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Hedge Fund modelling and analysis using Excel and VBA

PAUL DARBYSHIRE
DAVID HAMPTON

Hedge Fund Modelling and
Analysis Using Excel and VBA

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Hedge Fund Modelling and
Analysis Using Excel and VBA

Paul Darbyshire and David Hampton



A John Wiley & Sons, Ltd., Publication

This edition first published 2011
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Library of Congress Cataloging-in-Publication Data

Darbyshire, Paul.

Hedge fund modelling and analysis using Excel and VBA / Paul Darbyshire and David Hampton.

p. cm.

ISBN 978-0-470-74719-3 (hardback)

1. Hedge funds—Mathematical models. 2. Microsoft Excel (Computer file) 3. Microsoft Visual Basic for applications. I. Hampton, David. II. Title.

HG4530.D37 2012

332.64'5240285554—dc23

2011046750

A catalogue record for this book is available from the British Library.

ISBN 978-0-470-74719-3 (hbk) ISBN 978-1-119-94563-5 (ebk)

ISBN 978-1-119-94565-9 (ebk) ISBN 978-1-119-94564-2 (ebk)

Set in 11/13pt Times by Aptara Inc., New Delhi, India

Printed in Great Britain by TJ International Ltd, Padstow, Cornwall

Mum and Dad
To whom I owe everything.
P.D. and D.H.

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Preface

This book is a practical introduction to modelling and analysing hedge funds using the popular Excel spreadsheet tool and Visual Basic for Applications (VBA) programming language. The structure of the book is as follows. Chapters 1–3 cover the necessary foundations required in order to understand hedge funds and the alternative investment industry. With this fundamental knowledge in place, Chapters 4–7 cover the more quantitative and theoretical material needed to effectively analyse a series of hedge fund returns and extract the relevant information required in order to make critical investment decisions.

Throughout the book there are numerous snapshots of Excel spreadsheets and VBA source code. These are described as follows.

EXCEL SPREADSHEETS

The book assumes a working knowledge of Excel, with an ability to implement simple built-in functions, such as SUM(), AVERAGE() and STDEV(), and build dynamic spreadsheets. The following example schematic explains how to interpret an Excel spreadsheet snapshot within the book:

	A	B	C	D	E	F
1			Maximum	3.40	=fncMAXIMUM(B4:B75)	
2			Minimum	-2.17	=fncMINIMUM(B4:B75)	
3	Date	RoR (%)	Bins	Frequency	Frequency (%)	
4	Jan-05	0.62	-4.00	0	0	
5	Feb-05	-1.14	-3.75	0	=(D4/\$D\$37)*100	
6	Mar-05	-1.01	-3.25	0	0	
7	Apr-05	1.89	-3.25	0	0	
8	May-05	1.24	-3.00			
9	Jun-05	-2.17	-2.75	{=FREQUENCY(B4:B75,C4:C36)}		
10	Jul-05	1.40	-2.50	0	0	
11	Aug-05	0.85	-2.25	0	0	
12	Sep-05	0.51	-2.00	0	0	
13	Oct-05	0.28	-1.75	0	0	
14	Nov-05	0.05	-1.50	0	0	
15	Dec-05	-0.22	-1.25	0	0	
16	Jan-06	-0.49	-1.00	0	0	
17	Feb-06	-0.76	-0.75	0	0	
18	Mar-06	1.93	-0.50	2	3	
19	Apr-06	-0.90	-0.25	3	4	
20	May-06	0.85	0.00	6	8	
21	Jun-06	0.51	0.25	3	4	
22	Jul-06	0.83	0.50	4	6	
23	Aug-06	1.06	0.75	9	13	
24	Sep-06	1.00	1.00	6	8	
25	Oct-06	0.77	1.25	3	4	
26	Nov-06	0.54	1.50	2	3	
27	Dec-06	0.31	1.75	1	1	
28	Jan-07	0.08	2.00	0	0	
29	Feb-07	-0.15	2.25	0	0	
30	Mar-07	-0.42	2.50	0	0	
31	Apr-07	-0.69	2.75	0	0	
32	May-07	-0.96	3.00	0	0	
33	Jun-07	-1.23	3.25	0	0	
34	Jul-07	0.53	3.50	2	3	
35	Aug-07	3.40	3.75	0	0	
36	Sep-07	-0.28	4.00	0	0	
37	Oct-07	1.80		Sum	72	100
38	Nov-07	1.74		=SUM(D4:D36)		=SUM(E4:E36)
39	Dec-07	1.33				
74	Nov-10	-0.02				
75	Dec-10	2.51				

Sample Excel spreadsheet

EXCEL AND USER-DEFINED VBA FUNCTIONS

When a built-in Excel function is used in the book, a description of the use of the function is provided, where necessary, in the text or in a footnote. For example, if an Excel spreadsheet makes use of the NORMSINV() built-in Excel function, a brief description is given in a footnote.¹ All user-defined functions are implemented using the VBA programming language available free with all versions of Excel. There is no prior knowledge of VBA required, although a working grasp of the language would be advantageous. The book contains many user-defined

¹ The NORMSINV() function returns the inverse of the standard normal cumulative distribution, i.e. a distribution with a mean of zero and a standard deviation of one.

VBA functions (prefixed with the letters 'fnc') which are displayed in a source box, for example:

Source 4.3 User-defined VBA function to calculate the SKEWNESS of a returns array

```
'function to calculate the SKEWNESS of a
returns array
Function fncSKEWNESS(RoR As Range) As Double

    'count number in returns array
    n = RoR.Count

    'the mean of returns array
    avg = (fncMEAN(RoR) / 12) 'monthly
    'the standard deviation of returns array
    std = (fncSTDEV(RoR) / Sqr(12)) 'monthly

    'initialise sum to zero
    sum = 0

    For i = 1 To n
        sum = sum + ((RoR(i) - avg) / std) ^ 3
    Next

    fncSKEWNESS = (n / ((n - 1) * (n - 2))) * sum

End Function
```

Sample VBA user-defined function

HYPOTHETICAL HEDGE FUND DATA

Throughout the book there is constant reference to many hedge fund return series and factors. The 10 hedge funds and 15 factors used are all *hypothetical* and have been simulated by the authors as a unique data set for demonstration purposes only. The techniques and models used in the book can therefore be tested on the hypothetical data before being applied to real-life situations by the reader. The hypothetical data set is

nonetheless close to what would be expected in reality. The 10 funds are a mixture of several major hedge fund strategies, i.e. commodity trading advisor (CTA), long/short equity (LS), global macro (GM) and market neutral (MN) strategies as described in the table below:

Hedge Fund	Abbreviation
Commodity Trading Advisor	CTA1, CTA2, CTA3
Long Short Equity	LS1, LS2, LS3
Global Macro	GM1, GM2
Market Neutral	MN1, MN2

10 hypothetical hedge funds

The 15 factors are a mixture of both passive and active indices as described in the table below:

No.		Abbreviation
	Beta factors	
1	Passive Global Stock Index	PSDX
2	S&P 500 Equity Index	S&P 500 Index
3	Passive Global Bond Index	PBond DX
4	Passive Long Global Commodity Index	PCom DX
5	Passive Long USD Index	PUSD DX
6	Risk-Free Rate	Rf
	Industry reference alternative beta factors	
7	Commodity Trading Advisor Index	CTA Index
8	Long Short Equity Index	LS Index
	Fama–French–Carhart factors	
9	Value minus Growth	Val – Gr
10	Small Cap minus Large Cap	SC – LC
11	Momentum	Mom
	Active alternative beta factors	
12	Active Global Stock Futures Index	ASDX
13	Active Global Bond Futures Index	ABDX
14	Active Global Commodity Futures Index	ACDX
15	Active Global Foreign Exchange Futures Index	AFDX

15 hypothetical factors

BOOK WEBSITE

The official website for the book is located at:

www.darbyshirehampton.com

The website provides free downloads to all of the hypothetical data, Excel spreadsheets, and VBA user-defined functions as well as many other useful resources.

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The Hedge Fund Industry

The global credit crisis originated from a growing bubble in the US real estate market which eventually burst in 2008. This led to an overwhelming default of mortgages linked to subprime debt to which financial institutions reacted by tightening credit facilities, selling off bad debts at huge losses and pursuing fast foreclosures on delinquent mortgages. A liquidity crisis followed in the credit markets and banks became increasingly reluctant to lend to one another, causing risk premiums on debt to soar and credit to become ever scarcer and more costly. The global financial markets went into meltdown as a continuing spiral of worsening liquidity ensued. When the credit markets froze, hedge fund managers were unable to get their hands on enough capital to meet investor redemption requirements. Not until early 2009 did the industry start to experience a marked resurgence in activity, realising strong capital inflows and growing investor confidence.

This chapter introduces the concept of hedge funds and how they are structured and managed, as well as discussing the current state of the global hedge fund industry in light of the recent financial crisis. Several key investment techniques that are used in managing hedge fund strategies are also discussed. The chapter aims to build a basic working knowledge of hedge funds and, along with Chapters 2 and 3, to develop the fundamentals necessary in order to approach and understand the more quantitative and theoretical aspects of their modelling and analysis developed in later chapters.

1.1 WHAT ARE HEDGE FUNDS?

Whilst working for Fortune magazine in 1949, Alfred Winslow Jones began researching an article on various fashions in stock market forecasting and soon realised that it was possible to neutralise *market risk*¹ by buying undervalued securities and short selling (see Section 1.4.1)

¹ *Market risk* (or *systematic risk*) is the risk that the value of an investment will decrease due to the impact of various market factors, such as changes in interest and foreign currency rates.

overvalued ones. Such an investment scheme was the first to employ a *hedge* to eliminate the potential for losses by cancelling out adverse market moves, and the technique of *leverage*² to greatly improve profits. Jones generated an exceptional amount of wealth through his *hedge fund* during the 1950s and 1960s and continually outperformed traditional money managers. Jones refused to register the hedge fund with the Securities Act 1933, the Investment Advisers Act 1940, or the Investment Company Act 1940, his main argument being that the fund was a *private* entity and none of the laws associated with the three Acts applied to this type of investment. It was essential that such funds were treated separately from other regulated markets since the use of specialised investment techniques, such as short selling and leverage, were not permitted under these Acts, nor was the ability to charge performance fees to investors.

So that the funds maintained their private status, Jones would never publicly advertise or market the funds but only sought investors through word of mouth, keeping everything as secretive as possible. It was not until 1966, through the publication of a news article about Jones's exceptional profit-making ability, that Wall Street and *high net worth*³ individuals finally caught on, and within a couple of years there were over 200 active hedge funds in the market. However, many of these hedge funds began straying from the original *market neutral* strategy used by Jones and employed other apparently more volatile strategies. The losses investors associated with highly volatile investments discouraged them from investing in hedge funds. Moreover, the onset of the turbulent financial markets experienced in the 1970s practically wiped out the hedge fund industry altogether. Despite improving market conditions in the 1980s, only a handful of hedge funds remained active over this period. Indeed, the lack of hedge funds around in the market during this time changed the regulators' views on enforcing stricter regulation on the industry. Not until the 1990s did the hedge fund industry begin to rise to prominence again and attract renewed investor confidence.

Nowadays, hedge funds are still considered private investment schemes (or vehicles) with a collective pool of capital only open to a small range of institutional investors and wealthy individuals and

² *Leverage* is the use of a range of financial instruments or borrowed capital to increase the potential return of an investment (see Section 1.4.2).

³ A *high net worth* individual (or family) is generally assumed to have investable assets in excess of \$1 million, excluding any primary residence.

having minimal regulation. They can be as diverse as the manager in control of the capital wants to be in terms of the investment strategies and the range of financial instruments which they employ, including stocks, bonds, currencies, futures, options and physical commodities. It is difficult to define what constitutes a hedge fund, to the extent that it is now often thought in professional circles that a hedge fund is simply one that incorporates any *absolute return*⁴ strategy that invests in the financial markets and applies non-traditional investment techniques. Many consider hedge funds to be within the class of *alternative* investments, along with private equity and real estate finance, that seek a range of investment strategies employing a variety of sophisticated investment techniques beyond the longer established traditional ones, such as *mutual funds*.⁵

The majority of hedge funds are structured as limited partnerships, with the manager acting in the capacity of general partner and investors as limited partners. The general partners are responsible for the operation of the fund, relevant debts and any other financial obligations. Limited partners have nothing to do with the day-to-day running of the business and are only liable with respect to the amount of their investment. There is generally a minimum investment required by *accredited investors*⁶ of the order of \$250,000 to \$500,000, although many of the more established funds can require minimums of up to \$10 million. Managers will also usually have their own personal wealth invested in the fund, a circumstance intended to further increase their incentive to consistently generate above average returns for both the clients and themselves. In addition to the minimum investment required, hedge funds will also charge fees, the structure of which is related to both the management and performance of the fund. Such fees are not only used for administrative and ongoing operating costs but also to reward employees and managers for providing above average positive returns to investors. A typical fee basis is the so-called *2 and 20* structure which consists of a 2% annual fee (levied monthly or quarterly) based on the amount of *assets under management* (AuM) and a 20% performance-based fee, i.e.

⁴ *Absolute return* refers to the ability of an actively managed fund to generate positive returns regardless of market conditions.

⁵ *Mutual funds* are similar in structure to hedge funds but are subject to much stricter regulation and limited to very specific investments and strategies.

⁶ An *accredited investor* is one who has a net worth of at least \$1 million or has made \$200,000 each year for the past two years (\$300,000 if married) and has the capacity to make the same amount the following year.

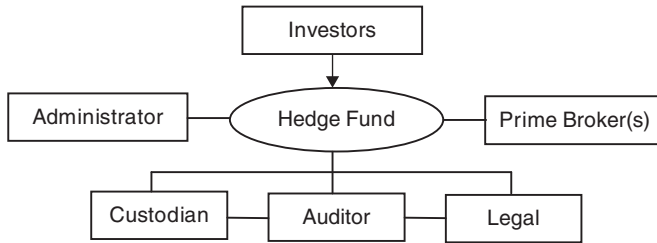


Figure 1.1 A schematic of the typical structure of a hedge fund

an incentive-oriented fee. The performance-based fee, also known as *carried interest*, is a percentage of the annual profits and only awarded to the manager when they have provided requisite returns to their clients. Some hedge funds also apply so-called *high water marks* to a particular amount of capital invested such that the manager can only receive performance fees, on that amount of money, when the value of the capital is more than the previous largest value. If the investment falls in value, the manager must bring the amount back to the previous largest amount before they can receive performance fees again. A *hurdle rate* can also be included in the fee structure, representing the minimum return on an investment a manager must achieve before performance fees are taken. The hurdle rate is usually tied to a market benchmark, such as LIBOR⁷ or the one-year T-bill rate plus a spread.

1.2 THE STRUCTURE OF A HEDGE FUND

In order for managers to be effective in the running of their business a number of internal and external parties covering a variety of operational roles are employed in the structure of a hedge fund, as shown in Figure 1.1. As the industry matures and investors are requiring greater transparency and confidence in the hedge funds in which they invest, the focus on the effectiveness of these parties is growing, as are their relevant expertise and professionalism. Hedge funds are also realising that their infrastructure must keep pace with the rapidly changing industry. Whereas in the past some funds paid little attention to their support and administrative activities, they are now aware that the

⁷ LIBOR is the *London Interbank Offered Rate*, a rate at which banks borrow from other banks in the London interbank market.

effective operation of their fund ensures the fund does not encounter unnecessary and unexpected risks.

1.2.1 Fund Administrators

Hedge fund administrators deal with many of the operational aspects of the successful running of a fund, such as compliance with legal and regulatory rulings, financial reporting, liaising with clients, provision of performance reports, risk controls and accounting procedures. Some of the larger established hedge funds use specialist in-house administrators, whilst smaller funds may avoid this additional expense by outsourcing their administrative duties. Due to the increased requirement for tighter regulation and improved transparency in the industry, many investors will only invest with managers who can prove that they have a strong relationship with a reputable third-party administrator and that the proper processes and procedures are in place. The top five global administrators in 2010 were CITCO, HSBC, Citigroup, GlobeOp and Custom House.

Hedge funds with offshore operations often use external administrators in offshore locations to provide expert tax, legal and regulatory advice for those jurisdictions. Indeed, it is a requirement in some offshore locations (e.g. the Cayman Islands) that hedge fund accounts must be regularly audited. In these cases, administrators with knowledge of the appropriate requirements in those jurisdictions would fulfil this requirement.

1.2.2 Prime Brokers

The prime broker is an external party who provides extensive services and resources to a hedge fund, including brokerage services, securities lending, debt financing, clearing and settlement, and risk management. Some prime brokers will even offer incubator services, office space and *seed* investment for start-up hedge funds. The fees earned by prime brokers can be quite considerable and include trade commissions, loan interest and various administration charges. Due to the nature of the relationship between the prime broker and hedge fund, in particular being the counterparty to trades and positions, only the largest financial institutions are able to act in this capacity. The top five global prime brokers in 2010 were Goldman Sachs, JP Morgan, Morgan Stanley, Deutsche Bank and UBS.

For this reason the prime brokerage market is relatively small and each prime broker tends to service a large number of hedge funds and therefore takes on an extremely high degree of risk. Some major restructuring occurred amongst prime brokers in 2008 and 2009, for example the acquisitions of Bear Stearns by JP Morgan, Merrill Lynch by Bank of America, and Lehman Brothers by Barclays Capital. This resulted in a shift in market share from some former investment banks to commercial banks and saw the prime brokerage industry begin to consolidate. In order to alleviate investor concerns since the collapse of several major financial institutions, many fund managers are cautious in employing a single prime broker and prefer to subscribe to multiple prime brokers.

1.2.3 Custodian, Auditors and Legal

Hedge fund assets are usually held with a custodian, including the cash in the fund as well as the actual securities.⁸ The custodian is normally a bank that will offer services, such as safekeeping of hedge fund assets, arranging settlement of any sales or purchases of securities and managing cash transactions.

The general structure of a hedge fund precludes them from the requirement to have their financial statements audited by a third party. However, in order to satisfy investors, many hedge funds have their accounts and financial reviews audited annually by an external audit firm. It is important that the auditing firm is seen to be independent of the hedge fund to give credence to their reports and services.

The legal structure of a hedge fund is designed to provide investors with limited liability, so that if a fund suffers a severe loss the maximum amount an investor can lose is only the level of capital invested in the fund. That is, an investor cannot be made liable for losses over this amount or any other outstanding debt or financial obligation of the hedge fund. In addition, the legal structure is also chosen to optimise the tax status and legal liability of the hedge fund itself. To facilitate this, there are a small number of standard hedge fund structures, such as the master–feeder structure, which is adopted by a large number of funds. These comply with the legal requirements of the various jurisdictions

⁸ This is true except when the assets are used as *collateral* for gaining leverage. In these cases, the assets used as collateral are held by the prime broker. As most hedge funds use some degree of leverage, it is common for assets to be held by both custodians and prime brokers.

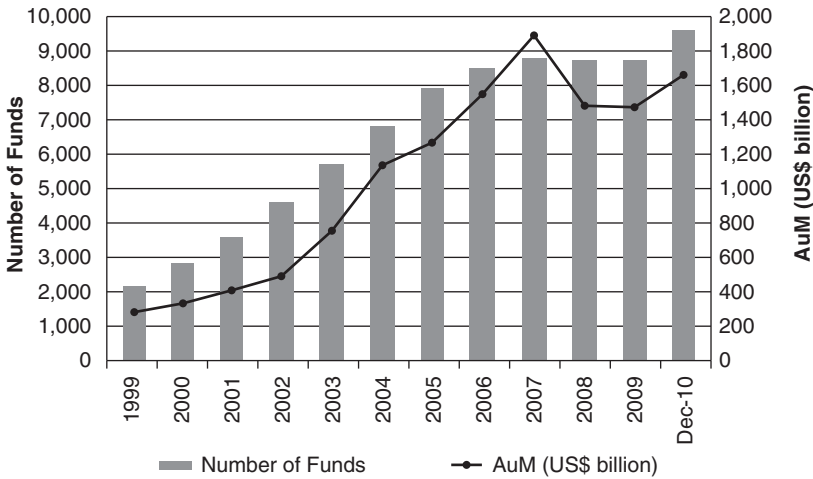


Figure 1.2 Growth in the global hedge funds industry since 1998

Source: EurekaHedge

where the hedge funds operate and obtain the optimal tax treatment. The master–feeder structure is a two-tier structure where investors invest through a feeder vehicle which itself invests in the hedge fund. There can be a number of feeder vehicles, located and domiciled in a number of different jurisdictions. Each can have a different legal form and framework. Depending on their tax status, investors can decide which feeder vehicle they wish to invest in. As a general rule the tax regime of an investor will depend on the location of the investor, i.e. *on-* or *offshore*.⁹

1.3 THE GLOBAL HEDGE FUND INDUSTRY

After exceptional growth since 1998, total assets managed by the hedge fund industry peaked at \$1.97 trillion in 2007. After the credit crunch and financial crisis of 2008, with well-publicised frauds and scandals as well as the collapse of several major financial institutions, the hedge fund industry suffered severe losses and investor loyalty. Not until early 2009 did the industry start to experience a marked resurgence in activity, realising strong capital inflows and growing investor confidence, as shown in Figure 1.2.

⁹ *Onshore* (or *domestic*) locations include the US and UK, and to a lesser degree Switzerland and some other European countries. *Offshore* locations include the Cayman Islands, Bahamas, Bermuda, Luxembourg and Ireland.

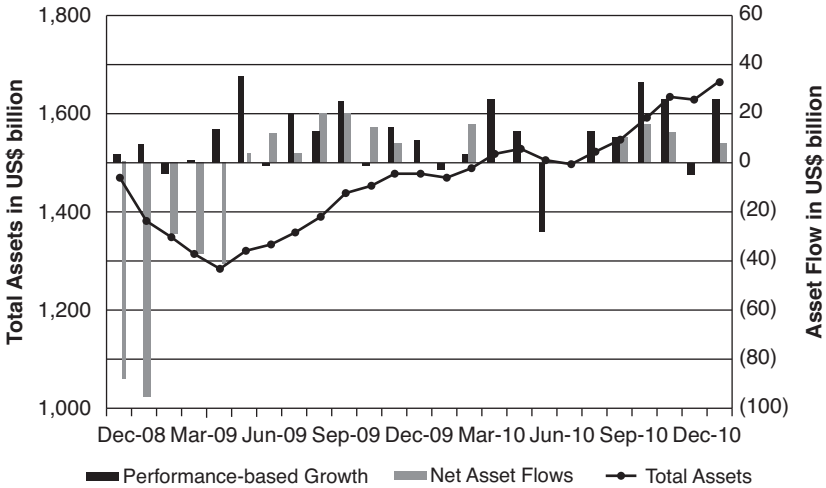


Figure 1.3 Monthly asset flows since December 2008

Source: *Eurekahedge*

It is estimated that the total amount of AuM in the industry at the end of 2010 stood at over \$1.60 trillion, with a strong stream of asset flows into hedge funds over the past several years (see Figure 1.3). It is widely assumed that the industry will cross the all-time high set in 2007 and exceed \$2 trillion by the end of 2011.

Over the last decade, the global hedge fund industry has consistently outperformed the underlying equity markets, as can clearly be seen in Figure 1.4.

North American funds still remain the most important global hedge fund market, making up around two-thirds of the global industry, followed, quite a long way behind, by Europe and then Asian sectors (see Figure 1.5).

1.3.1 North America

Despite periods of high volatility and market swings, North American hedge funds have consistently posted record returns since reaching their lowest point in early 2009. The total size of the industry at the end of 2010 was estimated at \$1.08 trillion, managed by over 4,500 funds (see Figure 1.6). This is a clear indication of the confidence investors began to show in North American funds after the fallout from the global financial crisis

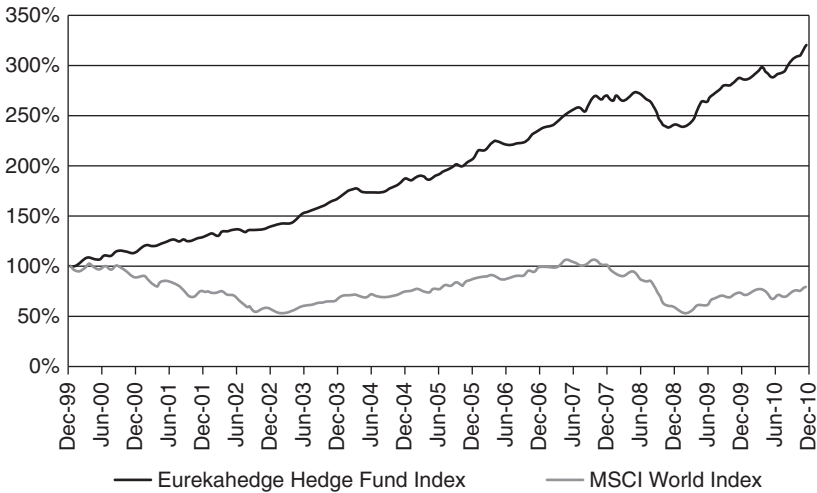


Figure 1.4 Performance of global hedge funds over equities since 1999

Source: *Eurekahedge*

of 2008, when billions of dollars were redeemed and funds suffered massive performance-based losses. Since then, hedge fund managers have provided significant protection against market downturns as well as addressing investors concerns over counterparty risk by engaging multiple prime brokers instead of the usual singular relationship. Moreover, managers have increased redemption frequencies, allowing investors better access to their capital, allowed for more transparency across investment

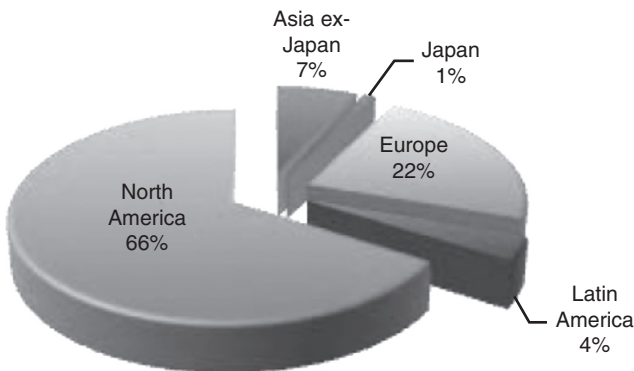


Figure 1.5 Geographical location of hedge fund

Source: *Eurekahedge*

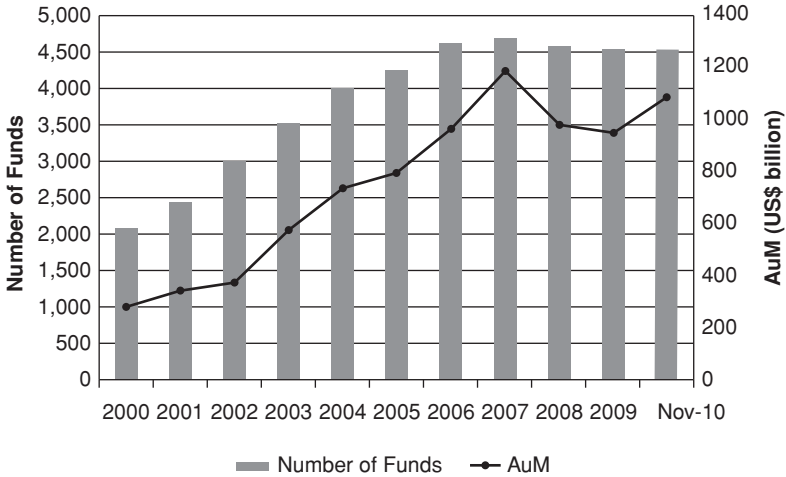


Figure 1.6 Growth of the North American hedge fund industry since 2000

Source: *EurekaHedge*

strategies and implemented more stringent risk management controls. Such changes, together with a much improved outlook on the US economy and the introduction of *quantitative easing*,¹⁰ have led to increased investor confidence and substantial asset flows into North American hedge funds, a situation which looks set to continue well into 2011.

1.3.2 Europe

The rapid growth of the European hedge fund industry over the first seven years of the last decade was eventually slowed by the onset of the financial downturn in 2008. As with North American hedge funds, the European sector experienced huge losses and increased pressure for redemptions from investors which continued until early 2009 when the global economy began to see a potential recovery (see Figure 1.7).

The European sector has shown some interesting trends with regard to fund launches since the market began to rebound in 2009. Although

¹⁰ *Quantitative easing* is a monetary policy that has been employed by the US, the UK and the eurozone since the financial crisis of 2008. When a country's interest rate is either at or close to zero, normal expansionary monetary policy fails so the central bank creates new money which it uses to buy government bonds and increase the money supply and excess reserves of the banking system. A further lowering of interest rates follows and it is anticipated that this will lead to a stimulus in the economy.