambiguous. In practice, therefore, a combination of the two may be superior, a direction that is favoured by new regulatory initiatives, such as the European Alternative Investment Fund Manager (AIFM) directive. Importantly, as we point out in **Chapter 17**, risk management policy is a living instrument rather than a static set of checks and balances. Periodic reviews are necessary to ensure that an investment firm's risk management policy is consistent with the industry's best practices. In installing a risk management framework, it is important to note that its effectiveness is not least a function of its organizational setting. To be effective, the risk management function has to enjoy a high degree of independence versus the firm's operating units, must be equipped with adequate resources and must have access to all information. The firm's reporting system is equally important. This and the general complexity of risk models imply an appropriate IT system that allows the running of large-scale stress tests and scenario analyses.

For LPs, putting in place an effective risk management policy is a prerequisite for adopting internal model-based approaches to risk management. In fact, regulated investors – such as banks, insurance firms and pension funds – have a strong incentive to employ internal risk models, which allow them to reduce significantly their regulatory capital charges compared with the standard approach. For the internal model to be approved by the regulatory authorities, it has to pass a “use test”, however. This entails, *inter alia*, explaining the rationale of the model, the underlying assumptions, the valuation methods and the data used. However, the use test also includes procedural questions, pertaining, for example, to the model's function in the broader governance system, its role as an integrated tool in decision-making processes and its adaptation to the investor's evolving risk profile.

