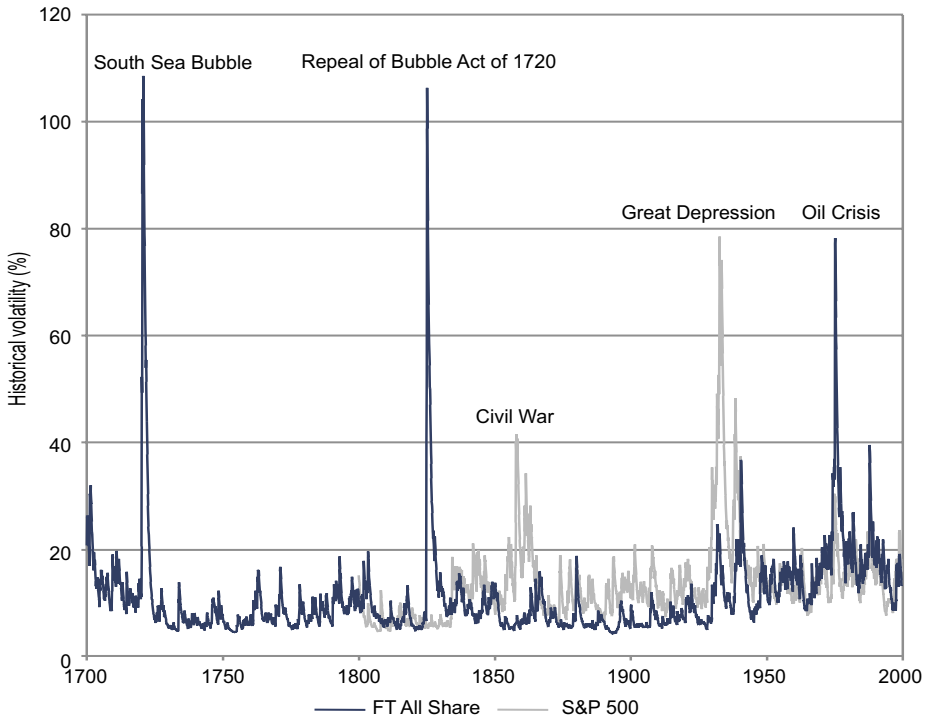
Global Equity Research

20th Century Volatility



Source: WDR

A review of the stock and derivatives markets in the 20th Century

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Introduction

The 20th century has been a turbulent time for equity investors. This report is a review of equity volatility and its instruments – the instruments which allow investors to deal with volatility, ie, derivatives. We intend to make this a regular publication. Please find the next issue on your desk in December 2099.

This report is slightly different from our usual equity derivatives research publications

In our derivatives research efforts we try to be to the point but thorough, focused without a lack of the big picture. We focus on economic and statistical significance as opposed to anecdotal evidence. This report is different: it is neither to the point nor thorough and is to a large extent anecdotal. Since we dive into the subject best described as 'financial anthropology', an approach covering every economically and statistically significant aspect of risk and derivatives over 100 years would most likely exceed the attention of the casual reader during the festive season. This self-imposed restriction means we will not be covering many exciting topics related to risk and derivatives, such as "bivariate generalised autoregressive conditional heteroscedasticity-in-mean studies of the relationship between return variability and trading volume in international futures markets". This, obviously, is a loss to the reader, for which we would like to apologise up-front.

In the first section we will be looking at volatility in equity markets in the 20th century, starting with a prologue covering the volatility of UK price inflation since 1300 (AD) and UK stock price volatility since 1700.

The subsequent section summarises some aspects in the history of derivatives.

In the next two sections we raise two questions and some attempts to answer them:

(1) Why have derivatives become so popular?
(2) Why have derivatives become so unpopular?

We conclude the report with an outlook for the next 100 years. If our predictions do not materialise until the next derivatives century-review is due, the author will take full responsibility. Our conclusions are intended to be thought provoking. Some readers, however, might regard them as fatuous or even ludicrous – probably as fatuous and ludicrous as a rational economic agent viewed the contemporary in December 1899 who stated that inflation would top 10,000% in Berlin and the conversion of Karl Marx's theories into the real world would cost 100m lives during the next 100 years.

The author would like to thank Alan Scowcroft, Mike Duff, Scott Mixon and Heinz Kubli for their contributions to this report.

The Warburg Dillon Read equity derivatives research team wishes you a pleasant holiday season.

Prologue to the 20th century

Volatility since *Divine Comedy*

The experience of price changes is not a phenomenon of modern times

The concept of volatility and the management of uncertainty were not new to the 20th century. Probably the most ancient volatility experienced by mankind is that of asset prices in general, ie, the interchange of inflation and deflation. Apparently, prices shot up in ancient Babylon between 1740 and 1700 BC by three-and-a-half times and the price of donkeys rose eightfold in Roman Egypt around 200 AD. Fluctuations in prices, uncertainty and the management of risk have caused headlines during the 1990s. Volatility and the management thereof is not new – neither conceptually nor instrumentally.

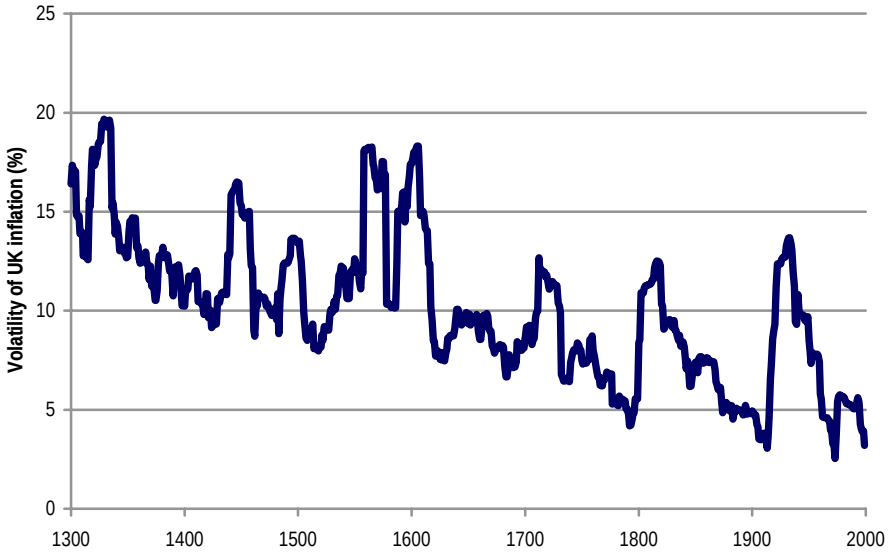
Before we take a closer look at equity volatility in this century we go back in time and look at how equity volatility would have been if stocks had been around for the past 700-plus years.

Since the Middle Ages, there has been a long term trend of falling volatility

In the search for such rather long-term data, we found consumer price data for the UK starting in 1264, ie, when Dante Alighieri was born, who later wrote *Divine Comedy* – perhaps the greatest literary expression of the Middle Ages. Since in this century extreme deflation (1930s) and inflation (1970s) were associated with high volatility in equity markets, one can assume that had *equities* been around in the 13th century, the volatility of consumer prices would, to some extent, be correlated with the volatility in equities.

Chart 1 shows the rolling 20-year volatility of yearly changes in UK consumer price inflation between 1300 and 1999. We have used UK consumer price volatility as a proxy for equity volatility.

Chart 1: Volatility of consumer price inflation since 1300 AD



Source: WDR (data from Global Financial Data)

Most extreme fluctuations were in the 20th Century

A comforting fact for market participants hit by increasing equity volatility in 1997 and 1998 is that the long-term trend of volatility is down. As we will point out later, the 1990s were a decade of low volatility – at least in a long-term context. With a long-term perspective the world has become a less volatile place. On the other hand, the most extreme price changes within 5,000 years of written human history of 10,000% in Berlin in the 1920s or 600% per month in Argentina in the late 1980s were in this century.

Chronology

Europe – 13th century: Jenghiz Khan increases volatility and French wine is discovered

On one hand, the 13th century can be described as "volatile" where volatility was event driven. On the other hand, trade and prosperity rose to their highest medieval level (Homer 1996). Mongol conqueror Jenghiz Khan conquered most of the Chin empire of north China, subdued Turkistan, Transoxania and Afghanistan, and raided Persia and eastern Europe. Marco Polo started opening the Orient for trade, the Teutonic knights completed their conquest of Eastern Germany, Prussia and Lithuania, and French wines began to enjoy a dominant position in trade.

Europe – 14th century: Hundred Years' War and Black Death

During the 14th century, medieval commercial expansion culminated. As in the previous century, volatility was event driven. It was a century of humanism, and also of economic and political progress. But it was also the century of the Hundred Years' War and the Black Death.

Europe – 1316: Population reduced by 50%

The first spike in the volatility of UK CPI data appeared in 1316 when bad weather and crop failure resulted in famine across north-western Europe. Unsanitary conditions and malnutrition increased the death rate. Even after the revival of agricultural conditions, weather disasters reappeared. A mixture of war, famine and plague in the late Middle Ages reduced the population by half.

England and France – 1356: *Tale of Two Cities*

A war begins between the English and the French directly following an occurrence of the Black Death in France. French peasants suffer the most economically, as is usual in medieval times during war, and physically: their homes are pillaged and burned. The friendly and warm behaviour of English football fans during the World Cup in 1998, and the easiness and efficiency with which British agricultural products go through customs in Calais are evidence that there are no 'hard feelings' between the warring parties and its citizens today. The risk of a further confrontation, for example, a trade war, is negligible, therefore.

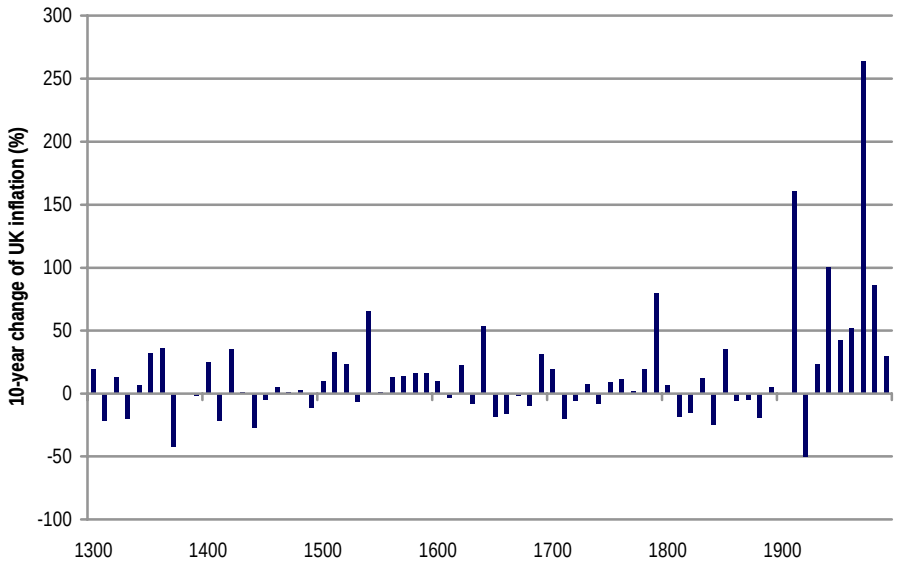
England – 1381: Reduced life expectancy of treasurers

The presence of the Black Death in England works to the advantage of English peasants, causing a shortage of labour, a freeing of serfs, a rise in salary and a decrease in rent. The aristocratic class, however, passes legislation that lowers wages to the amount before the plague and requires lower wages for labourers without land. The peasants rise against this oppression in what is called the English Peasants' Revolt when a national tax is levied for every individual in England. The peasants march to London, murder the Lord Chancellor and treasurer. The increased life expectancy of ministers not only might cheer Lord Irvine of Lairg and Gordon Brown; it is also an indication of reduced uncertainty of modern times.

Europe until the 15th century

Although there was great volatility in the CPI data, the index was only 13% higher at the onset of the 16th century than when the series started in 1264. The CPI index was at roughly the same level at the beginning of the Hundred Years' War in 1356 as at the end in 1453 but volatile in between. The spikes are (apart from wars) explained by the Black Death, which appeared during a time of economic depression in western Europe and re-occurs frequently until the 15th century. The Black Death is a combination of bubonic and pneumonic plagues, and has a major impact on social and economic conditions.

Chart 2: Volatility of UK CPI data form 1300 to 1999 per decade



Source: WDR (data from Global Financial Data)

Graph shows the change in UK CPI data in percent per decade.

Europe – 15th century: The Renaissance

The 15th century was a century of economic transition. Its opening decades saw a continuation of the past century's wars, agricultural depression, and local restrictions on free and prosperous trade. However, the Renaissance later saw the rapid rise in humanism (Erasmus [1466-1536]), science (Leonardo da Vinci [1452-1519]), the arts (Michelangelo [1475-1564]), inventions (Gutenberg [1397-1468]), astronomy (Copernicus [1473-1543]) and worldwide discovery (Columbus [1446-1506]). At the end of the century, the UK price index was around 10% lower than at the start of the century.

Europe – 16th century: Ivan the Great and Henry VIII contribute to volatility

Inflation increased by 17% from 1500 to 1516 and by 50% in the following five years. Ivan the Great of Moscow extending the Russian border into the Byelorussian and Ukrainian territories in 1505, and England's King Henry VIII succeeding his father in 1509 did not exactly contribute to making the world a safer place, hence large volatility in the CPI data.

Italy – 1532: Machiavelli writes *The Prince*

Nick Machiavelli's *The Prince* was first published in 1532. The work was not exactly material to be read by conquerors-to-be: "In order to win and retain power a man is fortunate if he is born to power, for a man who rises to power by conquest or treachery makes enemies who must be eliminated." The historical piece of political philosophy in itself does not add to an increase in volatility directly. However, the

interpretation (or misinterpretation) of *The Prince*, especially by the Corsican rebellion in the 18th/19th century and the Austrian painter in the 20th century, indirectly caused a great deal of "volatility".

Price revolution in 16th century Europe

Changes in price levels in the 16th century profoundly affected every economic sector but in ways that are disputed. The period witnessed general inflation, known traditionally as the "price revolution". It was rooted in part in frequent monetary debasements; the French kings, for example, debased or altered their chief coinage, the *livre tournois*, nine times in the 16th century. Probably even more significant was the infusion of new stocks of precious metal, especially silver, into the money supply. New sources of silver and new numbers of people thus launched pervasive inflation. According to one calculation, prices rose during the century in nominal terms by a factor of six and in real terms by a factor of three. The price revolution by itself did not assure capital accumulation and the birth of capitalism but it did clearly penalise the inactive and bring about increased outlays of entrepreneurial energy. UK prices rose by nearly 400% over the century.[1]

Europe – 17th century: Dutch trade tulip bulbs

Seventeenth-century European finance was a study in contrasts. The wars, the excessive loans, the inflation, and the defaults of the late 16th century brought the Crowns of Spain and France, and with them their great Italian and German bankers, to financial ruin. At the same time, the new Dutch Republic won its independence from Spain, achieved a trading empire, fought the British, and developed the high modern standards of state credit. The Amsterdam Exchange, brought indoors in 1613, at first dealt largely in shares, such as those of the Dutch East India Company. The Dutch of the 17th century even "invested" in tulip bulbs – an episode in finance most often associated with the first "derivatives disaster".[2] UK price inflation was only 50% for the century, which compares with around 5,920% for the 20th century.

Europe – 18th century: Amsterdam as the financial epicentre of Europe

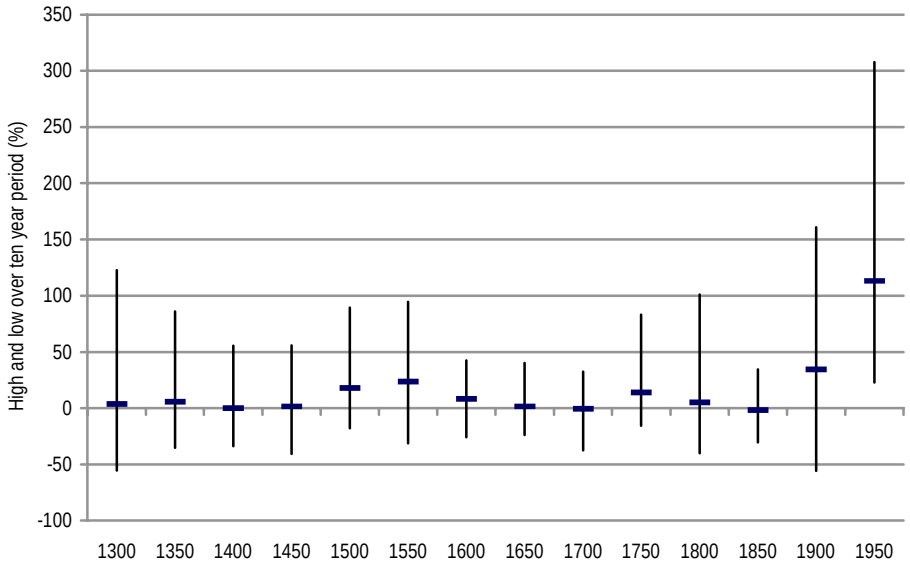
The Dutch had fought successfully against Spain, France and England. Amsterdam had become the financial centre of Europe. Larger countries developed their own shipping and ports. In their military partnerships with England, the Dutch inevitably became the junior partner. Therefore, the Dutch turned gradually from trade to finance. However, there were recurrent crises of over-speculation, which eventually sapped confidence in Amsterdam. A larger, more stable money market was developing in London, which at the end of the century displaced the Amsterdam market. In 1998, the AEX was the sixth largest derivatives exchange in the world. The stock exchange ranked ninth, based on market capitalisation of domestic equity at the end of 1998.

For England the 18th century was a century of growing economic and political strength at home and abroad. It was also regarded as a century of speculation as a large number of companies were promoted, and trading was active in their shares (Homer 1996). By 1763 England had, for the time being, reached the summit of her power. There followed 50 years of crisis and disaster: the loss of the American colonies in the War of Independence, 1775-83, the shock of the French Revolution, 1789, and the wars with France, which continued intermittently from 1793 until

[1] 400% over 100 years is actually only 1.6% per annum. This compares with 4.2% per annum for the 20th century.

[2] We will come back to "tulip mania" in a further chapter.

Chart 3: Ten-year high, low and mean of UK price inflation



Source: WDR (data from Global Financial Data)

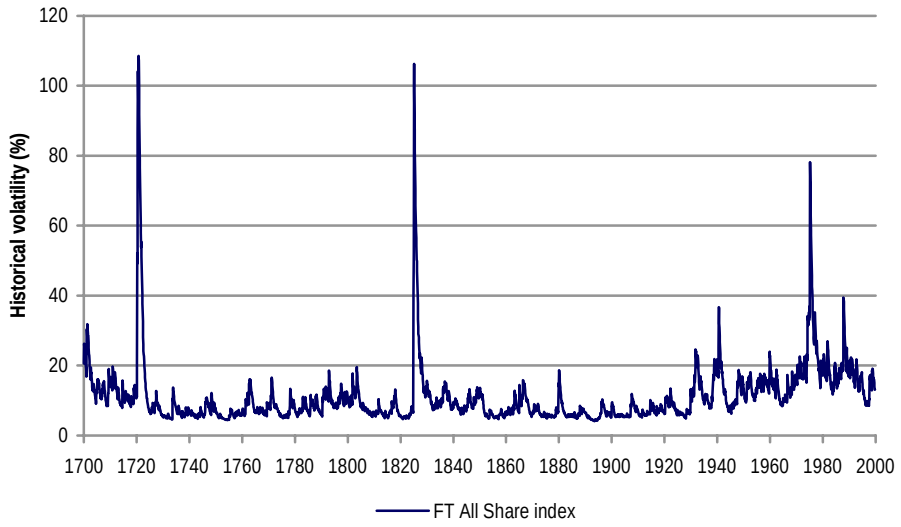
Graph shows 10-year high, low, and mean from 1300 until 1999 in 50-year time buckets.

1815. According to our data, UK prices were stable during the French revolution of 1789. When the 700 years of UK inflation data are segmented in 50-year periods, and ranked according to the difference between the most extreme 10-year inflation and 10-year deflation figure, then the first half of the 18th century is ranked 11th and the second half eighth respectively. Based on this analysis, the most extreme 50-year period is the most recent one followed by the 1900-49 period (Chart 3).

South Sea Bubble and Mississippi Bubble

The bursting of the South Sea Bubble in 1720 is one of the few financial disasters in history where historians do not – in one way or another – blame derivatives. The South Sea Bubble grew out of a scheme, backed by the government, to persuade the holders of almost all the new government debt to exchange their government obligations for shares in a semi-official trading company, the South Sea Company, which would hold the government debt. These shares stood at very high premiums, so that debt holders who seemed to be gaining a big premium by accepting the exchange were in reality parting with half or more of their investment. South Sea stock appreciated in 1720 from £128 to £1,000 a share. At such prices half of the government debt was exchanged for South Sea stock. By November 1720 the bubble had burst and South Sea stock was back to £135. As a result, the Chancellor of the Exchequer was imprisoned and the "Bubble Act" was passed, which restricted the formation of new companies. In the same year, in France, the Mississippi Bubble burst. For a more detailed analysis of these events we recommend Mackay (1980).

Chart 4: Long-term historical volatility for FT All-Share index



Source: WDR (data from Global Financial Data)

The graph shows historical volatility for the FT All-Share Index, which was developed with a base value of 100 as of 10 April 1962. The historical volatility is from a Garch (1,1) model based on monthly returns. The back calculations are derived from various sources. See Appendix for details.

Repeal of Bubble Act of 1825

Between September 1711 and January 1811 the index is based on the East Indies and South Sea stock, which explains the extreme spike in historical volatility around 1720. The second spike in historical volatility was in 1825 when the "Bubble Act of 1720" was repealed and the first railway was built. The Bubble Act of 1720 had restricted joint stock promotions, which led to widespread "projecting" of new companies. Note that the volatility spike in 1825 was caused by mushrooming share prices whereas the spike in 1720 was caused by falling prices. We have added the price level of the index and more detail of its construction to the Appendix of this report.

Kindelberger (1989) quotes Hyman Minsky as proponent of irrationality:

> "In an earlier day, such waves of excessive optimism (perhaps followed by excessive pessimism) might have been tied to sunspots or the path through the heavens of Venus or Mars. In Minsky's formulation they start with a 'displacement', some structural characteristics of the system and human error. Some event increases confidence. Optimism sets in. Confident expectations of a steady stream of prosperity and gross profits make portfolio plunging more appealing. Financial institutions accept liability structures that decrease liquidity, and that in a more sober climate they would have rejected. The rise is under way and may feed on itself until it constitutes a mania."

We wonder whether the same for the "internet bubble" will be said one day.

Europe – 19th century: *Thus Spake Zarathustra*

The German individualistic moralist, Nietzsche (1844-1900), wrote *Thus Spake Zarathustra* (1883-91) and *Beyond Good and Evil* (1886). Nietzsche regarded Christian civilisation as decadent and in place of "slave morality". He looked to the superman, the creator of a new heroic morality that would consciously affirm life and life values. That superman would represent the highest passion and creativity,

and would live at a level of experience beyond the conventional standards of good and evil. His creative "will to power" would set him aside from "the herd" of inferior humanity. As with the writings of Machiavelli, there is an indirect link to *volatility* in the 20th century. Nietzsche's thought had widespread influence but was of particular importance in Germany. Apologists for Nazism seized on much of his writing as a philosophical justification for their doctrines but most scholars regard this as a perversion of Nietzsche's thought.

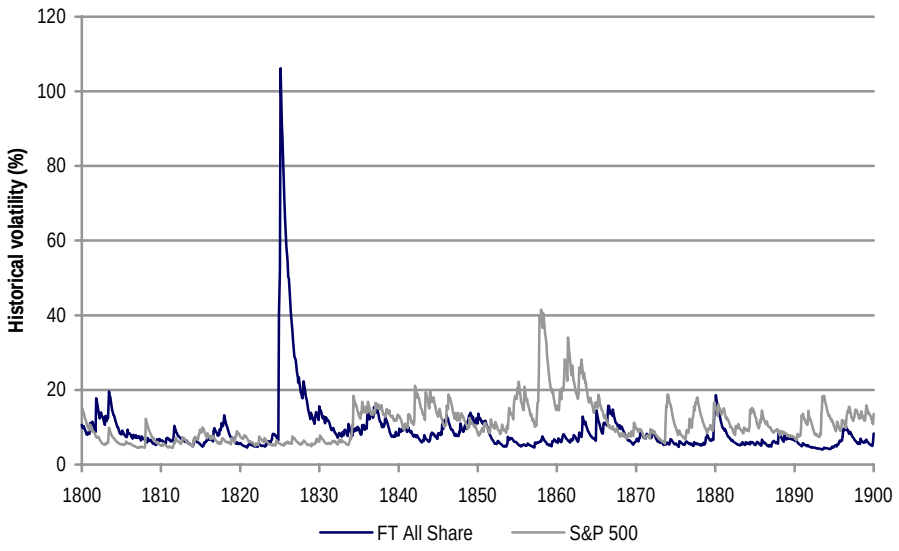
Erratic first half of the 19th century

The first half of the 19th century was the fourth most erratic with respect to UK consumer price volatility, only the 20th century and the first half of the 14th century being more extreme. Nearly every decade had a financial crisis. The UK CPI index, for example, fell by 40% between 1800 and 1850. In England the century, overall, was one of rapid economic growth, hard money and declining interest rates. The Industrial Revolution ran its full course. Railroads and factories transformed the economy, and the population quadrupled. After Waterloo, 1815, this was a century of relative peace. The volatility was derived from financial crises and less from political events. In the early years of the peace, Britain suffered a severe economic depression with falling prices and interest rates, and rising unemployment. In 1827 there was a crash which eliminated 400 out of 600 companies. Another one occurred in 1866.

London is Europe's new epicentre but for how long?

British wars after 1815 were small, brief and victorious. British supremacy was generally acknowledged. The Dutch had been eliminated as major commercial and financial rivals. The United States, united after the Civil War, was on its way to becoming a world power. Germany under Bismarck expanded rapidly geographically as well as economically after the Franco-Prussian War. Post-Napoleon France did not enjoy the same political stability of England, suffering two military disasters (Waterloo in 1815 and the Franco-Prussian War in 1870) and two revolutions (1830 and 1848). However, France managed great economic growth

Chart 5: UK versus US historical volatility in the 19th century



Source: WDR (data from Global Financial Data)

and ended the century as a worldwide empire, with an efficient banking system, great financial resources and a modern industrial basis. The Swiss kept their political and financial affairs local (similar to today, when judged by the rhetoric of one expanding political party).

US volatility was high during the Civil War

In the US, intense political rivalry and fierce financial competition were inseparably interconnected throughout the second half of the 19th century, during which the US finally grew into a world power, which was achieved without the benefit of central banking (Davies 1994). American's citizens decisively rejected the steps which were taken towards a sounder, more disciplined and centralised banking system. They favoured *laissez-faire* instead. After 30 years of such chaotic freedom, opinion was slowly swinging back towards greater discipline and uniformity when the outbreak of war, as it usually does, forced the pace of change. The American Civil War required a rapid transfer of resources from diffused and decentralised civilian expenditure to concentrated and centrally-controlled military expenditure, via some combination of taxing, borrowing and printing money. The mixture actually chosen differed so markedly between the Unionists and the Confederates as to offer the most instructive lessons of how governments can use and control money or abuse it and capitulate to inflation.

Volatility between markets was not correlated as it is today

Markets were not as integrated in the 19th century as they are today. Volatility was primarily driven by local events. There were no real global events before the First World War which correlated volatility between markets.[3] As noted previously, volatility in Europe was high in the early 19th century due to wars and revolutions. Volatility spiked in the mid-1820s due to a bull market. In the US, volatility was high during the Civil War.

In the following section we will be looking at aspects of volatility and later derivatives in the 20th century.

[3] One could argue that meteorological disasters, for example, the meteor impact off the Yucatan coast 60m years ago (mesozoic era), which evidently has led to a recent theory that global climate changes accounted for the extinction of dinosaurs, were global events and would have correlated volatility in 'markets'. However, the prologue of this report only covers the period starting in1294.

Markets in the 20th century

Overview

The greatest sources of risk to equity investors in the 20th century were price instability and resulting financial crises, wars, expropriations and political upheavals. With respect to price volatility, the 20th century was the most extreme by a wide margin.

Table 1 compares average stock returns and their standard deviation to some global equity markets in this century. Percentage returns are in real terms, deflated by the wholesale price index.

Table 1: Return and risk of global equity markets

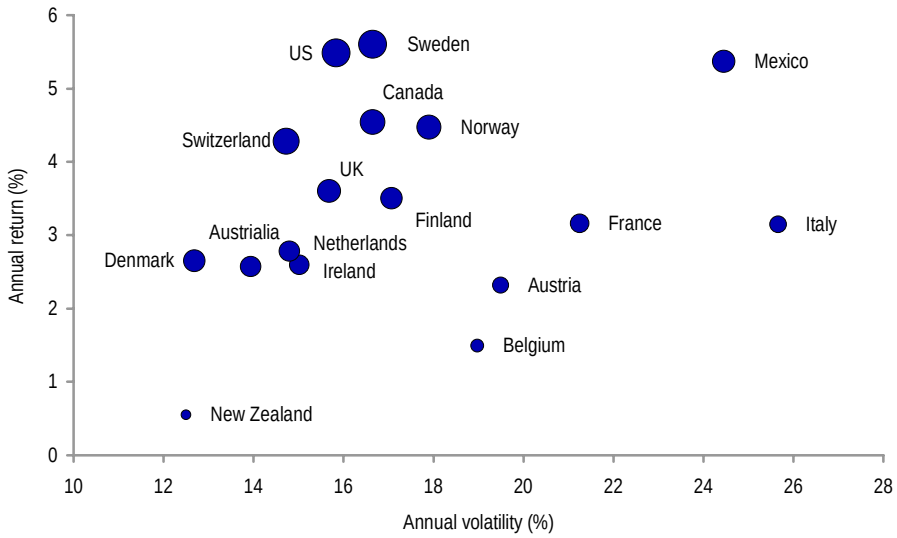
		Real return (%)		Risk/
Country	Period	Average	Volatility	return ratio
Equally weighted average		3.62	17.75	0.20
US	1921-96	5.48	15.84	0.35
Canada	1921-96	4.54	16.65	0.27
Mexico	1934-96	5.37	24.45	0.22
Austria	1925-96	2.32	19.49	0.12
Belgium	1921-96	1.49	18.97	0.08
Denmark	1926-96	2.65	12.69	0.21
Finland	1931-96	3.50	17.07	0.21
France	1921-96	3.16	21.25	0.15
Germany*	1921-96	7.25	21.82	0.33
Ireland	1934-96	2.59	15.02	0.17
Italy	1928-96	3.15	25.66	0.12
Netherlands	1921-96	2.78	14.80	0.19
Norway	1928-96	4.47	17.90	0.25
Portugal*	1930-96	6.06	24.64	0.25
Spain	1921-96	-0.51	16.00	-0.03
Sweden	1921-96	5.60	16.65	0.34
Switzerland	1926-96	4.28	14.73	0.29
UK	1921-96	3.60	15.68	0.23
Australia	1931-96	2.57	13.94	0.18
New Zealand	1931-96	0.55	12.50	0.04
Japan*	1921-96	5.13	17.04	0.30

Source: WDR (data from Jorion 1999)

The arithmetic average return is obtained from the monthly average multiplied by 12; the standard deviation is annualised by multiplying the monthly volatility by the square root of 12. Series with breaks are marked by *.

There are some limitations as to the comparability of the data presented in Table 1. Some countries have breaks: Germany and Japan due to wars, and Portugal due to the takeover of the leftist junta in April 1974. Jorion (1999) identified 25 such breaks. Most breaks in data are of a global nature, such as the Second World War, or the depression of the early 1930s. A number of breaks, however, are country-specific, involving a banking crisis or political turmoil (Argentina 1965, Chile 1971 and Portugal 1974). Chart 6 compares risk with return for those countries where there are no such breaks in the data.

Chart 6: Risk and return of global equity markets



Source: WDR (data from Jorion 1999)

Bubble size measures risk/return ratio. Graph excludes Spain (negative risk/return ratio), Germany, Portugal and Japan (break in data). Note that the graph is misleading in a sense that the return data is based on different starting points between 1921 (most markets) and 1934.

The US and Swedish stock markets were the best in terms of risk adjusted returns

Based on this analysis, the US and Swedish stock markets were the best in terms of real risk-adjusted returns. Both countries avoided major upheavals in this century. The volatility of both markets is not high when compared with other markets. Therefore, the high returns obtained in these markets do not seem to compensate for higher risk as measured by volatility. This obviously rises the question whether the volatility (annualised standard deviation of returns) is an appropriate measure for risk.

Wars and price instability are the greatest source of risk

By analysing price volatility from 1300 to date we have showed that the 20th century was the most extreme. Most erratic price changes (deflation in the 1930s and inflation in the 1970s) occurred in the past 100 years. In addition, there were two world wars, which, in many aspects, were unmatched in written human history.

Second World War

The advent of the Second World War led to a sharp fall of about 20% in the value of equities of allied countries (including the US, Canada and the UK). Neutral countries (Sweden and Switzerland) suffered a similar fall. Germany, Italy and occupied countries, in contrast, registered steady gains. However, the gains were wiped out later as stock prices started to reflect transaction prices (prices were kept artificially high) and as inflation became apparent. Japanese equity fell by 95% in real terms in the post-WWII area from 1944-49 during which there was no trading. Germany lost around 84% in real terms during the period 1944-50.

Table 2: Nominal stock market returns by decade (local currency)

(%)	1900s	1910s	1920s	1930s	1940s	1950s	1960s	1970-79	1980-89	1990-98
Argentina								85,389	590,837,997	2,327
Australia	94	31	102	46	49	118	110	13	230	71
Austria				-41	113	474	44	23	291	-9
Belgium			133	-59	185	158	-1	13	256	141
Brazil							11,814	1,203	111,279,332	101,023,000
Canada			130	-35	28	123	84	78	119	82
Chile				63	73	1,843	582	6,766,359	1,291	493
Colombia				4	59	32	47	160	160	1,482
Denmark			-45	-2	21	75	24	40	534	76
Finland				44	119	464	60	109	594	263
France	16	49	238	-43	734	476	15	37	416	86
Germany	3	-89	132	-7	-34	848	49	-20	260	97
Greece							501	75	380	497
Hong Kong								466	223	254
India			-56	35	5	23	8	53	556	292
Ireland					54	15	175	109	400	183
Israel						188	92	1,088	167,715	116
Italy		-4	0	20	1,067	385	-1	-45	734	480
Japan			-60	111	144	696	170	179	492	-64
Luxembourg				-78	118	94	51	411	134	178
Mexico				-9	39	98	-10	675	34,986	845
Netherlands			-50	-33	107	167	31	2	263	262
New Zealand				-11	37	52	135	9	458	4
Norway			-48	48	76	47	-8	37	362	23
Pakistan							47	56	159	58
Peru				33	16	77	-34	247	1,936,542	3,371,700
Philippines							78	60	155	77
Portugal					51	62	43	-35	1,829	67
Singapore								192	241	-1
South Africa Gold	-7	-18	-42	346	282	-26	-15	595	299	194
South Africa Industrials		137	39	38	91	-21	252	63	506	126
South Korea								625	665	-38
Spain	11	-9	67	-22	65	128	258	-48	644	192
Sweden			13	-37	59	187	56	28	1,162	163
Switzerland		-44	42	-16	58	142	38	-4	99	121
Taiwan								397	1,651	-60
UK	-8	-18	25	-32	1	175	46	56	424	122
US	71	-15	146	-42	34	257	54	17	227	248
Venezuela				9	40	25	17	19	857	3,688

Source: Global Financial Data

The table provides decade-by-decade performances for all the world's major stock markets. Data for the 1930s, for example, shows the increase in the domestic market's stock index between December 1929 and December 1939. All data is in nominal terms in the local currency. The problem with this type of international comparison is that countries have had significantly different inflation rates during the 20th century, making direct comparisons of returns more difficult. Table 3 on page 16 takes inflation into account.

Turn of decade occasionally marks turning point

One drawback of comparing stock markets at the end of each decade is that this approach ignores the fluctuations which occur within each decade. Stock markets have had swings of several hundred per cent within a decade, even when the index remained virtually unchanged during the decade. Nevertheless, in many cases the ends of decades have coincided with important turning points in financial and political history. Nineteen nineteen marked the end of World War I and the adjustments which followed. Nineteen twenty nine saw the end of Wall Street's great bull-market run and the beginning of the Great Depression. Nineteen thirty nine saw World War II begin. By 1949 countries were clearly aligned in the capitalist and communist camps, and currencies had stabilised after the devaluations of 1948-49. Many of the world's stock markets hit their lows in 1949 and rose steadily throughout the 1950s. Paul Volker was elected Federal Reserve chairman in 1979 and began killing the inflationary beast. And 1989 marked the final "blow-off" in the Japanese bubble and the beginnings of the last worldwide bear market. Nineteen ninety nine, perhaps, will go down in history as the start of the great Internet-led bull-market.

Political upheaval and expropriations were one of the main contributors to volatility in the 20th century

Argentina: 1960s

The Buenos Aires Stock Exchange, the oldest in Latin America, virtually disappeared as a result of inflation and interest rate policies in the late 1960s; reportedly, investors *lost* all interest in the market.

Chile: 1970s

The 1970s saw great volatility in Chile. In contrast to other political interruptions, most of the loss sustained by the Chilean stock market occurred before the interruption. The market lost 54% in the year to April 1971 during the Allende ascent to power but then increased by 62% after the 1971-74 Allende-era as the military junta reversed the socialist policies of the Allende government.

Portugal: 1970s

The Portuguese stock market, which closed in April 1974 as a military junta took over the country, re-opened in March 1977. Stock prices suffered a fall of 86% in real terms during the interruption.

The main lesson from long-term data analysis is that global capital markets have been systematically subject to dramatic changes over this century (Jorion 1999). Major disruptions have afflicted nearly all markets with the exception of a few, such as the US. This shows that the 4.3% real capital appreciation return on US stocks is rather exceptional as other markets have typically grown at 3.4%. Note that US$100 grown at 4.3% over a century results in an end value of US$6,736. At 3.4% the end value is US$2,832.

The equity premium puzzle

The fact that equities outperformed bonds in the past...

The term *equity premium puzzle* (or equity risk premium puzzle) refers to the puzzlingly high historical average returns of stocks relative to bonds introduced by Mehra and Prescott (1985). The authors show that standard general equilibrium models cannot explain the size of the risk premium on US equities, which averages 6% over the 1889-1978 period. Siegel (1992) points out that the US equity premium has been particularly high this century. In 1872 investors did not universally expect the US to become the greatest economic power in the next century.

Table 3: Real stock market returns by decade (US$)

(%)	1900s	1910s	1920s	1930s	1940s	1950s	1960s	1970-79	1980-89	1990-98
Argentina								86	50	55
Australia	94	2	141	2	-7	144	115	12	134	33
Austria				-21	-66	635	43	156	297	-5
Belgium			-32	-51	-66	160	0	101	173	189
Brazil							396	37	351	186
Canada			146	-43	29	165	63	60	125	23
Chile				-46	-58	89	-52	2,351	92	200
Colombia				-39	-3	-46	-47	13	-73	480
Denmark			-22	-30	-33	136	14	94	406	87
Finland				4	-67	482	33	136	525	195
France	16	-28	44	-67	-5	363	-2	98	249	108
Germany	4	-89	133	55	-72	1,271	69	71	255	95
Greece							472	36	23	241
Hong Kong								598	103	257
India			-65	12	-33	-8	-32	87	252	56
Ireland					-7	33	136	89	252	179
Israel						-30	3	55	182	197
Italy		-62	-32	-38	-35	421	-3	-57	418	70
Japan			-61	1	-98	1,080	188	336	889	-55
Luxembourg				-75	-74	96	52	806	79	-40
Mexico				-66	-13	38	-10	325	197	158
Netherlands			-47	-12	-6	194	36	94	252	280
New Zealand				37	4	64	70	11	245	-8
Norway			-33	25	-16	90	-8	96	243	56
Pakistan							0	30	48	-26
Peru				-42	-59	4	-60	58	65	509
Philippines							12	-88	-13	6
Portugal					46	63	41	-65	572	118
Singapore								315	286	-36
South Africa Gold	-7	-36	-26	266	138	-18	-18	543	26	-81
South Africa Industrials		85	76	13	20	-12	242	51	92	-1
South Korea								362	550	-65
Spain	32	-2	18	-23	-75	79	207	-46	357	132
Sweden			41	-44	3	261	53	63	732	44
Switzerland		-47	49	-3	64	141	38	159	102	245
Taiwan								456	2,379	-46
UK	-8	-36	60	-45	-39	224	25	45	276	131
US	71	-15	146	-42	34	257	54	17	227	248
Venezuela				76	34	25	-13	24	-4	189
EAFE Index			15	-24	-21	217	47	76	496	34
World Index			42	-30	-6	230	50	31	334	103

Source: Global Financial Data

All figures are percentage US$ returns for each decade for which data are available.

... could be a misinterpretation of the facts or a misleading indicator for the future

Rietz (1988) proposes a solution to the puzzle that involves infrequently occurring "crashes", ie, the small positive probability of important events affecting market prices. In fact, this problem is akin to the "peso problem" in the foreign exchange market, where peso forward rates appeared to be biased forecasts of future spot rates over short sample periods, essentially because they account for a non-zero probability of devaluation that is not observed. More generally, peso problems can be interpreted as a failure of the paradigm of rational expectations econometrics, which requires that the ex post distribution of endogenous variables be a good approximation to the ex ante distribution that agents think may happen. The failure may not be that of the investor but that of the analyst, who analyses series with continuous histories. Unusual events with low probability of occurrence but severe effects on prices, such as wars and nationalisations, are not likely to be well represented in samples and may be totally omitted from survived series.

Estimates of risk based on historical data could lead to underestimation of future uncertainty

A related point has been made by Brown, Goetzmann and Ross (1995). These authors argue that financial economists concentrate on the US stock market precisely because it has survived and grown to become to the world's largest market. In some markets (Russia, Argentina), investors have had all their wealth expropriated and so there is no continuous record of market prices. If this survivorship is important, estimates of average US stock returns are biased upwards.

We wonder whether it is wise to take the equity premium for granted, ie, extrapolate the past into the future (see page 98).

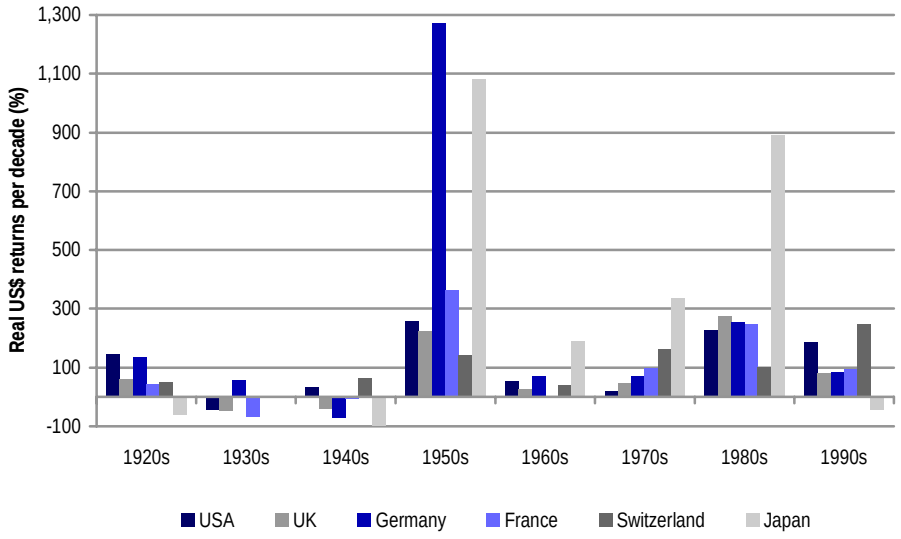
Stock market risk and return in the 20th century

Summary

The 1950s and 1980s were the best

The two best decades of this century for stock markets were the 1950s and 1980s. Not only were the returns high in each country but the number of stock markets which provided significant returns was also high. All of the OECD country stock markets provided positive returns in the 1950s and 1980s. During the 1950s, the political and economic chaos, which had continued in one form or another since 1914, finally ended, and stock markets recovered and advanced significantly. The 1980s saw a worldwide battle to end inflation and lower interest rates, which had been keeping the world's economies from achieving high rates of growth in the 1970s. Of the two decades, the 1980s provided the best returns to investors because bonds were in a bear market in the 1950s but in a bull market in the 1980s. Although investors could profit from rising stock markets in the 1950s, fixed-income investors lost money in the 1950s.

Chart 7: Real US$ returns per decade for major markets



Source: WDR (data from Global Financial Data and Datastream)

The 1990s show the real price returns in US$ for the broad domestic index until August 1999.

The 1910s and 1930s were the worst decades for equities

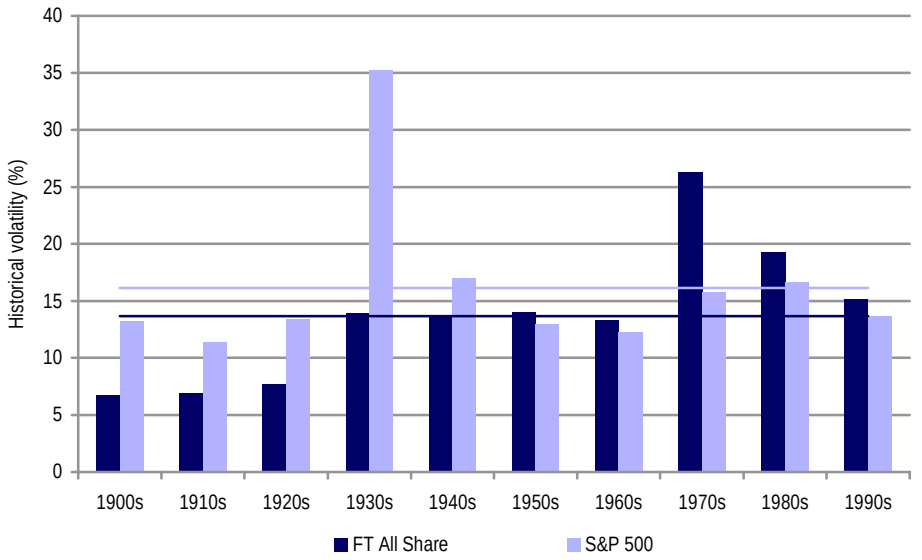
The two worst decades of this century were the 1910s and 1930s. The combination of economic and political chaos reduced corporate profits, created uncertainty and produced negative returns in almost every country. In both decades, the only countries which provided the opportunity for strong returns were countries such as South Africa and Australia in which commodities played an important role in their output. Industrial stock markets all suffered.

High correlation of long-term returns

Since global events shaped the 20th century, the large 10-year swings per calendar decade are somewhat correlated. The 1950s and 1980s were good decades for all major markets. This is probably little comfort to a domestic investor in Bogota where the market in the 1950s and 1980s lost 43% and 73% in real US$ terms.

Chart 8 shows average monthly historical volatility for the UK and US stock market by decade.

Chart 8: UK and US historical volatility by decade



Source: WDR

Long-term average historical volatility is around 14%

Average historical stock volatility for the UK and US stock markets was 13.7% and 16.1% respectively (vertical line in Chart 8) in the 20th century, and 11.4% and 13.5% respectively over a 200-year period. Average US historical volatility for the 20th century excluding the 1930s was 14.0%, ie, similar to average UK historical volatility of 13.7%. Note that the 1990s were of average volatility in the UK and slightly below average in the case of the US stock market.

Secular stock market trends

Do equities move in 30-year cycles?

Investors might ask whether there are important secular stock market trends for the world's stock markets. The 1920s, 1950s and 1980s all provided opportunities for strong, positive returns to investors. Does this provide evidence for a 30-year cycle in world stocks, which should repeat itself in the 2010s? Not necessarily. Both the 1920s and 1950s allowed economies to rebuild from the devastation of World Wars, providing positive returns to investors; and the 1980s' high returns came from the worldwide attack on inflation, which had occurred during the 1970s, and the concerted effort to free most countries' economies from government regulation. Moreover, going back to the 1800s, the 1890s did not provide spectacular returns to investors. With the exception of the UK (40%) and France (20%), none of the world's stock markets provided more than a 10% rate of return during the 1890s. A coincidence of events seems to drive this cycle more than any underlying, recurring factor.

A bear market every 30 years?

There is also evidence for a secular cycle of negative returns. The 1910s, 1940s and 1970s were all periods of high inflation during which returns to investors often were negative in real terms, though positive in nominal returns. Is this pattern likely to repeat itself in the next decade, the 2000s? Again, the evidence is as much correlated as causal. The 1910s and 1940s were inflationary because of World Wars I and II, and the primary cause of inflation in the 1970s was commodity price increases and a preference for Keynesian pump-priming over inflation fighting in most developed countries. Moreover, if one goes back to the 1880s, this was a

deflationary decade for almost every major world economy and not a period of inflation. Again, a coincidence of events seems to be more important than recurring, causal factors.

Which were the best and worst countries to invest in during each decade?

Table 4: Best and worst performing markets per decade

Decade	Best	Return (%)	Worst	Return (%)
1900s	Australia	93.9	UK	-8.1
1910s	South Africa	85.3	Germany	-89.1
1920s	US	146	Japan	-61.4
1930s	South Africa Gold	266.4	France	-67.5
1940s	South Africa Gold	138.2	Japan	-98.2
1950s	Japan	1,078.2	Colombia	-45.8
1960s	Greece	472.4	Chile	-51.7
1970s	Chile	2,350.8	Italy	-57.3
1980s	Taiwan	2,379.1	Colombia	-73.1
1990-1995	Peru	923.5	Taiwan	-52.5
1990-1999*	Finland	883.0	Indonesia	-66.9

Source: WDR (data from Global Financial Data and FactSet)

* From 1 January 1990-7 December 1999

Note that South Africa has been a good counter-cyclical investment during periods of low returns in the rest of the world. Most investors will be surprised that Japan and Germany were among the world's worst performers at different times prior to World War II. Table 4 provides information on which of the world's major stock markets had the best and worst performances during each decade. Data for the 1990s includes the period 1990 to 1995. All returns are in nominal dollars.

In the following section, we look at global stock markets in general and volatility in particular in the 20th century. The reader of the following pages might get the impression that the author is morosely apocalyptic. He is not. But focussing the discussion on volatility brings with it the analysis of events which are unpleasant. Although the rational economic agent defines risk as the standard deviation of returns, the human being associates risk with loosing money. On page 47 we start looking at derivatives.

Ten different decades

This chapter draws on material from Tayler (1996). Long-term index data is from Global Financial Data. The volatility graphs show historical volatility for the back-calculated FT All-Share and S&P 500 index, each with a 100-year moving average of historical volatility. The small price charts show the price index in local currency where the beginning of the decade was indexed to 100.

The 1900s: A calm start to the 20th century

Century started with low volatility

The 1900s were a period of limited volatility in both stock and bond markets. Bond prices dropped gradually between 1900 and 1910, increasing yields on government bonds to a small degree in most countries. In stocks, both the US and Australia showed significant gains of 71% and 94% respectively although European markets showed little change. By the time the decade had ended, France and Germany were up slightly, and London and South African gold stocks were down slightly.

Within these trading ranges, there were rallies to profit from and bear markets to avoid. The major stock market bottoms occurred in 1900, 1903 and 1907 in the US from which bull markets with gains in excess of 50% occurred before all of the gains were lost in the bear markets which followed. European markets saw significant stock market tops in 1900, and whereas the French and German markets generally trended upwards after 1903, the London and Italian markets followed a pattern of lower lows and lower highs throughout the decade.

The most striking aspect of the world's stock markets in the 1900s decade is the relative lack of volatility. Even when bull and bear markets occurred, the stock market moves were small by comparison with changes in other decades. The most important event of this decade was simply the expansion in the world's stock markets, rather than their percentage gains and losses. Shares in corporations, rather than government and corporate bonds, became the focus of stock market activity and by the end of the decade, the Berlin, Paris and London stock exchanges traded hundreds of shares. However, this decade was truly the lull before the storm. From

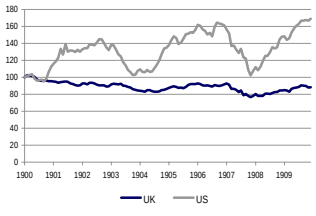
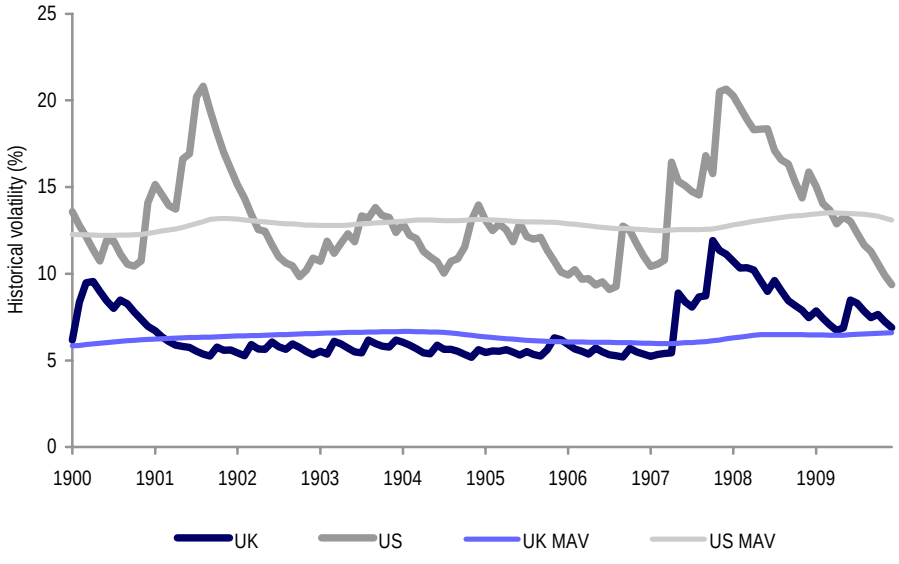


Chart 9: UK and US historical volatility during the 1900s



Source: WDR

the onset of World War I until the stabilisation of the international economic and political world at the end of the 1940s, volatility was the rule in share prices and stability the exception.

The 1910s: The worst decade

Worst decade this century

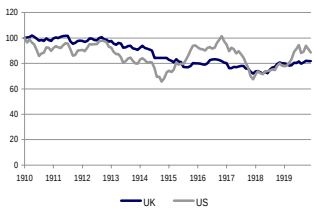
The 1910s were one of the worst decades for investors this century. This decade struck investors from two sides: first, most stock markets showed nominal declines in share prices; and second, triple-digit inflation for the decade deepened these losses significantly. Whereas some stock markets recovered from the bear market of the early 1930s and were able to show gains for the rest of the decade, the bear market which began prior to the onset of World War I continued for the rest of the decade. The only stock market which showed significant, positive returns during the 1910s was the market for South African Industrial shares; however, international investment in South African industrials was almost non-existent at this point in time and investors would have been more likely to invest in South African mining shares, which declined during the decade.

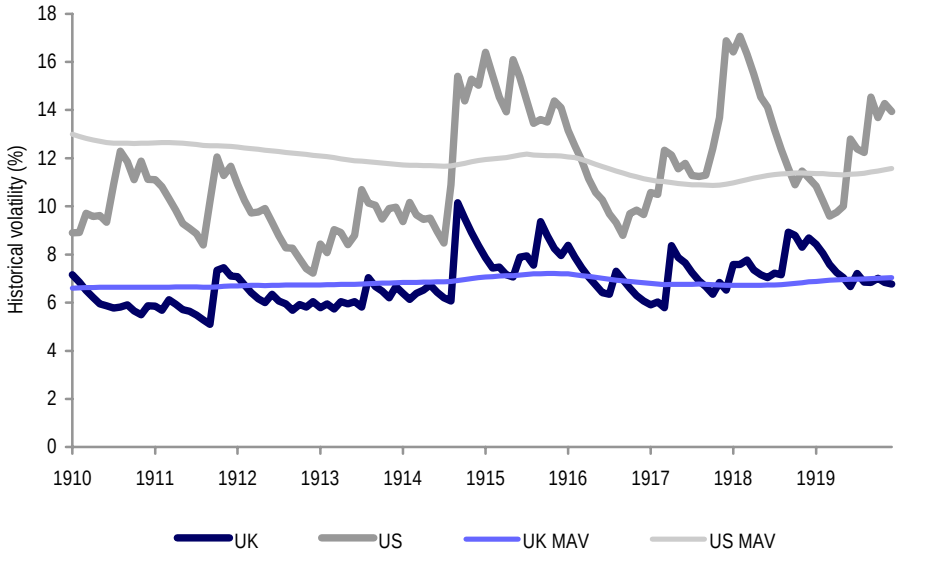
The printing of money caused high inflation

The reasons for this decade's dismal performance are easy to find. Because of the war, domestic profit opportunities were limited due to government controls over almost all areas of economic life and the war kept companies from taking advantage of international investment opportunities. Governments were unable to raise enough money through taxes to pay for the war, so they printed money to pay for their expenditures causing triple-digit inflation in most countries for the first time since the Napoleonic Wars. Measured in real terms, no world stock market increased in value between 1910 and 1920. In the US, for example, not only did the stock market fall in value by 15% between 1910 and 1920 but consumer prices increased by 103%. Keeping up with inflation was impossible, even if one reinvested dividends.

Both the US and London generally declined from 1910 until 1918 with rallies

Chart 10: UK and US historical volatility during the 1910s





Source: WDR

beginning in 1915 and 1918. Most stock markets on the continent which did re-open, bottomed in nominal terms in 1915 or 1916 and rose thereafter; however, since share prices rose less than consumer prices, shares were declining in real terms. Shares in neutral countries, such as Sweden and Switzerland, declined throughout the war.

Nowhere to hide

European share prices declined in Paris (-28%), London (-36%), Zurich (-46%), Milan (-61%) and Berlin (-89%). There was nowhere to hide. If one chose bonds rather than stocks, one would have lost money; if one put money in cash, inflation would have eaten away at the purchasing power and though commodity prices increased, the price of gold was controlled by governments. Even if one had put everything in silver, which did increase in price, one would still have barely kept up with inflation. Buy-and-hold was not a workable strategy.

Most exchanges were closed during WWI

There was little correlation between stock markets during the 1910s. Each stock market's performance depended on how the war was affecting domestic earnings. This low correlation was repeated in the 1940s for similar reasons. The war closed many stock exchanges. All European stock markets and the US stock market closed when war erupted in July 1914. The US market opened in December 1914 and the London market enjoyed a limited opening in January 1915 but the Berlin bourse did not re-open until December 1917.

When diversification does not work

Although little recognised today, it should be the memory of 1914 and not 1929 which strikes fear into investors' hearts. The combination of high inflation, government regulation and economic controls, limits on international trade and stock market closures provided a lethal combination from which no investor could escape. No matter in which country investors put their money, no matter which financial assets they purchased, no matter when they invested their money, losses were almost inevitable. The concept of negative correlation through the use of financial derivatives was not yet known.

The 1920s: Bubble and burst

The 1920s bull market ended with the 1929 crash

For most investors, the 1920s mean one thing: a roaring stock market bubble throughout most of the decade and a stock market crash in October 1929, which was followed by the worst bear market of the 20th century.

The 1920-23 bear market was one of the worst

The 1920s were not a period of easy profits for investors throughout the world. Although most of the world's stock markets saw increases in share prices during the 1920s, there were also a number of markets, especially in northern Europe, which saw significant losses. It should be remembered that the bear market which followed World War I between 1920 and 1923 was one of the three worst bear markets of this century, equalled only by 1929-32 and 1973-74. Many European markets had steeper declines in share prices between 1920 and 1922 than they did between 1929 and 1932 – a fact which is not often appreciated.

The most significant returns occurred in Australia, Canada and the US, all of which saw increases in share prices of around 140% during the 1920s. Germany's market performed strongly during most of the 1920s but its bull market was a rally back from a devastating 90% decrease in share prices between 1918 and 1923. Even after a 133% increase in share prices, investors would have suffered significant losses

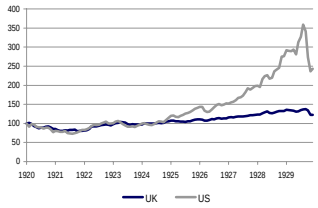
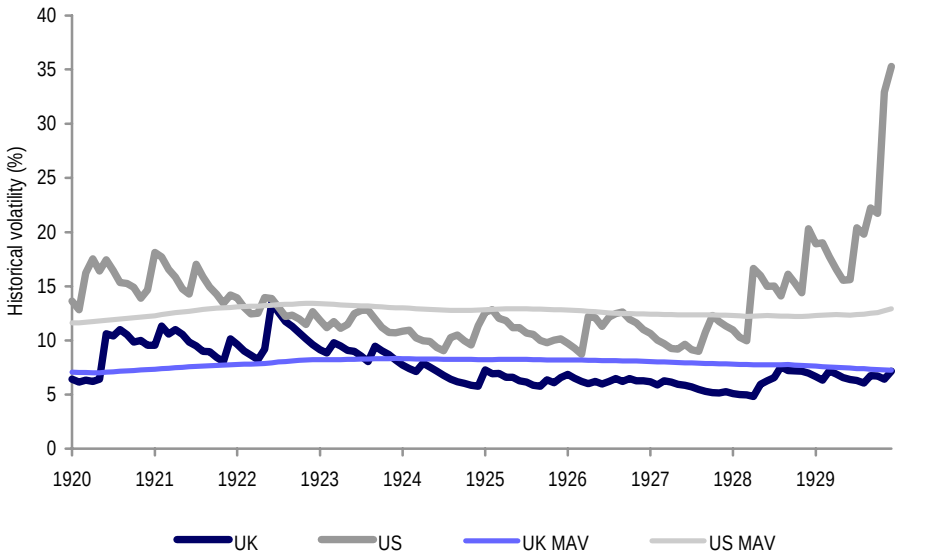


Chart 11: UK and US historical volatility during the 1920s



Source: WDR

had they invested in Germany before World War I. Other countries showed positive returns which failed to reach triple-digit proportions. Markets in France (44%), Sweden (41%), Switzerland (49%) and the UK (60%) all increased in value.

Not all markets participated in the 1920s bull market

Many European markets declined in value during the 1920s. Markets in Belgium (-32%), Denmark (-22%), Italy (-32%), the Netherlands (-47%) and Norway (-32%) all suffered real losses. Non-European markets performed poorly with declines in India (-65%), Japan (-61%) and South African gold shares (-26%). The primary reason these markets lost ground during the 1920s was that all of these markets suffered severe losses during the 1920-22 bear market and failed to significantly participate in the 1922-29 bull market.

Most of the negative returns during the 1920s came from countries which were tied to the German economy. All of them sold off sharply at the end of World War I and failed to recover for the rest of the decade. In fact, only four European stock markets (Belgium, France, Italy and Spain) hit higher highs in 1929 than they had hit in 1920. None of the stock markets in countries whose economies were tied to Germany hit higher highs in the 1922-29 stock market rally than they had hit in the 1920s.

Volatility was high during the two bear markets of the 1920s

Volatility was below mean levels for most of the decade. During the bear market at the beginning of the decade, volatility was high. Volatility spiked during the 1929 US crash.

The 1930s: The most volatile decade – so far

Worst decade for US investors

To most investors, the 1930s conjure up one image: the most devastating decline in American share prices since stock began trading in the US. The US stock market fell more than any other stock market in the world between 1929 and 1932. The Dow Jones failed to recover its 1929 high until 1954. Although some stock markets

rose in value, most declined, failing to recover from the steep sell-off of 1929-32.

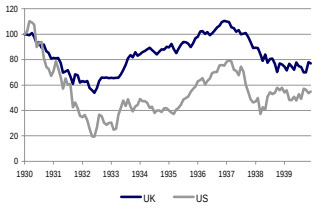
1930s were deflationary, 1910s were inflationary

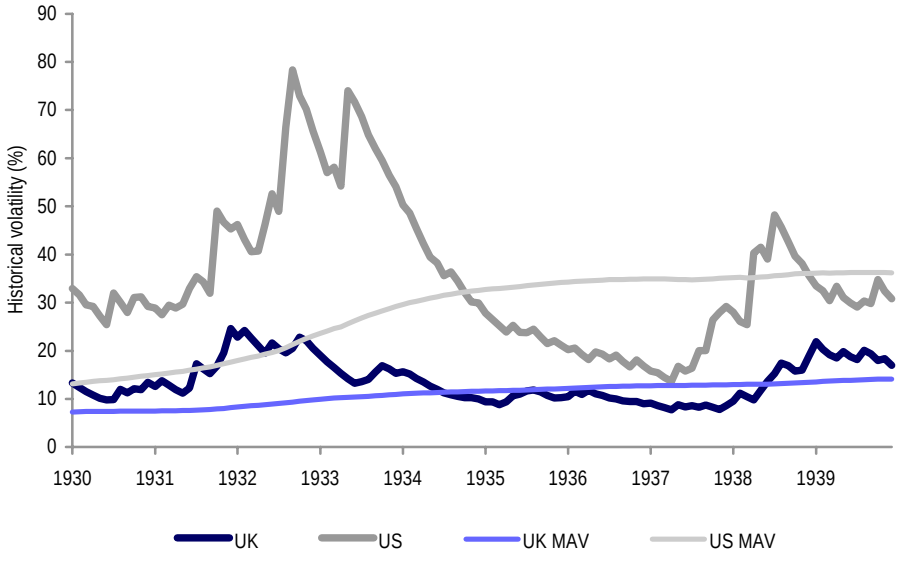
As during the 1910s, both bondholders and shareholders were unable to avoid losses in their portfolios although for different reasons. Both decades shared an increasingly important role for government regulation of the economy and for a reduction in international trade. However, whereas the 1910s were inflationary, the 1930s were deflationary. In the 1910s, higher inflation raised interest rates, which depressed bond prices as yields rose. In the 1930s, there was a genuine fear that even some developed countries, much less Latin American ones, would default on their debt, sending yields to levels not dreamed of during the inflationary 1910s and causing large capital losses to bondholders.

Despite the dismal record of the 1930s, there were places where investors could have profited. The most significant returns came from South African gold shares, which increased in value by 266% between 1930 and 1940. Shares in other countries in which commodities played an important role in their economies also saw increases in their stock market indices, among them Australia (2%), India (11%), New Zealand (37%), Norway (25%), South Africa (13%) and Venezuela (76%). Economies dependent on industrial production almost universally declined. Most markets fell in value between 30% and 50%. France showed the most significant losses, partly because it failed to bounce back after the 1929-32 bear market because left-leaning governments led the country.

Both asset classes dropped in value sharply during the 1930s. Table 5 (page 26) gives information on the timing of stock market tops and bottoms for the world's major stock markets, and the percentage decline suffered in each market. The table illustrates how substantial the declines were. Countries with the largest declines are listed first. The recovery date measures how long the average investor would have had to wait before they could have exited the market without a capital loss.

Chart 12: UK and US historical volatility during the 1930s





Source: WDR

Table 5: World stock markets during the 1929-32 bear market

Country	Market top	Market trough	Decline (%)	Recovery date
US	September 1929	June 1932	86.2	September 1954
Poland	April 1928	June 1932	85.1	?
Belgium	June 1928	March 1935	82.5	December 1941
Canada	September 1929	June 1932	80.1	November 1954
Netherlands	July 1929	June 1932	76.4	September 1941
Sweden	January 1929	May 1932	75.4	November 1950
France	February 1929	August 1936	75.0	April 1941
Italy	February 1925	May 1932	72.9	June 1941
Germany	June 1928	April 1932	67.7	February 1942
Austria	November 1928	December 1933	62.3	June 1954
Switzerland	September 1928	May 1932	61.2	January 1946
Spain	February 1928	July 1936	60.6	May 1946
Czechoslovakia	February 1925	June 1932	57.4	March 1937
UK	September 1929	June 1932	52.3	May 1954
S Africa Gold	March 1927	March 1930	51.9	January 1933
Norway	October 1924	June 1932	50.1	December 1935
Japan	July 1926	October 1931	48.9	May 1933
Australia	February 1929	August 1931	46.3	October 1934
India	November 1926	June 1932	45.9	October 1934
S Africa Industry	September 1929	December 1932	42.1	October 1933
Denmark	February 1925	June 1932	39.4	August 1935

Source: Global Financial Data

Why have shares performed so poorly during the 1930s? First, the Great Depression reduced international trade to extremely low levels and the global depression made it almost impossible to generate profits domestically. Governments' inability to find common ground for international economic co-operation added more problems, and the uncertainty generated by military aggression by Germany, Italy and Japan as well as the League of Nations' inability to act and American isolationism provided firms with few opportunities for international or domestic profits. Economic and political chaos, deflation, protectionist trade policies, government regulation and control, the rise of political parties of the extreme left and right, the mishandling of monetary policy in the US and other countries all hurt financial returns.

The 1930s were the most volatile decade of the 20th century

If the early 1930s were driven by expectations concerning the Great Depression, the late 1930s were driven by fear of war and its consequences. The American market increased by over 20% within a week of Germany's invasion of Poland, only to give it all back and more when Dunkirk fell. The 1930s were the most volatile decade this century for American share prices.

Bond and commodity markets were also volatile

Bond and commodity markets showed similar fluctuations in price volatility. Deflation lowered the nominal yields on bonds while increasing real returns. Real returns increased because of fears of governments defaulting on their bonds, for economic reasons in the early 1930s and political reasons in the late 1930s. Bond prices collapsed in days when economic crises struck countries or war began. Commodity prices collapsed in the early 1930s then began rising as governments supported commodity prices to reduce the impact of deflation on farmers and other constituents.

Cash was king

One successful investment strategy would have been to invest in those countries which relied on commodities for a significant portion of their national production. All of these countries did well during the 1930s, relatively. They were among the few to show positive returns to shareholders. The 1930s were the one decade in which cash was king.

Mean reversion at work

Almost without exception, stock markets which fully participated in the bull market of the 1920s (such as the US, France, Belgium and Canada) saw large declines in the bear market which followed. Countries which had barely participated during the 1920s saw smaller declines in share prices.

Markets globally correlated

Because the Great Depression was universal and there was a worldwide effort, or lack of effort as the case may be, to address the problem of the Great Depression, the world's stock markets were co-ordinated in their bull and bear market cycles to a degree unprecedented up until that point in time.

The 1940s: A turning point

The 1940s as a turning point for world equities

The 1940s were important not only for the degree to which political and military events influenced financial markets but also because four decades of dismal returns to investors came to an end for the world's stock markets. From the beginning of World War I until international currencies were stabilised and the Cold War began in 1949, investors were locked in a battle to make money in stock markets which was almost impossible to win. At the same time, the worst bear market in bond history began during the 1940s as inflation rates began to gradually increase after the war ended.

Inflation after the war was over

Once the war was over, inflationary pressures broke out as price controls were lifted. On the other hand, however, most contemporary investors feared that the world's economies would return to the stagnant ways which had prevailed in the 1930s. That inflation was only a short-term problem in the 1940s and economic growth would soon ensue, surprised everyone except the contrarians.

Governments do learn over time

Governments were more likely to allow stock markets to remain open while regulating their activities. During World War I, stock markets closed almost universally between August 1914 and December 1914, then gradually re-opened. In 1939, New York did not close and London closed for only a week; both Berlin and Tokyo remained open. The exchanges had found that closing only forced investors to carry out trades over-the-counter and failed to stop stock market activity.

War drove returns as well as volatility

In general, the war drove the markets. This is well exemplified in the US: shares rallied sharply in New York in September 1939 when war broke out because investors anticipated that the US would remain neutral and profit from sales to the warring countries. However, when France fell in 1940, shares immediately collapsed, and continued to decline until the war started to turn in the Allies' favour after victories in northern Africa, Stalingrad and the Pacific. Whereas shares in Berlin and Tokyo had been rising in price between 1939 and 1942, they declined in value thereafter. With the exception of London and New York, stock markets did not rise in value until after the war was over.

Peace presented new problems

When the war ended in 1945, instead of solving investors' problems, peace simply presented new problems. A post-war rally carried through until 1946 when most of the world's stock markets topped out and began a steady decline until 1949. By the time the decade of the 1940s was over, only a few stock markets had shown gains for the previous 10 years. For American investors, securing capital gains in foreign stock markets was even more difficult because the US dollar strengthened relative to other world currencies as Bretton Woods switched the world onto a dollar standard. Because of the capital controls and exchange rate restrictions which existed through most of the 1940s, any investment strategy other than buy-and-hold would not have been realistic.

High inflation resulted in losses in real terms

Although it would seem that world stock markets held up amazingly well, given the fact that World War II took place between 1939 and 1945, it should be remembered that consumer prices increased by 68.6% during the 1940s, creating real losses for investors. Most of the advancing markets were outside of the theatres of war while the majority of the declining markets were in countries invaded by the Axis powers.

Market shut-down as a source of risk

Measuring volatility does not address the full risk to a market. During both world wars some markets were closed for months or liquidity dried out completely. The risk of not being able to unwind positions is not something of the past. On 12 November 1999 Switzerland did not trade for more than a day. The electronic exchange broke down. The temporary shut-down of a trading place is on the risk manager's mind and should filter into his stress scenario analysis. With markets and risk management systems being fully electronic, shut-downs as in Switzerland could happen and possibly not be fixed within 24 hours. The fact that markets traded without major interruptions since the 1940s suggest that this sort of risk could be understated.

Nevertheless, what is most important about the 1940s was that this decade ended 35

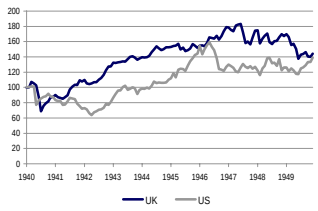
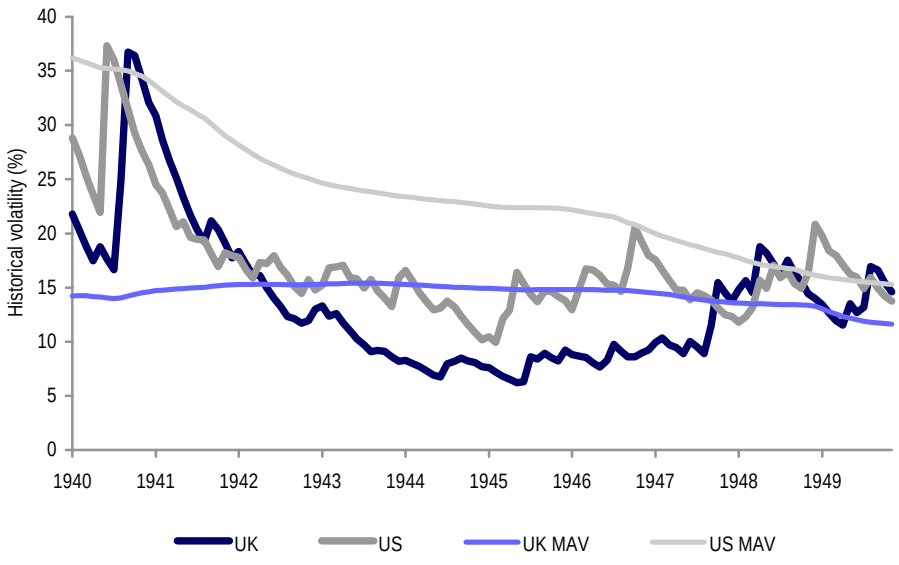


Chart 13: UK and US historical volatility during the 1940s



Source: WDR

years of underperforming stock markets throughout the world. Between 1948 and 1950, the tide began to turn, and stabilisation of the world's capitalist economies, government support of corporate activities and eventually the liberalisation of markets allowed corporate profits to grow again, benefiting shareholders.

The 1950s: In good memory

The 1950s were next to the 1980s the best decade for equities

Along with the 1980s, the 1950s were the best performing decade this century for the world's stock markets. Almost every stock market provided significant returns to investors, often in excess of 100%, as markets recovered from three decades of economic and political chaos. Whereas investors had to be very careful when and where to invest their money from 1914 through 1949, during the 1950s, almost any investment at any time, anywhere provided good returns. Buy-and-hold once again became the prevailing strategy. By the late 1950s, every one of the world's stock markets had at last exceeded the highs reached by world's stock markets in 1929.

Germany and Japan recovered

The two top performers were the countries which had been devastated by World War II: Germany and Japan. Germany's stock market index rose 848% and the Nikkei 225 increased by 696%. France (476%), Austria (474%), Italy (385%) and other countries which had been directly involved in the war recovered sharply while countries which had been outside of the main theatres of war and seen less significant declines in their stock markets in the 1940s saw smaller gains. However, even these gains were the best these countries had ever seen within a single decade.

Unlike the 1980s, the 1950s were good for equity investors but bad for bond investors

One important difference between the 1950s and the 1980s was that whereas in the 1980s, both bondholders and shareholders made significant returns, in the 1950s, stock markets provided fabulous returns while bond markets were beginning a bear market which was to last until the early 1980s. The British 2.5% Consol illustrates how significant this bear market was. Between 1946 and 1974, the British Consol fell in price from 99.625 to 14.50. These were the worst losses fixed-income investors had ever suffered since the British Consol had first been issued back in

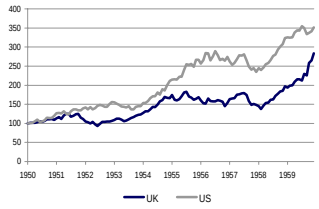
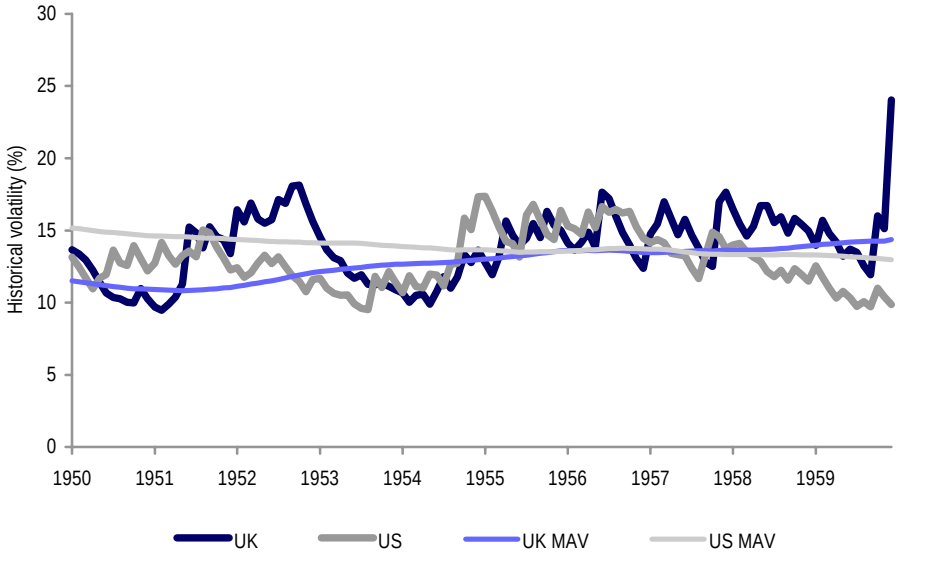


Chart 14: UK and US historical volatility during the 1950s



Source: WDR

1753. Similarly, the Dow Jones Bond Average declined from a high of 121.83 in 1946 to a low of 52.21 in 1982.

It took a long time to kill the inflation beast

Keynesian policies subjugated monetary to fiscal policy, and due to the 1930s and 1940s, unemployment and a lack of economic growth were seen as a greater evil than inflation. The creeping rise in inflation which snowballed into unprecedented peacetime inflation in the developed world in the 1970s and the developing world in the 1980s created a bear market in fixed-income investments which did not end until Volcker began attacking inflation at the Federal Reserve in the early 1980s.

Lessons to be learned from the 1950s

There are several lessons which can be gained from the 1950s:

(1) International economic co-operation not only enabled individual stock markets to recover but allowed all the world's stock markets to rise in value together. Unlike most decades, there was no period during the 1950s in which stock markets fell into bear markets. There were major rises in stock values globally in 1953-54 and 1958-59. During the other years, stock markets were in trading ranges. Although some of the gains in value are due to recoveries from over-sold levels, the fact that the recovery occurred and was sustained is significant.

(2) The 1950s showed that governments can provide the right conditions for economic growth and share price rises. Non-inflationary economic stability is needed for stock markets to rise in value and this situation was occurring at last.

(3) The divergence between bond and stock markets, which began in the late 1940s, showed that government policies could help some financial markets while harming others. However, this divergence cannot last forever. The inflationary conditions which struck down bond markets for 30 years eventually weighed down on stock markets, causing them to decline significantly in the 1970s.

The 1960s: A mixed blessing

Large differences between countries

The 1960s were a mixed decade for investors. Stock markets significantly diverged from one another. There were a couple of important differences between the 1960s and other decades. First, stock markets were still in the bullish secular trend which had started in 1949. Even if all stock markets were not moving up, there were still stock markets which were.

Rise of emerging markets

Probably the most significant event of the 1960s was the rise of emerging markets. From the 1920s through the 1950s, developing markets had consistently underperformed developed markets but in the 1960s, this pattern began to change. It is often forgotten that countries such as Argentina had income levels not significantly below income levels in Europe in the 1920s. However, the combination of economic policies, which hindered economic growth in developing countries, and government intervention, which hindered international trade in both developed and developing countries, reduced the opportunities for corporate profits.

Emerging markets, which focused on liberal markets and international growth, benefited

The recovery in emerging stock markets which began in the 1960s was selective. Countries which continued to depend on commodities for exports or maintained trade barriers continued their long-term secular bear markets. Even though some Latin American markets had declined by 90% in real terms between the 1920s and

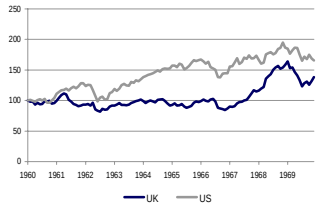
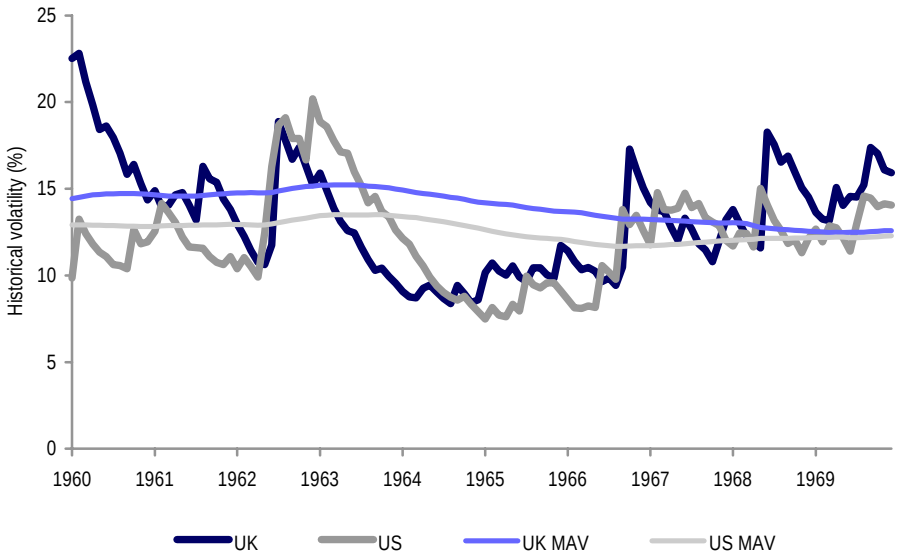


Chart 15: UK and US historical volatility during the 1960s



Source: WDR

1960s, they continued to decline in value until the 1980s. The best returns came in countries which had companies focusing on international trade as a source of growth.

No stock market indices exist for the east Asian tigers' stock markets before the 1960s. South Korea, Taiwan, Singapore and Hong Kong all introduced stock market indices in the 1960s, which rose sharply, though not without their periodic bear markets as their stock market bubbles burst. Brazil, Greece and South Africa joined the Asian tigers in providing strong returns to investors.

European recovery came to a halt

On the other hand, the recovery in European stock markets came to an abrupt halt in 1962. In the US, 1962 is remembered as the year in which President Kennedy faced off the steel industry over price increases, causing a decline in stocks, but it was not only in the US that stock markets topped out. Many European markets hit blow-off tops in 1961/62, which initiated down-trends, lasting until 1966 in most countries and 1982 in some countries. After the trough in 1966, stock markets began bull markets, which lasted until 1969. Whereas the 1950s were a combination of sharp advances mixed with trading ranges, the 1960s saw regular bull and bear markets return to the world's stock markets. The rising tide of inflation was also evident in the world's stock markets. During the last half of the 1960s, consumer prices began to advance faster than share prices.

A transitional decade

The 1960s can be seen as a transitional decade. The factors which had provided the sharp gains of the 1950s began to weaken. The international economic stability of Bretton Woods began to fall apart as hot money forced countries with weak currencies to devalue. The Keynesian policies, which had provided stability and growth in the 1950s, were now creating the inflationary pressures which would undo financial markets in the 1970s. The European stock markets, which had recovered during the 1950s, began to lose steam but emerging markets in Asia offered prescient investors important opportunities for profits. The 1960s still

provided investors with opportunities for profit although these were more difficult to find than in the 1950s. The 1970s, on the other hand, were a different story.

The 1970s: Inflation, OPEC and the end of Bretton Woods

A decade of inflation

The 1970s, along with the 1940s and 1910s, saw inflation reduce real returns to investors. Although stock markets increased in price in nominal terms, in real terms they declined in value. Investors in commodity markets were about the only investors who could make significant returns, assuming they could stand the volatility inherent in those markets. The 1970s contained one of the 20th century's three bear markets (in 1920-21, 1929-32 and 1973-74). Some markets, such as the UK, fell more in value during the 1973-1974 bear market than they had fallen during the 1929-32 bear market. Although stocks recovered after 1974, few stock markets were able to keep up with the rising inflation for long.

Not all markets suffered during the 1970s

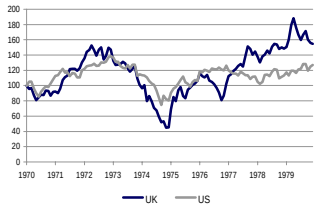
Lucky investors put their money in Asia and South African gold stocks. Japan returned 336% in real US dollar terms. Hong Kong returned 598%, South Korea 362%, Taiwan returned 456% and South African gold stocks returned 543%. Almost any other market provided nominal returns which were less than the consumer price inflation rate. During the 1970s, the Morgan Stanley World Index rose by 30.8% while the EAFE index by 75.7% in real US dollar terms.

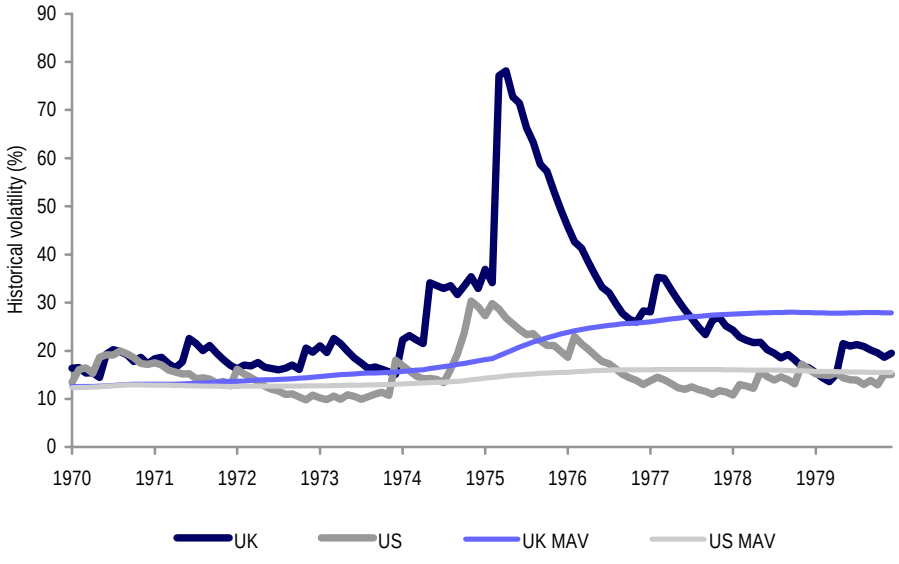
Bretton Woods system falls

Returns were also affected by the collapse of the Bretton Woods system in the early 1970s, first as countries began to devalue or re-value and finally as President Nixon pulled the US out of the system. The exchange rate float was originally meant to be temporary but the volatility in world financial markets which followed made a return to a system of fixed exchange rates almost impossible. Because the dollar generally devalued during the 1970s, American investors who put their money in foreign stock markets received higher returns than they received in US stocks.

In April 1973, the CBOE (Chicago Board Options Exchange) started trading

Chart 16: UK and US historical volatility during the 1970s





Source: WDR

A small step for mankind but a large step for risk management

derivatives in response to the volatility in financial markets. A new era started (the author might be slightly biased as to the importance of the introduction of derivatives). We will be looking at the history of derivatives in the following chapter.

Bond markets fell whereas commodity markets boomed

Bond markets, however, provided little solace. Interest rates continued to increase causing fixed-income investors to suffer capital losses for most of the decade. Although some bond markets, such as the London market, saw interest rates peak in 1974, the US and other countries saw interest rates continue their upward path for the rest of the decade. Commodity markets came alive in the 1970s. After a brief flourish in the Department of Labor/CRB Commodity Index following the outbreak of the Korean War, the index remained virtually unchanged for the next 20 years, finally breaking out in 1972, pausing in the middle of the decade, then moving up again, starting in 1977. The CRB index had tripled by the end of the decade.

Volcker and the (inflation) beast

Whereas economist and financial analysts saw the inflation of 1972-74 as an anomaly in which commodity prices rose while stock and bond prices fell, the inflation of 1977-79 proved the endemic nature of the inflationary problem. In 1979 Paul Volcker was elected to the Fed. He eventually brought an end to the 35-year bear market in bonds by defeating the inflationary beast. Just as the determination of international governments in the late 1940s to end 35 years of international economic chaos laid the foundations for the stock market rise of the 1950s, the determination of central banks to defeat inflation laid the foundations for the financial bull market of the 1980s.

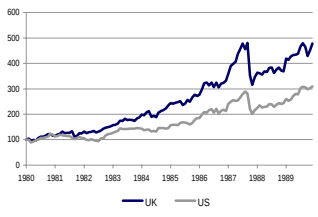
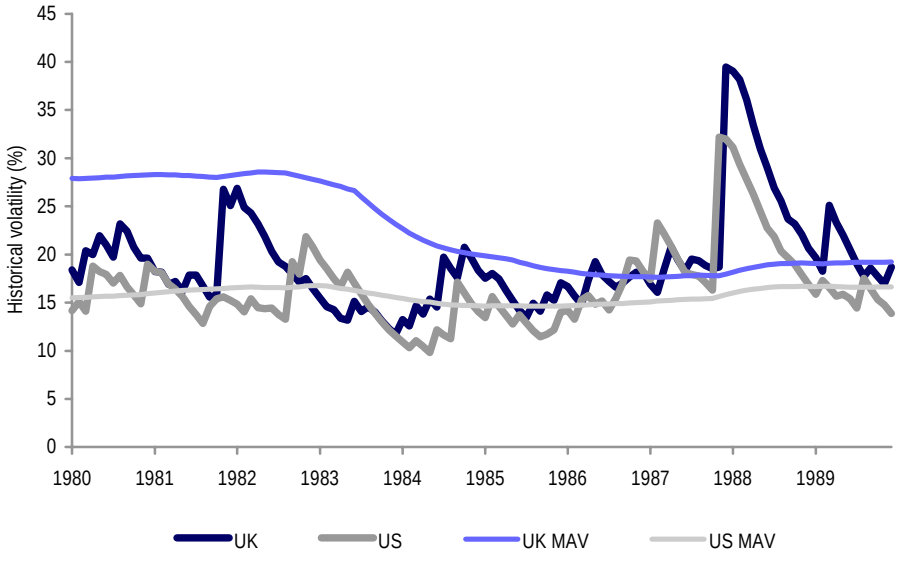


Chart 17: UK and US historical volatility during the 1980s



Source: WDR

The 1980s: Simply the best

Together with the 1950s, the 1980s were the best decade for equity investors

As any contrarian knows, when the market looks its least attractive, that is the time to invest. With inflation rampant, a second oil crisis beginning, interest rates at unprecedented peacetime levels and stock market values at their lowest levels in real terms since the 1930s, there was only one choice.

A decade for the contrarian investor

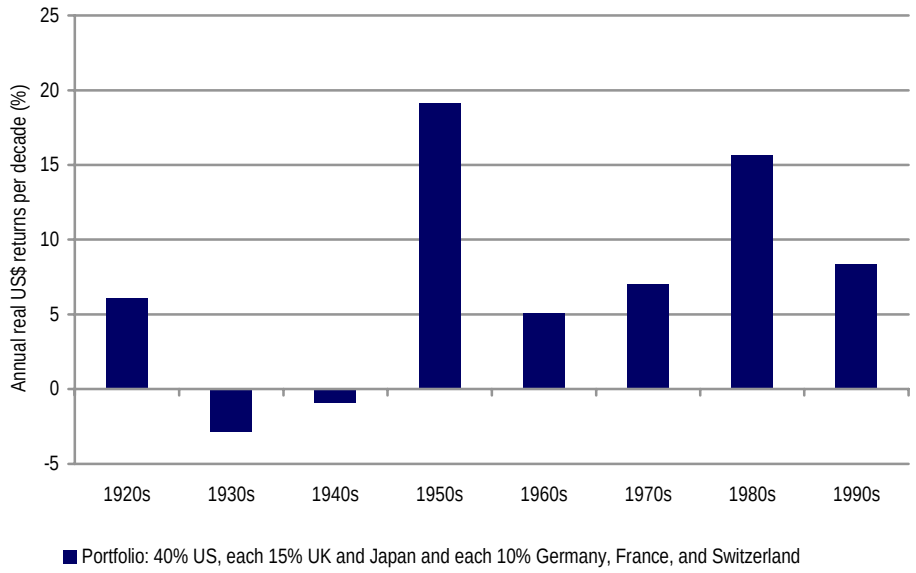
Investors had to work really hard to lose money in the stock market in the 1980s. The worst performer was Switzerland, up only 99% in real local and 102% in real US dollar terms. Only a few stock markets which were devastated by hyperinflation showed negative real returns. The winners once again were the Asian tigers, pulled up not only by their own economic growth but by the credit bubble that emerged in Japan. Strong returns occurred in Taiwan (1,651%), South Korea (665%), Japan (492%), Singapore (241%), and Hong Kong (222%). Contrarianism paid off in Portugal (up 1,829%) and Italy (734%). Northern European economies were also strong with large capital gains in Sweden (1,162%), Finland (594%), Denmark (533%) and the UK (424%).

The best decade for all investors

For financial markets, the 1980s were the best decade of this century, and probably the best decade financial markets have had since stock exchanges were founded back in the 1600s. Whereas the 1950s provided strong gains for shareholders but losses for fixed-income investors, the 1980s provided strong gains for all investors. Investors who are new to financial markets fail to see how exceptional the performance of financial markets in the 1980s was. There had never been a decade like the 1980s in the history of financial markets.

Chart 18 shows the annual real US dollar returns by decade for a weighted portfolio. The weights were reset every decade and are shown in the graph. The single country returns are shown in Chart 7 on page 18.

Chart 18: Annual real US dollar returns per decade for a weighted portfolio



Source: WDR (data from Global Financial Data and Datastream)

The 1990s show the annualised real price return in US dollars from January 1990 until August 1999.

The 1950s and 1980s both provided the ideal combination of market liberalisation and economic stability, which is conducive to strong returns in financial markets. First, central banks worldwide made a concerted effort to reduce interest rates in the 1980s and the 1990s. Second, the success of the Asian tigers and the decrepit state of the socialist countries convinced governments worldwide that economic liberalisation and not state regulated socialism was the path to economic growth. Third, capital markets were freed to an extent not known since World War I and with the aid of computers, investors were able to quickly seize on financial opportunities which presented themselves. In short, governments made a 180 degree turn from inflation-favouring Keynesianism to inflation-controlling monetarism, from import substitution to export promotion, from socialism to capitalism, from nationalisation to privatisation, from protecting workers to promoting corporate profits, from regulated capital markets to complete capital freedom. All of these changes benefited shareholders and strengthened capitalism visible to everyone except, perhaps, Fidel Castro and the North Koreans.

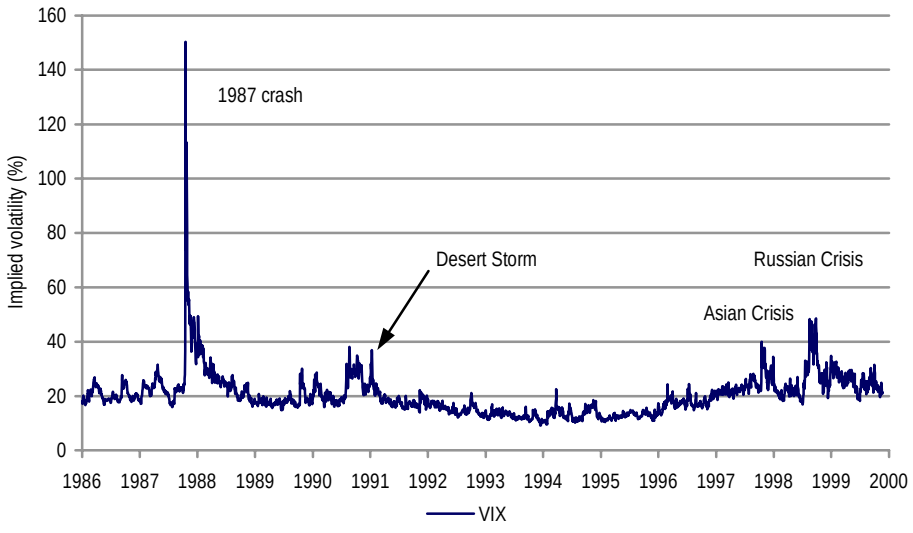
The belief that inflation is dead is good for equities

World stock markets and bond markets bottomed out in 1982, and began a steady increase for the rest of the decade. The rise between 1982 and 1985 was gradual but from 1985 until 1987, stock markets worldwide rallied at staggering rates as investors became convinced that the inflationary beast was being slain. For American investors, the rise in foreign markets between 1985 and 1987 was even more dramatic since the dollar was collapsing in value at the same time.

In 1987 there was a small...

On Black Monday, 19 October 1987, the Dow Jones Industrial Average fell 508 points – a drop of 22.6% in one day. This "crash" was unprecedented in stock market history. The next biggest one-day drop in the index, on Monday, 28 October 1929 was only 12.8%. Three drops in the index preceded the 1987 crash, on Wednesday, 14 October, Thursday, 15 October, and Friday, 16 October 16, of 95, 58, and 108 points respectively. The 1987 crash came in the initial stages of a world bull market, not at the end of a topping pattern in world stock markets – its end as

Chart 19: US implied volatility since 1986



Source: CBOE and FactSet

VIX measures a 30-day implied volatility for OEX index options.

was true in 1929. Therefore, the 1987 crash was but a temporary set back which was followed by an epic bubble in Asian markets, which ended in 1989. The Nikkei 225 index reached 40,000, concluding an more than 200-fold increase in value since 1949. Other Asian stock markets showed similar gains. Taiwanese stocks increased in value by 1,651% during the decade.

... correction

Apparently, then US-president Ronald Reagan was laughed at as he referred to the 1987 crash as a "correction" shortly after it occurred. Wall Street, focusing as so often during its history on the short term rather than the long term, did not at all find the remarks humorous. In terms of volatility, the crash of 1987 was significant but short lived. It took roughly two years for the Dow to reach the then all-time high from August 1987. After the 1929 crash, it took more than two decades. Chart 19 shows implied volatility for the VIX volatility index, which measures implied volatility from short-term S&P 100 index options. The index spiked during the crash and quickly reverted to mean levels.

Friday the 13th

On Friday, 13 October 1989, there was a mini-crash. Implied volatility increased erratically but by only a fraction of the rise two year's earlier (Chart 19 on page 35).

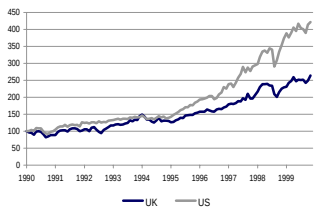
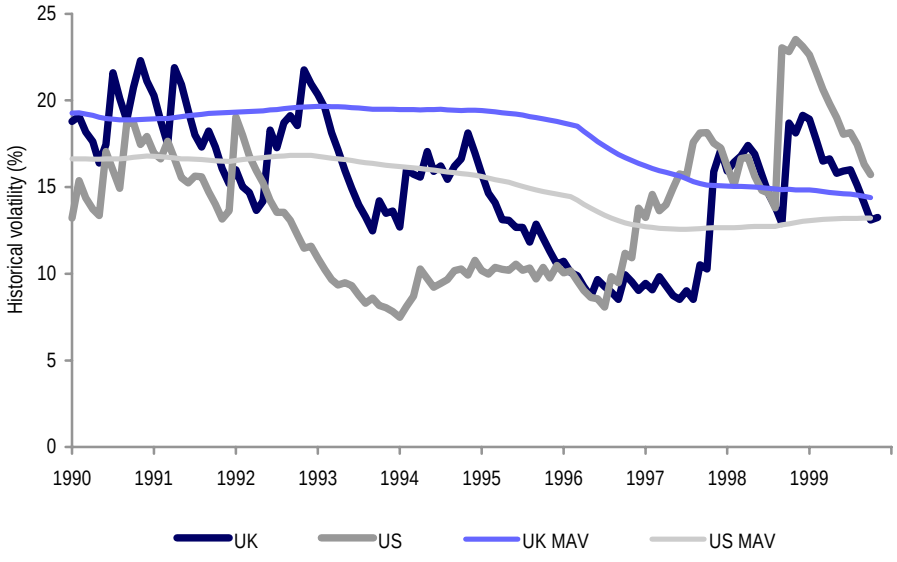


Chart 20: UK and US historical volatility during the 1990s



Source: WDR

The 1990s: Low volatility but hardly boring

Volatility was below average during the 1990s

With respect to volatility, the 1990s were shaped by the invasion of Kuwait on 21 August 1990, Desert Storm starting 17 January 1991, the financial crisis in Mexico in December 1994, the Asian crisis starting in July 1997 and the Russian debt crises in 1998. Overall, however, the last decade of the millennium was one of low volatility. From a long-term perspective, volatility was below average. Chart 20 on page 36 shows historical volatility for the US and UK stock markets. Historical volatility was below its 100-year moving average for most of the decade.

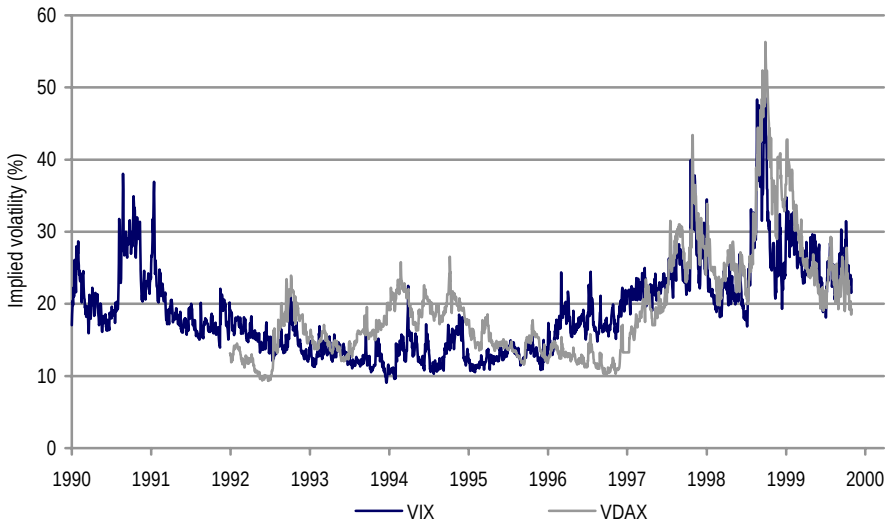
Not another oil shock!

From the start of the decade until one day before Desert Storm, the FT/S&P World index lost 23.3% in US dollar terms. The price of Brent Crude oil rose 45% in the same period. Global stocks increased by 5.2% in one day when the alliance attacked on 17 January 1991. The oil price fell by 35.7%. Volatility was above average.

Implied volatility increased during the second half of the 1990s

Chart 21 shows the implied volatility for VIX and VDAX. VIX measures 30-day implied volatility of OEX (S&P 100) options whereas VDAX is a measure for 45-day implied volatility on DAX options. The graph shows that implied volatility was between 10% and 20% for at least half of the 1990s. VDAX increased from around 10% at the end of 1996 to above 50% in autumn 1998.

Chart 21: VIX versus VDAX



Source: WDR (CBOE, Bloomberg, FactSet)

Volatility spikes are globally correlated

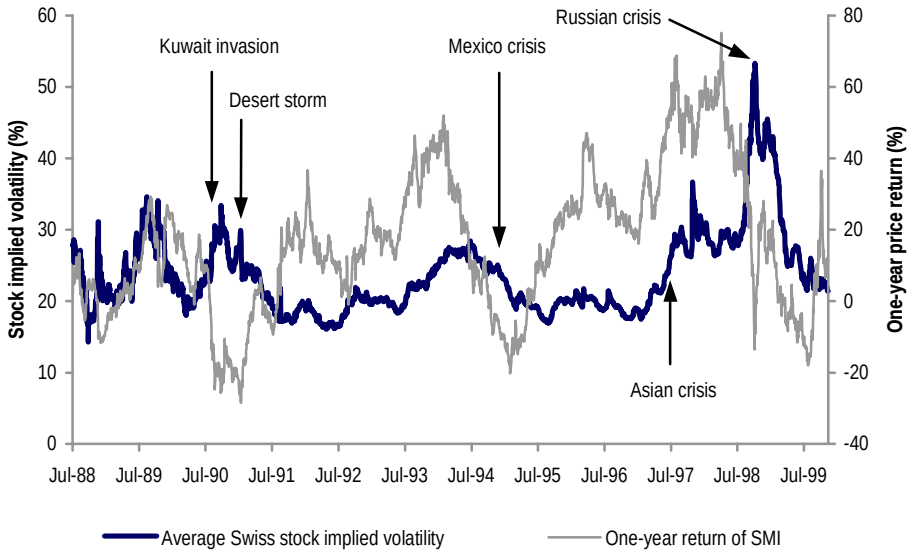
Intuitively one would assume that volatility is globally correlated during global events, such as the Asian crisis. Chart 21 shows that the spikes in volatility were correlated between markets during the past decade. It is fair to assume that with markets being integrated, correlation of volatility between markets should remain high.

Are changes in implied volatility correlated with changes in the market?

One question which occasionally passes our desk is whether volatility is positively or negatively correlated with returns. Chart 22 shows the relationship between average Swiss stock implied volatility and one-year price returns on the SMI. We have chosen Switzerland because our stock implied volatility data in Switzerland is of the highest quality, the series starts in July 1988 when Soffex (now Eurex) opened and the data is of daily frequency.

Implied volatility is not a leading indicator

Chart 22: Swiss stock implied volatility versus SMI returns



Source: WDR

Chart 22 shows that when markets fall heavily and erratically, implied volatility increases strongly; this intuitively is what one would expect. Historical volatility increases and so does future volatility, of which implied volatility is the markets' estimate. The fact that implied volatility rises during a correction is also a function of supply and demand of options. We have shown in recent derivatives research how implied volatility and skew of index options are not leading indicators for a correction or the market in general; they are lagging indicators. In other words, optionality – especially put options – is bought after (or during) the event and before.

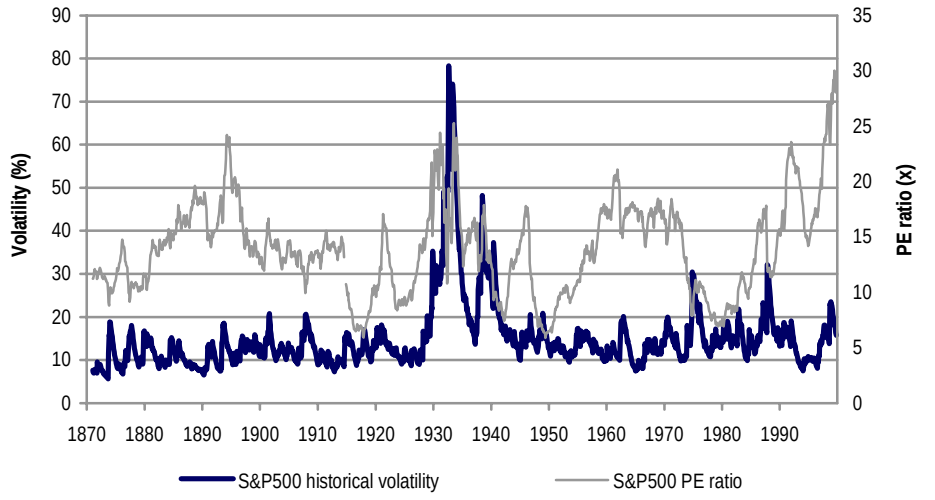
Implied volatility has a low negative correlation with the stock market

The correlation coefficient between weekly changes in average Swiss stock implied volatility, and weekly changes in the SMI index between July 1988 and November 1999 was -0.30, and statistically significant at the 99% level. In other words, generally speaking, volatility increases when markets fall and implied volatility falls when markets rise. However, although statistically significant, the relationship is weak.

Is the volatility of the market correlated with its valuation level?

During the second half of the 1990s implied volatility has been increasing in line with the market. In other words, volatility was positively correlated with the market and not negatively. This raises the question whether implied volatility is positively correlated with valuations, ie, does the risk increase as stock markets get more expensive? Intuitively this makes sense. One could argue that the probability of a correction rises as valuation rise, ie, the stock market becomes a riskier place.

Chart 23: SPX historical volatility versus PE ratio



Source: WDR (data from Shiller 1989 and IBES)

PE is computed by the index price series divided by the earnings series for the preceding year (in nominal terms). For the PE from December 1998 to November 1999, we used consensus estimates from IBES

Volatility follows a different cycle than valuations

Chart 23 shows the relationship between the PE ratio for the S&P 500 index and historical volatility. Although we have some reservations regarding some of the long-term data we use in this report, the graph gives an indication of the valuation level of the US stock market over a long period of time. Valuations were high in the 1960s, low in the 1970s and have risen since the start of the current bull market. The comparison of the two lines shows that occasionally there is some degree of positive correlation. For example, both figures fell during the first half of the 1990s and both figures have risen in the second half of the decade. However, both indicators are more or less mean reverting but have completely different cycles. A valuation cycle is characterised, in theory, by the long-term swings of the business cycle whereas volatility is driven by short-term events. In other words, both show a tendency to revert to a mean after an extreme high or low but not necessarily at the same time and/or at the same speed.

Irrational exuberance

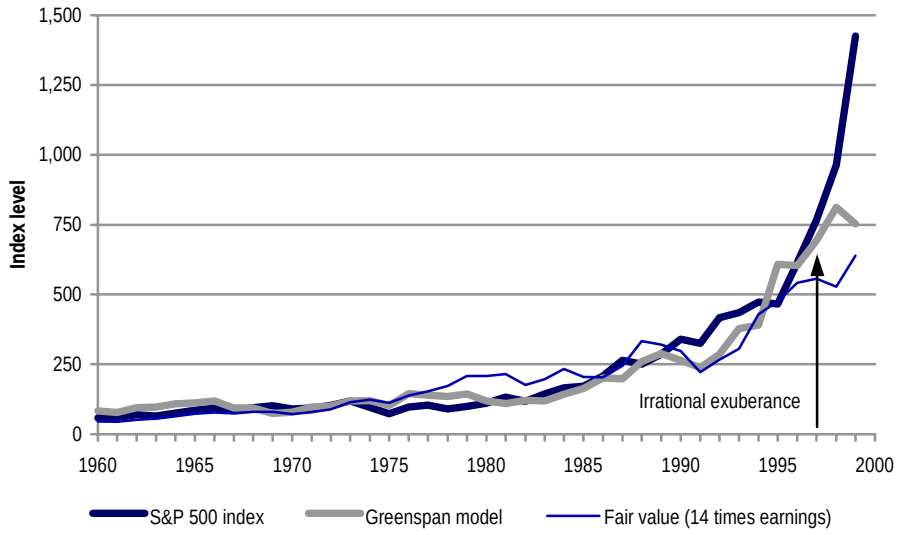
On 5 December 1996, Alan Greenspan, chairman of the Federal Reserve Board, shocked the global markets when he used the term "irrational exuberance" to describe the state of the US stock market. The S&P 500 index was at 744 points at the time, ie, around half of its value three years later. Greenspan introduced what is today referred to as the "Greenspan model", which is simply earnings divided by 10-year government bond yields.

Greenspan as the cause for the bubble?

Chart 24 compares the S&P 500 index since 1960 with the theoretical value derived from the Greenspan model and a fair value based on 14 times trailing earnings (which is the 126-year average)[4]. The graph illustrates that based on the models in use and the data available, Wall Street has been richly valued for a while. Some market observers argue that Greenspan himself has helped inflate the speculative bubble because he has been signalling that the Fed would not raise interest rates as

[4] In the Appendix, we show a graph which compares the S&P 500 index with PE bands from 1870 to date.

Chart 24: S&P 500 valuation comparison since 1960



Source: WDR (data from Shiller 1989, Compustat and Datastream)

long as the inflation rate for goods and services remains tame, even if equity prices continue to inflate at a rate that may be excessive.

Table 6: SPX PE ratios in the 20th century

	Start	High	Low	Mean	End
1900s	12.7	16.0	11.8	13.3	11.9
1910s	13.8	16.1	6.1	11.1	8.4
1920s	11.0	24.5	8.5	12.4	15.4
1930s	**22.4**	26.2	12.2	17.9	13.9
1940s	11.7	17.0	6.5	10.7	6.6
1950s	5.9	16.4	5.9	11.1	16.4
1960s	17.7	18.8	15.8	17.2	17.7
1970s	17.6	17.6	6.7	11.8	6.7
1980s	7.5	15.1	7.5	11.0	12.5
1990s	15.9	**31.2**	13.7	**19.9**	**31.2**

Source: WDR (data from Shiller 1989, Compustat and Datastream)

Little to no correlation between valuation and volatility

Table 6 shows the PE ratio for the S&P 500 index per decade. For comparative purposes, we have added a table showing the PEs from above plus the annual inflation rate to the Appendix (page 107). Note that based on the data available, the 1990s saw high valuations. Correlation between mean valuations in Table 6 and average historical volatility in Chart 8 on page 19 reveals no significant correlation between average valuation levels and average volatility.

Asian crises

The Asian crisis caused volatility to increase

One of the main events shaping the 1990s with respect to volatility was the Asian crisis. The crisis started with declining currencies. With the exception of Thailand, the decline in the east Asian currencies was small in the year prior to 1997. Most of the depreciation came after July 1997 and despite a bounce in Asian currencies in January 1998, depreciation continued throughout 1998. Table 7 shows that none of the stock markets in east Asia have shown positive returns to investors in the year that has occurred since July 1997.

Table 7: Equity returns in east Asia during the Asian crisis

Country	Domestic returns, July 1997-July 1998	Domestic returns, October 1997-July 1998	Dollar returns, July 1997 to July 1998	Dollar returns, October 1997-July 1998
Indonesia	-33.2	-3.7	-86.7	-73.6
Malaysia	-60.3	-39.4	-74.6	-50.7
Philippines	-38.6	-11.6	-57.8	-25.7
Singapore	-45.9	-32.9	-53.9	-36.5
South Korea	-33.8	-52.7	-67.4	-42.8
Taiwan	-9.7	-24.0	-37.2	-5.8
Thailand	-59.9	-40.4	-68.3	-40.9

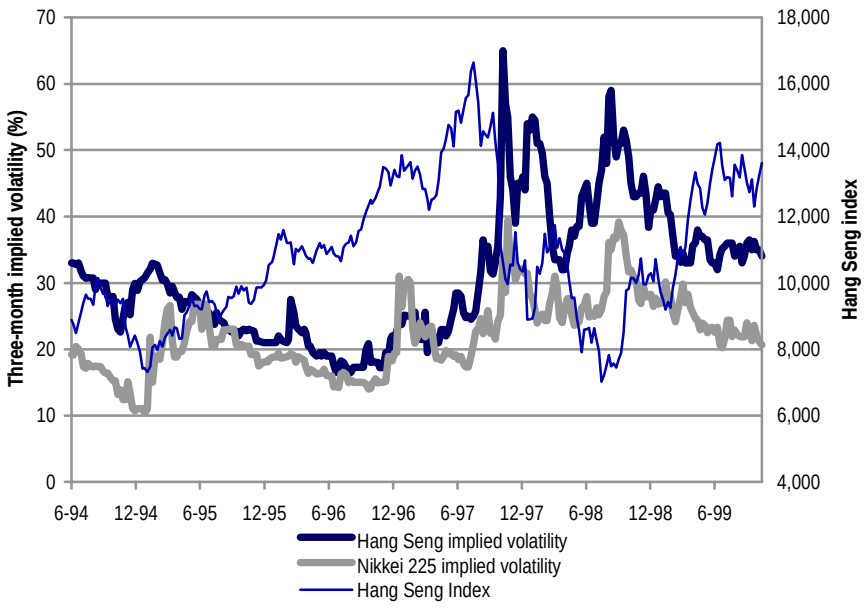
Source: Global Financial Data

The crisis started in Thailand

What started off as a currency crisis in Thailand unexpectedly brought with it severe repercussions in the region. Practically no one remained untouched; in one way or another, rightly or wrongly, economies in this region have been tainted with the same brush as a combination of sharp foreign investment withdrawals and speculative onslaught brought the regional financial markets to their knees. By the year end, what was thought to be initially a correction in an over-valued Baht broadened into a regional currency crisis that led to bandwagon efforts by some regional authorities to abandon previously rigidly-held exchange rate systems. The equity markets were particularly hard hit as investors bailed out on concerns over viability issues following the sharp currency depreciation and tight liquidity situation. In local currency terms, the key stock market index lost as much as 53.60% of its value in the case of Thailand that year, wiping out the gains made over the past nine years.

These results seem particularly surprising, given the strong returns in stock markets in North American and Europe since October 1997, though it could be that investors have abandoned the risk of east Asia for the relative safety of North

Chart 25: Hang Seng and Nikkei 225 implied volatility versus Hang Seng index



Source: WDR

America and Europe. At the same time, the Japanese economy has remained weak and the prospect of a Chinese devaluation has continued, making the possibility of a second Asian crisis a real problem.

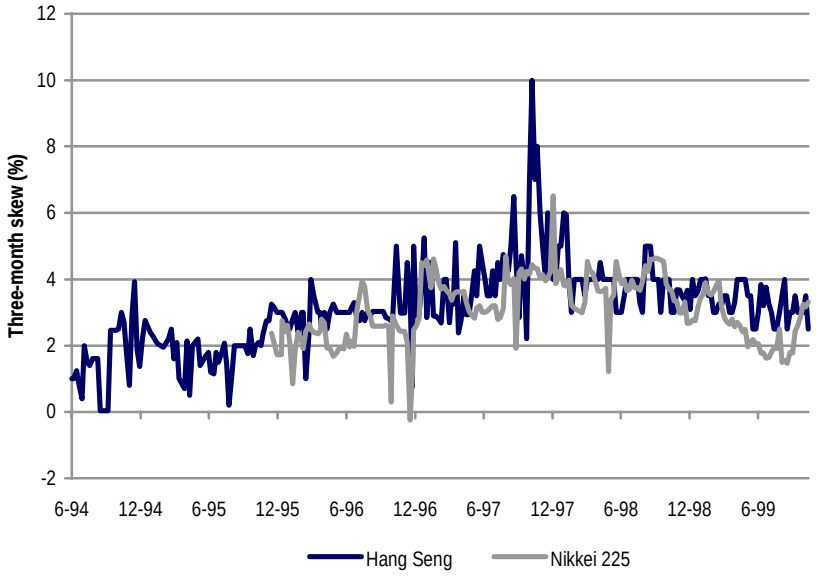
Implied volatility is not a leading indicator

Chart 25 shows implied volatility of three-month at-the-money options for the Hang Seng and Nikkei 225 index from June 1994 to November 1999. The graph illustrates that implied volatility is not necessarily a good leading indicator for markets, as it is occasionally claimed. Asian implied volatility fell when the Hang Seng was rising during 1995. Implied volatility reverted late in 1996 and peaked during the Asian crises in October 1997.

Hang Seng skew was high during the Asian crisis

Chart 26 shows skew of three-month Hang Seng and Nikkei 225 options. Skew here is defined as the difference between implied volatility for 90% puts and at-the-money options. A high figure indicates that out-of-the-money puts were expensive relative to at-the-money options. As one would expect, skew was high during the Asian crisis, especially in Hong Kong. At one stage, three-month 90% puts were 10 volatility percentage points more expensive than at-the-money puts.

Chart 26: Hang Seng and Nikkei 225 skew



Source: WDR

The Russian crisis

As Russia defaults

The next crises to characterise the 1990s following the Asian crises was the Russian debt crisis of 1998. On 17 August, the Russian government made two announcements: (1) It would be rescheduling some payments in GKOs, the country's short-term, ruble-denominated debt obligations; and (2) it was imposing a moratorium on payments by Russian banks on their obligations under certain OTC forward and non-deliverable forward contracts. It was estimated that Russian banks owed some US$50bn on foreign currency forward contracts. Holders of Russian debt felt the immediate impact. As illustrated in Chart 27, the price of Ministry of Finance bonds fell over the year from approximately 60 cents on the dollar to 10 cents on the dollar.

Chart 27: Russian debt versus global equity markets

Source: WDR (data from Datastream)

Hedge funds hard hit

In August, several banks reported Russia-related losses. Hedge funds were the biggest losers. Many of the hedge funds had bought ruble-denominated Russian bonds. Consequently, they needed to offset their risk that the ruble might fall; so, when they bought their bonds, they sold the currency forward. These forward contracts were transacted with Russian banks. When the Russian government imposed a moratorium on payments by Russian banks on their obligations under certain OTC forward and non-deliverable forward contracts, the hedge funds were hit with now unhedged currency losses.

Flight to quality

As Russia defaulted, the world's investors fled to quality. Moreover, "quality" included not just US Treasury bonds or German Bunds but specific, highly liquid maturities within those markets. These shot up in price while, by comparison, everything else plummeted. The result was ballooning swap and bond credit spreads, and 20% declines in equity markets.

Rise in swap and bond credit spreads

One of the victims was Long-Term Capital Management (Smithson 1999b). The rise in spreads had a disastrous impact on LTCM's positions. According to press reports, LTCM's portfolio included positions on the spread between the yields of AA-rated corporate bonds and comparable US Treasuries narrowing. When the flight to quality began, Treasury yields plunged, and the gap between government and corporate yields widened, rather than narrowed. The fund lost 40% of its capital in August alone, leaving it with US$2.5bn, while still carrying cUS$100bn in debt.

Learning by doing

LTCM members promoted their firm as an exploiter of pricing anomalies in global markets. In this regard, consider the following exchange between Myron Scholes, LTCM partner and Nobel laureate, and Andrew Chow, vice president in charge of derivatives for potential investor Conseco Capital. Chow was quoted in the *Wall Street Journal* of 16th November 1998 as saying to Scholes: "I don't think there are

many pure anomalies that can occur". Scholes responded: "As long as there continue to be people like you, we'll make money."[5]

Vega-effect

As implied volatility was rising strongly in August 1998, the trading books of banks, who were short long-term options, hit internal vega risk limits[6]. In other words, investment banks were forced to buy back volatility. The only two-way market where there is some liquidity is the short-term options market. To prove this point and demonstrate causality, we have analysed the magnitude of the increase in implied volatility and compared it with the estimated size of the guaranteed equity funds market relative to market capitalisation. We argue that the larger the guaranteed equity funds market relative to the market capitalisation, the larger is the effect on implied volatility. In recent history, there were two extreme spikes where we could observe this phenomenon: 28 October 1997 and 28 August 1998.

What was the driver of implied volatility?

The magnitude of the increase in stock implied volatility could be explained well by the size of the guaranteed equity-linked product market relative to market capitalisation. The rationale was that the hedging institutions of the guaranteed equity funds were short the long-end of the volatility curve and there was no real market for the long-end of the volatility curve. Alternatively, to hedge positions, banks had to buy gamma and vega through short-term options[7]. The gamma was not really a problem in connection with long-term options because gamma is small for longer-term options. In other words, long-term option positions do not move erratically in volatile markets (delta is inelastic, hence gamma is small).

A bigger problem was the vega exposure. If long-term implied volatility rises, so do the long-term short option positions embedded in the guaranteed products (which investors were long and banks short). The only way to hedge this vega risk was to buy vega somewhere else. In the short term, the only alternative was buying vega through short-term options in the traded options market. Hence, the spike in short-term implied volatility. In the medium term, banks were able to buy back vega through reverse convertibles and related products.

Chart 28 on page 45 shows the increase in stock implied volatility in the week of Mad Friday (28 August 1998) on the vertical axis and the estimated domestic size of guaranteed equity-linked products in first half 1998 relative to market capitalisation. The graph shows the change in average stock implied volatility by country from 21 August 1998 to 28 August (y-axis) and an estimate of the amount invested in domestic structured (guaranteed) equity-linked products as a proportion of total market capitalisation at the end of first half 1998.

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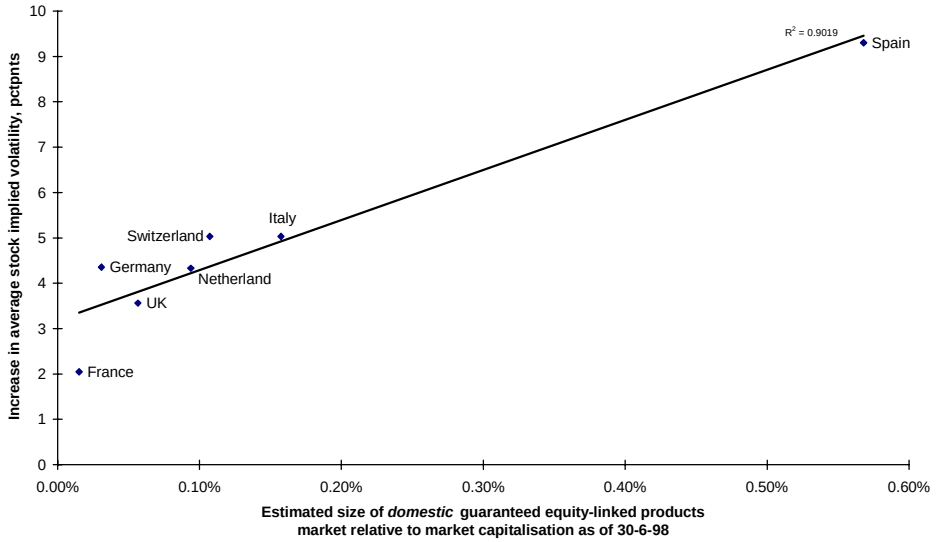
[5] from Shefrin (2000)

[6] The vega of an options position is a common designation for the dollar change in option price in response to a percentage point change in volatility when volatility is measured in percentage terms. Also called occasionally by the Greek letters Kappa, Tau, Lambda, and Zeta. The value of an equity portfolio with a vega of US$1m from short options, for example, increases by US$1m if implied volatility decreases by one volatility percentage point.

[7] The gamma is the second derivative of the option price with respect to the price of the underlying. It is a measurement of the rate of change of the rate of change in the option price with respect to the underlying price. If the gamma of a position is positive, an instantaneous move either up or down in the underlying will give the position a higher value than the static delta would predict.

Chart 28: Change of implied volatility versus size of structured product market



Source: WDR

The larger the size of the structured products market, the more erratic the move in implied volatility

R-squared was 0.90 and the t-statistic 6.8. In other words, 90% of the weekly increase in implied volatility was explained by the relative size of the guaranteed equity notes market. The larger the relation between the size of the guaranteed products market, the more erratic was the change in implied volatility. We observed and measured this phenomenon twice, the first time in October 1997 and the second time in August 1998. Note that the y-axis shows the change of average stock implied volatility of one week only.

The gamma effect

A further phenomenon was the gamma effect in late 1998 in the two main warrants markets: Switzerland and Germany. The gamma effect was induced by the implied volatility curve moving from a normal shape to an inverted shape where short-term implied volatility was higher than medium- and long-term implied volatility. The difference from the issuer of warrants' perspective between hedging warrants exposure through buying stock or buying short-term call options is that with the former the issuer has to sell stock when the stock falls whereas he/she has to buy stock with the latter.

Warrant market increases market volatility in exceptional circumstances

In autumn 1998 warrants were launched and hedged through long stock in the cash market. As markets fell, the position deltas of the warrant issuers increased: the delta of the warrants decreased whereas the delta of the long stock remained the same. This means the delta of the trading books increased as markets fell. To reduce exposure, ie, to move closer to a delta neutral position, the issuers of warrants had to sell deltas, ie, stocks. The banks sold stock when everyone else was selling, ie, increased volatility. These were exceptional circumstances.

Normally, warrants are hedged primarily through short-term call options. If the issuer is hedged through short-term options and markets fall, the total delta does not increase but decrease because the initial position is gamma positive (short-term options have higher gamma than long-term options). The warrant issuer then does the opposite of the market, ie, buys stock when markets fall, thus reducing volatility and providing the market with liquidity when liquidity is needed. To cut a long story short: under normal circumstances the warrants market reduces volatility

because the issuers are long gamma and therefore do the opposite of everyone else. Under exceptional circumstances, ie, when the market is short gamma, the warrant issuing institutions can increase market volatility as it does the same transactions as the market.

Learning by doing

The vega and gamma effect had an educational effect for investment banks. The events of 1997 and 1998 influenced the way equity risk is viewed and managed today. In general, vega exposure was reduced and gamma, as a risk measure, increased in importance.

Implied volatility fell towards the end of the millennium

The last year of the millennium was characterised by rapidly falling implied volatilities. Y2k has not had an effect on implied volatility as this went to print (mid-December 1999) as we occasionally assumed it would. The fall was primarily attributable to institutional selling of option premium, the purchase of reverse convertibles, and falling historical volatility after the turbulent events during the Russian debt and LTCM crises – and thanks to calming words from Alan Greenspan.

This concludes our tour through the 20th century with respect to risk and returns in global equity markets. In the following section, we will focus on the interesting stuff, ie, derivatives – the instruments of managing risk.

Derivatives in the 20th century

Derivatives are one of the greatest innovations of the century

The 1990 Nobel Laureate in Economics, Merton Miller, had the audacity to proclaim that the invention of financial futures ranked as "the most significant financial innovation of the last 20 years". As Alan Greenspan (1999) put it:

> "By far the most significant event in finance during the past decade has been the extraordinary development and expansion of financial derivatives. These instruments enhance the ability to differentiate risk and allocate it to those investors most able and willing to take it – a process that has undoubtedly improved national productivity growth and standards of living."

In the following section we illustrate that derivatives are not new. They have existed for thousands of years. We continue with a chronology of derivatives markets over the past century. Thereafter, we highlight why derivatives have become so heavily utilised, followed by a section where we illustrate that the benefits from derivatives have not been convincing for 'everyone'.

Prologue to the 20th century

Joseph bought first option – the first case of settlement risk

The earliest reference to a business option appears in The Bible. Apparently, Joseph wished to marry Rachel, the youngest daughter of Leban. According to Frauenfelder (1987) Leban, the father, had sold a (European style call) option with a maturity of seven years on his daughter (underlying). Joseph paid the price of the option through his own labour. Unfortunately, at expiry, Leban gave Joseph the older daughter, Lea, as wife after which Joseph bought another option on Rachel (same maturity). This is the first example of optionality we could find. It probably is also the first case of settlement risk.

Thales of Miletus appreciated the benefits from long gamma positions

Some derivatives historians quote Aristotle's writings as the starting point for options. Aristotle tells the story of Thales, a poor philosopher of Miletus who developed a "financial device, which involves a principle of universal application". People reproved Thales, saying that his lack of wealth was proof that philosophy was a useless occupation and of no practical value. But Thales knew what he was doing and made plans to prove to others his wisdom and intellect. Thales had great skill in forecasting and predicted that the olive harvest would be exceptionally good the next autumn. Confident in his prediction, he made agreements with area olive-press owners to deposit what little money he had with them to guarantee him exclusive use of their olive presses when the harvest was ready. Thales successfully negotiated low prices because the harvest was in the future and no one knew whether the harvest would be plentiful or pathetic and because the olive-press owners were willing to hedge against the possibility of a poor yield. Aristotle's story about Thales ends as one might guess:

> "When the harvest-time came, and many (presses) were wanted all at once and of a sudden, he let them out at any rate which he pleased, and made a quantity of money."

The concepts of leverage, insurance and optionality are not new

Thus he showed the world that philosophers can easily be rich if they like, but that their ambition is of another sort. So Thales exercised the first known options contract some 2,500 years ago. He was not obliged to exercise the options. If the olive harvest had not been good, Thales could have let the option contracts expire unused and limited his loss to the original price paid for the options. But as it turned out, a bumper crop came in, so Thales exercised the options and sold his claims on the olive presses at a high profit.

Risk management in Venice – 1470

Steinherr (1998) cites Venice in 1470 as the starting point for options and tells the story of Geramolo Foscati. On 4 April 1470, Geramolo Foscati, one of the wealthiest patricians of the Serenissima Repubblica, considers protecting his wealth from losses. Recently many ships with Chinese silk, indigo, salt and oriental spices fell prey to the Turks or Arab pirates in the Aegean Sea or along the Dalmatian coast. Foscati was offered a contract by a silk merchant who wanted to buy a call option on the (uncertain) delivery of silk. Foscati decided, after seeking the Lord's advice, not to sell the option and take the risk. However, the story exemplifies the early use of optionality in the context of risk management decision-making.

On tulips, kings, and convertibles in the 17th century

Derivatives trading, as we know it today, probably began in the 17th century. At this time the Royal Exchange in London allowed forward contracts on Dutch tulip bulbs. The Amsterdam exchange opened in 1611. There, options on tulip bulbs were traded.[8] The first standardised forward contract, ie, futures, appears to have been traded in Osaka on rice around 1650. The first convertible security (securities with an embedded option) first traded in 1631 when King Charles I of England was allowed to convert his shares in the New River Company into debt when the company did not do as well as expected. Convertibles are early hybrids of pure equity and pure debt. Much of the financial engineering of recent years has refined and generalised this cross-breeding (Steinherr 1998). Furthermore, if conversion is a right, but not an obligation, then it is a security enhanced by an option.

Amsterdam – 1688: Options literature starts

The first options book was printed in 1688 and was written by Don Joseph de la Vega (Frauenfelder 1985). The book describes the speculation on the Amsterdam exchanges and is in Spanish.[9] Apparently, calls as well as puts were available on stocks on the Amsterdam exchange in the 17th century. On 22 October 1693, options were prohibited. Since the prohibition was ignored, the ban was lifted in 1703.

Financial engineering is not a phenomenon of the late 20th century

One of the earliest examples of financial engineering was the dual currency optionable bond created by the Confederate States during the American Civil War. Because there was substantial credit risk involved with the Confederate States, the likelihood was that they would lose the civil war and cease to exist. No lender would lend in their currency or wished to receive their currency as payment. But they did have one major asset, Cotton. They borrowed in sterling with an option to pay back in French francs. The holder of the bonds had the option to convert them into cotton.

[8] The Dutch Tulip Bubble burst in 1636.

[9] The original title was 'Confusion de confusiones, dialogos curiosos entre un Philosoph agudo, un Mercador discreto y un Acconista erudito, descrivendo el negocio de las Acciones, su origen, su ethimologia, su realidad, su jego y su enredo'.

Chicago – 1851: First futures contract in the US

The first formalised futures exchange in the US was the Chicago Board of Trade (CBOT), which opened in 1848 with 82 members. In March 1851, the first futures contract was recorded. The contract called for the delivery of 3000 bushels of corn in June at a price of one cent per bushel below the March price. In 1865 these forward contracts became standardised, and in 1925 the first futures clearing house was established. The Chicago Mercantile Exchange (CME) was established in 1899 as the 'Chicago Butter and Egg Board'.

England – 1858: Charles Darwin publishes the *Origin of Species*

Charles Darwin firmly established the theory of organic evolution known as Darwinism. His interest in natural history led to his friendship with the botanist JS Henslow; through him came the opportunity to make a five-year cruise (1831-36) as official naturalist aboard the Beagle. This started Darwin on a career of accumulating and assimilating data that resulted in the formulation of his concept of evolution. In 1859, Darwin set forth the structure of his theory and massive support for it in the superbly organised *Origin of Species*, supplemented and elaborated in his many later books, notably *The Descent of Man* (1871). In the year Harry Markowitz turned 14 years old (1941) he read Darwin's *Origin of Species* (Bernstein 1992). According to Bernstein, Markowitz was impressed by Darwin's ability to marshal evidence for his revolutionary hypothesis, the care with which he presented his arguments and considered counter-arguments, his tone, and his style. Although the point that Darwin had anything to do with volatility and the evolution of derivatives somewhat sounds stretched, he has in two ways: (1) Darwinism, or the misinterpretation of Darwinism, had a large impact, politically as well as ideologically, on the 20th century and the way we evaluate risk today. (2) Markowitz caused investors to look at wealth in mean-variance space of which risk is a variable. Had this not occurred, portfolios would possibly be viewed differently and derivatives be obsolete.

Switzerland – 1893: Long history of derivatives trading

Switzerland started trading derivatives earlier than one would expect the alpine confederation to have. The relationship between cash market, forward market and (then called) premium transaction in 1893 was 5%, 77% and 18% respectively. Since forward transactions are non-standardised futures and a premium transaction is the predecessor of an options contract, one can argue that derivatives have existed in Switzerland for a long time.

The next chapter looks at the evolution of equity derivatives in the 20th century. A bias was given to the more recent past, ie, the last 30 years.

Derivatives in the 20th century

Summary

Table 8 shows annualised futures turnover in billions of US dollars for the first 10 months of 1999 and compares this figure with the market capitalisation at the end of October 1999 and with turnover in the cash market as of 1998. We calculated futures volumes as the sum of index value in US$ times multiplier times number of contracts traded. The table was sorted by futures turnover.

Table 8: Market capitalisation global equities, stock turnover and futures turnover

Country	Futures contract	Market capitalisation US$bn	Stock turnover (domestic companies) US$bn	Futures turnover (main contract) US$bn	Futures turnover relative to market capitalisation (%)	Futures turnover relative to stock turnover (%)
US	**SPX**	9,316	(r,t)* 12,017	8,886	95	74
Germany	**DAX-30**	838	(r) 1,393	1,810	216	130
Japan	**Nikkei 225****	2,509	(t) 907	1,086	43	120
France	**CAC-40**	839	(r) 2,013	1,050	125	52
Italy	**MIB-30**	334	(t) 486	952	285	196
UK	**FTSE-100**	1,784	(r) 1,044	886	50	85
Spain	**IBEX-35**	235	(r) 639	521	221	82
Hong Kong	**Hang Seng**	193	(t) 206	410	213	199
Netherlands	**AEX**	471	(r) 385	399	85	104
Switzerland	**SMI**	561	(r) 654	321	57	49
Australia	**SPI**	211	(t) 159	181	86	114
Sweden	**OMX**	202	(r) 203	97	48	47

Source: WDR (data from FactSet, FIBV, and Datastream)

Market capitalisation based on MSCI universe as of 29 October 1999; trading volume as of 1998 from FIBV; futures volume from January-October 1999 volumes (annualised)

* NASDAQ = (r), NYSE = (t); **OSE contract, cash volume from Tokyo and Osaka

Stock exchanges use different definitions and calculation methods to compile turnover statistics. This means that turnover figures cannot be compared between the various stock exchanges. Following the classification adopted by the European Federation of Stock Exchanges, the FIBV has split its members among two main groups: those adopting the Trading System View (TSV) and those adopting the Regulated Environment View (REV). TSV (t) exchanges include as turnover only those transactions which pass through their trading systems or which take place on the exchange's trading floor. REV (r) exchanges include in their turnover figures all transactions subject to supervision by the market authority (transactions by member firms, and sometimes non-members, with no distinction between on- and off-market and transactions made into foreign markets reported on the national market).

SPX most liquid contract

The most liquid contract is the SPX in the US with a 1999 market share of 53.5% among the most liquid futures contracts in Table 8. Second and third are the DAX with a market share of 10.9% and the Nikkei 225 futures contract at the Osaka Securities Exchange with a market share of 6.5%.

MIB-30 futures volume was 285% of market capitalisation

Futures volume relative to market capitalisation varies strongly among countries. Most extreme is Italy where futures volume was 285% of market capitalisation of US$334bn. The smallest futures volume relative to market capitalisation was in Japan where only 43% of market capitalisation was turned over in 1999.

Hang Seng and MIB futures volume is twice as high as cash volume

Comparing futures volumes with cash volumes, the most extreme countries are Hong Kong and Italy where futures volumes were around twice that of the cash market in 1999. A small relationship was observed in Switzerland and Sweden. Note our reservations expressed in the note to Table 8 with respect to comparing cash volumes across different markets.

Chronology

Derivatives are not only thought to have caused the 1987 crash, they also caused the 1929 crash

Options trading increased in the bull market after 1920. The senate report No. 1455 from 1934 concludes that malpractice with options was one of the causes for the stock market to crash in 1929. The origin of the manipulation with options was the formations of pools. These pools bought call options and then tried to manipulate the stock with artificial buying and wrong information.

The issue of regulating derivatives is nearly as old as derivatives themselves

It is interesting to note that at various times in history derivatives have been heavily regulated or even banned in various countries. Considerable regulation was enacted during the Great Depression out of the belief that derivatives destabilised the underlying assets. This was later proven to be a fallacy. The banning of options on futures in the US in 1936 is an example of this. To this day the only thing futures are not allowed to be traded on in the US are onions. In the 1950s future president Gerald Ford succeeded in having this ban put in place.

The invention of the transistor, 1947

Melamed (1999) regards the invention of the transistor as the landmark event that spurred the use and growth of financial derivatives as a tool in risk management. On 23 December 1947, John Bardeen, Walter Brattain and William Shockley, all Bell Laboratory scientists who would receive the Nobel Prize a decade later, demonstrated the first transistor. It was the birth of a technology that would serve to dominate the balance of this century and, probably, much of the next as well. Transistors and their offspring, the microchip, revolutionised everything: the computer, the space programme, the television, telecommunications and the markets. It brought the curtain down on the gold standard and replaced it with the information standard, thereby introducing financial markets to globalisation. The ramifications were revolutionary. Among its many effects, globalisation demanded the invention of instruments of finance that would enable market participants to insure against financial exposures not simply limited to a single geographical area, but ones encompassing the entire world. It thus gave birth to the 1970s era of financial futures.

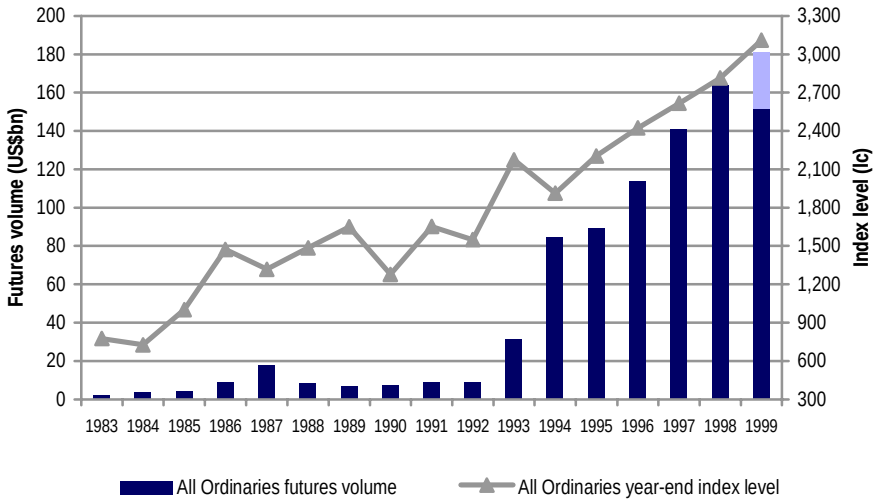
Harry Markowitz – 1952 – and modern portfolio theory

In 1952 Harry Markowitz demonstrated how to create a frontier of efficient portfolios, each having the highest possible expected rate of return for a given level of risk – as measured by the standard deviation of portfolio returns. In the 1960s, financial theorists began to investigate how Markowitz's model influenced the valuation of securities. The investigation focused on the impact of efficient portfolio formation within a frictionless marketplace. The result of investigation became what is now known as the capital asset pricing model (CAPM), developed independently by W Sharpe in 1964, J Lintner in 1965 and J Mossin in 1966. This model demonstrates that an asset's equilibrium return is a linear function of its systematic risk. Specifically, an asset's return is equal to the riskless rate of interest plus a risk premium that depends on the asset's covariance with a broadly diversified market portfolio. As we will highlight further on, there is a natural link between modern portfolio theory and the use of derivatives since the latter allows the addition of negative correlation, ie, reduce risk or alter one's risk-return profile in mean-variance space.

Sydney – 1960: Starting with greasy wool futures

In Australia the first exchange traded derivatives began in 1960 with the trading of greasy wool futures on the Sydney Greasy Wool Exchange, which later became the SFE. Government regulation on the price of wool ended the trading of these futures. In 1978 gold futures were introduced and they were followed by futures on Bank Accepted Bills (BAB) in 1979. In 1983 the SFE became the first exchange outside the US to list futures and options based on a stock index, the Share Price Index (SPI). The SFE currently trades futures and options contracts on the All Ordinaries Share Price Index, 90-day bank accepted bill, three-year Australian treasury bond, 10-year Australian treasury bond, wheat and wool; and Share Futures contracts on 12 Australian companies, New South Wales and Victoria electricity futures. The Australian Stock Exchange Derivatives (ASX Derivatives) was formed in 1976 as the Australian options market. Initially, call options were traded on shares of four companies, and put options were first listed in 1982. Today, there are call and put options listed on over 50 of Australia's leading companies. In 1991, the first warrants were issued through ASX Derivatives and the SPI contracts approved by the CFTC. In April 1995, Low Exercise Price options were introduced.

Chart 29: All Ordinaries and All Ordinaries futures volume (US$bn)



Source: WDR (data from Datastream)

Futures volume until October 1999 and annualised. Index level as of 8 December 1999.

The SPI has existed for some time. Volumes picked up in 1994. Estimated futures volume for 1999 were cUS$181bn which compares with a market capitalisation for the MSCI Australia of US$211bn and 1998 cash volumes of US$159bn.

The 1970s: The beginnings

Black-Scholes – October 1970: A winning formula

In October 1970, Myron Scholes and Fischer Black handed a paper entitled 'A Theoretical Valuation Formula for Options, Warrants and Other Securities' to the *Journal of Political Economy*. The paper was rejected without review. The *Review of Economics and Statistics* also rejected the paper. The original paper was then broadened to show how corporate liabilities could be viewed as options. The final version of the paper was published, with some support from Eugene Fama and Merton Miller, in 1973 in the *Journal of Political Economy* under the title 'The Pricing of Options and Corporate Liabilities'. Robert Merton independently developed a similar model, also published in 1973: 'Theory of Rational Option

Pricing', Bell Journal of Economics and Management Science, Spring, 1973.

Honoured with the Nobel Prize

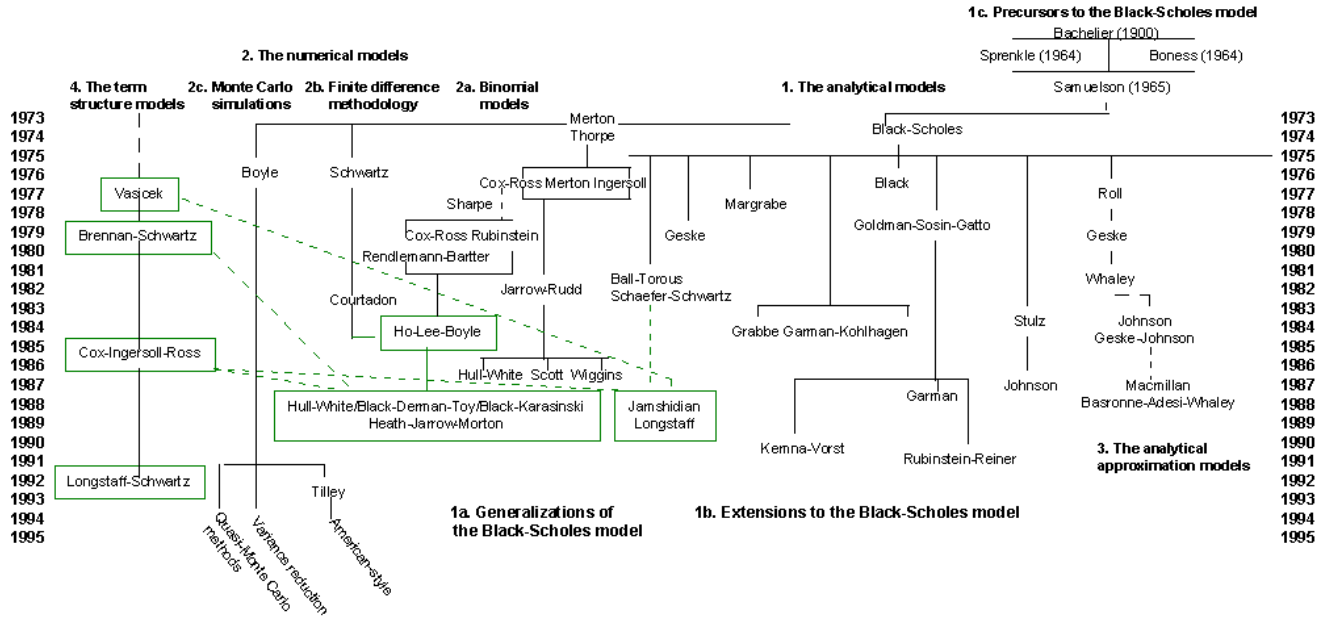
The 1997 Nobel Prize[10] in economics was awarded to Myron Scholes (Stanford) and Robert Merton (Harvard). Professors Scholes and Merton were cited by the Royal Swedish Academy of Sciences for developing "a pioneering formula for the valuation of stock options." The citation said: "The method has created new areas of research, inside as well as outside of financial economics. A similar method may be used to value insurance contracts and guarantees, or the flexibility of physical investment projects." Fischer Black died of cancer in 1995, aged 57; had he lived, he would surely have shared the Nobel Prize. The rules of the Nobel Prize prohibit awarding the prize posthumously.

Making money with a winning formula

In 1974 Texas Instruments marketed a handheld calculator that gave Black-Scholes model values and hedge ratios. When Scholes asked them for royalties, they replied that the formula was in the public domain. When Scholes asked whether he at least could have a calculator, they suggested that he bought one. He never did (Scholes 1998).

Table 9 shows the evolution of option pricing theory schematically. A summary in text format can be found on www.schoolfp.cibc.com/articles/index.html.

Table 9: Evolution of options pricing



Source: Smithson and Song (1996)

[10] Strictly speaking there is no Nobel Prize in economics since economics is not a 'real science'. The Nobel Prize is an award given for outstanding achievement in physics, chemistry, physiology or medicine, peace, or literature. The awards were established by the will of Alfred Nobel, the Swedish industrialist and inventor, who left a fund to provide annual prizes in the five areas listed above. These prizes were first given in 1901. Alfred Nobel did not have the dismal science (economics) in mind when he wrote his famous 1894 will. The economics prize was not created until 1969, the brainchild of the then head of the Swedish central bank. The prize is financed by the bank and administered by the Royal Swedish Academy of Sciences and the Nobel Foundation. It is not, in fact, a Nobel Prize, but rather 'The Central Bank of Sweden Prize in Economic Science in Memory of Alfred Nobel'.

It all started in Chicago

Chicago – 1972: IMM

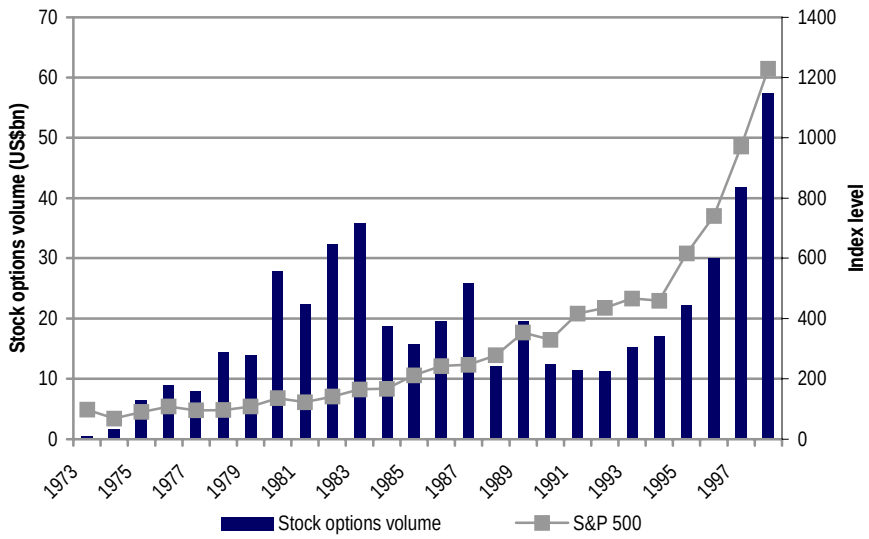
The Chicago commodity futures exchanges in their drive to diversify had, by the late 1960s, developed their interest in new kinds of contracts, building on their accumulated expertise in commodities. In view of higher currency volatility after the demise of the Bretton Woods fixed exchange rate system, the idea of foreign exchange contracts was particularly attractive and contract design was seen as exceptionally easy as foreign exchange is a perfectly standardised commodity. The International Money Market (IMM) was inaugurated in 1972 as an offshoot of the CME and the era of financial futures trading began.

Chicago – 1973: CBOE

In April 1973 call options on 16 stocks commenced trading on the Chicago Board of Options Exchange (CBOE)[11]. The New York Stock Exchange (NYSE) began trading options in June 1985. On 28 April 1997, CBOE assumed all NYSE options business. Note that the CBOT (Chicago Board of Trade) was established in 1848 and today lists some equity derivatives such as CBOT Dow Jones Industrial Average options.

An interesting source of history of derivatives exchanges and current products can be found on the web under www.fiafii.org/default.asp. Search for 'World Map'.

Chart 30: S&P 500 index and stock option volume at CBOE



Source: WDR (data from CBOE and Datastream)
Note: Bars show premium volume (as opposed to notional value)

Chart 30 shows premium volume (calls and since 1977 puts) at the CBOE from launch in 1973 until 1998. Note that premium volume to some extent is a function of implied volatility since the higher the implied volatility the higher the premium

[11] The CBOE currently lists options on more than 1,100 stocks and the Dow Jones Industrial Average Index (DJX), the Dow Jones Transportation Average (DTX) and the Dow Jones Utility Average (DUX). In addition, CBOE lists options on the Dow 10, Lipper Analytical/Solomon Brothers Growth Funds Index, the Lipper Analytical/Salomon Brothers Growth and Income Funds Index, S&P 100, S&P 500, Nasdaq 100 Index, S&P SmallCap 600 Index, S&P/Barra Growth Index, S&P/Barra Value Index, Russell 2000 Index, Goldman Sachs Technology Indexes, Morgan Stanley Multinational Composite Index, and 22 sector indices. Options on the CBOE Mexico Index, Latin 15 Index, Nikkei 300 Index, and CBOE Israel Index comprise CBOE's foreign index-option complex. CBOE also offers interest rate options, LEAPS (long-term options on individual equities and stock indices), and FLEX (Flexible Exchange) options.

paid for an option. Since 1974, the listed stock options business at the CBOE grew by 15.9% per year on a premium basis which compare with 14.2% on a number-of-contracts basis and with 12.8% annual price return for the S&P 500 index. Since the trough in 1992, these annual growth rates were 31.1%, 20.6% and 18.9% respectively.

New York – 1975: AMEX

By 1975 the American Stock Exchange (AMEX) and Philadelphia Stock Exchange (PHLX) began offering stock call options. A year later the Midwest Stock Exchange also began listing stock options. Amex currently trades more than 1000 stock/index options and warrants. The PHLX trades 500 equity options, 11 index options and 11 currency options. Until 1989, the SEC only allowed stock options on one exchange. However, no exchange listed stock options which were listed on another exchange until 23 August 1999 when Dell options were traded on the CBOE. The Philadelphia Stock Exchange had been the only exchange with those options (its most active). CBOE then listed Microsoft and Compaq on 27 August, which were the pride of the Pacific Stock Exchange. On 20 September, CBOE listed options on Amex's pride, Intel. These took lots of volume away from other exchanges.

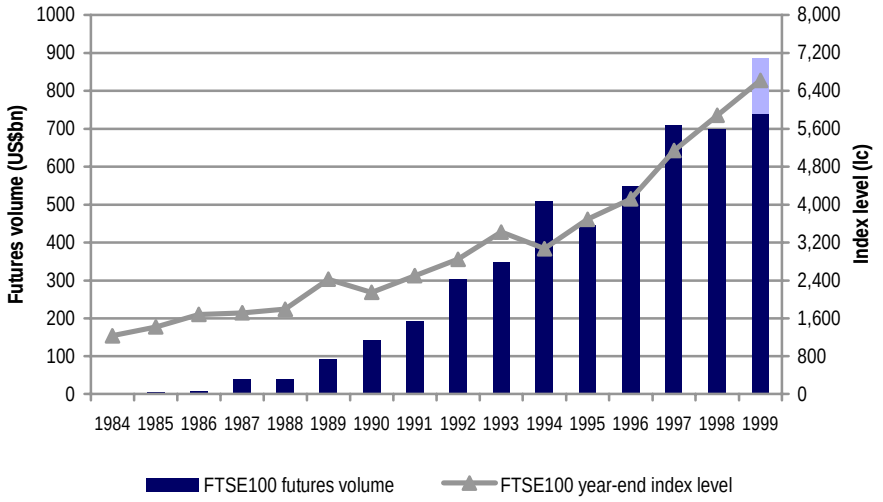
US – 1977: The introduction of put options

In 1977 the Securities and Exchange Commission (SEC) authorised the limited trading of put options, allowing each exchange to list up to five put option series. Concerned by the rapid growth of the derivatives market and the appearance of abuses in options trading, the SEC declared a moratorium on additional options listings (Junkus 1995).

London – 1978: LTOM

In 1978 derivatives markets started to open in Europe. The LTOM in London and the EOE were founded in 1978. Equity derivatives in the UK began with options; the London Traded Options Market (LTOM) under the auspices of the London Stock Exchange. In general terms, however, it was not a success (Walmsley 1995). Firstly, the Stock Exchange was dominated by firms that had relatively little interest in new derivative products and, in so far as they did, perceived them to be a threat to their existing business. Secondly, the tax position of pension funds (a critical component of the market given the institutional dominance of UK equity markets) inhibited them from using derivatives until 1990. The UK taxation authorities took the view that operations in derivatives were ‘trading’ rather than ‘investment’, and therefore taxable, even though the pension fund itself might be tax-exempt. Another tax consideration delaying the introduction of active options trading in the UK was the authorities’ treatment of options as ‘wasting assets’. Thus, the purchaser of an option that expired worthless could not claim a tax-deductible loss. In 1991, LTOM was merged into LIFFE.

Chart 31: FTSE and FTSE futures volume (US$bn)



Source: WDR (data from Datastream)

Futures volume until October 1999 and annualised. Index level as of 8 December 1999.

Estimated 1999 futures volume for the FTSE 100 contract at LIFFE is cUS$886bn, ie, cUS$3.5bn per day. This compares with cUS$1.8trn for the DAX and US$2.1trn for the market capitalisation of the FTSE 100 index at the end of October 1999. The FTSE 100 is the fourth most heavily traded futures contract in Europe after the DAX, the CAC 40 (US$1.05trn), and the MIB 30 (US$952bn). Until 1997, the FTSE 100 had been the most active contract in Europe.[12] Since there is no liquid pan-European futures contract available in the market, investors can trade pan-European exposure by buying 65% DJ Euro STOXX 50 and 35% FTSE 100.[13]

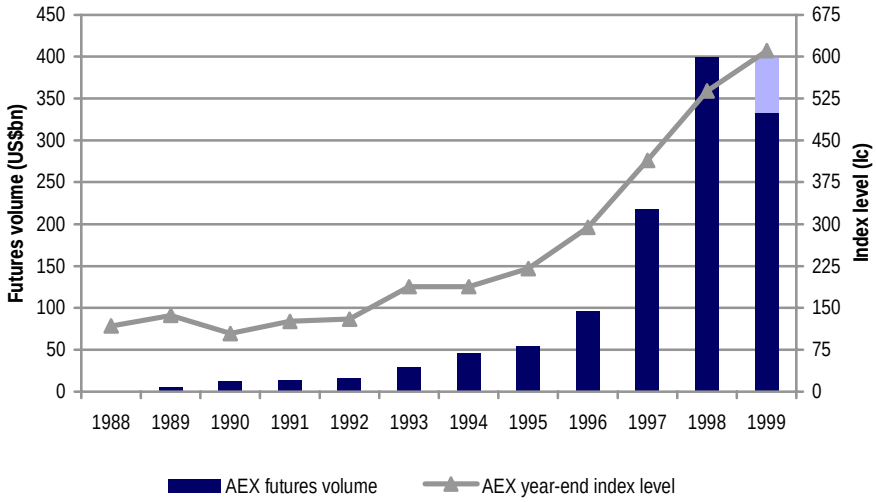
Amsterdam – 1978: EOE

Derivatives were certainly not new to the Dutch when the European Options Exchange (EOE) was founded in 1978. Options on tulips were traded in the 17th century. The agricultural futures market in Amsterdam was founded in 1888, starting with sugar contracts. The AEX (Agrarische Termynmarkt) now trades live hog and piglet futures, and potato (Bintje) futures and options. The equity options and futures exchange merged with the stock exchange in 1997 and is now called AEX-Optiebeurs. Futures on the AEX were launched in October 1988 and index options in May 1992. However, stock options on Dutch shares remained the main business. In 1990 equity options accounted for 95% of its turnover. Attempts to introduce fixed-income and currency options have been of limited success. In 1991 the EOE introduced the Eurotop 100 index, a competitor to the LIFFE Eurotrack Index. Like the Eurotrack at LIFFE, the Eurotop at EOE never took off. Today the underlying index for pan-European equity is called FTSE Eurotop 100. Options on this index are traded at AEX, LIFFE and AMEX in the US and futures are traded at LIFFE and NYMEX in New York.

[12] Except in 1993 and 1994 when the CAC 40 was the most heavily traded based on volume for the full calendar year. See Table 19 on page 80 for futures volumes from 1988-99.

[13] The only liquid cross-country futures contract in Europe is the DJ Euro STOXX 50 at Eurex which covers euroland, ie, excluding the UK, Switzerland and Norway. The weight of the FTSE 100 in an optimised basket varies between 25-35% depending on the observation period and return frequency.

Chart 32: AEX index and AEX futures volume (US$bn)



Source: WDR (data from Datastream)

Futures volume until October 1999 and annualised. Index level as of 8 December 1999.

For the first 10 months of 1999 the volume for single stock options has been US$53bn (assuming average delta of 0.4). This compares with US$103bn for AEX index options, US$332bn for AEX index futures and a market capitalisation for the AEX index at the end of October 1999 of US$512bn. In other words, the annualised exchange traded equity derivatives volumes for 1999 was c125% of AEX market capitalisation. This does not include OTC and guaranteed structures.

Table 10: Introduction of listed index options and futures on non-US exchanges

Year	Date	Futures	Options	Exchange
1983	February	All Ordinaries		SFE
1984	May	FTSE 100	FTSE 100 A	LIFFE
1985	June		All Ordinaries	SFE
1986	May	Hang Seng		HKFE
	September	Nikkei 225		SIMEX
1988	May	FOX (Finland)	FOX	FOM
	June	CAC 40		MATIF
	September	TOPIX		TSE
	September	Nikkei 225		OSE
	October	AEX		EOE
	November		CAC 40	MONEP
1989	June		Nikkei 225	OSE
	December	KFX (Denmark)	KFX	FUTOP
	December	OMX	OMX	OM
	December		SMI	SOFFEX
1990	February		FTSE 100 E	LIFFE
	June		OBX (Norway)	OSE
	September	DAX		DTB
	November	SMI		SOFFEX
1991	June	Eurotrack 100**	Eurotrack 100**	EOE
	August		DAX	DTB
1992	January	IBEX	IBEX	MEFF
	March		Nikkei 225*	SIMEX
	May		AEX	EOE
	August	ATX (Austria)	ATX	OTOB
	September	OBX (Norway)		OSE
1993	March		Hang Seng	HKFE
	March	MSCI HK		SIMEX
	April		BEL 20	BELFOX
	September	BEL 20		BELFOX
1994	February	Nikkei 300	Nikkei 300	OSE
	November	MIB-30		IDEM
1995	November		MIB-30	IDEM
1998	June	DJ Euro STOXX 50***	DJ Euro STOXX 50***	EUREX
	June	DJ Euro STOXX 50***	DJ Euro STOXX 50***	MONEP ^
1999	May	FTSE Eurobloc 100	FTSE Eurobloc 100	LIFFE
	May	FTSE Eurotop 300	FTSE Eurotop 300	LIFFE
	May	FTSE Eurotop 300 ex UK	FTSE Eurotop 300 ex UK	LIFFE
	May	MSCI Euro	MSCI Euro	LIFFE
	May	MSCI Pan-Euro	MSCI Pan-Euro	LIFFE
	June	FTSE EStars	FTSE EStars	LIFFE
	June	FTSE EStars	FTSE EStars	AEX
	September	FOX	FOX	EUREX
	September	FTSE NOREX 30	FTSE NOREX 30	NOREX
	October	DJ STOXX Nordic 30	DJ STOXX Nordic 30	EUREX
	October		FTSE Eurotop 100	LIFFE
	November	FTSE Eurotop 100		AEX

Source: WDR (adopted from Hill 1995)

* Options on futures. ** Converted into FTSE Eurotop 100. *** DJ STOXX 50. ^ Different maturity cycle than EUREX contracts.

The 1980s: Start of the bull run

London – 1981: LIFFE

LIFFE (London International Financial Futures Exchange) was founded in 1981 and began open outcry trading the following year. Options and futures on the FTSE 100 were introduced in 1984. At LIFFE, American and European style index options are available on the FTSE 100 Index. The European style contracts were introduced in February 1990. In the first 10 months of 1999, volume of the American style contract was US$29bn which compares with US$159bn for the European style contract. By 19 November 1999, LIFFE had finally made up its mind with respect to trading systems and had moved completely to electronic trading.

Chicago – 1982

In February 1982 the first index futures contract, the Value Line, was introduced and was viewed with a great deal of scepticism by many equity brokers and investors who believed that the whole concept would soon fail. In April 1982 futures on the S&P 500 started trading on the CME. The launch of the future coincided with the start of the longest bull run in the history of equities. It was also a time where modern portfolio theory concepts regarding indexing and the general benefits of diversification were gaining increased acceptance among institutional investors. Options on US indices were launched on CME, CBOE, CBOT and NYSE the following year. In 1983 the face value of stock index futures and options contracts outstripped the value of underlying stocks traded in the US. In quick progression global markets around the world followed suit: LIFFE in 1984, the Nikkei 225 contract on SIMEX in 1986 and in Osaka two years later. Thereafter the MATIF followed with its CAC 40 in 1988, and in 1990 the Deutsche Terminbörse listed the DAX.

Launch of derivatives coincides with start of bull run – coincidence?

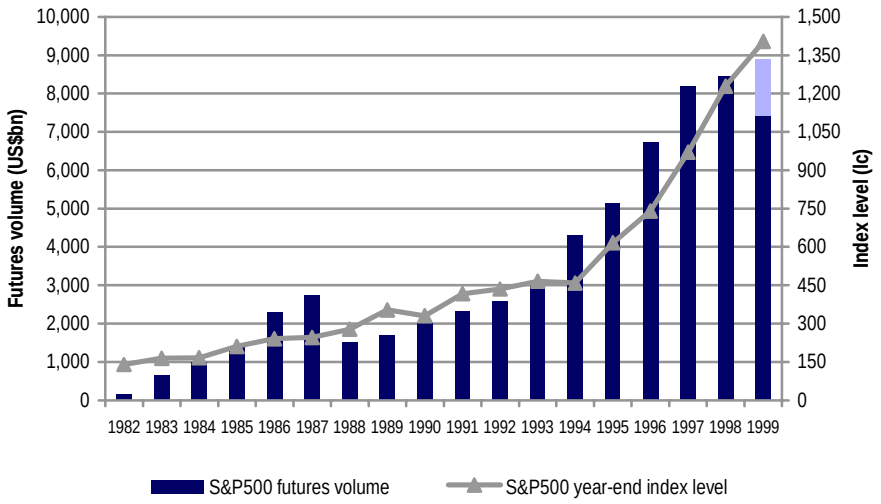
The year 1982 is often associated with the start of the bull run which was still in progress as this report went to press (Q4 99). The birth of stock index futures coincided with the beginning of the bull run. One could argue that this is not a coincidence. Derivatives enhance the ability to differentiate risk and allocate it to those investors most able and willing to take it – a process that has undoubtedly improved national productivity growth and standards of living. In addition, derivatives allowed the introduction of guaranteed equity structures. Investors could enter the market in a modified, ie, protected fashion. This expansion of ‘products’ increased demand for equity, ie, increased the community which is willing to hold equity.

Table 11: Introduction of listed index options and futures on US exchanges

Year	Date	Futures	Options	Exchange
1982	24 February	Value Line		KCBT
	21 April	S&P 500		CME
	6 May	NYSE		NYFE
1983	28 January		S&P 500 Futures	CME
	11 March		S&P 100	CBOE
	29 April		MMI	CBOT
	1 July		S&P 500	CBOE
	23 September		NYSE	NYSE
1984	29 April	MMI		CBOT
	6 August		MMI	AMEX
1985	17 May		XOC	PHLX
1986	3 October		XII	PHLX
1988	21 May		Value Line	PHLX
1990	25 September	Nikkei 225	Nikkei 225 futures	CME
	27 September		Japan index	AMEX
	11 December		S&P 100 LEAPS	CBOE
1991	21 January		S&P 500 LEAPS	CBOE
	11 October	MMI		CBOT
1992	13 February	S&P 400	S&P 400	CME & AMEX
	15 October	FTSE 100	FTSE 100	CME & CBOE
	26 October	Eurotop	Eurotop	COMEX & AMEX
	11 November		Russell 2000	CBOE
1993	11 January	Wilshire 250	Wilshire 250	CBOT-PSE
	4 February	Russel 2000		CME
1994	7 February		NASDAQ 100	CBOE
1995	5 June		S&P SmallCap 600	CBOE
	6 November	S&P/BARRA Value	S&P/BARRA Value	CME & CBOE
	6 November	S&P/BARRA Growth	S&P/BARRA Growth	CME & CBOE
1996	30 May	Mexican IPC	Mexican IPC	CME & CBOE
1997	6 October	DJ Industrial Average	DJ Industrial Average	CME & CBOE
	6 October	DJ Transport Average	DJ Transport Average	CME & CBOE
	6 October	DJ Utility Average	DJ Utility Average	CME & CBOE
1999	4 January		Dow 10	CBOE
	25 February		DJ Internet Commerce	CBOE
	15 April		DJ Equity REIT	CBOE

Source: WDR (adopted from Hill 1995)

Chart 33: S&P 500 and SPX futures volume (US$bn)



Source: WDR (data from Datastream)

Futures volume until October 1999 and annualised. Index level as of 8 December 1999.

The SPX contract is by far the most actively traded futures contract in the world. Estimated 1999 volumes are US$8.9trn, ie, cUS$35.3bn per day. The SPX is five times more liquid than the next most liquid future, the DAX at EUREX, with an average daily volume of cUS$7.2bn for 1999. Volumes and open interest is usually c50-55% of global futures volume and open interest. This is not surprising since the US stock market accounts for between 50-55% of the global equity market.

Japanese warrants market – starting 1982

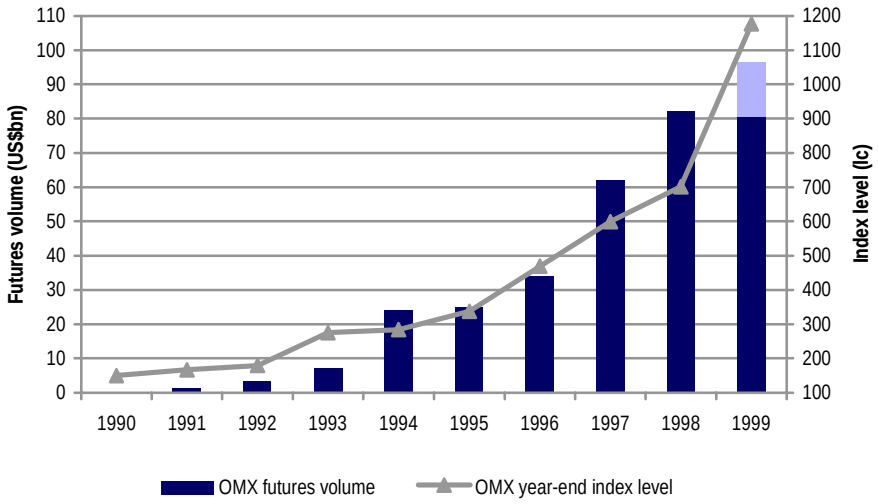
The memory of the Japanese warrants market is fading. In the 1980s, warrants became almost a metaphor for the excesses of the Japanese bubble economy, and the behaviour of participants matched the extremes of history's crowd phenomena (Sucher and Knight 1995). The long bull market in securities and land warped the concept of risk in anything related to Japanese equity. As the stock market nearly tripled over the period 1986-89, demand for new warrant issues – then the only leveraged way to play Japanese shares – soared. Increasingly confident of their global reach, Japanese companies obliged, issuing warrants either to fund ambitious capital spending programmes or simply to exploit what appeared to be an easy financial arbitrage. The first Japanese warrant cum bond was issued by Mitsubishi Kaisei in 1982. The bear market of the early 1990s destroyed the market. By some estimation, the value of all outstanding Eurowarrants shrank from a high of US$65bn in December 1990 to US$3bn in mid-August. Whole classes of investors, principally Japanese and Swiss individual investors, simply abandoned warrants as an investment vehicle.

Stockholm – 1985: OM

On 12 June 1985, OM (Optionsmaklarna) introduced options trading on Swedish stocks as the world's first commercially operated exchange. Within Sweden, OM's position was initially threatened by the decision of the Swedish Government to impose a turnover tax on all futures and options contracts in 1989. In 1989, therefore, OM set up a London based exchange, OM London Exchange (OMLX), which was the world's first electronic link-up of exchanges. At the same time, the turnover tax also destroyed the potential domestic competitor, the Swedish Options and Futures Exchange (SOFE), leaving OM as the sole domestic exchange. Subsequent tax relaxation by the Government helped OM to develop its activity

further, but the main product range remained concentrated on equity derivatives, primarily the OMX options contract. On 12 June 1997, a letter of intent was signed between the Copenhagen Stock Exchange and the Stockholm Stock Exchange with the intention of creating a joint Nordic securities market – NOREX. In 1998 OM merged with the Stockholm Stock Exchange. In September the options and futures on the FTSE NOREX 30 were launched. To date, liquidity in both Nordic derivatives contracts is rather limited. The DJ STOXX Nordic 30 at Eurex has also not, as yet, taken off in terms of volume.

Chart 34: OMX index and OMX futures volume (US$bn)



Source: WDR (data from Datastream)

Futures volume until October 1999 and annualised. Index as of 8 December 1999. The OMX index was split 4:1 as of 27 April 1998.

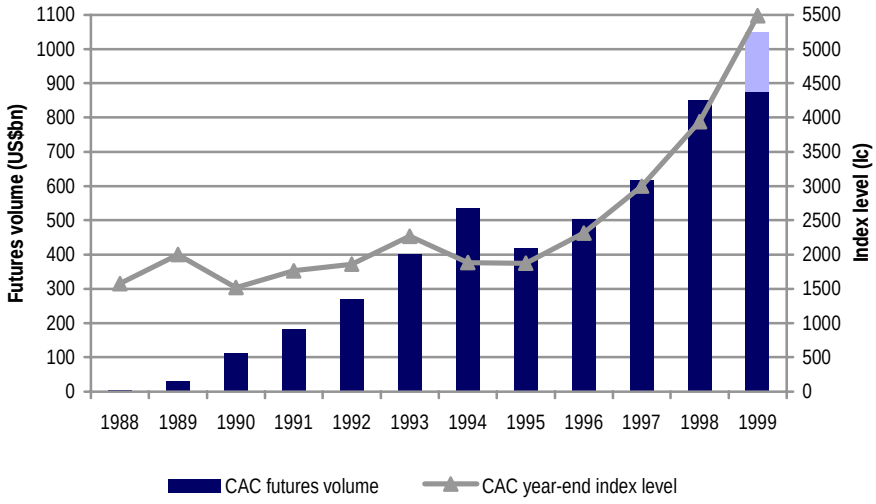
In 1998 OMX index options volume was cUS$43bn and futures volume cUS$82bn. This compares with a market capitalisation for the OMX at the end of October 1999 of US$327bn. Based on these figures (data from FIBV and Datastream) the relationship between derivatives and market capitalisation is rather low. Chart 34 shows OMX futures volume. The volume rallies in 1997. Note that the OMX contract is CFTC approved since 23 June 1996. We have added a list of contracts which are CFTC approved to the Appendix of this report (Table 29 on page 108).

Paris – 1986: MATIF and MONEP

Commodity futures markets were established in France in 1885 and closed in 1939. The cocoa futures market was reopened in 1962. MATIF, the Marché à Terme International Financier, was founded in 1986, the MONEP, the Marché des Options Négociables de Paris, was founded in 1987. Today both exchanges are the derivatives markets of the Parisbourse SA. Futures on the CAC 40 index were launched at the MATIF in June 1988 and index options at the MONEP in November 1988. Initially only six stock option contracts were listed at the MONEP.

Chart 35 shows yearly cumulative trading volumes for the CAC 40 futures and the year-end index level. Volume of the CAC futures was cUS$850bn in 1998 and US$875bn in the first 10 months of 1999. This compares with cUS$587bn volume in the cash market in 1998 (based on data from FIBV). In other words, CAC 40 futures volume alone is c144% of the cash market in notional terms and larger than the market capitalisation of the CAC index (cUS$875bn at the end of October 1999).

Chart 35: CAC 40 and CAC 40 futures volumes (US$bn)



Source: WDR (data from www.matif.com)

Odd-lot splitting and change in multiplier have been accounted for (FFr 200 until 30 June 1998, FFr 50 until 30 December 1998, and EUR10 since the beginning of 1999). 1999 data until 29 October 1999 and annualised. Index as of 8 December 1999.

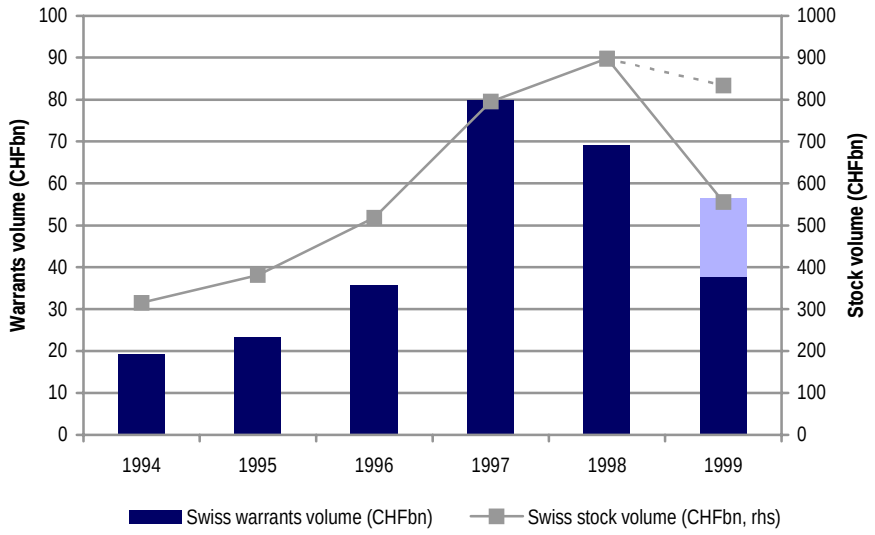
Between 1990 and 1998 CAC 40 futures volume grew at an annual rate of 29.7%. This compares with 21.8% for cash volume and 12.7% for the CAC 40 index. Today, the French equity derivatives market is well balanced with a healthy mix between retail structures, institutional fund and corporate use of derivatives. In 1999, the CAC 40 futures contract was the second most actively traded contract in Europe.

Switzerland – 1986

Although there were derivatives in the last century and gold options in 1976 and equity warrants on Japanese stocks during the 1980s, the start for the equity options and warrants boom in Switzerland started in 1986. During the course of 1986 Martin Ebner's BZ Bank issued warrants on the registered shares of Ciba-Geigy (which became a merger partner of Sandoz to form Novartis a decade later). This was innovative for two reasons. Firstly, it was a covered warrant[14] and secondly, it allowed foreign investors to participate in the registered shares of Swiss companies that, at the time, traded at a massive discount and could not be purchased by foreigners. This was the start of the equity warrants business in Switzerland. Warrant volumes increased until 1997 (Chart 36 on page 64). Today, Switzerland and Germany have the largest equity warrants businesses in the world.

[14] More precisely, it was a 'Stillhalteroption' which lacks a sound translation. Stillhalteroption is usually translated as 'covered warrant'. However, warrants issued by banks are also called covered warrants, because they are synthetically hedged by the issuer, ie, covered. The Stillhalteroption is Swiss jargon and refers to a covered warrant whereby the coverage is physical as opposed to synthetic, ie, an investor holds the stock and sells a call warrant on that stock.

Chart 36: Volume in the Swiss warrants and stock market



Source: WDR

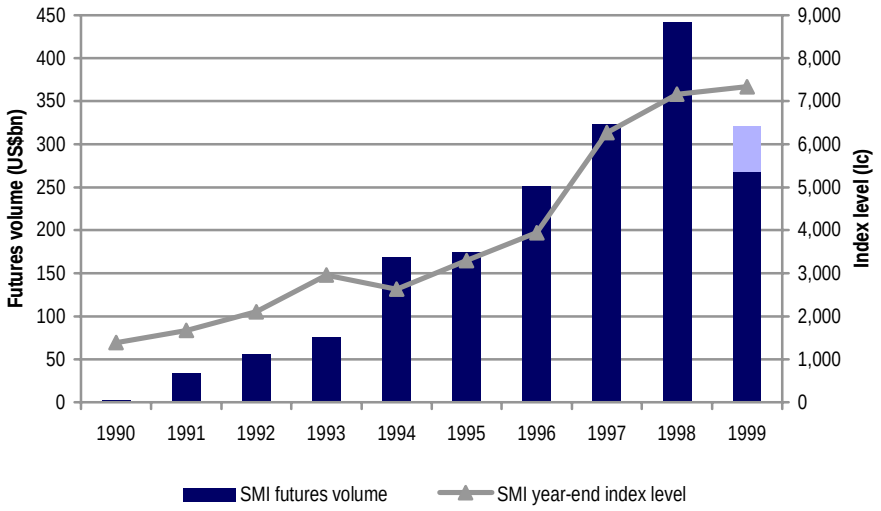
1999 volumes until August 1999 and annualised.

The compound annual growth rate for the warrants market between 1994-99 (estimate) has been 24% which compares with 21.5% for cash volumes and 20% for the SMI. Since 1994, Swiss warrants premium volumes have been c6-10% of cash volumes. The volume peak was in 1997 where the equivalent of cCHF80bn (US$50bn) was traded, which compares with CHF795bn in the cash market. Note that the CHF80bn is premium volume and not notional. Assuming the average liquid warrant has a remaining life of six months, an average implied volatility of 34%, and an average strike price of around at-the-money then the average premium paid in the warrants market is 10% of spot. In other words, the notional volume is about 10 times as high as the premium volume. Given these assumptions the warrants market has been trading in cash equivalent terms between 60-100% of the cash market.

Zurich – 1987: SOFFEX was the first fully electronic options exchange in the world

The Swiss Option and Financial Futures Exchange (SOFFEX) was founded in 1987 and started trading on 19 May 1988 as the first fully electronic options exchange in the world. Options on the SMI were launched in December 1989 and the futures followed in November 1990. In 1995 Switzerland's three regional stock exchanges in Geneva, Basle and Zurich were merged to form SWX. In 1998 the SWX Swiss Exchange and Deutsche Börse merged their derivatives exchanges (SOFFEX and DTB) to form EUREX. Based on 1998 volumes from FIBV, EUREX is the third largest exchange with respect to equity derivatives after CME and CBOT in Chicago. Volumes at EUREX were roughly 25% of those of CME. In the press EUREX enjoys favourable headlines as the largest derivatives exchange. This is because often the total number of traded contracts are compared across exchanges which is misleading because different contracts have different notional values. One DAX future, for example, has a value of US$150,000 per contract which compares to US$352,000 for the SPX contract. So if EUREX trades one DAX contract and CME one SPX contract, volumes at CME, to our mind, is twice as high and not equal. Table 18 on page 77 shows a comparison of 1998 equity derivatives volumes on an exchange basis.

Chart 37: SMI index and SMI futures volumes (US$bn)



Source: WDR (data from Datastream)

Futures volume until October 1999 and annualised. Index level as of 8 December 1999.

Based on estimated 1999 volumes, the compound annual growth rate for SMI futures volumes has been 35% which compares with 20% for the SMI. Until the end of October the SMI futures volumes have been US$267bn. This compares with US$59bn for index options (assuming average delta of 0.4) and US$46bn for stock options. SMI market capitalisation was US$555bn at the end of October. In other words, annual derivatives volumes (index futures and options plus equity options) was US$353bn, ie, 76% of the market capitalisation of the SMI. If we add our annualised estimate for *notional* volume in the warrants market, total exchange traded equity derivatives volumes of US$350bn amounts to US$703bn which is 127% of the market capitalisation of the SMI at the end of October 1999. This does not include OTC and retail structures.

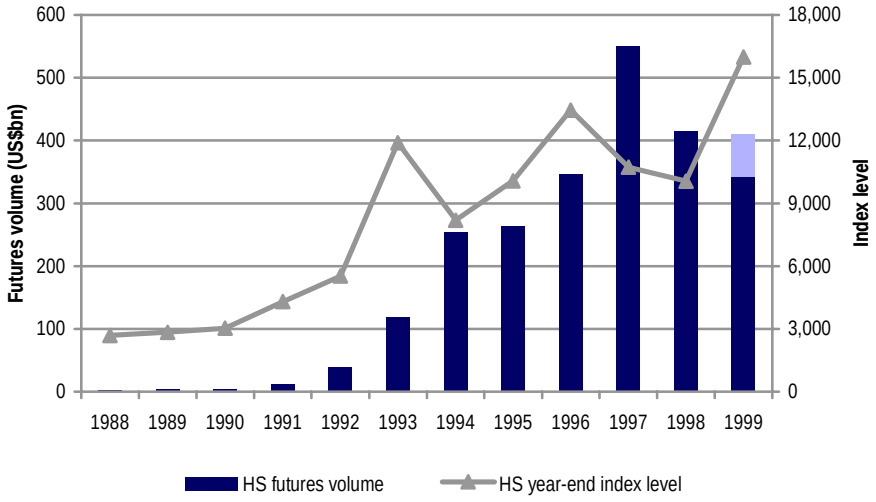
Singapore – 1986: SIMEX

SIMEX was inaugurated in September 1984 as the first financial futures exchange in Asia. The Nikkei 225 contract was introduced in September 1986. Options on Nikkei 225 futures were launched in March 1992 and futures on the MSCI Hong Kong index in March 1993.

Hong Kong – 1986: HKFE

Established in 1976 as the Hong Kong Commodity Exchange, the exchange originally traded futures on agricultural commodities, including cotton, sugar and soybean and, in 1980, introduced gold futures. In the mid-1980s, the Hong Kong Commodity Exchange changed its name to the Hong Kong Futures Exchange (HKFE). The first financial product, the Hang Seng Index future, was launched in 1986. The HKFE suffered severely in the crash of 1987 by being closed for three days. The subsequent arrest of the Chairman of the Hong Kong Stock Exchange for corruption was also unhelpful. But investors' enthusiasm for emerging markets, and for China in particular, helped restore the Hong Kong market. An international electronic trading link with New York Mercantile Exchange began on 13 June 1997 allowing members to trade NYMEX contracts through ACCESS during Asian hours. The exchange now trades Hang Seng Index, Hang Seng 100, Red Chip Index and HKFE Taiwan Index futures and options, foreign currency, rolling forex (currency), stock and one- and three-month HIBOR futures.

Chart 38: Hang Seng and Hang Seng futures volume (US$bn)



Source: WDR (data from Datastream)

Futures volume until October 1999 and annualised. Index level as of 8 December 1999.

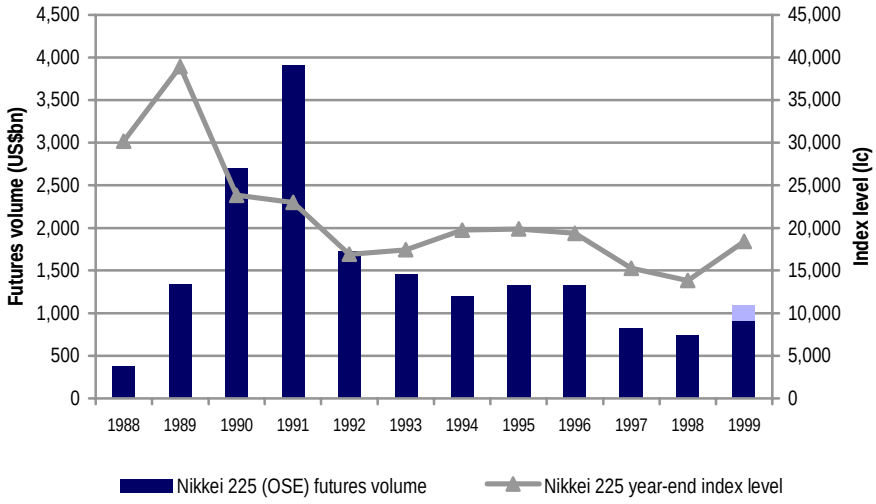
Futures volume peaked in 1997 where the notional futures volume was US$550bn. Estimated 1999 futures volume was US$410bn (cUS$1.6bn per day). This compares with a market capitalisation of the Hang Seng Index of US$366bn at the end of October 1999. When futures volume is compared with market capitalisation or turnover in the cash market, Hong Kong is one of the most actively traded futures markets (Table 8 on page 50.

Osaka 1988

The equity derivatives market in Japan is dominated by the Osaka Securities Exchange (OSE). The Osaka Securities Exchange was established in 1949; its predecessor, the Osaka Stock Exchange, was opened in 1878. The exchange currently trades the Nikkei 225, Nikkei 300 and sector indices futures and options, and equity options. The attempt by Tokyo to trade a competing derivatives instrument as important as the Nikkei 225, the TOPIX, has fallen well behind after a promising start. Nikkei 225 futures on the OSE started trading in September 1988.[15] By that time futures already existed on the Nikkei 225. SIMEX (Singapore International Monetary Exchange) launched futures in September 1986. The Nikkei 225 contract at the CME was issued in September 1990. Since 1993 the OSE had between 70-75% of total futures volume in the Nikkei 255, the SIMEX the rest. Volume in the contract at the CME is negligible.

[15] In 1998 as well as in 1999 TOPIX futures volume was c22% of Nikkei 225 volume at the OSE despite the strong outperformance of the former in 1999.

Chart 39: Nikkei 225 index and Nikkei 225 futures volume (US$bn, OSE contract)



Source: WDR (data from Datastream)

Futures volume until October 1999 and annualised. Index level as of 8 December 1999.

Chart 39 shows that derivatives volume in Japan follows a slightly different path than most other markets. Volumes have been falling during the bear market. Futures volumes, by definition, move to some extent in line with the market because the index value is reflected in the US$-value of the futures volume calculation. The value of one Nikkei future at an index level of 40,000 is twice as high as at an index level of 20,000. Our 1999 estimate of notional volume for the OSE contract is US$1,086bn (cUS$4.3bn per day). This compares with a market capitalisation for the Nikkei 225 index of US$1,969bn at the end of October 1999, and 1999 estimated volumes for the Nikkei 225 contract at SIMEX of US$38.2bn, and US$3.7bn for the contract at the CME in Chicago.

Helsinki – 1988: SOM

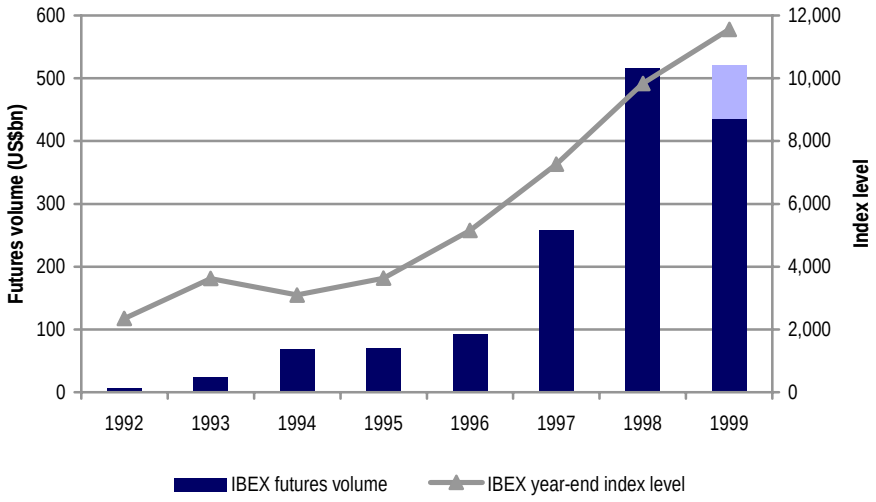
128 years after the first trading sessions in Finland were arranged, Finnish options and futures trading began in May 1988 at the Finnish Securities and Derivatives Exchange and Clearing House (SOM).[16] The exchange was not really successful. This might have been due to initial restrictions on foreign participation, and to the impact of developments in Russia on the Finnish economy. Options and futures on the FOX index were launched in May 1988. In 1995 the weight of each company in the FOX index was limited to 20%, unlike the HEX 20 index where the weight of Nokia was more than 70% in December 1999. In 1998, the Finnish Options Market (SOM Ltd) and the Helsinki Stock Exchange Ltd merged into HEX Ltd, Helsinki Securities and Derivatives Exchange, Clearing House. In April 1999 HEX signed a co-operation agreement with Eurex. Finnish derivatives have been trading at Eurex since September. The FOX futures at Eurex trades cUS$1.5m per day, ie, liquidity is thin.

[16] The first trading sessions in Finland were arranged as far back as the 1860s. In the beginning, besides securities, commodities and currencies were also traded at the Stock Exchange.

Spain – 1989: MEFF

Derivatives trading in Spain was launched in 1989 with the creation of OM Iberica, located in Madrid. Within six months a second exchange, located in Barcelona, was launched – the Mercado de Futuros Financieros (MEFF). In February 1991, OM sold its stake to other shareholders, and the exchange was restructured to become the Madrid Options and Futures Exchange (MOFEX). This move led to the merger later in 1991 of the two exchanges in Madrid and Barcelona into a combined holding company called MEFF RV (RV stands for Rentas and Valoras – bonds and equities). The combined exchange duly launched options and futures contracts on the IBEX 35 in January 1992.

Chart 40: IBEX and IBEX futures volumes (US$bn)



Source: WDR (data from Datastream)

Futures volume until October 1999 and annualised. Index level as of 8 December 1999.

Between 1993-99 futures volumes grew at an annual rate of 67% which compares with 18% for the IBEX 35 index. In 1999 futures volume (annualised estimate) was US$521bn which compares to US$515 in 1998, and with US$255bn market capitalisation for the IBEX 35 at the end of October 1999, and with cash volume for 1998 of US$570bn. In other words, futures volume relative to market capitalisation is huge, ie, more than twice market capitalisation.

VaR appeared in the late 1980s

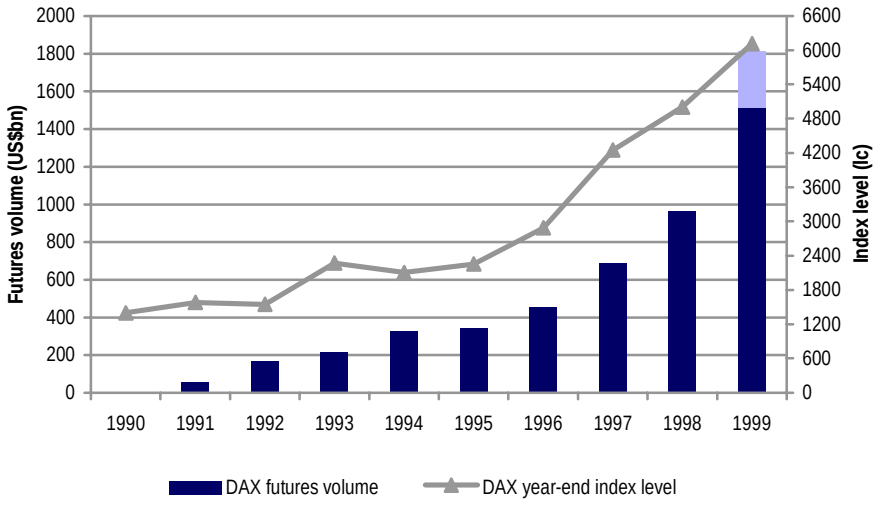
The VaR (value at risk) approach was developed by banks in the late 1980s as a tool to measure the potential change in value of a trading portfolio over a short horizon, typically 24 hours. The objective was to create a measure that would facilitate communications of risk across the organisation, enable risks to be aggregated across asset classes, and permit the estimation of a required level of capital to support trading businesses. Today, VaR is widespread among dealers but not among investors (Hayt 1999). Fiduciaries must rely on external managers to provide VaR figures or the data necessary for its calculation. The longer investment horizon typical of institutional investors is also less suited to the use of VaR.

The 1990s: Continuous growth

Frankfurt – 1990: DTB

In Germany, derivatives started late. The DTB (Deutsche Termin Börse) was established in 1990. The reason for the late arrival of derivatives was the ingrained conservatism of the German financial establishment, especially the Bundesbank, which was reluctant to countenance rapid financial innovation in the German market. A further problem arose from section 764 of the Civil Code, under which derivatives transactions by private individuals were treated as gambling contracts until the 1989 amendment of the Stock Exchange Act (Walmsley 1995). The DAX index futures contract was launched in September 1990 and the index options contract was launched in August 1991. Both contracts were a success from the start. Today, they are the most active index derivatives contracts in Europe by a surprisingly wide margin. Among the eight most actively traded single-country futures contracts in Europe, the DAX has a market share of c30%, with the CAC 40 c18% based on trading volume. A letter of intent between Deutsche Börse AG and the Swiss Exchange to merge DTB with SOFFEX was signed in December 1996. In May 1998 the first trading release was introduced. On 22 June 1998, Eurex started trading options and futures on the derivatives indices of Dow Jones STOXX, the DJ STOXX 50 and the DJ Euro STOXX 50. To date, the latter is the only liquid multi-country futures contract in Europe. In August 1999 the moratorium on admission of EUREX participants in the US was lifted.

Chart 41: DAX index and DAX futures volume (US$bn)



Source: WDR (data from Datastream)

Futures volume until October 1999 and annualised. Index level as of 8 December 1999.

Estimated 1999 DAX futures volume was US$1,810trn, which is cUS$7.2bn per day and amounts to an increase of 88% compared with 1998. From the main global equity index futures the DAX experienced the most extreme annual increase in volume terms in 1999. The next largest increase was the Nikkei 225 at the OSE where volumes increased by 47% (see Table 19 on page 80 for growth in different futures contracts).

The initial main focus of the DTB has been equity options and derivatives. Today EUREX stock option volumes are highest by a wide margin. One reason is that the proportion of institutional usage is higher in the UK and institutions often prefer

Table 12: Stock option volume in Europe

	Exchange	Total volume 1999 by market (US$m)	Average volume by stock (US$m)	Average daily volume by market (US$m)	Average daily volume by stock (US$m)
German stocks	**EUREX**	68,955	1,915	320.7	8.9
Swiss stocks	**EUREX**	45,976	2,299	213.8	10.7
UK stocks	**LIFFE**	13,487	167	62.7	0.8
Dutch stocks	**AEX**	52,786	1,228	245.5	5.7
French stocks	**MONEP**	29,843	765	138.8	3.6

Source: WDR (data from Datastream)

1999 volumes until 29 October 1999. Selection of exchanges due to data availability. Volume calculation: stock in US$ * number of contracts traded * multiplier * 0.4 (assumption for average delta)

OTC as opposed to exchange traded contracts than is the case in EUREX space, ie, Germany and Switzerland. A second reason is that Germany and Switzerland have developed warrants markets which are non-existent or very small in the rest of Europe. Warrants issued by banks are often hedged through a combination of stocks in the cash market, exchange traded options and, to a lesser extent, other warrants. We will show that this activity reduces volatility (and not increases it – as occasionally postulated) in the cash market at a later stage in the document.

Table 12 compares total stock options volume for five exchanges in Europe. These five markets (four exchanges) had volumes of cUS$197bn in 1999 until the end of October. This equals cUS$6bn daily. The market share of EUREX was 54%. Note that Swiss stocks show the highest volumes on a single stock basis. How do these stock option volume figures compare with the US stock options market? Equity options at CBOE in 1998 was US$264bn given the same assumptions as in Table 12. In 1997 the total notional amount of equity options in the US (all exchanges) amounted to US$402bn where the CBOE had a market share of 42%, the AMEX 30% and the Philadelphia Stock Exchange (PSE) 19%. Based on 1998 figures, CBOE stock options volume was four times higher than stock option volume on German stocks at EUREX.

Vienna – 1991: OTOB

In the autumn of 1991 the Vienna Stock Exchange launched the Österreichische Termin und Optionen Börse (OTOB). OTOB linked up with OM and initially launched five equity options and an option on the ATX index in August 1992. While, traditionally, the Austrian equity market has been restricted by state participation in key firms, lack of legislation on insider trading, and a shallow level of activity, the beginnings of a move toward privatisation has been helpful in developing the market, and the OTOB options have been very successful, regularly trading three times the volume of the underlying shares (Walmsley 1995). Today, OTOB is a subgroup of the Wiener Börse. There are options and futures not only on Austrian underlying securities but also on Polish, Hungarian, Czech Republic and Russian indices. In addition, derivatives on the CECE index – an index covering Central and Eastern Europe – were made available. Should, one day, eastern European countries trade as 'conversion plays', it is fair to assume that the OTOB will be the first place smart money will seek leverage in these economies.

Table 13: Notional volumes at OTOB (US$m) in 1998

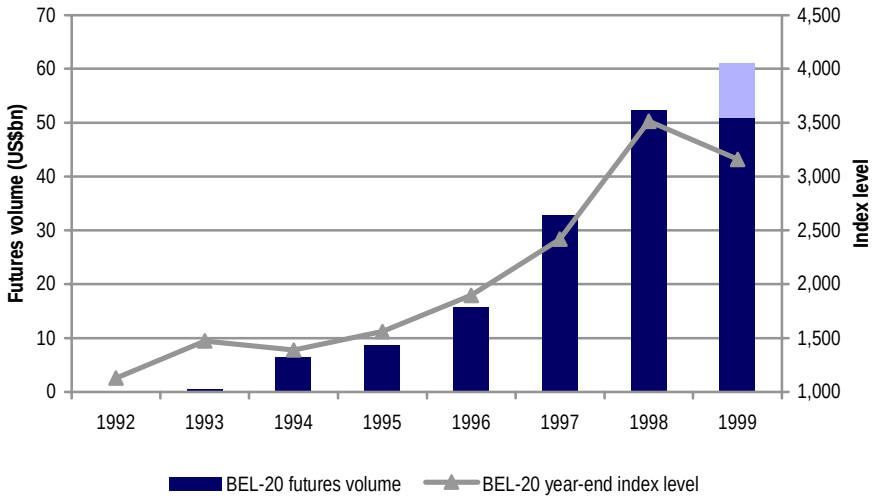
(US$m)	Stock options	Index options	Index futures
Austria	9,341.7	6,085.4	6,740.2
Russia	NT	134.8	682.6
Hungary	NT	115.9	631.7
Poland	NT	69.6	512.4
Czech Republic	NT	24.4	252.4

Source: WDR (data from FIBV)
NT = not traded

Brussels – 1991: BELFOX

In Belgium, equity options were introduced in the early 1980s on the Brussels Stock Exchange. However, a number of difficulties prevented any real progress from being made. In 1988, the BSE and the Dutch EOE signed an agreement intended to lead to the formalisation of equity options trading in Belgium. This activity coincided with a more widespread reform of the Belgian financial market generally and, as a result, the Belgian Ministry of Finance sponsored a commission on derivatives. The result of these discussions was BELFOX, a fully automated, integrated futures and options exchange, founded in 1991. The first instrument to be traded was Belgian Government bond futures, followed by options on Petrofina and Delhaize. Index options on the BEL-20 were introduced in April 1993 and BEL-20 futures in September 1993.

Chart 42: Bel-20 index and Bel-20 futures volume (US$bn)



Source: WDR (data from Datastream)
Futures volume until October 1999 and annualised. Index level as of 8 December 1999.

Futures volumes in 1999 were cUS$60bn. This compares with a market capitalisation of US$113bn for the BEL-20 index at the end of October 1999 and cash volume in domestic shares of cUS$50bn in 1998.

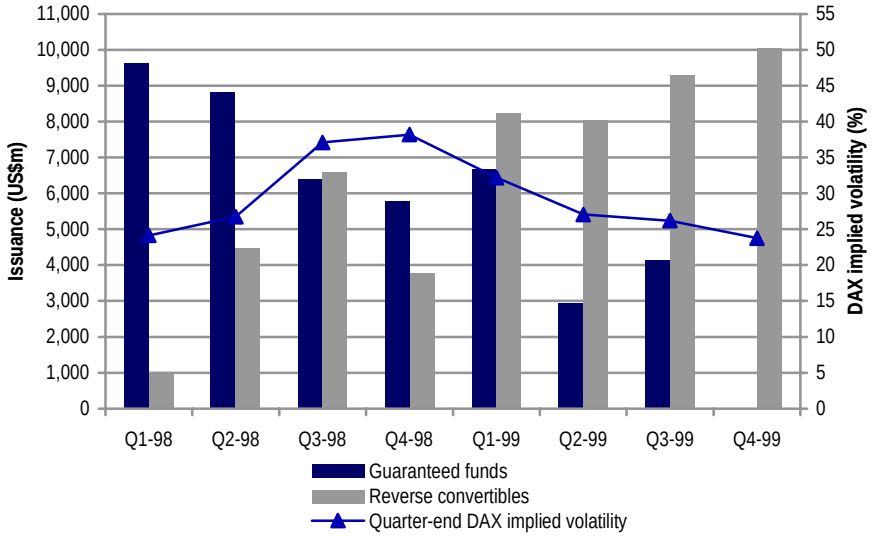
Switzerland – 1991: Desert Storm

Bond-plus-call structures have existed for decades. There is no official start date for the guaranteed equity products market in Europe. However, an early appearance of bond plus call structures was in Switzerland on 16 January 1991 – one day before the UN operation 'Desert Storm' ended the global bear market due to the second Gulf War. Swiss Bank Corporation (SBC) issued so-called GROI-units (Guaranteed-Return-On-Investment) on the Swiss Market Index (SMI). Only a few

weeks later the competition followed with Credit Suisse issuing SMI-deposits and UBS (back then, a friendly competitor of SBC) IGLU-units (Index-Growth-Linked-Units). Other banks followed with the same or similar structures putting the creativity effort mainly into the product branding. On 26 April 1991, SBC issued CMM-units (Convertible-Money-Market) on its own bearer share. This stock-plus-short-call (or bond-plus-short-put) structure allowed investors to sell options and is the predecessor of today's discount certificates and reverse convertibles.

Chart 43 shows WDR estimates for quarterly issuance of guaranteed structures in Europe (excluding Switzerland) and global reverse convertibles issuance since 1998. The chart is overlaid by average one-year DAX implied volatility.

Chart 43: Issuance of guaranteed funds and reverse convertibles (US$m)



Source: WDR

Guaranteed funds: Issuance in Europe ex Switzerland. No estimate for Q4 99 available. Reverse convertibles: Global issuance. Reverse convertible issuance for Q4 99 extrapolated from issuance in October and November 1999. DAX implied volatility: one-year implied volatility at the end of respective quarter.

The issuance of guaranteed funds is negatively correlated with a rise in implied volatility (which determines the price of the insurance) and positively correlated with interest rates. In other words, as interest rates fell and implied volatility increased, guaranteed structures became less attractive. On the other hand, the reverse convertibles market excelled as implied volatility increased in 1997 and 1998. To some extent these two markets evolved oppositely. As guaranteed structures – which are long volatility – became less attractive, reverse convertible structures – which are short volatility – gained popularity. Note that the reverse convertibles market continued to grow in 1999 although implied volatility was falling during the full year. A further reason of the boom in reverse convertibles is that they pay a coupon and therefore attract bond investors in search of an 'equity-kicker', ie, higher yields.

World – 1992: GLOBEX

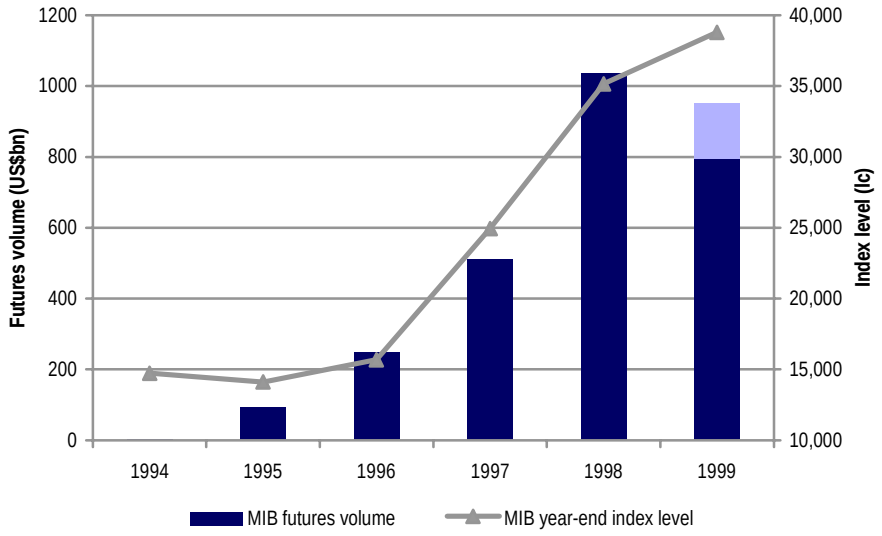
Alliances between exchanges have become increasingly fashionable and most likely will continue to do so in the future. Alliances allow exchanges to distribute products more widely and gain from the underlying economies of scale. One alliance is the global electronic trading system, GLOBEX. It was set up by the CME with Reuters

and co-owned with the CBOT for a few years. MATIF and SIMEX joined later. The decision to develop GLOBEX was taken in 1987 (Steinherr 1998). Efforts to convince the CBOT to drop a rival project, Aurora, delayed opening to 25 June 1992. In 1994 CBOT left after governance issues with the CME. The major event in transnational co-operation has been the formation of EUREX as a result of a merger between Switzerland's SOFFEX and Germany's DTB signed in 1996.

Milan – 1994: IDEM

Trading in exchange derivatives in Italy started late. It began on 28 November 1994 with index futures on the MIB 30. Index options followed in November 1995 and stock options in February 1996.

Chart 44: MIB index and MIB futures volume (US$bn)



Source: WDR (data from Datastream)

Futures volume until October 1999 and annualised. Index level as of 8 December 1999.

Annualised futures volumes for 1999 were cUS$952bn. This compares with a market capitalisation of the MIB 30 index at the end of October 1999 of only US$391bn. In other words futures volumes are c2.5x market capitalisation. The market capitalisation for the MIBTEL index was US$534bn. Based on 1999 volumes, the MIB 30 contract is the third most active after the DAX and the CAC 40. Futures volume is nearly three times market capitalisation and two times cash volume. It is interesting to point out that the latecomers in Europe, Germany and Italy had (together with France) the most liquid futures contracts in 1999. To some extent the high growth rates in the euroland markets is attributable to the introduction of the Euro in January 1999 and the subsequent increased activity of cross-country investing. Further factors are the bull market itself, indexing and probably an increasing equity in traditional bond-biased countries such as Germany and Italy.

DAX and Eurex have become household brand names

Trading in DAX futures started in September 1990 and options in August the following year. At the end of the century, the DAX futures contract established itself as the most heavily traded in Europe with a market share of c30% among European single-country futures followed by the CAC 40 (17%) and the MIB 30 (16%). Table 14 compares open interest and average trading volumes for the eight most active single-country futures contracts. Note the large differences between

open interest relative to average daily volume. We do not believe open interest is a meaningful liquidity measure because different contracts have different maturities and different maturity cycles. Average daily volume is our preferred measure.

Table 14: Volume comparison of single-country futures in Europe

Contract	Exchange	Open interest, US$m	Open interest, market share (%)	Average daily volume, US$m	Average volume, market share (%)	Average bid/ask spread, bp of spot
DAX	**Eurex**	26,280	29.4	7,183	30.0	2.0
CAC	**Monep**	16,064	18.0	4,167	17.4	2.7
MIB	**IDEM**	2,686	3.0	3,778	15.8	2.8
FTSE100	**LIFFE**	21,143	23.7	3,516	14.7	3.1
IBEX	**MEFF**	5,531	6.2	2,067	8.6	4.1
AEX	**AEX**	7,472	8.4	1,583	6.6	5.8
SMI	**Eurex**	7,520	8.4	1,274	5.3	4.1
OMX	**OMS/OMLX**	2,588	2.9	385	1.6	8.0

Source: WDR (data from Reuters and Datastream)

Open interest from all maturities as of 17 November 1999. Average daily volume based on annualised volume from January to October 1999. Bid/ask spread based on intraday data (every 15 minutes between 9.15 and 16.00 London time) of front-month contract from 1 June 1999 to 17 November 1999.

Table 14 shows that the average daily volume of single-country futures in Europe is cUS$24bn per day. This figure compares with US$32bn per day for the SPX contract in the US and with US$0.95bn for multi-country futures contracts in Europe, such as the Dow Jones Euro STOXX 50 futures contract at EUREX. As a comparison, Nikkei 225 futures in Osaka and Hang Seng futures in Hong Kong have average daily volumes of US$4.3bn and US$1.6bn respectively. Activity in European sector futures is negligible.

Euroland – 1998: The battle of indices

In February 1998 STOXX – a joint venture between the German, French and Swiss stock exchanges, together with Dow Jones, the founding company of the Dow Jones Industrial Average – launched new pan-European and especially Euroland indices, the latter covering stocks in countries which were to join the Euro as of 1 January 1999.[17] The battle of indices commenced.[18] From a derivatives standpoint the Dow Jones Euro STOXX 50 index gained attention and popularity globally but especially in Continental Europe. The index was used as a reference or 'transition benchmark index' for money invested in local indices. This amplified the outperformance of large stocks relative to smaller stocks.

On 22 June 1998, EUREX and MONEP started trading options and futures on the DJ Euro STOXX 50 and the pan-European equivalent the DJ STOXX 50. LIFFE, slightly behind the curve in this case, launched options and futures on various FTSE and MSCI indices in May and June 1999. Table 15 on the next page compares futures volumes in multi-country futures in Europe.

[17] Warburg Dillon Read clients who have access to www.wdr.com/researchweb can search for a publication called 'European Indices' which started in February 1998 and analysed most of the new indices.

[18] There are actually two battles. One between benchmark indices for investors to benchmark against and one between blue-chip (derivatives) indices for derivatives products and index tracking funds.

Table 15: Volume comparison of multi-country futures in Europe

Contract	Exchange	Open interest, US$m	Open interest, market share (%)	Average daily volume, US$m	Average volume, market share (%)	Average bid/ask spread (bp of spot)	Price availability (%)
DJ Euro STOXX 50	**EUREX**	11,361	76.3	801.3	84.1	5.5	99
DJ STOXX 50	**EUREX**	1,024	6.9	42.5	4.5	23.8	98
DJ Euro STOXX 50	**Monep**	884	5.9	38.1	4.0	26.1	88
DJ STOXX 50	**Monep**	38	0.3	4.4	0.5	24.1	81
FTSE Eurotop 100	**Liffe**	960	6.4	34.5	3.6	46.0	88
FTSE Eurotop 100	**NYMEX**	291	2.0	24.5	2.6	NA	NA
FTSE Eurotop 300	**Liffe**	10	0.1	0.2	0.0	107.0	82
FTSE Eurotop 300	**NYMEX**	71	0.5	NA	NA	NA	NA
FTSE Eurotop 300 ex UK	**Liffe**	0	0.0	0.7	0.1	33.3	19
FTSE Eurobloc 100	**Liffe**	8	0.1	0.2	0.0	37.6	1
FTSE EStars	**Liffe**	5	0.0	0.4	0.0	108.1	80
FTSE EStars	**AEX**	0	0.0	0.0	0.0	138.6	12
MSCI Euro	**Liffe**	193	1.3	3.9	0.4	39.2	97
MSCI Pan-Euro	**Liffe**	41	0.3	2.3	0.2	44.3	97

Source: WDR (data from Reuters and Datastream)

Open interest from all maturities as of 17 November 1999. Eurex has quarterly and Monep monthly expiries for STOXX futures. The table shows all maturities for all STOXX futures. Bid/ask spread, and price availability based on intraday data (every 15 minutes between 9.15 and 16.00 London time) of front-month contract from 1 June 1999 to 17 November 1999. Price availability measures the frequency a quote was available to the market.

Note that the market share of the DJ Euro STOXX 50 contract at Eurex dominates with a market share of 84% in terms of trading volumes. One way of trading pan-Europe equity exposure, as opposed to euroland exposure with the DJ Euro STOXX 50 contract, is to trade baskets of futures such as 65% DJ Euro STOXX 50 and 35% FTSE 100. Such a basket does not have higher tracking error with a broad pan-European benchmark index, but it has the liquidity all listed pan-European futures contracts lack. The basket had an average daily volume of cUS$1.7bn futures volume per day at the end of 1999. This compares with US$43m for the DJ STOXX contract at Eurex.

In the following section we will take a closer look at equity cash and equity derivatives volumes today.

Volumes overview by market

Global equity volumes

Global equities increased from US$9.6trn at the end of 1990 to US$28.7trn at the end of 1998 which equals a growth rate of 14.6% per annum. Table 16 on page 76 shows the market capitalisation of most stock exchanges of domestic equity at year-end in US$m. At the end of 1998 domestic US equity accounted for 53.8% of global market capitalisation followed by Japan with a 8.5% share and the UK (8.3%). Developed Europe had a market share of 25.3%.

Table 16: Market capitalisation of shares of domestic companies (in US$m)

Exchange	End -90	End-91	End-92	End-93	End-94	End-95	End-96	End-97	End-98	1998 (%)
Amex	102,302	124,454	88,797	105,116	86,036	103,147	97,911	124,606	126,307	0.44
Chicago	-	-	-	-	-	-	1,763,428	2,142,753	2,397,117	8.37
Mexico	41,054	102,764	138,745	200,865	130,246	90,694	106,770	156,595	91,746	0.32
Montreal	216,755	239,817	197,807	268,907	260,662	305,423	392,819	422,694	536,442	1.87
NASDAQ	310,800	490,685	618,774	791,706	793,669	1,159,940	1,511,824	1,726,390	2,527,970	8.82
NYSE	2,692,123	3,484,340	3,798,238	4,212,956	4,147,937	5,654,815	6,841,988	8,879,631	10,271,900	35.85
Toronto	241,924	265,697	241,875	326,549	315,054	366,345	486,978	567,635	543,394	1.90
Vancouver	2,546	3,101	3,234	5,530	4,449	5,348	10,747	6,614	4,447	0.02
Buenos Aires	3,615	18,640	18,623	44,055	36,867	37,784	44,692	59,252	45,333	0.16
Brazil	11,201	32,152	45,416	96,779	189,303	147,636	216,906	255,478	160,886	0.56
Lima	812	1,118	2,630	5,113	8,178	10,907	12,583	15,485	9,869	0.03
Santiago	13,636	27,990	29,595	44,887	68,195	72,928	65,971	72,046	51,866	0.18
Amsterdam	119,825	135,983	134,931	182,629	224,501	286,651	375,357	468,631	603,182	2.11
Athens	15,309	12,921	10,724	13,597	12,819	16,527	23,558	33,784	80,126	0.28
Brussels	65,449	71,114	64,089	78,207	84,422	101,752	119,124	138,938	245,657	0.86
Copenhagen	39,063	44,793	30,140	41,651	48,784	57,692	71,074	93,766	98,881	0.35
Deutsche Börse	355,311	392,470	346,891	460,754	499,278	577,365	664,913	825,233	1,093,962	3.82
Helsinki	22,721	14,237	12,205	23,595	38,308	44,137	62,579	73,322	154,833	0.54
Irish	-	-	-	-	-	25,836	34,738	49,371	66,593	0.23
Istanbul	19,065	15,508	9,756	36,613	21,605	20,772	30,312	61,095	33,646	0.12
Italy	148,766	158,811	123,659	145,300	185,971	209,522	256,595	344,665	569,732	1.99
Johannesburg	136,869	167,958	148,675	215,883	240,026	277,109	239,579	211,599	150,670	0.53
Lisbon	9,201	9,613	9,213	12,417	16,249	18,362	24,452	38,954	62,954	0.22
Ljubljana	-	-	-	-	216	297	891	1,876	2,985	0.01
London	850,012	986,107	928,393	1,150,557	1,145,290	1,346,641	1,642,582	1,996,225	2,372,738	8.28
Luxembourg	10,456	11,276	11,921	19,314	28,518	30,443	32,411	33,892	38,182	0.13
Oslo	26,130	21,997	17,840	27,542	36,459	44,587	56,879	66,503	46,273	0.16
Paris	311,687	373,357	349,608	455,485	452,050	499,990	586,963	676,311	991,484	3.46
Spain	111,449	127,297	98,847	118,869	123,616	150,914	241,028	290,355	402,163	1.40
Stockholm	92,015	97,055	78,079	106,968	130,603	172,550	240,382	264,711	278,708	0.97
Switzerland	157,635	173,766	189,117	270,879	284,721	398,088	400,285	575,339	689,199	2.41
Tehran	NA	NA	1,333	1,149	2,360	6,535	12,869	11,476	11,115	0.04
Tel-Aviv	8,274	13,228	27,884	47,518	31,130	35,116	34,463	44,371	39,230	0.14
Vienna	26,320	26,040	21,680	28,322	30,792	32,513	33,629	37,280	35,779	0.12
Warsaw	-	146	227	2,719	3,057	4,564	8,413	12,135	20,461	0.07
Australian	107,936	142,404	133,555	202,014	216,826	243,475	311,865	295,766	328,929	1.15
Colombo	917	1,936	1,439	2,501	2,857	1,998	1,865	2,096	1,705	0.01
Hong Kong	83,386	121,881	171,984	385,043	269,508	303,705	449,219	413,323	343,567	1.20
Jakarta	8,081	6,823	12,038	32,824	47,241	66,454	90,857	29,050	22,078	0.08
Japan (Tokyo)	2,928,534	3,117,297	2,318,929	2,906,299	3,592,194	3,545,307	3,011,161	2,160,585	2,439,549	8.51
Korea	110,301	96,466	107,661	139,584	191,778	181,955	139,122	41,881	114,593	0.40
Kuala Lumpur	47,869	56,722	91,471	219,759	190,163	213,757	306,165	93,174	95,561	0.33
New Zealand	8,824	14,285	14,680	24,595	27,118	31,950	36,879	29,889	24,458	0.09
Philippine	6,632	10,835	15,335	40,148	56,648	58,780	80,464	31,211	34,911	0.12
Singapore	34,269	47,594	48,934	135,050	136,303	150,959	153,107	106,317	96,473	0.34
Taiwan	98,927	123,460	100,166	193,252	247,325	187,206	273,776	287,813	260,498	0.91
Thailand	20,777	37,526	57,278	127,474	125,599	135,774	95,901	22,792	34,118	0.12

Source: FIBV

Data on market capitalisation exclude Investment funds, rights, warrants, convertibles, foreign companies and include common & preferred shares, and shares without voting rights

Table 17: Ten largest stock exchanges by market capitalisation as of August 1999

Exchange	Number of domestic companies with equity shares listed	Market capitalisation (US$m)	Market capitalisation (%)
Total		33,103,589	
NYSE	2,240	10,995,366	33.2
Japan (Tokyo)	1,859	3,454,000	10.4
NASDAQ	4,444	3,306,749	10.0
Osaka	1,269	2,574,088	7.78
London	2,337	2,526,151	7.63
Deutsche Börse	880	1,187,225	3.59
Paris	961	1,110,775	3.36
Switzerland	234	651,482	1.97
Toronto	1,359	628,461	1.90
Amsterdam	234	613,605	1.85

Source: FIBV

Table 17 shows the 10 largest stock exchanges at the end of August 1999. At the end of August 1999 the global equity market capitalisation was valued at US$33.1trn. How do these figures compare with derivatives volumes?

The total notional value of equity derivatives in 1998 was US$28.24trn. This figure compares with US$28.7trn of global market capitalisation excluding investment

Table 18: Volume on global equity derivatives exchanges in 1998 (US$m)

Exchanges	Total	Index futures	Index options	Stock option
Total	28,236,379	15,985,637	9,865,222	2,385,519
CME	10,431,761	9,059,284	1,372,477	NT
CBOT	5,837,619	307,905	4,868,810	660,904
EUREX	2,638,846	1,211,672	1,017,222	409,952
LIFFE*	2,095,790	1,630,180	423,676	41,935
MONEP (France)*	1,545,577	1,059,654	445,554	40,370
AEX (Netherlands)*	1,048,885	390,535	446,388	211,961
Osaka and Tokyo (Japan)	961,325	326,806	614,321	20,198
Brazil	490,390	237,599	11,834	240,957
HKFE (Hong Kong)	485,173	425,479	48,673	11,021
SIMEX (Singapore)	434,117	384,225	49,891	NT
Korea SE (S Korea)	408,395	300,038	108,357	NT
AMEX*	360,527	NT	54,509	306,018
MEFF Variable (Spain)	356,849	174,570	174,570	7,709
ASXD and SFE (Australia)	234,518	151,865	34,987	47,667
PSE	211,201	0	102	211,100
NYCE/NYFE (USA)	188,231	162,532	25,700	NT
SAFEX (S. Africa)*	166,598	78,914	87,511	174
PHLX (USA)	156,191	NT	2,437	153,755
Toronto SE (Canada)	76,855	57,477	9,708	9,669
TASE (Israel)	61,972	54	61,918	NT
OTOB (Austria)	24,591	8,819	6,430	9,342
KLOFFE (Malaysia)	10,146	10,146	NT	NT
KCBT (USA)	8,002	7,853	149	NT
Montreal SE (Canada)	2,427	NT	NT	2,427
NZFOE (New Zealand)*	390	30	0	360

Source: FIBV

* Single stock options volume from 1997. NT = not traded

funds at the end of 1998. In other words, on a global scale, exchange traded equity derivatives volumes are roughly equal to market capitalisation.

Here we conclude our brief evolution of derivatives and its markets. In the following two sections we discuss why to some investors derivatives are a valuable risk management tool and to others they are (still) demonic.

Why have derivatives become popular?

In this section we answer the question 'why have derivatives become popular?'. We will keep this chapter short since the reasons are straightforward, the economic reasoning hardly seriously challenged and the growth of derivatives speaks for itself. In the next section we will ask and answer 'why have derivatives become *unpopular*?'. This section will contain more detail because we will attempt to elaborate the misconception and myths which are still associated with derivatives today. In a foreword to a derivatives handbook the late Fischer Black (1995) lists the following ways one can use derivatives:

- **Trading on news.**
- **Hedging.**
- **Changing your position without trading.**
- **Raising or using cash.**
- **Changing yield.**
- **Calming your customer.**
- **Making profits on mispricing.**
- **Diversifying.**
- **Customising.**
- **Insuring against disaster.**

Derivatives: A growth story

There is little doubt that risk management and its instruments, derivatives, is a growth area. The calculation of one annual growth rate of the equity derivatives business, however, proved rather difficult. Here are a few attempts.

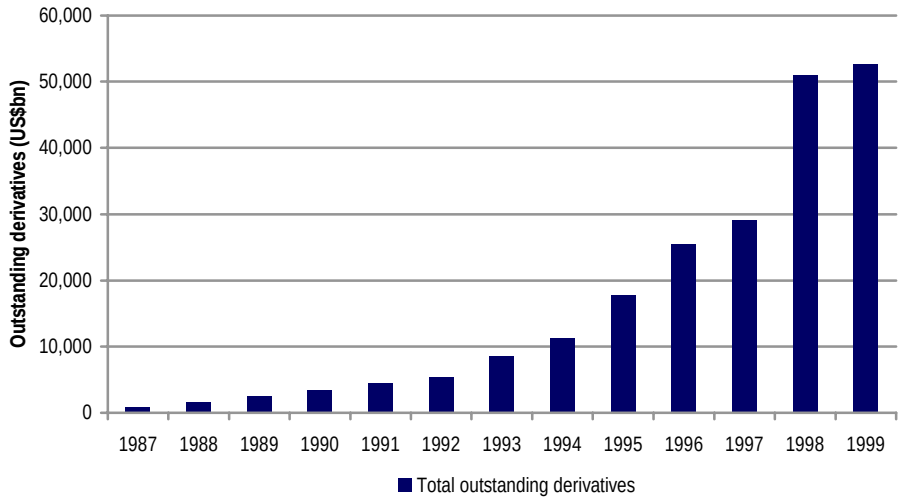
ETD growth rate is c20% including the US and c24% excluding the US derivatives market

The number of contracts traded at the CBOE grew at a compound annual growth rate of 14.2% between 1975-91. However, if we calculate the annual growth period between the introduction in 1973 and 1990 the resultant annual growth rate equals 32.2%. Futures volumes of the main contracts increased at a rate of 21% annually (Table 19 on page 80). Between 1995-99 growth has fallen to c19%. However, less developed derivatives markets grow faster. Ex-US futures annual growth between 1995-99 was 24%. The DAX growth in this period was 52% and IBEX-35 volumes have even risen at an annual rate of 66%. Note that recent futures volume growth in the euroland area is higher than in the UK, Sweden and Switzerland (last column in Table 19 on page 80).

The OTC market has been expanding at a higher rate

Chart 45 on page 80 shows year-end total outstanding derivatives from ISDA (International Swaps and Derivatives Association). The bars show a total of interest rates swaps, currency swaps and interest rates options.

Chart 45: Total outstanding OTC derivatives at year-end



Source: ISDA

Figures for 1999 as of June 1999

Chart shows notional amounts outstanding of the worldwide consolidated OTC derivatives exposure of major banks and dealers in the G10 countries.

The OTC market is growing at a rate of around 40%

The compound annual growth rate of the derivatives volume shown in Chart 45 is 40%. The semi-annual market report issued by the International Swaps and Derivatives Association showed that worldwide growth in the use of privately negotiated derivatives, as measured in the notional principal of outstanding transactions, slowed to 3.4% in the first half of 1999. The notional amount, which is a measure of volume but not risk, amounted to US$52.711trn at 30 June 1999 compared to US$50.997trn six months earlier and US$36.974trn one year earlier. Including equity OTC contracts the total outstanding notional amount was US$81.5trn at the end of June 1999 which compares with US$80trn at end-December 1998 and with US$72trn reported for June 1998.

Table 19: Total exchange traded futures volumes (US$bn)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999**	Growth (%)***	Growth (%)****
Total	1,936	3,184	4,994	6,743	5,177	5,642	7,427	8,324	10,608	12,839	14,731	16,421	21	19
SPX	1,510	1,707	2,022	2,318	2,579	2,988	4,320	5,152	6,744	8,201	8,448	8,886	17	15
DAX-30			2.4	58	168	215	327	343	452	688	962	1,810	54	52
Nikkei 225*	377	1,342	2,695	3,909	1,723	1,459	1,201	1,325	1,327	824	741	1,086	10	-5
CAC-40	3.4	31	111	183	269	400	535	419	502	617	850	1,050	42	26
MIB							3.0	94	248	511	1,035	952	78	78
FTSE-100	38	92	141	191	304	347	508	444	546	709	698	886	33	19
IBEX-35					5.3	24	68	69	92	257	515	521	67	66
AEX	0.3	5.3	12	14	17	30	46	54	96	218	399	332	51	58
SMI			2	33	56	75	168	175	251	324	442	321	33	16
Hang Seng			1.2	27	43	65	142	135	201	287	394	298	35	22
All Ord	8.4	7.1	7.7	9.2	9.0	32	85	89	114	141	164	181	32	19
OMX			0.06	1.3	3.4	7	24	25	34	62	82	97	72	40

Source: WDR (data from Datastream)

* Contract at the OSE. ** Until October 1999 and annualised. *** Annual growth rate from first year of full inclusion to 1999. **** Annual growth 1995-99.

DaimlerChrysler's market capitalisation is traded every day in the futures markets

Table 19 shows futures volume in exchange traded contracts from 1988-99. The annual growth rate of the main futures contracts was 19% from 1988-99 and 21% from 1995-99. This implies a slower growth rate than that of OTC derivatives contracts. Estimated futures volumes of the contracts in Table 19 is US$16.4trn which equals cUS$64.4bn per day. In other words, daily futures volumes equal roughly DaimlerChrysler's market capitalisation. The open interest of the contracts in Table 19 was US$289bn at the beginning of December 1999. This compares with total outstanding OTC equity derivatives as estimated by BIS at the end of June of US$1.27trn (forwards, swaps and options).

Attractive characteristics

Main benefits of derivatives are risk reduction, market completion and increased investors' utility

The main benefits of derivatives and therefore the success factors for its markets' growth are: (1) risk reduction, ie, the introduction of negative correlation and the associated ability to reduce risk; (2) the completion of markets and the associated ability to attain risk-return combinations that may be otherwise unattainable or may be extremely costly; and (3) the enhancement of investor utility and, thereby, social welfare.

Hedging, ie, adding negative correlation to a portfolio

One positive aspect of derivatives is to reduce risk, ie, hedging. Derivatives allow the introduction of negative correlation to a portfolio and the associated ability to reduce risk, where short selling might be hampered by restrictions.[19] Trading a derivative security makes it possible to artificially and efficiently introduce negative correlation not naturally found in spot markets. Assuming that rational investors are utility maximisers who exhibit disutility from risk, and risk is reduced with portfolios of less correlated assets, it should be clear that derivatives are to be centre point for any portfolio optimisation strategy.

Derivatives increase social welfare

Some risk-return combinations are not attainable, or are extremely costly without the use of derivatives. Thus, the trading of derivative instruments serves to expand the investment opportunity set, allowing market participants to attain points in mean-variance space that maximise their particular utility function. This argument has been expressed more formally by using the theory of complete markets. If markets are complete, then investors can contract to establish any risk-return combination desired. The more complete the markets are, the more that investors, and thus society, benefit from the ability to optimise utility. From this perspective, we can argue that derivatives can contribute to social welfare by making markets more complete. Alan Greenspan, for example, thinks along these lines (quote on page 47).

High degree of efficiency

Financial markets allow economic agents a frictionless and efficient co-ordination of saving and investing in an economy. The market should allow an optimal allocation of capital and risk. Derivatives markets are the instruments which allow an efficient control and management of risks. The heterogeneity of market participants (end-users, banks, hedge funds, etc) guarantees a high degree of efficiency.

[19] To some investors, both short selling and the use of derivatives is restricted.

Speculation is important for markets to function

In any market, speculation, here defined as a bet on an intertemporal change in price, is important. In a liquid market there have to be some market participants who believe they can buy low and sell high, ie, benefit from intertemporal changes in price. It is speculation, which allows the efficient transfer of risks, increases the liquidity and the probability of executing a transaction. The search for positive utility, for example in the form of an increase in wealth, is the lubricant of markets and capitalism itself.

The main economic function of derivatives

Do derivatives have additional benefits?

The justification for derivatives in the economic/academic literature is rock-solid. The question is not, for example, whether call options are attractive financial instruments or not, but whether call options have additional benefits or risks compared to the next best alternative in the underlying cash market. As a matter of fact, many (or most) derivative instruments have close or almost perfect substitutes in the underlying cash market. Hence, the economic question is whether the derivative market system adds additional benefits or risks to the existing financial market structure.

Gibson and Zimmermann (1994) list three main economic functions in financial markets in general which also apply to derivatives:

- **Risk sharing and market completion.**
- **Implementation of asset allocation decisions.**
- **Information gathering.**

Three dimensions: risk, time and information

The economic function of financial markets can be seen in three dimensions: time, risk and information. Borrowing and saving are the major functions of the financial systems in order to achieve an efficient intertemporal allocation of funds. Capital markets allow households and firms to match earnings and expenses in each period by issuing or acquiring claims against their future income. To achieve this purpose they would write financial contracts. In other words, saving (or borrowing) allows households to manufacture any desired stream of consumption, and firms can implement their optimal investment and payout policies. Particularly, capital markets allow firms to separate investment and financing decisions, which implies a separation of two basic economic functions within the firm: the ownership and the management of resources.

Uncertainty is an inherent characteristic of financial decisions

As a matter of fact, the intertemporal nature of financial decisions implies uncertainty. Financial contracts are written on future cash flows, which are by nature uncertain. Risk is therefore an inherent characteristic of financial decisions. It is not surprising that a major function of the financial system is to allocate risk related to interest rates, stock prices, exchange rates, commodity prices and others. The capital market provides a wide range of instruments or institutional arrangements to either diversify risks, ie, to eliminate risks for the society as a whole, or to (re)allocate the undiversifiable part of the risks among households and firms (risk sharing). In order to achieve an unconstrained efficient allocation of these risks within a market system, capital markets must provide sufficient opportunities to trade and price the various kinds of risk. Market prices help

individuals and institutions to target the amount of risk they are willing to bear. This illustrates that capital markets provide a valuable source of information for economic agents in a decentralised market economy.

The above paragraphs sum up the reason why derivatives have existed for so long and also shows the economic logic behind their rapid growth. We easily could do so on much longer idolising derivatives. However, in the following section we do the opposite. We analyse why still only a fraction of the financial community uses derivatives. We continue by putting some of the misconceptions and myths surrounding derivatives into perspective.

Why have derivatives become unpopular?

The negative image of derivatives

Derivatives are an old concept in a new wrapping

Although – as shown above – the concept of derivatives is not new, the word 'derivatives' is. Indeed, it may come as a surprise to students entering financial courses at the universities today, that there is no mention of financial derivatives in the original edition of Paul A Samuelson's, Economics, published in 1955, which was destined to become the most-read fundamental textbook. Nor does the word derivatives appear in Milton Friedman's classic statement of economic philosophy, Capitalism and Freedom, published in 1963. Nor for that matter, was the concept of financial derivatives seriously considered an important instrument of finance until Harry Markowitz, William Sharpe and Merton Miller received the 1990 Nobel Prize in Economic Sciences for their pioneering work in the theory of financial economics and corporate finance.

The d-word

Does 'd-word' stand for derivatives or deflation?

The word 'derivatives' is contaminated. Some people in the writing profession even associate the expression 'd-word' with derivatives instead of deflation; obviously giving the word a negative spin. Negative associations are obviously not good for marketing.

The 'scapegoat function'

We believe there are two main reasons for derivatives not being very popular even by some professional investors. Firstly, there are some financial disasters which are associated with derivatives. Although derivatives were only the instrument of malpractice, derivatives fulfil a scapegoat function. Secondly, there are still some 'myths' surrounding derivatives although options and forwards have existed for decades (or millennia, depending when one draws the starting point). In this section, we attempt to clarify these misconceptions and myths.

Who knows that derivatives, in monetary terms, are zero-sum deals?

Note that Merton Miller (1999) argues that the negative image from derivatives is partly because they are relatively new and, therefore, are still poorly understood by the press and the public. Miller argues that not many know that, even though *both* sides benefit from the transaction – otherwise they would not have entered into it – derivatives, in monetary terms, are a zero-sum game. The great financial disasters that we address on the next page, which are blamed on derivatives, are thus transfers of wealth from one counter-party to the other. In other words, it is a transfer of wealth from losers to winners, but not destruction of society's hard earned wealth.

Chronology of derivatives disasters

There are no risky derivatives, only risk averse or less risk averse investors

Most financial crises and crashes are in one way or another blamed on derivatives. In the following we highlight a few of these 'derivatives disasters'. We will make the point that it is actually rather silly to blame derivatives. A derivative instrument, by definition, cannot cause anything. It is the *usage* of derivatives which might cause something to happen. A derivative on its own is not risky. Nikkei 225 futures at SIMEX do not bring down traditional British banks, they are not risky simply by being listed. However, the wrong usage can cause damage. It is the usage, ie, the market participant using the instrument to gain or reduce exposure, which is the source of risk. We attempt to clarify.

Tulipmania in 17th century Holland

Tulipmania in 17th century Holland is often associated with derivatives. However, Tulipmania is an early example of speculation, irrationality and/or exaggeration of markets rather than the use of derivatives. Unfortunately, from the derivatives industry's perspective, derivatives are often associated with speculation as opposed to risk management. So what is referred to in history as Tulipmania is categorised under 'derivatives disasters' although the bubble was caused entirely by demand for the underlying (tulip bulbs) and has little to do with the instruments used to get the exposure. Investors went out to buy tulip bulbs, not derivatives.

Stock crash of 1987

On Black Monday, 19 October 1987, the Dow Jones Industrial Average fell 508 points, a drop of 22.6% in one day, the largest one-day drop ever. Occasionally the crash of 1987 is blamed on derivatives (portfolio insurance). However, consensus on the issue is that the correction primarily was caused by rising interest rates around the world, and a row between James Baker, the then Treasury secretary, and the Bundesbank after a rate increase. Mr Baker was worried that the Germans were reneging on their obligation under the 1987 Louvre Accord to support the dollar when the current account deficit on the US balance of payments was approaching 4% of GDP. On the eve of the crash, the Japanese Ministry of Finance was armtwisting domestic financial institutions into buying US$40bn-worth of privatisation of NTT at an astonishing multiple of 300 times earnings. As a result, the flow of portfolio capital to the US from the world's biggest creditor country dried up. According to Shiller (1989) only 5.5% of investors followed a portfolio insurance scheme. Due to a CFTC commissioner of the time futures-related strategies had limited part in the stock market crash of 1987. We regard it as safe to state that the 1987 crash cannot be blamed on derivatives.

Metallgesellschaft – 1993

MGRM, Metallgesellschaft's US subsidiary, was long short-term oil and oil-products futures (and swaps) so that when oil prices fell in 1993, MGRM had to pay US$1.3bn in maintenance margin calls. However, MGRM was also short in long-term fixed-price forward delivery contracts to its customers. MRGM held its long position in futures and swaps precisely to hedge its short position in the forward delivery commitments. As with any other hedge, the fall in value of one leg is offset by the rise in value on the other. However, the hedge was not perfect. The company did sustain a net loss when short-term futures prices fell by more than longer-term futures, ie, when the market's typical 'backwardation' turned into 'contango'. Miller (1997) makes the point that most 'derivatives disaster' are actually just wealth transfers. MGRM had positions and lost money due in part to the 'rollover'

costs under its strategy. The holder of the opposite position would have gained. Investment banks in Europe suffered from a similar phenomenon in 1998 when the implied volatility curve changed its shape from normal to inverted. More on this later.

Procter & Gamble – 1994

P&G negotiated an exotic swap with Bankers Trust in the notional amount of US$200m. The deal amounted to P&G selling BT a put option on long-term bond prices. When bond prices fell in March 1994, the put option came into money and P&G had to pay Bankers Trust US$150m to buy it back. The bet was on stable or rising bond prices, ie, stable or falling interest rates. If interest rates had gone down instead of up, P&G would have been just fine. In other words, it was the position not the instrument which caused the loss. The Procter & Gamble case also brought up the term 'reputation risk' with respect to derivatives as the 'G' in 'P&G' was a sitting duck for the writing guild to target.

Orange County – 1994

Orange County's treasurer bought structured notes known as 'inverse floaters' whose stream of interest receipts goes up when LIBOR and other short-term interest rates fall. The treasurer also made use of 'reverse repos', which essentially allows to buy bonds on margin. The bet was on falling interest rates. When short-term interest rates rose, the value of the county's inverse floaters and leveraged long-term bonds fell, by US$1.7bn or so below the value of the county's liabilities. Miller and Ross (1997) find that the portfolio was neither illiquid nor insolvent and that its financial condition did not mandate bankruptcy. If the portfolio had not been liquidated but had instead been allowed to follow its hold-to-maturity strategy, Orange County would not only have avoided the losses it realised and reported but also would have generated substantial cash inflows during 1995. The bottom line is that the Orange County case has more to do with financial and business risk in general than with derivatives in particular.

Barings – 1995

The failure of Barings Bank is probably the most often cited 'derivatives disaster'. While the futures market has been the instrument used by Nick Leeson to transact, it certainly was not at fault for the losses. The losses can be attributed to a complete lack of internal control, lack of understanding of how futures worked by senior management, failure of management to properly reconcile their trading positions, and fraud. The Barings case is, without doubt, a major event, not only with respect to risk management.

The Barings case

Nick Leeson was employed by Barings Futures in Singapore. He was posted from London to establish the settlement operations. Although he had no previous trading experience, he immediately became involved as the floor trading manager. This is an obvious internal control flaw which management was made aware of by auditors on more than one occasion. He was authorised to execute orders placed by other Barings' companies. Over time his role changed and he began trading on behalf of Barings Bank. His principal activity was to take advantage of arbitrage opportunities on differences between the prices quoted for identical contracts in Singapore and Japan. Leeson also began taking unhedged bets on the movement of the Nikkei 225 index, which eventually turned against him.

Leeson opened account 88888. This became the subject of considerable controversy. The transactions charged to this account were very large, unhedged and consistently reflected losses. Transactions were carried out in such a way that artificially generated a profit for other accounts at the expense of account 88888. The existence of this account was apparently not known to senior management. The result was that it appeared that Leeson was the major contributor to Barings profits and he received large bonuses in 1993 and 1994.

Considerable funds were needed to fund margin calls on account 88888, and a total of S$1.7bn was advanced by the head office and other Baring companies to facilitate these margin calls. No questions were asked as to the nature of these payments. Senior management in London believed the Singapore operation was accountable to local managers. Local managers believed it was Nick Leeson's own responsibility and did not monitor his activities. Senior managers accepted the profit reports with considerable admiration and did not question how such large profits could be made from arbitrage.

At all times senior management had the information available to them to discover what Nick Leeson was doing. Singapore was linked by computer to London and reports were available which would have highlighted the margin requirements of account 88888. Senior management has to bear a great amount of the blame for its negligence in failing to determine the true position of the Singapore operation. How they could allow someone with no previous trading experience to take charge of this operation as well as settlements and without any monitoring defies belief.

Today the Barings case is probably one of the main drivers of risk management tools and software. The Barings case is also a textbook example of how risk management should not be done. However, we believe that, unfortunately, the Barings case is especially responsible for the continuing negative aura surrounding derivatives today.

Sumitomo – 1996

Sumitomo Corp, the leading player in the global copper business, said that its widely respected veteran trader, Yasuo Hamanaka, admitted falsifying the company's books for 10 years to conceal losses of up to US$1.8bn. Hamanaka was his own bookkeeper, a management flaw just highlighted. The immediate victim was Sumitomo, one of the biggest and most powerful Japanese companies, which traces its roots to the 17th century when founder Masamato Sumitomo, an ex-monk, got into the copper refining business. Although Sumitomo had money to cover the losses, the scandal has damaged the company's credibility and raised basic questions about how it polices employees. The scandal also has impacted the global market for copper, where Sumitomo's influence is enormous because it is believed to control up to half the world's production of 10bn tons. The Sumitomo scandal was just another case where derivatives were mentioned in a negative context although the causes were mismanagement and fraud, rather than derivatives.

Table 20: Summary of derivatives disasters

	Insufficient management oversight	Unexpected market moves	Strategy was profitable at first	The bet was on	Dominant risk	Was fraud involved?
Metallgesellschaft	Yes	Yes	Position in derivatives was a hedge	Hedge (market neutral)	Market risk (roll risk)	No
Procter and Gamble	Yes	Yes	Yes	Falling interest rates	Market risk	No
Orange County	Yes	Yes	Yes	Falling interest rates	Market risk	No
Barings	Yes	Yes	Yes	Increase in Japanese equity	Business risk	Yes
Sumitomo	Yes	(No)	(Yes)	Copper	Business risk (accounting risk)	Yes

Source: WDR

Risk management is more than just the aggregation of deltas, gammas and vegas

Table 20 summarises a few similarities among the highlighted derivatives scandals which are associated to a company or county. It seems clear to us that derivatives are not the cause of the disaster.[20] Often the disaster was simply a bet which went wrong and which would not have caused losses if markets went the other way. The two most recent cases amplify the fact that risk management is not simply about the aggregation of 'Greeks' but is a function which touches many aspects of a business and should rest with senior management. Merton Miller argues that all these derivatives disasters ought to be more properly renamed 'management disasters' (Steinherr 1998).

No derivatives – no leverage?

Occasionally the LTCM crisis in 1998 is attributed to derivatives as well, although the focus was on the hedge fund industry. One could argue that the opportunity to implement strongly geared exposures are not possible without the use of derivatives. According to a memo circulated by the Commodity Futures Trading Commission (CFTC) to members of the US Congress, however, 'dangerous gaps' in the regulatory structure for US financial institutions were revealed as the source of the near-collapse of LTCM. The memo identified three gaps: lack of information about the hedge fund's holdings, lack of restrictions on lending to the hedge fund, and lack of 'prudential controls' on the hedge fund and its counter-parties (Smithson 1999b). This leads us to believe that also the LTCM case is not a case against derivatives. The debate over whether and how derivatives should be regulated, however, continues but is not the subject of this report.

Although, as we have tried to point out, derivatives have existed for a couple of thousand years and that the misuse of derivatives has more to do with financial or operational misjudgement than with derivatives itself, there is still a myth surrounding these risk management instruments. In the following section we attempt to de-mystify some of the myths surrounding derivatives.[21]

[20] Even adjusting for the bias the author might have.

[21] This chapter draws on material in Siems (1997).

The myth of derivatives

Myth 1: Derivatives are new, complex, high-tech financial products created by rocket scientists

Derivatives are not new

Regardless of where we put the start date of derivatives trading – at ancient times or the 1970s or even the 1990s – many regard derivatives as 'new'. As we have pointed out in previous pages, however, derivatives are not new: they have existed for years.

One does not have to be Einstein to drive a car

Options are regarded as complex mainly because of their asymmetric payout distributions, and some Greek letters used to characterise them. We argue, however, that derivatives are no more complex than the construction of a car. To build a car one needs knowledge covering thousands of years of physics, centuries of electrical and mechanical engineering, decades of electronics theory, a fair understanding of design and aerodynamics, and (nowadays) in-depth knowledge of computer technology. But one needs only a few driving lessons to reap the benefits of the car. It's the same with derivatives. There are some simple rules and common sense – once adopted – that allow the user to unfold multitudinous benefits.

Not derivatives – the world itself is getting more complex

A further myth is about rocket scientists[22] continually creating new, complex, sophisticated financial derivative products. These products, however, are all built on a foundation of the four basic types of derivatives. Most of the newest innovations are designed to hedge complex risks in an effort to reduce future uncertainties and manage risks more effectively.

Myth 2: Derivatives are purely speculative, highly leveraged instruments

A derivative by definition cannot be speculative

As earlier sections have shown, derivatives are often associated with gambling or disasters that involve leverage. We believe there are no speculative derivatives, but speculative investors and speculative strategies. A derivative instrument, by definition, cannot be 'speculative', it is its use that is speculative (or not). For every call buyer, there is a call seller. If the call buyer loses money, the call seller makes money.[23] The derivative instrument simply transfers wealth in an efficient manner.

Myth 3: The enormous size of the financial derivatives market dwarfs bank capital, thereby making derivatives trading an unsafe and unsound banking practice

In notional terms the derivatives market is worth US$94trn

The worth of the financial derivatives market is reported as US$94trn (Table 21 on page 90). Those often-quoted figures are notional amounts. For derivatives, notional principal is the amount on which interest and other payments are based. Notional principal typically does not change hands. It is simply a quantity used to calculate payments. It is a measure of volume, not risk.

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[22] The term 'rocket scientist' appeared in the 1970s. The story goes that after NASA's Apollo programme (which climaxed when man landed on the moon in 1969) ended, the rocket scientists were sacked. They found jobs in the finance industry where options started to trade on organised exchanges.

[23] In the OTC market, both can lose money in the case where the call seller defaults on his liability.

Notional amounts are not a measure of risk

While notional principal is the most commonly used volume measure in derivatives markets, it is not an accurate measure of credit exposure. A useful proxy for the actual exposure of derivative instruments is replacement-cost credit exposure. That exposure is the cost of replacing the contract at current market values should the counter-party default before the settlement date. According to BIS, the global OTC derivatives market at the end of December 1998 was US$80.3trn, which compares with exchange traded contracts of US$13.6trn. The replacement cost (gross market value) was 'only' US$3.23trn and the gross credit exposure US$1.33trn. Credit risk of exchange traded derivatives is negligible.

Table 21: The global over-the-counter (OTC) derivatives markets[1] as of June 1999

	Notional amounts (US$bn)	Gross market values (US$bn)
Foreign exchange contracts	18,011	786
Interest rate contracts	50,015	1,675
Equity-linked contracts	1,488	236
Commodity contracts	415	43
Other	10,371	490
Grand total	80,300	3,230
Gross credit exposure[2]		1,329
Memorandum items:		
Exchange-traded contracts[3]	13,549	

Source: BIS

[1] All figures adjusted for double counting. Notional amounts outstanding have been adjusted by halving positions with other reporting dealers. Gross market values have been calculated as the sum of the total gross positive market value of contracts and the absolute value of the gross negative market value of contracts with non-reporting counter-parties. [2] Gross market values after taking into account legally enforceable bilateral netting agreements. [3] Sources: Futures Industry Association; various futures and options exchanges.

Myth 4: Derivatives link market participants more tightly together, increasing systemic risks

In the developmental years of financial derivatives, dealers, for the most part, acted as brokers, finding counter-parties with offsetting requirements. Then dealers began to offer themselves as counter-parties to intermediate customer requirements. Once a position was taken, a dealer immediately either matched it, by entering into an opposing transaction, or 'warehoused' it – temporarily using the futures market to hedge unwanted risks – until a match could be found.

Transactions are not hedged individually

Today dealers manage portfolios of derivatives and oversee the net, or residual, risk of their overall position. That development has changed the focus of risk management from individual transactions to portfolio exposures, and has substantially improved dealers' ability to accommodate a broad spectrum of customer transactions. Because most active derivatives players today trade on portfolio exposures, it appears that financial derivatives do not wind markets together any more tightly than do loans.

Myth 5: Derivatives increase volatility in the underlying market

Derivatives are often blamed as the cause for markets to fall

One myth about derivatives is that they increase volatility in the underlying spot markets. We do not want to appear cynical, but having read hundreds of market comments over the past 10-plus years, we get the impression that often when there is an erratic, unexplained upwards-move, it is caused by 'more buyers than sellers'. However, whenever there is an erratic, unexplained downward move it is caused by derivatives. This was particularly the case in the first half of the 1990s. Empirical research, however, shows that the introduction of options is either neutral or reduces volatility.

Table 22: The impact of the introduction of options on individual shares on the beta of shares

Study	Number of shares/ period examined	Impact on beta of individual share
Trennepohl/Dukes (1979)	32 / 1970-76	Beta declined
Klemkosky/Maness (1980)	40 / 1972-79	Beta declined
Skinner (1988)	NA	no change of beta
Damodaran/Lim (1991)	200 / 1973-85	no change of beta

Source: Smithson (1995)

Table 23: The impact of the introduction of options on the volatility of the price of the underlying asset

Study	Change in volatility
Hayes/Tennenbaoum (1979)	decreased
Klemkosky/Mannes (1980)	decreased
Witeside/Duke/Dunnes (1983)	decreased
Ma/Rao (1986,1988)	decreased
Bansai/Pruitt/Wei (1989)	decreased
Conrad (1989)	decreased
Skinner (1989)	decreased
Damodaran/Lim (1991)	decreased

Source: Smithson (1995)

Volatility and speed of price adjustment are two different pairs of shoes

A plausible explanation why many observers intuitively accuse derivatives for increased volatility is that they confuse volatility with speed of adjustment. Table 24 lists empirical research on the impact of derivatives on speed of adjustment in the underlying markets.

Table 24: The impact of the introduction of derivatives on the speed of price adjustments

Study	Finding
Jennings/Stark (1986) **180 stocks - 1981-82**	Prices of optioned stocks adjust more quickly to earnings reports
Skinner (1990) **214 stocks - 1973-86**	Reaction to earnings reports is smaller after listing of options
Damodaran/Lim (1991) **200 stocks - 1973-85**	Prices adjust more quickly to information after options are listed

Source: Smithson (1995)

Options trading improves liquidity for the underlying market

More recent research confirms these findings. Results from Kumar et al (1998) indicate that option listing increases trading volume, average transaction size, trading frequency, and market depth and reduce bid-ask spreads. Improvements in spread and market depth are significant even after controlling for changes in price, variance, and volume of the underlying stock. The results support the hypothesis that option trading improves underlying market liquidity.

Option volume dictating stock volume is the exception not the rule

Easley et al (1998) show that in complete markets, the behaviour of a stock price should dictate the price of the option because an option is a derivative security and not the other way round. The authors show that, although stock prices typically lead option volumes, option volumes lead stock price changes under certain circumstances. Thus, particular option volumes carry information about future stock price changes. On page 45 we highlighted the gamma-effect of 1998 as an exception to the rule.

We hope this de-mystifying exercise shed some light on the misconceptions surrounding derivatives and, potentially, converted any non-believers. In the following section we quote some surveys with respect to who uses derivatives today.

Use of derivatives today

Who uses derivatives and how are they used today?

Firms with high growth opportunities and tight financial constraints are likely to use derivatives

Géczy et al (1997) conducted one of the first cross-sectional empirical tests of why large US firms use currency derivatives. The authors find that firms with high growth opportunities and tight financial constraints are likely to use currency derivatives. The authors also show that a firm's choice of which type of currency derivative to use depends on the type of foreign exchange risk facing the firm.

Almost 21% of US equity mutual funds use derivatives

According to Koski (1999) only 21% of US equity mutual funds use derivatives. The authors find no systematic differences in various risk measures and the higher moments of return distributions between funds that do and do not use derivatives. Managers who decide to use derivatives combine them with non-derivative assets to maintain net portfolio risk and return comparable to those of funds that do not use derivatives. Funds that use derivatives have similar performance to funds that do not use derivatives. Derivative use is significantly related to changes in systematic risk, but not to changes in idiosyncratic risk, suggesting use of stock index derivatives.

In 1998, the New York University Stern School of Business, in conjunction with CIBC World Markets and KPMG, undertook a survey of derivatives usage and risk management practices among US institutional investors (summarised in Hayt 1999). The survey did not include hedge funds, investment managers or counsellors.

Table 25: Permission to use derivatives in the US

	Institutions that permit derivatives use (%)	Institutions with open positions on Dec 31, 1997	Mean open position as % of assets
Full sample	46	27	7
Pension plan sponsors	63	43	7
University endowments	38	19	6
Foundations	28	11	6
Large institutions	70	62	7
Medium-size institutions	49	30	7
Small institutions	26	2	3

Source: Hayt (1999)

Percentages taken with respect to the number of respondents in each category. Except for the large and medium-size categories, these cannot be interpreted as population estimates. Derivatives were defined as forwards, futures, options and swaps only.

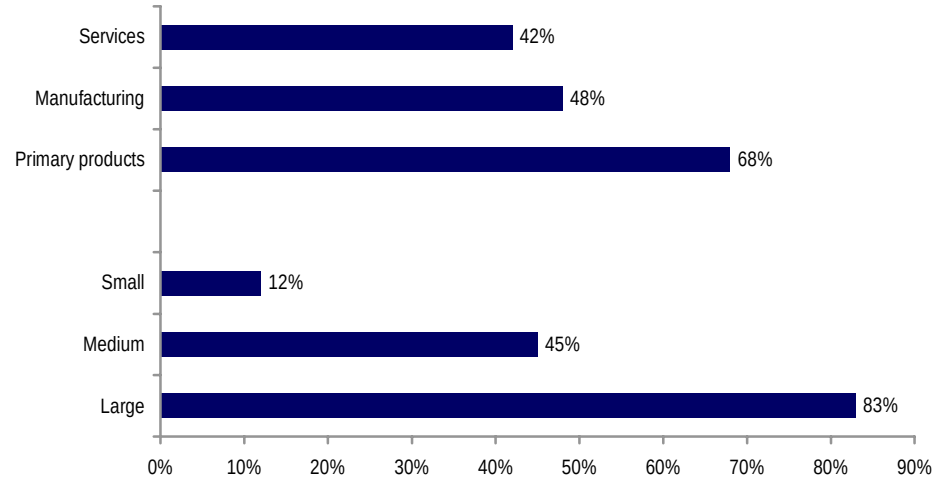
46% of US institutional investors permitted derivatives use

For the entire sample, 46% of respondents reported that they permitted derivatives use by their asset managers (internal or external). Asked why derivatives are used, risk reduction/hedging was the most frequent answer (55% of permitted users) followed by asset allocation (26%) and achieving incremental returns (15%).

What kind of firms use derivatives?

The 1997-98 Wharton/CIBC World Markets Survey can provide some insight into the kind of firms that are using the risk management products (Bodnar 1998). Wharton also conducted similar surveys in 1995 and 1994. The percentage of respondents using derivatives increased from 35% in 1994 to 41% in 1995 and 50% in 1998.

Chart 46: Derivatives usage by industrial sector and size

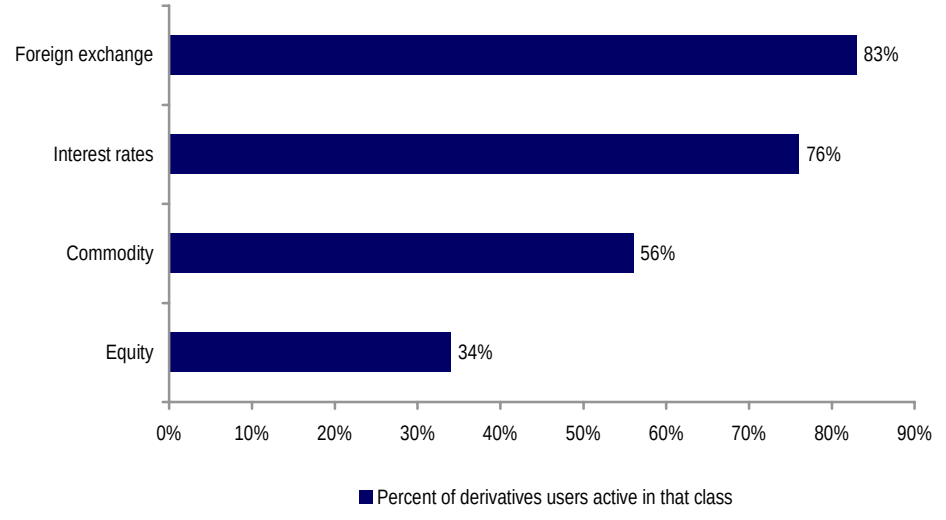


Source: Bodnar (1998)

Large firms more likely to use derivatives

Chart 46 shows that large firms are more likely to use the products than small firms and that firms in the primary products sectors are more likely to use the products than are firms in the manufacturing or service sectors. In the industrial dimension, derivatives usage is greatest among primary product producers at 68%. Given that futures exchanges were originally established to help manage commodity risk, it is not surprising that such a large percentage of primary product producers use derivatives. In the size dimension, usage is heaviest among large firms at 83%.

Chart 47: Derivatives usage by asset class



Source: Bodnar (1998)

Derivatives not frequently used to manage equity risk

Chart 47 reveals that, of the firms using derivatives, foreign exchange is the risk most commonly managed with derivatives, being done so by 83% of all derivatives users. Interest rate risk is the next most commonly managed risk with 76% of firms indicating interest rate derivatives use. Commodity risk is managed with derivatives by 56% of derivatives users, while equity risk is the least commonly managed risk

at just 34%. Examples of equity risks that are commonly hedged with equity derivatives by non financial firms include using equity puts as part of a share repurchase programme, or using total returns swaps to monetarise equity positions in other companies.

The next 100 years

"Forecasting is always difficult – particularly the future."

(Mark Twain)

"Banks are dinosaurs. Give me a piece of the transaction business – and they are history."

(Bill Gates)

What the future holds

Anyone's guess...

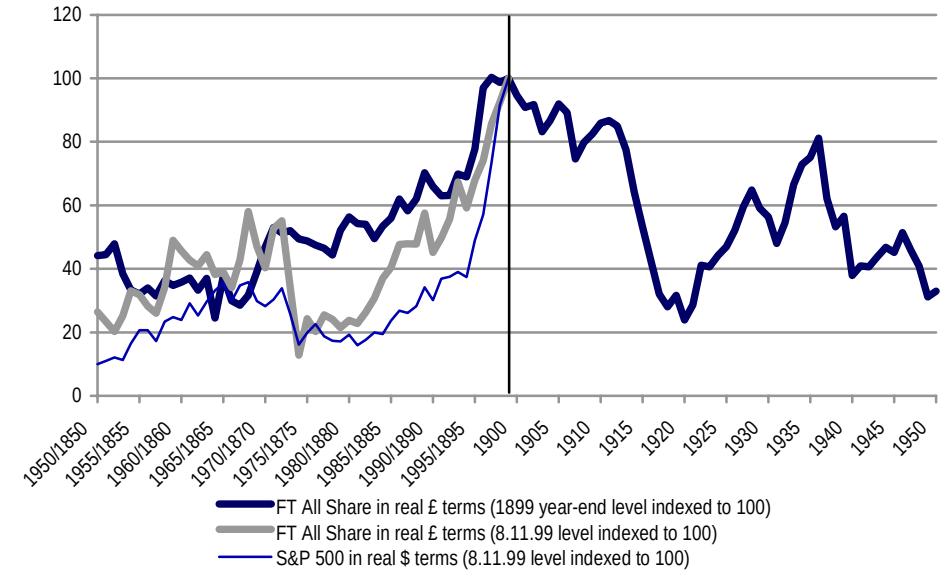
A heading 'The next 100 years' implies, admittedly, a certain degree of ignorance and/or naivety. We have shown in this report that the really big issues to equity investors are not foreseen. The future is depicted with risk factors and noise. Risk management is the pursuit of addressing this uncertainty. However, a collection of past anecdotes or 'financial archaeology' – however this report may be classified – is incomplete without a window looking into the future. In the following section we highlight and comment on a few topics related to equity risk. A detailed pitch on the changing environment for derivatives can be found in Steinherr (1998).

Risk management

The bull is old

The last decade of the 19th century was similar to today in one respect. By the end of the century, the great bull market in British funds was very old. There had been brief reversals in times of financial crises. The experience of several generations of British investors proved that markets declines would always eventually reward the patient holder, and that every sharp decline in price was just one more opportunity

Chart 48: UK and US stock price performance from 1950 to date compared with UK stock price performance from 1850 to 1950



Source: WDR (data from Global Financial Data and Datastream)

FT All-Share and S&P 500: From 1965 to date from Datastream. Prior to 1965 from Global Financial Data (reconstructed using other indices). CPI data from Global Financial Data.

to buy which probably would never recur. The market toped during 1899. Chart 48 on page 96 compares the past 50 year period of the UK and US stock market with the period from 1850 to 1950 for the UK stock market. The indices are in local currencies and in real terms, ie, adjusted by domestic consumer price inflation.

Inflation was already dead 100 years ago

Occasionally a point is made, that forecasting the future is a useless task unless one is a philosopher.[24] What strikes us by viewing Chart 48 is the thought how wrongly we would have predicted markets and their volatilities in the 20th century if we were in a the position to do so at the end of the last century. The misinterpretation of Marx and Darwin, ie, the rise and fall of communism and fascism, probably the most dramatic events shaping the 20th century, were hardly foreseen in 1899. Given the high volatility of the early 19th century and the relative peace and economic expansion of the later 19th century, we probably would have predicted that the new world, ie, the 20th century would involve less dramatic events. Erratic swings in consumer prices were nearly forgotten, ie, belonged to the first half of the century. "Inflation was dead" already 100 years ago, so to speak.

Uncertainty is here to stay, definitely

We probably would have been tempted to explain the new world as a new paradigm or Goldilocks and extrapolate the trend into the future. Chart 48 illustrates how wrong we would have been. Nobody knows what the long run holds.[25] Neither in 1899 nor in 1999. We can only conjecture. Any argument to the contrary must derive from a model with an R^2 of 1.00 (Bernstein 1999). However, there is no such thing. Decision making with respect to the future will always involve uncertainty regardless of the approach (fundamental economics, technical analysis, market psychology, astrology, tea leaves, etc) used. What we know for sure about equity markets and their volatility of the next 100 years, is uncertainty itself. There will always be uncertainty.

Banks and insurers manage risk not return

The above statement is not as fatuous as it may sound. It raises the question what a money manager should be focusing on in the long-term: expected return or risk. Looking at the world from the view of a risk manager it is obvious: risk (otherwise risk managers would be called 'expected return manager'). A risk manager would argue that one cannot manage expected return, but one can manage risk. Banks today do not manage portfolios, they manage risk. Their long-term investment strategy is to define the risk they want to be exposed to and manage the exposure accordingly. The same can be said for insurance companies. Insurance companies do not manage their assets according to whether they are bullish or bearish but with respect to their pre-defined risk parameters such as average duration of insured agent or object and asset-liability mix.

The only certain input to long-term investors is uncertainty itself

A strong point can be made that risk awareness and the management of risk will increase in the future: the only certain input to long-term investors is uncertainty itself. In other words, risk management could be a better approach to dealing with uncertainty than trying to guess what the future might be.

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[24] We have highlighted some forecasting errors due to human biases and heuristics in our report on value stocks 'Europe Value 20 Index' from 14th October 1999.

[25] With Lord Keynes being the one exception: "In the long run we are all dead".

Equity premium

Will equities remain superior to any other asset class in the future?

There is no doubt that equity has been unbeatable in the past. The equity risk premium was substantial, especially in the US. Table 26 shows the US equity premium for different time periods.

Table 26: Compound annual real returns for the US stock market

	Stocks	Bonds	Bills	Gold	Inflation
1802-1998	7.0	3.5	2.9	-0.1	1.3
1802-1870	7.0	4.8	5.1	0.2	0.1
1871-1925	6.6	3.7	3.2	-0.8	0.6
1926-1998	7.4	2.2	0.7	0.2	3.1
1946-1998	7.8	1.3	0.6	-0.7	4.2

Source: Siegel (1999)

Stock market historian Jeremy Siegel (1999) quotes a survey of more than 200 academic economists who estimate the equity premium at 5-6 percentage points over the next 30 years. In other words the equity premium of the past is extrapolated long into the future. Siegel holds against it that such a premium would require a 9-10% real return on stocks, given the current (autumn 1999) real yield on treasury inflation-indexed securities. This means that real per share dividends would have to grow by nearly 8-9% per year, given the current 1.2% dividend yield, to prevent the PE ratio from rising farther from its current record levels. This growth rate is more than six times the growth rate of real dividends since 1871 and more than triple their growth rate since the end of World War II.

According to Siegel's math the equity premium should narrow. But then, perhaps there *is* such a thing as a new paradigm.

Forecasting

What if everyone knew how wrong experts forecast?

Forecasting is important. Usually forecasting is done by experts. However, experts err. As a matter of fact, experts err predictably and often (Dreman 1979). The problem of expert failure can be traced to man's capabilities as an information processor. Every human organism lives in an environment that generates millions of new bits of information every second, but the bottleneck of the perceptual apparatus does not admit more than 1,000 bits per second. We react consciously to only a fraction of the information which is given to us.

Illusionary correlation

Dozens of studies discrediting experts have made it clear that expert failure extends far beyond the investment scene. And the problems often reside in man's information processing capabilities. Current work indicates that the expert is a serial or sequential processor of data who can handle information reliably in a linear manner – that is, he can move from one point to the next in a logical sequence. However, a solution to a complex problem can require configural (or interactive) reasoning. In a configural problem, the forecaster's interpretation of any single piece of information changes depending on how he evaluates many other inputs. The configural relationships of a company or the market place itself are extremely complex. In addition, research in configural processing has shown that experts can

not only analyse information incorrectly, they can also find relationships that are not there – a phenomenon called *illusionary correlation*.

The complexity of the marketplace naturally leads to an attempt to simplify and rationalise what seems at times to be reality. Often investors notice things that are simply coincidental, and then come to believe that correlations exist when none are actually present. And if they are rewarded by the stock going up, the practice is further ingrained. The market thus provides an excellent field for illusionary correlation.

Experts are here to stay

If experts err so badly and are wrong so consistently, will the experts be relieved of their duty to forecast? Probably not. When dealing with volatility and uncertainty, an expert's view is likely to be considered in the decision-making process. Consulting an expert is better than the next best alternative. What is the next best alternative? Alternatives to an expert's view is the non-expert's view or a fortune-teller's view. Those might not be considered an alternative at all.

A case for objective models in decision making

However, there is a further alternative: regression and factor models. A strong point could be made that decision making (in finance and elsewhere) will become more quantitative in the future than it is today. Concepts and terms such as skewness and kurtosis, leptokurtic and platykurtic distributions, homoscedasticity and heteroscedasticity will belong to the standard vocabulary of finance professionals. This is not the case today. It was not too long ago, when the term 'volatility and standard deviation of returns' were terms not widespread among market participants. This has changed.

Objectivity is better than subjectivity, which is better than expert intuition

Much research indicates that subjective models are better than an expert's view and objective models are better than subjective models. With an intuitive prediction, the expert analyses the case and, intuitively, weights the factors. Subjective models use the expert's skill in making judgements but ignores biases. The subjective model uses the expert's analysis of the factors but derives the weights of the factors through regression analysis. This regression analysis will show how much weight, on average, the experts put on each of the underlying factors. The idea behind this is as follows: When a person makes a prediction, one gets wisdom mixed with random noise. Intuitive judgements suffer from serious random inconsistencies due to human biases and heuristics. The ideal decision process would eliminate the random noise but retain the real insights that underlie the prediction. A subjective model, therefore, eliminates the noise, and retains the core wisdom of the human

Table 27: Different decision models

	Degree of correlation with the true outcomes		
Types of judgements experts had to make	**Intuitive prediction**	**Subjective model**	**Objective model**
Changes in stock prices	.23	.29	.80
Business failures using financial ratios	.50	.53	.67
Life-expectancy of cancer patients	-.01	.13	.35
Academic performance of graduate students	.19	.25	.54
Performance of life insurance salesman	.13	.14	.43
Mean (across many studies)	.33	.39	.64

Source: from Russo and Schoemaker (1989)

expert (Russo and Schoemaker 1989). The objective model goes one step further. Instead of inferring the weights from the subjective predictions of an expert, the weights are inferred statistically from actual past results.

Oncologists have negative alpha

Table 27 on page 99 shows some comparisons between experts' intuition, subjective models, and objective models. Based on the research in Russo and Schoemaker (1989) the subjective model is superior to the experts intuition and inferior to an objective model. Note that the skill of an oncologist estimating life expectancy of cancer patients is negative. The estimate, however, can be improved by using simple regressions in form of subjective or objective decision-models.

Objective models are not the Holy Grail in finance and could prove dangerous

Before we get too excited about objective models and quantitative analysis a note of caution is opportune. Objective models are not and will not be the Holy Grail of finance. As a matter of fact, models based entirely on the past could prove quite dangerous. The point we do want to raise here, however, is that the evolution of decision-making will continue and most likely become more quantitative in nature.

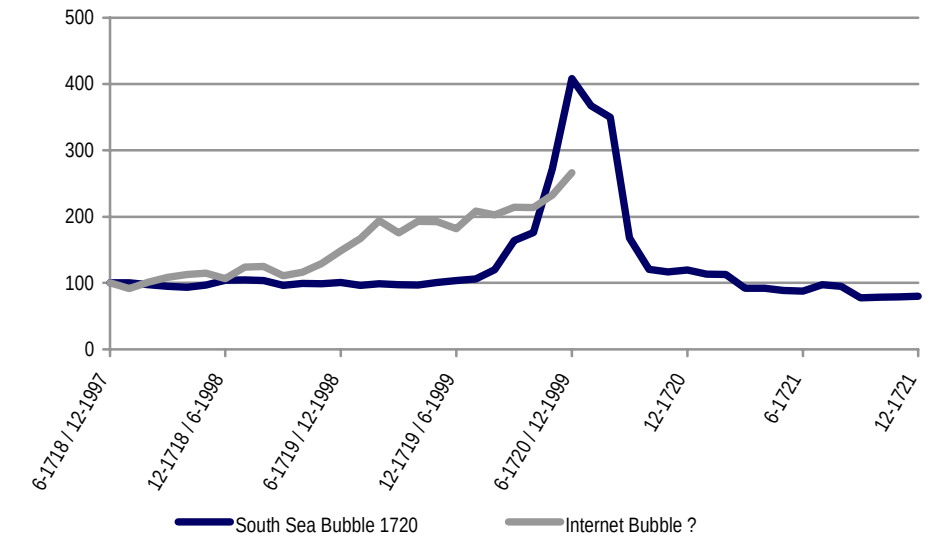
Internet stocks

Will the Internet Bubble burst?

The difference between the South Sea Bubble of 1720 and the Internet Bubble is that the latter has not burst yet. As a matter of fact, it is rather bold to speak of the internet boom as a bubble. Perhaps there is such a thing as sustainable growth of 50% a year. But then, perhaps, there is not.

Chart 49 compares the NASDAQ 100 index in US$ terms, indexed to 100 two years ago with the FT All Share index, in £ terms, and indexed to 100 two years before the crash.

Chart 49: South Sea Bubble of 1720 compared with Internet Bubble



Source: WDR (data from Global Financial Data and Datastream)

South Sea: FT All-Share in real terms and local currency indexed to 100 two years prior to peak

Internet: NASDAQ 100 index in real terms and in local currency indexed to 100 in December 1997

The buzz words are 'new' and 'global'

There is one commonality between the South Sea bull market and the current technology boom. Both bull markets were/are carried by *new global* horizons that led investors to discount great wealth in the future into current share prices. In the case of the South Sea Bubble it was new ways of global trade and new markets on a global scale. In the case of the current internet boom it is again the trust in the way the Internet will change global trade, new markets, and the way business is conducted globally.[26] However, the two periods show significantly different paths.

Investment management

As everything else will change in the next one hundred years, so will the investment management profession. We have already expressed the view that decision-making should become more quantitative. Further down we will highlight that new technology will inevitably give many areas of human activity a technical bias.

Move away from allocating assets to optimising Sharpe ratios

Over the past decades, investment managers have used capital market theory to combine financial assets together into the so-called optimal portfolio. Using this approach, managers follow an almost universal pattern: if the client wants a more aggressive portfolio, add more equity. If the client wants a less aggressive portfolio, add more bond or cash exposure. The portfolio is viewed in terms of allocations to the different asset classes in the investable capital market. This approach, however, is suboptimal. In the future, portfolios will be constructed using global financial assets to optimise Sharpe ratios without specifically determining an asset allocation (Brinson 1998).

Benchmarks will probably become even more influential than they already are today

More and more investors are already today requesting more than just high returns. They are focusing on high risk-adjusted returns in excess of the portfolio benchmark (Putnam 1998). This is somewhat surprising because of the sustainability of the bull market which tends to paper over a lot of investment sins. It is fair to assume, in our opinion, that a move from a focus on returns to risk-adjusted returns would accelerate in the case of a large correction or, God forbid, a bear market.

Trade wars

Disputes surrounding the bull's meat one day might be the flap of a butterfly's wing ...

Probably one of the greatest risk to equity in the decades to come is a trend-reversal in free international trade or worse, a trade war. The recent bull market had a lot to do with globalisation and free international trade. Economies utilising their competitive advantage has led to greater aggregate wealth. The mechanics of free trade could reverse. This is an uncertainty, ie, a risk factor.

... causing a hurricane and ending the long-term bull market

As often in human history, small events can trigger a chain reaction of other small events leading to events of great magnitude. Followers of chaos theory occasionally use the example of a butterfly in the amazon leading to a hurricane in Florida. We wonder whether one of these small events could damage the system of free trade. There are enough examples of 'small events': recommendations by the German health authorities not to buy British products (beef) and not selling to British buyers

[26] There is more to the South Sea Bubble than just high expectations. We have highlighted some aspects in a previous chapter.

(Mannesmann shares), French government not accepting EU guidelines (beef again), disputes between EU and US with respect to bananas and 'hormone-contaminated' beef. What if, one day, a 'not-so-diplomatic' reaction is triggered?

Political risk

Political risks are here to stay

By reviewing the brief discourse of equities risk and returns over the past centuries it is clear that political risks are system-inherent and unlikely to disappear. Wars, one of the more 'hands-on' instruments of politics, still occur and most likely will continue to do so in the future. The beginning of the Second Gulf War was observed with great disbelief in most parts of the world. It took place despite the disbelief and was able to destabilise the sensitive system of the global economy. Although most readers will agree that Saddam Hussein has little in common with a butterfly, a point could be made that political events such as the invasion of Kuwait are not foreseen but trigger events which are a great source of risk to equity investors. The Balkans, for example, is full of potential butterfly wing flaps.

The heart beats on the left

What not only surprises the author, is that after all turmoil, chaos, misery, and pain that non-liberal political thinking has caused to humanity over the past 100+ years, totalitarian-socialist ideas are still alive and breeding. One should not have to be a right-winger to assess that the freedom of the individual is the most valuable merit in a civilised, free, and educated society. At the conference of leftist European industrial nations in Florence on 20-21 November 1999, the French premier Jospin made it clear on which side his heart was beating. He presented the opinion that the capitalist system and the market must be regulated by the government prudently, even in modern times of globalisation.[27] He went on to claim that from his point of view the market is not an independent merit, but an instrument that the government should use 'cleverly' for the utility of the whole society.

A philosophical rift in Europe

On 2 December 1999 the Euro traded below parity against the US dollar for the first time since its introduction. Doubts about the direction of economic policy under Gerhard Schröder, Germany's Social Democratic chancellor, have been partly responsible for the euro's weakness. The bail-out of Holzmann and the government intervention in Vodafone's bid for Mannesmann exposed a philosophical rift in Europe between those forces pressing for more open markets and those defending a model of consensus capitalism.

Not all risk are measured by standard deviation

Needless to say that repetitious clashes between ideologies and its potential impacts are not good for the building and sustainability of wealth and that this risk is not measured by standard deviation of returns. Unfortunately, history occasionally repeats itself.

On real wars and terrorism

Although trade wars are probably the more likely 'unlikely-event' to harm the global economy, real wars have always reappeared in human history despite the feel of contemporaries having reached a high degree of civilisation.

[27] Neue Zürcher Zeitung, International edition, 22 November 1999, pp 1-2.

Nuclear weapons...

The risk is that in a real war, a nation could use a weapon of mass destruction. Within the past two years, the US has bombed Iraq out of concerns that it was rearming itself with chemical and biological weapons of mass destruction. India and Pakistan each detonated nuclear bombs of their own. North Korea fired a ballistic missile that flew over Japan. Soon these missiles will have the capabilities to reach Alaska. China is deploying missiles along its south-east coast that are capable of carrying nuclear weapons and are targeted at Taiwan. Starving Russian scientists are selling their nuclear know-how to Iran and perhaps Libya and Syria (Kadlec 1999).

...and germ warfare

Perhaps a risk greater than war is a terrorism attack in which germ warfare of a biological weapon were used. Weapon scientists from Iraq, Russia and South Africa are hunting for new jobs and spreading germ secrets. Radical states with reputations for supporting terror are seeking germ weapons. Terrorists, such as Osama bin Laden, are increasingly interested in pestilential germs. Some boast openly of being able to kill foes with deadly plagues.[28]

Should low probability events be ignored?

These are unpleasant thoughts. The events described are highly unlikely to occur. However, it raises the question of whether viewing risk in mean-variance space and maximising risk/returns ratios is the optimal approach to investment management. If variance of returns does not capture real-world risk factors, perhaps a simple country allocation is not that bad after all.

Information risk

Information as a source of risk

We do not want to sound too 'Gates-esque' but information is changing everything from private life to business life. For many service companies, such as banking, the future will involve providing information, ie, the right information, to the right recipient, at the right time, in the right quantity and quality, as fast as possible. Whether information is a liability by the provider of information or a liability to the gatherer, ie, the user of information is ambiguous and not subject of this note. The point raised here is that information itself is a source of risk.

Economically, information today is as important as oil was 25 years ago

Information risk was made aware by those who proclaimed that Y2K would lead the global economy into recession (which, fortunately, did not materialise as this went to press in December 1999). The argument was that information for the economy today is what oil was for the economy in the 1970s. This actually makes sense. The economy as a whole is much less dependent on oil than a quarter of a century ago. Also, the dependence on information and information technology is increasing. A higher price for 'information' could, and this was the main argument for Y2K leading into recession, have a similar effect on the global economy as had a higher oil price in the 1970s.

Information has been getting cheaper over the past few decades. An (unforeseen) reversal of this trend is a risk factor.

[28] The *New York Times* from 27 December 1998 quoted in Kadlec (1999).

New technology – new uncertainty

Trading in cyber space

Today's cyber-wizards have combined the sorcery of electrical and electromagnetic waves, and propelled them at incredible speed, about three-quarters of the way to the moon with every second.[29] In doing so, they have produced a wave of energy that can carry a computer command, the human voice, or virtually any program including market information, quotations, analysis, and orders from anywhere to anywhere. The new technology will create a world in which applications impossible with wires will result in not just a series of new technological marvels, but a spectacular market emancipation. By unplugging us from existing infrastructures, we will suddenly have many more choices about where we live, work, or how we trade. Everyone will be connected. Tiny chips might even be implanted in our bodies that could act as a universal credit card, passport, driver's license, or even to transmit buy and sell orders (Melamed 1999). Telephones as we knew them will be history. The Internet changes all the rules. Surely, national and economic borders which have already been blurred, may dissolve completely, as communication satellites enable consumers and traders to do transactions in cyberspace.

Customised risk management solutions are today's soup du jour

But simply embracing technology will not be enough to survive in the 21st century. Finance is a dynamic science and the pace of change has accelerated exponentially. The distinctions between types of markets are vanishing. Strategies pertaining to equity, debt, indexing, foreign exchange, futures, forwards, options, swaps, and cash, are all interdependent and interchangeable. The digital age has unbundled all manner of risk and is capable of repackaging it in any form the investor wants at the moment he wants it. Customised strategies and customised instruments of trade are today's soup du jour.

The tyranny of the status quo

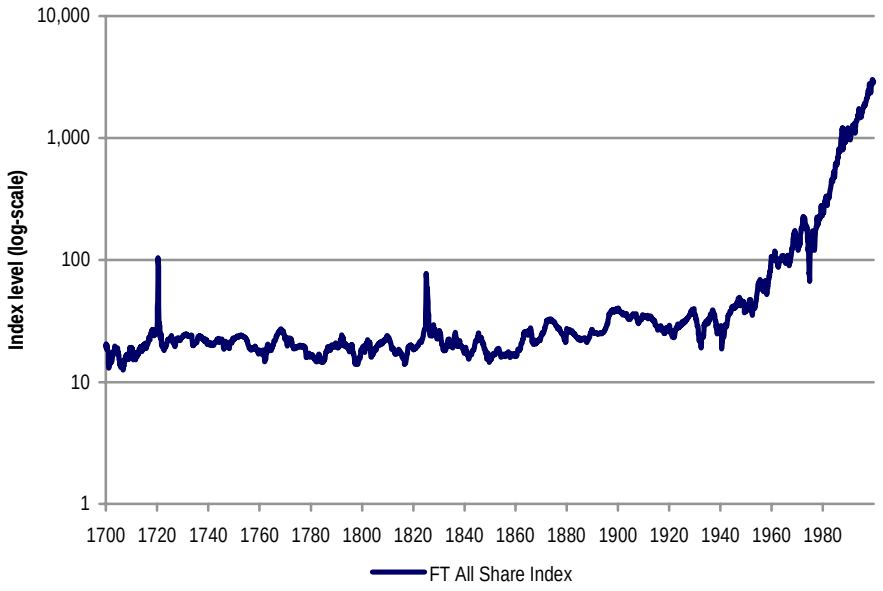
The only certainty about the future is to expect the unexpected – which by definition is unpredictable. We must not become victim to what Milton Friedman calls the 'Tyranny of the Status Quo'. New ideas and innovations must remain our middle name.

[29] This section draws on material from Melamed (1999).

Appendix

Charts

Chart 50: FTSE All-Share Index from January 1700 to October 1999 (log scale)

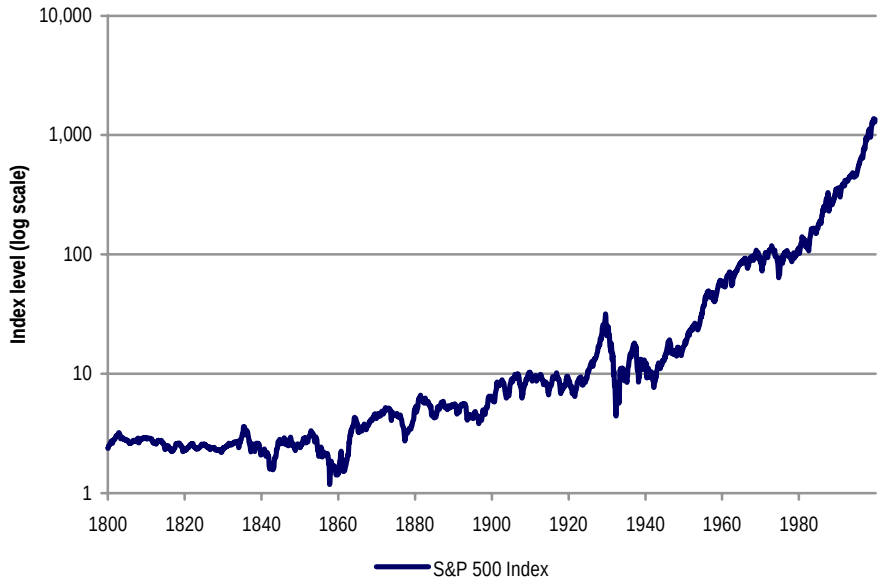


Source: Global Financial Data

Sources: Thorold Rogers, A History of Prices in England, (1693-1697), Larry Neal, The Rise of Financial Capitalism: International Capital Markets in the Age of Reason, New York: Cambridge Univ. Press, 1990 (1698-January 1811), W. W. Rostow and Anna J. Schwartz, The Growth and Fluctuation of the British Economy 1790-1850), (2 vols.), Oxford: Oxford U.P., 1953, p. 368, (February 1811-December 1850), Hayek as given in Rostow, ibid., p. 456 (January 1851-June 1867), K.C. Smith and G.F. Horne, An Index Number of Securities, 1867-1914, London and Cambridge Economic Service Special Memorandum No. 37, (July 1867-December 1906), Banker's Magazine (January 1907-May 1933), Economist (1933-1962), Financial Times (1950-)

Notes: East Indies Stock is used for 1693. The index is an unweighted arithmetic average of Bank of England and East Indies stock from 1694 to August 1711, and of Bank of England, East Indies and South Sea stock from September 1711 to January 1811. Rostow's Total Index of Share Prices is used from 1811 to 1850. Hayek's index was taken from Rostow and excludes banks, insurance and bridge stocks, but includes industrial stocks. This index is linked to the London and Cambridge Economic Service index, which begins in July 1867 and continues until 1906. The L&CES index consisted of 25 stocks in 1867 and had grown to 75 stocks by 1914. The Banker's Magazine kept a capitalisation-weighted index of 287 stocks, which gave the total capital values of the companies that were included. This was the broadest index of London shares at the time and the index is used beginning in 1907. Although this index was calculated beginning in 1887, the Banker's Magazine usually omitted calculating the index for one month during the summer, and for this reason it is excluded until 1907 when calculations were made for every month. The London market closed in August 1914 and reopened in January 1915. The Banker's Magazine Index is used through May 1933. Beginning in June 1933, The Actuaries General Index. This index included financial stocks, commodities and utilities, but excluded debentures and preferred shares. Beginning in April 1962, the Financial Times-Actuaries All-Share Index is used. All indexes have been chain linked to one another to create a continuous index with the All-Share index's base of 10 April 1962 used as the base for the entire index.

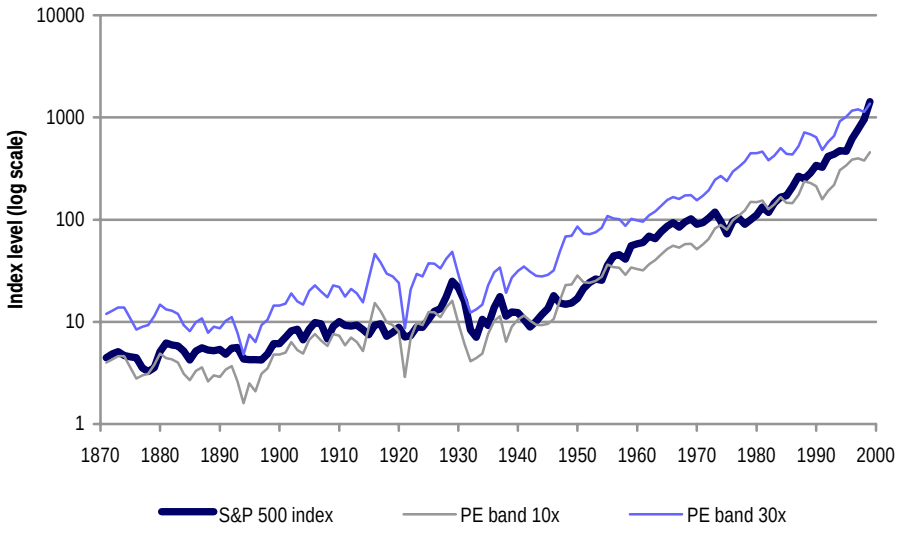
Chart 51: S&P 500 Index from January 1800 to October 1999 (log scale)



Source: Global Financial Data

Sources: From January 1800 to December 1801, the actual prices of US 3% stock are used, drawn from Walter B Smith and Arthur H Cole, Fluctuations in American Business, 1790-1860, Cambridge; Harvard Univ. Press, 1935. This series uses Schwert's methodology to provide an index of US stocks dating back to 1802. (G William Schwert, 'Indexes of US Stock Prices from 1802 to 1987', Journal of Business, 63:3 (1990): 399-425. This index combines the monthly price indexes of bank stocks (1802-1815), bank and insurance stocks (February 1815-December 1845), and Rails (1834-1862) from Smith and Cole, ibid; and Railroads (1863-1870) from Frederick R Macaulay, The Movements of Interest Rates, Bond Yields and Stock Prices in the United States since 1856, New York: National Bureau of Economic Research, 1938. Where these indices overlap, the indices have been weighted according to the number of stocks included in the indices. Beginning in 1871, the Cowles/Standard and Poor's Composite index of stocks is used. The Standard and Poor's indices were first calculated in 1918, and the Cowles Commission back-calculated the data to 1871 using the Commercial and Financial Chronicle. For more information, see Standard and Poor's, Security Price Index Record, New York: Standard and Poor's, 1996.

Chart 52: S&P 500 index with PE bands since 1870 (log scale)



Source: WDR (data from Shiller 1989 and Datastream)
PE bands are based on trailing earnings

Tables

Table 28: SPX PE ratio plus inflation rate in the 20th century

	Start	High	Low	Mean	End
1900s	**29.6**	29.6	9.2	16.3	15.2
1910s	24.5	39.8	Negative	19.4	15.8
1920s	28.3	28.3	Negative	9.9	14.8
1930s	18.7	39.6	6.2	16.3	8.9
1940s	14.7	**42.6**	5.2	18.6	5.2
1950s	0.8	26.5	0.8	12.8	17.0
1960s	17.4	20.6	15.9	18.1	20.6
1970s	22.5	28.6	13.7	19.7	17.2
1980s	22.9	22.9	10.8	15.2	18.1
1990s	19.9	32.9	16.4	21.9	**32.9**

Source: WDR (data from Shiller 1989, Compustat and Datastream)

Table 29: CFTC approved futures contracts

Exchange	Contract	Approved	Approval pending
AEX	FTSE Eurotop 100	✓	
Eurex	DAX	✓	
	MDAX		✓
	STOXX 50		✓
	Euro STOXX 50		✓
LIFFE	FTSE 100	✓	
	FTSE 250	✓	
	FTSE Eurotop 100		✓
	FTSE Eurobloc 100		✓
	FTSE Eurotop 300		✓
	FTSE Eurotop 300 ex UK		✓
	MSCI Pan-Euro		✓
	MSCI Euro		✓
MATIF	CAC 40	✓	
	STOXX 50		✓
	Euro STOXX 50		✓
MEFF	IBEX 35	✓	
IDEM	MIB 30	✓	
OM/OMLX	OMX	✓	
BELFOX	BEL-20		✓
BSE	Budapest Stock Index		✓
HKFE	Hang Seng	✓	
	HKFE Taiwan	✓	
	HS China-Affiliated		✓
OSE	Nikkei 225	✓	
	Nikkei 300	✓	
TSE	TOPIX	✓	
SIMEX	Nikkei 225	✓	
	Nikkei 300	✓	
	MSCI Taiwan	✓	
	MSCI HK	✓	
	MSCI Singapore Free		✓
	DJ Thailand		✓
KLOFFE	Kuala Lumpur SE Composite		✓
SAFEX	JSE Actuaries Top-40		✓
TFE	TSE 300 Composite	✓	
	TSE 100	✓	
	TSE 300 Spot	✓	
	TSE 35 Index	✓	
	TSE 35 Spot index	✓	
SFE	All Ordinaries	✓	

Source: www.cftc.gov/opa/backgrounder/part30.htm

As of 15 July 1999

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Periodic research

Title	Geography covered	Instruments covered	Periodicity of publication	Dissemination method (1)	Contact
Volatilities for Major International Equity Indices	Global	Index options	Weekly	Fax	Michael Duff
Weekly Volatilities Sheet	Global	Index options	Weekly	Fax	Michael Duff
Global Markets Report	Global	Equity indices	Weekly	Fax	Michael Duff
Indicative Swap and Option Levels	Global	Index swaps and options	Weekly	Fax	Michael Duff
Derivatives Insight	Global	Equity derivatives (2)	Ad hoc	Hard copy	Alexander Ineichen
Index Derivatives Strategy	Global	Index derivatives	Ad hoc	Hard copy	Alexander Ineichen
Index Volatility Watch	Global	Index derivatives	Weekly	Hard copy	Alexander Ineichen
Structured Equity Products	Global	Structured derivatives	Quarterly	Hard copy	Alexander Ineichen
Quantitative Equity Country Allocation Monthly	Global	Equity and bond indices, currencies	Monthly	Hard copy	Scott Mixon
Flow Watch	Global	Equity and derivatives	Weekly	Hard copy	Jaspreet Khaira
US Daily Equity Derivatives Market Update	US	Indices, futures, options, stock options, stocks	Daily	Fax	Carl Mason
SPX Options	US	Index options	Daily	Fax	Carl Mason
SPX Futures Daily Update	US	Index futures	Daily	Fax	Carl Mason
US Equity Implied Volatilities Report	US	Stock options	Weekly	Fax	Carl Mason
Earnings Watch	US	Equity Derivatives	Weekly	E-mail	Paul Koo
Stock Volatility Watch	Europe and UK	Stock options	Ad hoc (roughly quarterly)	Hard copy	Alexander Ineichen
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Portfolio Modeller	Europe and UK	Stocks	Quarterly	Hard copy	Alun Jones
Benchmark Monitor	Europe and UK	Stocks	Quarterly	Hard copy	Alun Jones
European Style Monitor	Europe and UK	Stocks	Monthly	Hard copy	Alun Jones
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Swiss Equity Warrants	Switzerland	Equity warrants	Weekly	Hard copy	Heinz Kubli
Swiss Benchmark Warrants	Switzerland	Equity warrants	Ad hoc (roughly quarterly)	Hard copy	Heinz Kubli
Warrants Focus	Switzerland	Equity warrants	Ad hoc	Hard copy	Heinz Kubli

Source: WDR

(1) All publications are also available on our web site at http://www.research.wdr.com/

(2) The term 'equity' refers to both stocks and equity indices.

(3) Published as part of the Equity Derivatives Weekly once per month.

Monographs

Title	Date	Contact
Stock Prices and Earnings	December 1999	Scott Mixon
Understanding Risk	July 1999	Alun Jones
A Long-term Look at Japanese Volatility	June 1999	Scott Mixon
Tracking Errors	April 1999	Alan Scowcroft
What Does the Term Structure of Implied Volatility Mean?	April 1999	Scott Mixon
Pan European Share-based Incentive Schemes	March 1999	Alexander Ineichen
SPX Puts are Relatively Expensive; SPX Calls are Relatively Cheap	March 1999	Scott Mixon
A Long-term Look at UK Equity and Gilt Market Volatility	March 1999	Scott Mixon
A Long-term Look at Equity and Bond Market Volatility	October 1998	Scott Mixon
The Reality of Hedge Funds	October 1998	Scott Mixon
Improve Your Morningstar Rating Using Options	July 1998	Scott Mixon
Risk Modelling Post EMU	June 1998	Alun Jones
Gaining Exposure to the Greek Equity Market	June 1998	Alexander Ineichen
Volax Future	January 1998	Alexander Ineichen
Improving Portfolio Selection with the DDM	April 1998	Mark Bulsing
Taiwanese Equity Related Investment Products	December 1997	Alexander Ineichen
Equity Related Investment Products	November 1997	Alexander Ineichen
International Diversification for UK Investors: How Much is Enough?	October 1997	Scott Mixon
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Optimal EAFE Implementation	June 1997	Scott Mixon
Passive Equity Investment in Taiwan	August 1996	Scott Mixon
A Review of Exchange-Traded Japanese Equity Derivatives	July 1996	Alexander Ineichen
A Note on Dispersion Trading	June 1996	Scott Mixon
Why and How Fundamental Managers Should Use Options	June 1995	Scott Mixon
SPX Put-Writing Strategy	February 1995	Scott Mixon
All Ordinaries Call Overwriting Strategy	January 1995	Scott Mixon

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