

MILLENNIUM BOOK II

101 Years of Investment Returns

Elroy Dimson, Paul Marsh and Mike Staunton

London Business School

MILLENNIUM BOOK II

101 Years of Investment Returns

Co-published by:



and:



ABN AMRO Equities (UK) Ltd
250 Bishopsgate
London EC2M 4AA
UK
Tel: +44 (0)20 7678 8000
Fax: +44 (0)20 7678 7353

London Business School
Regents Park
London NW1 4SA
UK
Tel: +44 (0)20 7262 5050
Fax: +44 (0)20 7724 7875

Copyright © 2001 Elroy Dimson, Paul Marsh and Mike Staunton

No part of this document may be reproduced or used in any form, including graphic, electronic, photocopying, recording or information storage and retrieval systems, without prior written permission from one of the publishers. To obtain permission, clients of ABN AMRO should contact ABN AMRO (UK) Equities Limited, and others should contact the authors at London Business School with details of the required extracts, data, charts, tables or exhibits. Documents that incorporate reproduced or derived the authors and publishers, *'Elroy Dimson, Paul Marsh and Mike Staunton, Millennium Book II: 101 Years of Investment Returns, ABN AMRO/LBS, 2001.'* Charts and tables must carry the acknowledgement *'Copyright © Dimson, Marsh & Staunton – ABN AMRO/LBS'*. If granted permission, a copy of published materials must be sent to the authors at London Business School at the address above. There may be a fee in connection with granting permission.

All rights reserved. Please refer to ABN AMRO terms and conditions, on the last page of this book.

ISBN 0 9537906-1-4

Contents

Chapter 1 Introduction and Overview	1
1.1 Overview	2
Chapter 2 Measuring long-term returns	7
2.1 Guidelines for measuring long-term returns	7
2.2 Success bias in equity indices	9
2.3 Dividends, coverage and weightings	12
2.4 The ABN AMRO/LBS indices for the UK	14
2.5 Easy-data bias in international indices	17
2.6 Measuring inflation and fixed-income returns	20
2.7 Summary	21
Chapter 3 World markets: today and yesterday	22
3.1 The world's stock markets today	22
3.2 Why stock and bond markets matter	25
3.3 The world's stock markets yesterday	27
3.4 Industry composition: 1900 versus 2000	31
3.5 Stock market concentration	34
3.6 Summary	36
Chapter 4 Recent history: millennial year review	38
4.1 UK capital market returns during 2000	38
4.2 Worldwide capital market returns during 2000	44
4.3 Millennial year in its historical context	48
4.4 Why a long-term perspective matters	50
Chapter 5 International capital market history	51
5.1 The ABN AMRO/LBS indices for the UK	51
5.2 The impact of income	53
5.3 101 years of international stock market history	55
5.4 Equities compared with bonds and bills	56
5.5 Risk and the distribution of annual returns	58
5.6 Summary	60
Chapter 6 Interest rates and inflation	62
6.1 Inflation in the UK	62
6.2 Inflation around the world	64
6.3 UK treasury bill returns and real interest rates	67
6.4 Real interest rates around the world	68
6.5 Summary	70
Chapter 7 Bond returns	71
7.1 UK bond returns	71
7.2 Bond returns around the world	74
7.3 Bond maturity premia	76
7.4 Inflation-linked bonds	78
7.5 Summary	82
Chapter 8 Exchange rates and currency-adjusted returns	83
8.1 Long-run exchange rate behaviour	83
8.2 The international monetary system	85
8.3 Long-run purchasing power parity	87
8.4 Deviations from purchasing power parity	89
8.5 Volatility of exchange rates	90
8.6 Currency adjusted bond and equity returns	92
8.7 Summary	96

Chapter 9 Size effects and seasonality in stock returns	98
9.1 The size effect around the world	98
9.2 The size effect in the UK	101
9.3 The reversal of the size premium	104
9.4 Seasonality and size	108
9.5 Summary	111
Chapter 10 Equity risk and the risk premium	113
10.1 Equity risk	113
10.2 Risk premia relative to bills	117
10.3 Risk premia relative to bonds	121
10.4 Risk premia around the world and over time	126
10.5 Summary	127
Chapter 11 The Prospective Risk Premium	130
11.1 Why the risk premium matters	130
11.2 Measuring the prospective risk premium and the cost of capital	132
11.3 What this means for the future	136
11.4 Interpreting history to estimate future risk premia	138
11.5 What returns can we expect over the 21 st century?	143
11.6 Are companies under-investing?	144
Chapter 12 Conclusion	146
12.1 Equity returns have previously been overstated	147
12.2 Future uses of our data	148
12.3 The equity risk premium	149
Chapter 13: The individual countries	151
Chapter 14: Australia	153
Chapter 15: Belgium	161
Chapter 16: Canada	169
Chapter 17: Denmark	177
Chapter 18: France	185
Chapter 19: Germany	193
Chapter 20: Ireland	201
Chapter 21: Italy	209
Chapter 22: Japan	217
Chapter 23: Netherlands	225
Chapter 24: Spain	233
Chapter 25: Sweden	241
Chapter 26: Switzerland	249
Chapter 27: United Kingdom	257
Chapter 28: United States	265
Chapter 29: References	273
List of Tables and Figures	280

Foreword

This second edition of the *Millennium Book* builds on fifteen years of successful collaboration between ABN AMRO and Professors Dimson and Marsh. The first edition of the *Millennium Book*, published one year ago, rapidly established itself as a leading source of long-run returns data for all investment professionals. Institutional investors from around the world attended a series of presentations given by Professors Dimson and Marsh, and the level of interest, while not surprising, was extremely gratifying. The audience turnouts at venues in Australia, China, Denmark, England, France, Germany, Ireland, Israel, Italy, Scotland, Spain and the US quite often ran into the hundreds, and many cities required multiple appearances from the authors.

Over the course of last year, there were more than 200 articles in the press about the *Millennium Book*, and there were repeated demands for media appearances by the authors. There have been requests for editions of the Book to be published in three different continents. To our great pleasure, the authors' research has been selected as the keynote presentation for major academic and practitioner conferences in Britain and abroad. It was honoured as the lead article in the January 2001 issue of *The Journal of Business*, published by the University of Chicago Press. Finally, in February 2001, it was announced in the US that the *Millennium Book* has been awarded the prestigious First Prize in the Roger Murray Competition of the Institute for Quantitative Research in Finance.

At ABN AMRO, we have been delighted to respond to ongoing requests from clients in many countries for further details and elaboration of the contents of the *Millennium Book*. Our clients have used the Book in many different ways. Some have used it as a direct input into their strategic planning. Others have entered into a dialogue with the authors, and have dug deep into the underlying methodology. Yet others have used the Book as part of wider training exercises for their investment professionals. All have found uses for the data. Like many of our clients, we have looked forward to the new edition.

Of course, the *Millennium Book* is much more than just data. Description and analysis are at its core. This year the analysis is extended to include more markets, and the returns data now incorporate detailed analysis of the impact of exchange rate fluctuations. The importance of a reliable and truly international dataset for the investment industry, as it continues its relentless march on 'globalisation', is obvious. One of the many changes taking place in our business is the increasing demand for locally sourced research to be placed in a global context. Another innovation is the increasing number of truly global mandates being given to fund managers. 'Globalisation' may be a cliché, but for our business it is fast becoming a reality. Access to a properly constituted and rigorously maintained international database is a *sine qua non* for the start of any investment process.

The year 2000 felt like an abnormal year, particularly for those who had become used to the bull market conditions of previous years. The bursting of the TMT bubble was an unusual event, but for the broader markets, it was not an aberrant period. In the last edition of the *Millennium Book* it was argued that the single most important variable for any investment decision is the equity risk premium. That is surely right. The authors also argued that the high returns on equities relative to bonds observed in recent years were unlikely to continue.

We can explain and justify the relatively high rating of today's stock markets in terms of a historically low forward-looking risk premium. But we cannot expect high past returns from equities to resume. For the investment strategist this raises the most fundamental question of all: do investors realise that returns must revert to more normal levels or do current valuations still embody exaggerated expectations based on an imperfect understanding of history? For the optimistic strategist it is comforting that the *Millennium Book* is now available for investment research: good data is the key to understanding history.

Chris Johns

Global Strategist, ABN AMRO Equities (UK) Ltd

Preface

This is the second edition of the *Millennium Book*. Within a matter of months from publication of the first edition, our work had achieved widespread visibility and adoption in the investment world, both at home and internationally. Yet wherever we made it available, we met individuals who had suggestions for further enhancing the study.

During presentations in Spain and in Ireland, for example, we met researchers who were themselves undertaking studies of the long-run performance of their home markets. At academic conferences we met individuals who are assembling databases for the Belgian and Danish markets. And at other events we were pointed towards sources for missing data, such as early Japanese equity indices, that had so far eluded us.

Meanwhile, at ABN AMRO client meetings and elsewhere, we were asked many penetrating questions. We were asked what effect currency fluctuations have on our analysis; what history tells us about the future equity risk premium; and what we can say about subjects we had omitted from the first edition of the book – stock market seasonality, index-linked bonds, and many other topics.

This second edition of the *Millennium Book* is the result of that dialogue. With much assistance from the colleagues identified above (we thank them by name in Part Two of this volume), we have extended and expanded the *Millennium Book* to address many of the issues that readers of the first edition felt to be important. We welcome a continuing involvement with the investment profession, and look forward to maintaining the new index series as an input to setting long-term strategy for global investors.

New in the second edition

This version of the *Millennium Book* is substantially enlarged, compared to the initial edition. There are two major extensions to the coverage of the book; three completely new chapters and several that are radically revised; major additions to the country chapters in Part Two; and substantial enhancements and revisions throughout the volume.

The major extensions include three additional countries: Belgium, Ireland and Spain. The contributors of preliminary index histories for these markets are making available interim results, which are subject to later correction, and the final index estimates may vary from the provisional results presented here. Despite this, we feel that the added breadth from introducing additional markets further strengthens the appeal of the *Millennium Book*. The other major extension is the addition of exchange rates for all fifteen markets included in this study. This makes it possible to present some new insights and new perspectives on financial market history.

As noted above, there are three new chapters. The first is an evaluation of recent stock market history in the context of the long-run record (chapter 4). The second is a 101-year analysis of exchange rates and how they have impacted on financial market performance (chapter 8). The third is a detailed appraisal of what the historical risk premium can reveal about investors' expectations for the future (chapter 11). In addition, each of the individual country chapters in Part Two has been doubled in scope and size. For every country, we now provide extensive information about nominal and real returns on all asset categories, about the variability of asset returns, and about historical risk premia in the equity and bond markets. Other revisions include new material on the evolving attributes of our fifteen national markets (chapter 3), and discussions of topics such as index-linked bonds (chapter 7) and stock market seasonality (chapter 9).

In terms of enhancements and revisions, we have revisited the data from the first edition, and tightened up extensively on exposition. Amongst the data improvements, we have now acquired equity data for Japan for the troublesome period before the First World War; we have estimated Swiss bond returns for the first decade of our database; and we have revised our estimates of the impact of Germany's hyperinflation on investment returns. We are still looking for Swiss and Danish equity indices over the pre-WW1 period. In terms of exposition, we have given ourselves the opportunity to revise the entire volume in the light of comments received from readers and users over the past year. We will appreciate receiving further suggestions.

Acknowledgements

We received generous help and guidance from many colleagues. We are grateful to the staff at the Guildhall Library for their assistance in accessing historical documents. Within Part Two, we thank many individuals for contributing data on other countries. These academic researchers provided most of our index series for non-UK markets. We apologise for any omissions from our individual acknowledgements in Part Two. We also thank Bryan Taylor of Global Financial Data for supplementary data.

We are pleased to acknowledge our substantial debt to Mark Brown for his encouragement with the first edition of the *Millennium Book*, and Chris Johns for supporting this second edition and for his kind foreword. The book was again prepared by Polly Trotman at ABN AMRO, who continues to astonish us with her efficiency, unflappability and good humour. Finally, this book only saw the light of day because of the forbearance of family and friends, especially Helen and Steff, to whom we are truly appreciative.

Elroy Dimson

Paul Marsh

Mike Staunton

London Business School

PART ONE

Chapter 1 Introduction and Overview

As we enter the third millennium, investors have more cause than ever to ask where the markets are heading. What returns can be expected from equities, bonds and bills in different markets around the world? What are the risks of stock and bond market investment from the perspective of both domestic and international investors? And what are the likely long-term rewards?

Companies also need answers to these questions, to understand what returns their shareholders and bondholders require, and to ensure they raise and use capital to best effect. Similarly, these are crucial issues for governments, since market returns provide the yardsticks for judging the worth of public sector projects, and for raising and managing government debt. Regulators, too, need to know the cost of capital in order to set 'fair' rates of return for regulated industries.

It is difficult to form a judgement about future prospects or about required or "fair" rates of return without making comparisons with the past. Recent market returns are widely publicised. But it has hitherto been difficult to get a reliable impression of what investors have achieved over the long-term. Accurate historical records are available for the USA. However, America has had a remarkably successful economy. It would be dangerous for investors to extrapolate into the future from the US experience.

The purpose of this book is to provide investors with a comprehensive record of past investment returns around the world, and to help them understand the historical record, so they can make informed judgements about the future. It does this by providing a comprehensive record of the returns from equities, bonds and bills, as well as inflation rates and currency movements, in fifteen different countries over the whole of the last 101 years. Our data thus covers the whole of the 20th century, plus millennial year, 2000.

Assembling the data for this book was a major task. For the UK, we compiled our own authoritative record of UK equity market performance over the last 101 years. We did this because we were not satisfied with the data which previously existed, and there was anyway no comprehensive record of equity returns extending back to 1900. To construct our UK indices, we devoted intensive efforts to financial archaeology. This involved transcribing original source data from dusty newspaper archives and ancient reference books into our database. A resulting benefit is that we have not simply assembled an index, but we also have the underlying stock-by-stock data, so we can now study the performance of segments of the market, such as industry sectors and market-capitalisation bands. We have also compiled a series of UK government bond indices especially for this study.

For the other fourteen countries covered in this book, we have linked together the best quality indices and returns data available from previous studies and other sources, a number of which are previously unpublished, and some of which are still work in progress. In addition to the UK, we cover two North American markets, the United States and Canada; ten other European markets, namely Belgium, Denmark, France, Germany, Ireland, Italy, the Netherlands, Spain, Sweden and Switzerland; and two Asia-Pacific markets, Australia and Japan. Taken together, these fifteen countries make up over 87 percent of today's world market capitalization, and were also dominant at the start of the century. In each country we cover the same asset classes: equities, bonds, bills, inflation, and the local currency. We are therefore able to make comparisons between the investment performance of different asset classes, in different economic and political environments, while focusing on whichever time period is of interest.

Unlike most previous long-term studies of global markets, our investment returns all include reinvested income as well as capital gains. Our new indices are more representative than those used in any previous study, and cover a longer time span for a larger number of countries. Furthermore, the common start-date of 1900 facilitates cross-country comparisons. We can now set the US data alongside comparable 101-year series for the same asset classes for fourteen other countries, and make international comparisons that help set the US experience in perspective.

Measuring what has happened in the past is only the starting point for assessing the future. Interpretation of the data and being able to apply it to a modern-day canvas are as important. Throughout this book, therefore, our emphasis is not simply on describing the past, but also on interpreting what has happened, always with an eye to what it tells us about the future.

1.1 Overview

In **Chapter 2**, we begin by considering the guiding principles which we need to follow if we are accurately to measure long-term investment performance. Even with good index construction, an index is only as reliable as the underlying data and sample, so we also discuss the coverage of indices, both across securities and over time. We highlight the dangers of survivorship and success bias. Taking the UK as an example, we show how these biases have in the past exaggerated the historical attractiveness of investing in shares.

Turning to the international evidence, when making comparisons across markets there has been a reliance on index series for countries that have not experienced a break in trading. Even more marked, however, is the impact of initiating an index series after unrest, or wars and their aftermath have been resolved. We show that this "easy data bias", the tendency by researchers and index compilers to limit their research and indices to easily obtained data, has provided investors with a misleadingly favourable impression of long-term equity performance.

Our real story begins in **Chapter 3**. We start not at the beginning, but at the end of our 101 year period by looking at world markets as they stand today – their overall size and significance and the split between markets and countries. The world league tables presented in section 3.1 help set in perspective the importance of the fifteen Millennium Book countries covered in this study. We then look back to the beginning of our period to review what stock markets looked like 101 years ago, at the start of the 20th century, and at how, and why, they had evolved since their origins several centuries before.

Using the detailed stock-by-stock data which we have assembled for the UK, Chapter 3, then provides some informative snapshots of how the corporate landscape has changed over the last 101 years. In particular, our analysis of industrial composition reveals some major contrasts – and also some surprising similarities – between the structure of the UK equity market today and 101 years ago. We also consider how concentration levels have changed over time. We find that concentration has increased rapidly in recent years. However, on a longer-term view, markets have several times in the past been even more concentrated than today.

In **Chapter 4**, we begin our review of worldwide capital market performance by focussing on the very recent past, namely the performance of markets during millennial year. In the first edition of the Millennium Book, we presented and analysed data for the whole of the 20th century. In Chapter 4 we update this history by reviewing what has happened since then during the year 2000.

Millennial year will be remembered as a disappointing year for equities and more especially, as the year when the technology “bubble” burst. But while events during millennial year were endlessly fascinating, one of the main messages of Chapter 4 is that a single year is an inadequate basis for generalisation. In order to understand risk and return in the capital markets – which is the principal objective of this book – we need to examine much longer periods of history than just a single year, or even a decade.

The remainder of the book is devoted to precisely that, namely an examination of stocks, bonds, bills inflation and currencies over the last 101 years. In **Chapter 5** we provide an overview of international capital market history, focusing on our 101-year study of the UK and fourteen other markets. We quantify the impact of dividend income on the total return from UK equities. We examine the performance of the main asset classes in both real and nominal terms, and draw comparisons across our full sample of international capital markets. Real rates of return on equities have been higher than the return on government bills and bonds, but by a smaller margin than many investors have perceived. We also provide an indication of the relative risks of different assets in each market.

The next two chapters deal in turn with the returns from investing in short-term deposits (treasury bills) and long-term bonds. **Chapter 6** describes the

historical record on interest rates and inflation. **Chapter 7** presents the evidence on bond returns and bond maturity premia. We compare bond maturity premia across both different time periods and national markets. In these two chapters, we view the last 101 years through the lens of the financial markets. We see in the financial data all the turbulence of the past – inflation and hyperinflation, extreme periods when even bond and bill investors lost everything, deflation and the great depression, as well as two World Wars and their legacies.

For the international investor, currency movements matter, since investment returns need to be converted from the local currencies of the countries in which the portfolio is invested into the investor's own "home" reference currency. Exchange rate changes thus impact on performance, and are critical for measuring and comparing the returns from different countries. In **Chapter 8**, we report on the exchange rate fluctuations that were experienced by the fifteen Millennium Book countries over the course of the last 101 years.

Chapter 8 also examines the extent to which has held over the long-run. Purchasing power parity implies that goods and services will have a similar price experience in different countries, but this is a poor description of year-to-year foreign exchange fluctuations. Over the long-run, however, we find that changing relative price levels do tend to be reflected in changes in exchange rates, and that real exchange rates are relatively stable. Chapter 8 concludes by comparing the currency-adjusted returns on equities and bonds across our fifteen Millennium Book countries, and comparing these with the earlier rankings from Chapter 5 based on the real, inflation-adjusted returns within each country.

In **Chapter 9**, we return to the equity markets to focus on two particular aspects of equity investment, namely the effects of size and seasonality. Over the last twenty years, the size effect, or the tendency for smaller companies to outperform larger ones, has become the best documented stock market anomaly around the world. In Chapter 9, we review the international evidence, including the UK record based on the ABN AMRO/LBS indices for the UK. A frustrating feature of the size effect is that, soon after its discovery, the size premium went into reverse, with smaller companies subsequently underperforming their larger counterparts. We show that this reversal was also a worldwide phenomenon.

Chapter 9 also touches on stock market seasonality, providing a brief review of the various calendar-related anomalies that have been noted in the world's stock markets. While a fuller analysis of these anomalies is beyond the scope of this book, we have singled out just one for closer attention, namely the January effect. There are two reasons for this. First, of all the calendar anomalies, the January effect is by far the most important, and is more famous than all the others. Second, it is closely intertwined with the size effect, since in the US, the entire historical outperformance of smaller stocks is attributable to their returns in January. Intriguingly, however, when we seek

to replicate the US findings for the UK, we find no evidence of a size-based seasonal in January, or any other month.

Investment in equities over the 20th century has proved rewarding, but has been accompanied by correspondingly greater risks. In **Chapter 10**, we examine the risks of equity investment in more detail, as well as the historical rewards that investors have enjoyed for bearing this risk.

In particular, we measure the reward for risk which investors have received in the past. We do this by comparing the return on equities with the return from risk free investments. When measured over a sufficiently long period, the difference between these two returns is called the equity risk premium. In chapter 10 we use the new UK and international index series to provide evidence on the long-run magnitude of the equity risk premium, estimated relative to both bills and bonds. Our resultant risk premia are somewhat lower than those which have been reported in previous studies of UK and US stock market performance. The differences arise from previous biases in index construction (for the UK), and (for both countries) from the use of a rather longer time frame, extending back to 1900.

The equity risk premium is an extremely important economic variable. An estimate of the premium is central to projecting future investment returns, calculating the cost of equity capital for companies, valuing companies and shares, appraising capital investment projects and determining fair rates of return for regulated utilities. All of these applications require an estimate of the prospective risk premium, whereas, by definition, the only premium which we can measure is the historical risk premium. The prospective risk premium forms the subject of **Chapter 11**.

Many people argue that the historical risk premium, if measured over a long enough time span, gives an unbiased estimate of the prospective premium. We present evidence which suggests that academic experts typically subscribe to this view, and that their own forecasts are heavily influenced by the historical record. The research conducted for this book, however, leads us to question whether this is correct, and whether the historical risk premium really does provide a reasonable estimate of the prospective premium. Our belief is that historical equity returns have almost certainly exceeded investors' *ex ante* risk premium requirements, and also that the required risk premium has itself fallen over time. We use evidence from historical dividend growth to back up these assertions, and to suggest an alternative, rather lower, estimate of the future risk premium.

Finally, we speculate about what this implies for future equity returns as we embark upon the third millennium. We also consider the implications for the cost of capital and for real investment decisions, and express a concern that companies may themselves be seeking too high a rate of return, and if so, that they run the risk of under-investing.

We conclude in **Chapter 12** with a summary and some observations on further issues that can now be researched using the new ABN AMRO/LBS index series.

Part Two of the book commences with **chapter 13**. The subsequent fifteen chapters describe our database for each individual country, and provide some highlights of the research results for each individual market. We also explain our data sources and research methodology. This part of the book comprises one chapter for each country, listed alphabetically. We include a record of nominal and real (inflation adjusted) returns and of risk premia, estimated over a variety of recent and long-term intervals, and presented in both tabular and graphical formats.

Chapter 2 Measuring long-term returns

Good measures of long-run returns should accurately reflect the outcome of an implementable investment strategy. The strategy should be one that could have been set up in advance, followed in real life, and which is representative of the asset class and country in question. Unfortunately, many prior studies are seriously flawed because they fail to meet these criteria.

In this chapter, we begin in section 2.1 by setting out the general principles that need to be followed in constructing long-run returns. These provide a benchmark for assessing previous studies, and have been the guiding principles for this book. Given that our data goes back to the beginning of the last century and covers fifteen countries, we have not always been able to adhere to every principle, especially in earlier years. Nevertheless, these standards have guided our choices, and where compromises have been necessary, we indicate this.

Next, in section 2.2 we take a closer look at equity index construction, and at a pervasive bias that has afflicted prior studies. When an index is compiled retrospectively, a crucial issue is how to avoid tilting its composition towards companies that, with hindsight, are known to have survived and/or to have been successful. In section 2.3, we review some of the other issues that arise in index design, such as reinvestment of dividends, index coverage, and the methods used to weight constituent returns.

We apply these principles when we construct the new ABN AMRO/LBS index series for the UK. The procedure followed in compiling the UK index numbers is described in section 2.4. In section 2.5 we consider how best to assemble a sample of international indices. We show that reliance on data that is easy to acquire, such as indices that start after the end of a war, tends to result in overstated performance. Both success bias and easy-data bias arise from a focus on assets that have survived or prospered over a particular period, and both can lead to over-estimates of index returns and risk premia.

In section 2.6, we focus on the special problems that can arise when measuring inflation rates, as well as long-term returns on bonds, bills and currencies. We conclude in section 2.7.

2.1 Guidelines for measuring long-term returns

There are five guiding principles that underpin our measures of long-term performance. They are to avoid bias in index construction; to focus on total returns; to ensure the widest possible coverage within each market; to apply appropriate methods of weighting and averaging; and to maximise the extent to which comparisons can be made across national boundaries.

First, it is essential that equity indices should avoid bias. Good indices correspond to an investment strategy that could be followed in real life. Apart

from dealing costs, an index tracker should in principle be able to replicate index performance. Indices, especially when they are constructed retrospectively, must therefore be free of any look-ahead bias. That is, they must not be constructed using information that would have been unavailable at the time of investment. Serious biases can arise if index constituents are tilted towards companies that subsequently survived or became large, or towards sectors that later became important. Some biases can be quite subtle, as we discuss below.

Second, long-term returns must be total returns. Investment returns comprise income plus capital gains or losses. Ignoring either leads to serious bias. Yet many early equity indices measure just capital gains, ignoring dividends. Conversely, but equally seriously, early bond indices often recorded just yields, ignoring price movements. As we will see in the next chapter, the omission of dividends from stock returns imparts a huge cumulative downward bias. Similarly, estimating bond returns simply from promised yields would frequently have overstated achieved returns during the last 101 years, since bond investors have often been disappointed.

Third, equity indices need to be representative of their markets, and the ideal would be full coverage. In recent years our data meets or is close to this ideal for several countries, including the UK and USA. For earlier years, fully comprehensive indices simply do not exist for most countries. Our guiding principle has therefore been to select the available series with the best coverage. For the UK, no satisfactory series existed for 1900-54, and so we painstakingly constructed an index of the top 100 companies from original archive data. Collecting prices, dividends, capital changes and shares outstanding over 55 years proved a huge task, even for 100 companies, and hence our choice of 100 companies was partly dictated by pragmatism. Even so, our top 100 index covers over 60 percent by value of the UK market, and over the first part of the century, is arguably the best quality index in the world. Prior to the start of the US CRSP database in 1926, it provides measures of return that are superior in coverage even to the US indices.

Fourth, long-term return indices need to be computed using appropriate methods of weighting and averaging. While investors hold stocks in very different proportions, in aggregate all stocks are held in proportion to their market capitalisation. For an equity index to be fully representative, therefore, stock returns also need to be weighted by each company's market capitalisation. Virtually all the index series used in this study conform to this principle, although for earlier periods in a couple of countries, we have been forced to settle for equally weighted stock return indices (for details, see Part Two). The method of averaging stock returns also matters. Index returns over a particular holding period should be calculated using arithmetic averaging, since this measures the investors' true change in wealth. While certain older indices employ the inappropriate alternative of geometric averaging, all the series used in this book are based on arithmetic averaging.

Finally, we obviously wish to maximise the extent to which comparisons can be made across countries. In the past, researchers had emphasised the US experience, but it is dangerous to extrapolate from the remarkably successful US economy. That is why many students of the market have also examined the UK. But like the US, Britain has also had a relatively prosperous economy and may be non-typical. Hitherto, there has been insufficient evidence on the long-run performance of non-Anglo Saxon markets. To be sure, indices for other countries have been compiled for limited periods, but these are potentially misleading. For example, the stock market performance of Germany and Japan is known to have been good in the decades following the Second World War, but a focus on the post-war recovery flatters these markets. How are we to compare post-war returns in these countries with the longer record for the US or UK? Our final guiding principle is, therefore, to assemble as broad a cross-section of countries as possible, all with index series conforming to the four requirements outlined above. To facilitate comparisons, we also, where appropriate, convert all indices to a standard currency at the appropriate exchange rates.

2.2 Success bias in equity indices

Our first guiding principle above was the avoidance of bias. Unfortunately, many published index back-histories fail to meet this standard, and are exposed to both survivorship and success bias. This is because the back-histories are too often based on shares that were index members at the date the index went live. This leads to survivorship bias, whereby the back-history has an almost total absence of companies that had disappeared by the time the index was launched. It also leads to success bias, especially for indices that are designed to cover the largest stocks in the market, such as the top 30 or top 100. Success bias arises because the back-history has an over-representation of companies that grew large enough to enter the index, and an under-representation of companies that underperformed over the interval up to index launch.

Hitherto, the most widely used index for long-run performance of the UK stock market has been the de Zoete index, which underpinned various *Equity-Gilt Study* publications over the period from 1955 to 2000. These old index series contained misleading back-histories. We estimate that, from 1900 to 1954, the latter being the date when the first *Equity-Gilt Study* was published, real equity returns were just 3.8 percent per annum. Up to publication of the first edition of the *Millennium Book*, other UK studies estimated the real equity return for the 1919-54 period at 8.8 percent per annum. As we will see below, roughly half of this difference arose from upward bias in the *Equity-Gilt Study* back-history, while the balance was due to the different start dates. But the net effect was that real returns over the first half of the 20th century were much lower than most people had believed. Indeed, overestimation of the expected return on equity investment may have persuaded companies, regulators, and policymakers to set excessive required rates of return on risky investment.

The *Equity-Gilt Study* indices represented a significant advance at the time the original work was undertaken, on behalf of stockbrokers de Zoete & Gorton. Even then, however, it is noteworthy that London Business School's Professor Tony Merrett (1963, page 26) felt compelled to ask, "Why has the return on equities been so high?" Unfortunately, after starting his explanation with the observation that "the real return achieved by shareholders pre-war is seen to be remarkably high" he missed the possibility that the numbers might simply be wrong. Since that study was completed in the 1950s, however, researchers have become more aware of the dangers of survivor bias.

By replicating the construction of earlier index numbers using our own database (see section 2.4 below), we discovered that the biases in the *Equity-Gilt Study* arose partly from inappropriate adjustments for rights issues. Mostly, however, they arose from choosing index constituents with hindsight. By doing all they could to minimise turnover in index constituents, the original researchers had been able to assemble a record for a group of stocks whose composition rarely altered: only one constituent had been changed, on average, in each successive period of seven years. There were thus three main problems: survivor bias in shares that comprise the index; survivor bias in sectors; and poor representation of the target segment of the market within the index. In addition, the choice of start-date also had a significant impact.

The first source of bias was hindsight in share selection. The initial research had been completed in 1955, on a retrospective basis, and then updated annually by de Zoete & Gorton and successor companies. The index constituents were chosen to match, as closely as possible, the composition of the *Financial Times* Ordinary Share Index, which did not come into existence until 1935. The retrospective study incorporated companies that were important at the time the back-history was assembled. It therefore included companies that were to become large, but which had previously been much smaller. Not only did this lead to bias in index returns, but it generated a highly unrepresentative index. Especially before 1935, the *Equity-Gilt Study* index had too little exposure to under-performing companies, and too much exposure to companies that performed well.

A second, and closely related problem, was hindsight in sector selection. *Equity-Gilt Study* constituents were drawn from sectors that were important in the *FT* Ordinary Share Index. The index therefore covered only four out of 19 industry sectors from the *Stock Exchange Daily Official List*. Included companies are from the commercial and industrial; iron, coal and steel; brewers and distillers; and shipping sectors. At the beginning of the last century these sectors represented about 18 percent of the top 100 (FTSE 100 equivalent) index. The big sector then was railways (see section 3.4), and this was omitted (along with telegraphs, electricity, banks, insurance, etc).

A third source of bias arose from the non-representative nature of the stock index in the *Equity-Gilt Study*. The latter was restricted to only 30 shares, but

these were not the largest 30, even allowing for the sector biases. Index constituents were a curious mixture of a few very large companies, coupled with some quite small stocks. On average, five shares constituted two-thirds of the index' value, and three shares accounted for half its value. In one year, more than 40 percent of the index was invested in just one company, Imperial Tobacco, which in reality had less than a 7 percent market weighting that year. Thus in addition to being subject to serious bias, the *Equity-Gilt Study* index was dominated by just a handful of companies, making it too concentrated to represent the overall market.

Finally, the start date for the old *Equity-Gilt Study* was 1919, since the decision had been taken to start with data from after the First World War. This captured post-war performance, whilst omitting wartime losses. It is in fact possible to assemble an unbroken history of annual returns for 1900 through 1918. This was a lower-return, higher-inflation period, and its inclusion in the ABN AMRO/LBS index history considerably lowers the real return on equities over the first half of the 20th century.

As part of our research, we reconstructed the *Equity-Gilt Study* indices from the data we collected. This not only provided a check on the accuracy of our investigation, but also verified the computations undertaken in the mid-1950s by the EIU. In Table 1, we are therefore able to compare the original *Equity-Gilt Study* estimates for the performance of equities over the 1919-54 period, with our own figures for 1900-54:

Table 1: Comparison of pre-1955 returns with original Equity-Gilt Study

<i>Index calculation % pa</i>	<i>Nominal return</i>	<i>Real return</i>
<i>Original Equity-Gilt Study index return 1919–1954</i>	9.68	8.79
<i>Less Bias from incorrect rights-issue adjustment</i>	-0.37	-0.36
<i>Less Bias in choosing companies with hindsight</i>	-1.57	-1.56
<i>Less Bias from choosing sectors with hindsight</i>	-0.21	-0.20
<i>Less Bias from choosing only 30 shares</i>	-0.22	-0.22
<i>Less Impact from electing to start after WW1</i>	-1.12	-2.62
<i>Millennium Book estimate of index return 1900–1954</i>	6.19	3.83

Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

Contrary to popular belief, there is a marked difference between the returns achieved in the first and second halves of the period since 1900. Over the first half of the 20th century, asset returns were much lower, with an especially low relative return from equities. In the period from 1955, which coincidentally marks the end-date of the *Equity-Gilt Study* back-history, and the start-date of the authoritative London Share Price Database, returns are much higher, especially on equities. Since the first edition of the *Millennium Book* was published, Barclays Capital independently re-collected the *Equity-Gilt Study* back-history, starting in 1900 (see Bond and Adams, 2000). It is interesting to note that their results broadly confirm that the original *Equity-Gilt Study*

equity index was biased by the retrospective procedure used for index construction, as well as being affected by the start date of 1919.

As the ABN AMRO/LBS index history extends back to 1900, we can now reassess the long-term returns that investors have achieved from the UK market. The full record of returns for 1900-1954, 1955-2000 and the entire 101-year period is given in Table 2. The old *Equity-Gilt Study* numbers reported in Table 1 above indicated that equities gave a high annualised (ie, geometric mean) real return of 8.8 percent over the period 1919-54, very similar to the 8.2 percent reported in Table 2 below for the period since then. We noted above that the 8.8 percent figure for 1919-54 should really have been 6.4 percent after correcting for bias. But Table 2 shows that with a start-date of 1900, rather than 1919, the annualised real return was just 3.8 percent. Contrary to popular belief, real equity returns in the UK were much lower over the period 1900-54 than they have been subsequently.

Table 2: Annualised real returns for UK asset categories, 1900-2000

<i>Real return</i>	<i>1900-1954</i>	<i>1955-2000</i>	<i>1900-2000</i>
<i>Equities</i>	3.8	8.2	5.8
<i>Bonds</i>	0.6	2.1	1.3
<i>Bills</i>	0.3	1.9	1.0
<i>Inflation</i>	2.3	6.2	4.1

Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

The total return on equities, including reinvested dividends, over the 1900-1954 period is just under 4 percent in real terms. This is a low real rate of return. If it were to apply today, for example, it would imply an equity risk premium over inflation-linked government bonds of only two percentage points. As we discuss in Chapter 11 below, a risk premium of two percent is below the historical average premium that is cited by most market commentators.

The knowledge that the real return on equities over the first 55 years of this century was less than half the level that many had previously assumed suggests that we should now revise downwards our estimates of the all-important equity risk premium (see Chapter 10 and Chapter 11). This has important implications. The bad news is that some investors may find future stock market returns prove to be lower than they were expecting. The good news, however, is that today's high stock market levels can more easily be justified if we are prepared to assume that the expected future risk premium is closer to that experienced in the first half of the 20th century.

2.3 Dividends, coverage and weightings

Stock market indices have for some time been available for measuring the performance of the London Stock Exchange during the 19th, as well as the 20th,

centuries. Unfortunately these are, almost without exception, indices of capital appreciation. The FT-Actuaries All Share index, introduced in 1962, provides only an approximate record of the dividends on UK shares. It was for many years well known that *the income yield for the FT-Actuaries All Share relates partly to payments announced and not yet paid, and may not make allowance for increased interim dividends. Consequently income figures derived from the index are necessarily approximate*" (Roden, 1983).

Despite the importance of reinvested dividends, index producers were slow to introduce return indices. FTSE International, for example, did not publish total return indices until 1993. Fortunately, our UK data is not reliant on commercial sources, since we have computed total returns from original stock-level dividend and price data. Similarly, our UK bond indices are constructed from detailed bond-level price and coupon data. For other countries, we have, where possible, utilised similar series prepared in the same way by academic researchers. For the early years of the 20th century, however, total equity returns for some countries have been estimated by combining capital gains with published dividend yields. While this provides good estimates when the yield relates to the constituents of the capital gains index, in a few cases we have been forced to use yields which are not strictly matching (for details, see Part Two).

In terms of coverage, we have systematically favoured broader over more narrow indices. In the next section, we describe the design features of our own, specially constructed indices for the UK. For equities we have sought to cover as large a proportion as possible, and for much of the period all, of the equities listed on the stock exchange. For bonds, too, we base our UK indices on a portfolio of eligible government bonds, where this is possible. The decision process for other countries involves choosing the best equity index in each country, tracking this index forward from the beginning of the last century, and switching to a superior index as and when a suitable series is initiated. The criterion for superiority is, naturally, based on the accuracy of price and dividend figures; but additionally, we favour broader and more comprehensive indices, as they become available.

Our index calculations are based on end-of-year index levels, unless there is no choice but to use a time-averaged or intra-year index value. On the occasions this has been necessary, it is highlighted in the documentation in Part Two. As explained earlier, we also emphasise appropriate methods of index weighting and averaging. Within each market, our indices are wherever possible weighted by market capitalisation and averaged arithmetically. Nevertheless, it should be noted that, in the early years of the last century, value weighted indices were comparatively rare, and for a number of countries the index series commence with an equally weighted design.

In more recent years, virtually all index compilers have weighted their indices by the constituent companies' full market capitalisations, even though this

may overstate the proportion of the equity which is available for trading, i.e. the “free float”. More recently, concerns have been raised over cross-holdings and hence double-counting, as well as possible market distortions that might arise from index funds seeking full market capitalisation weightings in companies with low free floats. This is causing many index compilers to switch over to weighting by a measure of free equity, and our index series will reflect these developments.

A related issue is the procedure used for averaging returns across markets. If we wish to take a global perspective on equity market performance, we cannot simply average index returns. Annual index returns are denominated in a variety of currencies, are subject to inflation rates that differ internationally, and experience timing differences. We therefore calculate global equity returns from a global equity index. In principle, we would wish this to be in a common currency, and weighted by the market capitalisation of each country’s stock market as at the start of each year. In practice, for all but recent decades, we do not have national market capitalisations – at least, not yet. We approximate market capitalisations by using weights based on each of our fifteen countries’ gross domestic products (GDPs) until 1979, switching in 1980 to weights based on their market capitalisations.

The process for constructing a global index is, therefore, as follows. For each year we take a market’s local-currency return, and convert it to a common currency such as sterling. We therefore have the return that would have been received by, say, a UK citizen who bought foreign currency at the start of a year, invested it in the foreign market for one year, liquidated his or her position, and converted the proceeds back at the year-end into UK pounds. We assume that at the beginning of each year our investor bought a portfolio of fifteen such positions in each of the Millennium Book countries, weighting each country by its GDP or (from 1980) by its market capitalisation.

This strategy provides us with a portfolio return for each year from 1900 through 2000. We then link this sequence of returns, to give an index expressed in common currency, for example in nominal British pounds. To convert this to real terms, we then adjust for the appropriate inflation rate, in this case UK inflation. This gives rise to a global index return denominated in real terms, from the point of view of, say, our UK investor. Note that for bond markets, it is not clear that there is a rationale for departing from a simple, unweighted average, so our global index construction process relates essentially to equity index market computations only.

2.4 The ABN AMRO/LBS indices for the UK

For the United Kingdom, it was clear that there was a need for a long and consistently compiled equity return series. We therefore created a new index that adheres to the guidelines presented in section 2.1. The basis for our study of the UK market is a database that comprises two elements. To compile share prices for the period starting in 1955, we use the fully

representative record of equity prices maintained by London Business School. This database covers several thousand shares, and is described in Dimson and Marsh (1983). The London Share Price Database (the LSPD) provides reliable measures of stock market returns, which cover most of the second half of the century. We refer the reader to our recent article in the *Journal of Business* (Dimson and Marsh, 2001) for details on our comprehensive UK index histories for the period from 1955 to date.

The period from 1899 to 1954 presented a rather different challenge. Rather than accepting a standard back-history at face value, we took on the painstaking process of collecting share prices from old issues of the *Financial Times* from 1899 onwards. This enabled us to calculate an index of the returns from the top 100 companies over the period from New Year 1900 to the end of 1954. The companies that enter the ABN AMRO/LBS Equity Index are included without reference to whether or not they survive after entering the index. The ABN AMRO/LBS Index resembles the FTSE 100 in its method of construction. Our new value-weighted equity index contains the 100 companies that, prior to the start of each year, have the largest market capitalisation for their ordinary or deferred shares. For the entire 101 years, we follow the same criteria for index membership: inclusion of UK companies with ordinary or deferred shares, and omission of companies with non-UK registration/head office. We exclude preference shares.

The first stage was to identify a list of shares that were eligible for investment. To avoid any upward returns bias, this had to be a set of firms that existed at each point in time, and which had not been screened for subsequent survival. Our definition of the companies eligible for inclusion was based on those with stock prices published in the *Financial Times* (*FT*) for 1899-1954, and in the *Stock Exchange Daily Official List* (*SEDOL*) for 1955-99.

For the earlier period, we constructed a cross-section of all shares with prices quoted in the *FT* on the last trading day of 1899, 1909, 1918, 1927, 1936 and 1945. Despite omission from the end-1899 and end-1909 *FTs*, the banking and insurance sectors were included (based on *SEDOL* prices) since these sectors appeared regularly (though not daily) in the *FT*. Note also that in 1899 and 1909 smaller mining shares were excluded. The number of shares in our pre-1955 cross-section rose from 247 in 1899 (when *SEDOL* contained 783 shares) to 604 in 1954 (when *SEDOL* contained 3789 shares). Compared to the full list of companies in *SEDOL*, our sample covers a minority by number but a substantial majority by value of all quoted companies.

Share prices before 1955 were taken as the average of bid and offer prices for the last trading day of the year as quoted in the *FT*. Very occasionally, where necessary, other prices were taken from *SEDOL*. Year-end prices for 1914 were taken from 4th January 1915, the first day of trading after the closure of the Stock Exchange following the outbreak of World War 1. From 1955 onwards, our database is the LSPD, which provides full monthly share price and ancillary information taken from *SEDOL*, Exshare and other sources.

The share capital of index constituents was checked against the annual *Stock Exchange Official Yearbook* throughout the period up to 1955, to account for bonus and rights issues as well as other issues (typically acquisitions). The timing of rights issues and nearly all bonus issues was identified to the specific month. Market capitalisations were calculated as the product of number of shares and market price. Typically, ordinary and 'A' ordinary shares (with similar share prices) were combined, while with two different classes of ordinary shares (e.g., certain banks and insurance companies) the one with the larger market capitalisation was chosen.

The next step was to identify index constituents without imposing any "look-ahead" bias. To do this, each cross-section of shares is ranked by market capitalisation and the top 100 companies are chosen to comprise the initial index constituents. In addition, a reserve list of additional companies is compiled at the same time. The reserve list is sufficiently large that index constituents can be replaced without compromising the desire to start each year with 100 constituents for the index. Thus, for example, sufficient shares were chosen at end-1899 to ensure that no less than 100 companies would be available for index constituents in 1900, 1901, and so on.

Obviously, constituents do need to be replaced. Replacement is necessary when an index constituent is acquired or nationalised, converts its ordinary or deferred shares into preferred or preference shares or, occasionally, when its share price disappears from the *FT* and *SEDOL*. The replacement company is the acquiring company (if eligible and not an index constituent) or the reserve-list company with the highest market capitalisation at the end of the year of acquisition.

Prior to 1955, all cash flows are assumed to occur at the end of each year, including dividends, special dividends, returns of capital, and cash from acquisitions. Where companies are acquired for shares, or when they merge during the year, we base returns on the end-year share price of the acquirer or merged entity, taking account of the exchange ratio. Prior to 1955, the primary source of information regarding dividend cash flows was *the Stock Exchange Ten-Year Record* published by Mathiesons. After 1955, monthly data from the LSPD is used, and dividends are assumed to be reinvested at the end of the ex-dividend month, while cash from acquisitions etc. is reinvested at the end of the month the acquisition is consummated.

Returns are calculated in three ways: raw price movements, capital returns and total returns including reinvested dividends. The price returns reflect annual price changes, adjusted for bonus issues and rights issues (in the latter case using the standard LSPD adjustment with sufficient rights sold to take up the remaining rights). Capital returns add returns of capital (such as special dividends, the distribution of shares in other companies and the distribution of non-ordinary shares as a bonus to ordinary shareholders) to the price returns. Total returns add income returns (dividends received during the

year) to the capital returns. We report both capital returns (i.e., capital appreciation or loss) and total returns, including reinvested income.

A benefit of our bottom-up approach to creating a UK equity index is that we are now able to study the performance of segments of the market that are of interest. Industry sectors and market-capitalisation bands, for example, can now be investigated. We can also look at secular trends in market concentration, and at the risks of investing in ordinary shares. In addition to equities, our study also covers investment in government bonds, short-term deposits such as treasury bills, inflation and currencies. Our bond index, in particular, has been specially compiled for this study.

2.5 Easy-data bias in international indices

Our final guideline in section 2.1 was to maximise the scope for making cross-country comparisons. Previous researchers had adopted one of two solutions to the problem of international comparisons. Ibbotson Associates, among others, measure international risk premia using a modern series of indices with a common start date. They select the Morgan Stanley Capital International indices, most of which commence in 1970, as the basis for their estimates of non-US equity risk premia. This is a rather brief period, and it tends to overestimate equity premia. Jeremy Siegel follows this option in his best-selling book, *Stocks for the Long Run*, though he also brings in longer measurement intervals by adding Germany and Japan to his sample over the post-1925 period. Similarly, Philippe Jorion and William Goetzmann, in their widely cited *Journal of Finance* article, identify only four non-Anglo Saxon markets with pre-1970 dividend information, and none of these series commence earlier than the 1920s. The influential work of Ibbotson and others has thereby inspired researchers in other countries to emulate their American colleagues, and there are therefore a growing number of single-country studies of long-term stock market returns.

This provides a special opportunity to undertake a comparison across national stock markets. In addition to the UK we cover ten European markets, two North American markets, and two Asia-Pacific markets. We are therefore able to make comparisons between investment performance in different economic and political environments, while focusing on whichever time period is of interest. Our cross-country database covers the performance of stocks, bonds, bills, inflation and currencies across fifteen countries. Drawing on supplementary data sources, we are able to cover the whole of the period from 1900 to date, for almost all the main asset categories, in all fifteen markets. In this way, we have some 1500 observations of annual market returns for each of five asset categories. Our data series are therefore remarkably comprehensive. As the following table makes clear, for 73 out of 75 asset/market combinations, we are able to estimate total returns for all of the last 101 years:

Table 3: Period covered for each asset category (✓ denotes 101 years of data)

Country	Equities	Bonds	Bills	Inflation	Currency
Australia	✓	✓	✓	✓	✓
Belgium	✓	✓	✓	✓	✓
Canada	✓	✓	✓	✓	✓
Denmark	From 1915	✓	✓	✓	✓
France	✓	✓	✓	✓	✓
Germany	✓	✓	✓	✓	✓
Ireland	✓	✓	✓	✓	✓
Italy	✓	✓	✓	✓	✓
Japan	✓	✓	✓	✓	✓
Netherlands	✓	✓	✓	✓	✓
Spain	✓	✓	✓	✓	✓
Sweden	✓	✓	✓	✓	✓
Switzerland	From 1911	✓	✓	✓	✓
UK	✓	✓	✓	✓	✓
USA	✓	✓	✓	✓	✓

Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

An issue that has achieved prominence is the impact of market survival on estimated long-run returns. Markets can experience not only disappointing performance, but also total loss of value through confiscation, hyperinflation, nationalisation, and market failure. By measuring the performance of markets that survive over long intervals, we draw inferences that are conditioned on survival. Yet, as pointed out by Brown, Goetzmann and Ross (1995) and Jorion and Goetzmann (1999), one cannot determine in advance which markets will survive and which will perish.

The danger arises if long-term return measures are based only on surviving markets, while other markets, which at some point failed to survive or experienced total losses – Russia, China, Poland and so on – get omitted from the record. If markets that experienced returns of -100% are left out, this inevitably inflates our estimates of long-run average returns and risk premia. But how important is the bias introduced from focusing on markets that survive? The jury is still out, but the risk of market failure looks increasingly inadequate as a full explanation for the high *ex post* returns to equity investment. Evidence for this includes Li and Xu (2000) and several other studies.

We believe there is an additional explanation for the high returns that have been recorded for the major markets. Typically, researchers have used data that is relatively easy to obtain, which tends to be flattering to stock market history. In consequence, equity returns have tended to be overstated. The long-run return series compiled for this book provide an insight into the consequences of researchers focusing on data that is easy to acquire.

Compared to our 101-year index series, the following table compares the performance of equities with the returns indicated by the start-dates of various commercial studies. (For comparability, we use the data analysed in the *Millennium Book* for computing all returns.) Compared with the early base date selected here for all countries, previous studies tend to start their index history at a convenient date. Long-run performance can easily be overstated.

Table 4: Annualised real equity return based on period used in prior studies

Country	Previous study*	Previous study		This study		Difference % p.a.
		Period	Real return	Period	Real return	
Australia	ASX	1974-	7.4	1900-	7.5	-0.0
Belgium	Ibbotson	1970-	7.4	1900-	2.6	4.8
Canada	FARF	1950-	7.0	1900-	6.4	0.6
Denmark	Ibbotson	1970-	7.9	1915-	5.2	2.7
France	Barclays	1951-	9.1	1900-	3.9	5.2
Germany	Barclays	1952-	8.5	1900-	3.6	4.9
Ireland	Ibbotson	1988-	14.6	1900-	5.6	9.0
Italy	Ibbotson	1978-	11.2	1900-	2.7	8.5
Japan	Ibbotson-Hamao	1971-	4.8	1900-	4.6	0.2
Netherlands	Barclays	1947-	9.0	1900-	5.8	4.2
Spain	Ibbotson	1976-	4.8	1900-	4.5	0.3
Sweden	Ibbotson	1970-	10.7	1900-	8.0	2.7
Switzerland	Pictet	1926-	6.2	1911-	5.0	1.2
UK	Barclays	1919-	7.4	1900-	5.8	1.6
USA	Ibbotson	1926-	7.4	1900-	6.7	0.7

* The previous studies are from the Ibbotson *Yearbooks*, Ibbotson *Equity Risk Premia Reports*, BZW/Barclays, *Equity-Bond Studies*, Pictet and the Financial Analysts Research Foundation. For one market we use an index that underpins a published study. References are contained within Dimson and Marsh (2001)

Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

On average, the start-dates of the fifteen previous studies of long-run returns, listed in Table 4 indicate long-run equity market performance that is overstated by more than three percentage points. As explained in Part Two, some of these studies may also have upward-biased estimates of return because of success bias within a national market. However, the principal source of the difference in the equity returns reported above appears more to do with the researchers' focus on easy data.

Easy-data bias arises from researchers' preference for data that are not obfuscated by 'unusual' events such as war or government default, are based on good quality price and income information, do not suffer from trading halts, and are produced on a continuing basis. Easy-data preferences explain why (until publication of the *Millennium Book*) equity-gilt studies in the UK started at the end of 1918, in the Netherlands in 1947, in Germany in 1952, and in Japan in 1971. They also explain the focus of services that select as their start-date the birth in 1970 of the Morgan Stanley Capital International

database. For the UK we demonstrated earlier (Table 1) that if the focus is on capital market history since 1900, easy-data bias contributes even more to overstated real equity returns than success bias. In this section, we have shown that easy-data bias is endemic.

The international index series utilised and reported in this book have extensive coverage and (wherever feasible) a common start date. This mitigates, but does not remove, easy-data bias from our long-run return study. Our estimates of long run returns are still likely to be upward biased as an estimate of investment returns around the world. This is in part because we restrict our study to the countries for which we are able to estimate total return, and our own work, too, is therefore exposed to potential easy-data bias. In addition, as we document in Part Two, the data for some of our chosen markets has been compiled partly on a retrospective basis. Finally, we should point out that studying the entire period since 1900 – though by no means particularly easy – is easier than starting at a still earlier date. Since last year, we have become aware of several new initiatives in this direction, but we do not know what results will be obtained from new studies of 19th century security prices in non-Anglo Saxon stock markets.

2.6 Measuring inflation and fixed-income returns

Most of the guiding principles listed in section 2.1 above extend beyond equity indices to the measurement of inflation and bill and bond returns. In addition, however, there are some further considerations that apply.

The measurement of inflation is an interesting case in point. In the UK, the government first introduced a Cost of Living Index in 1914. Before then, inflation was measured by a price index based on a handful of staples. Even the 1914 index contained just 14 items, regarded as essentials for the “working class”, such as candles, corset lacing and mangles. In 1947, it was superseded by the 80-item Retail Price Index, but still focussed on working class essentials, such as unskinned rabbits and tram fares. Today’s index includes over 600 items, including internet subscriptions and mobile phones. The development of the US consumer price indices (CPI) is similar. The number of items on which the CPI is based has also grown steadily over time. Until 1978, it related to “urban wage earners and clerical workers”, although since then, the new CPI-U covers “all urban consumers”.

Inflation indices quantify price changes, but cannot easily measure changes in productivity and quality. For example, improvements in the quality of UK restaurant meals have outstripped the costs of eating out. Similarly, monitoring computer prices over time gives no guide to the large increases in capacity and capability that have taken place. Several US researchers have argued that this leads consumer price indices to overstate inflation by as much as one percent per annum. While we should bear such caveats in mind, we have little alternative but to use the published measures. At least for the last fifty years or so, these measure consumer price changes fairly well.

Treasury bills are a very simple instrument, and it is straightforward to measure their returns. The only problem that arises here is that they have not always existed in every country that we cover. When this is the case, we adopt the closest equivalent we can find, namely a measure of the short-term interest rate, with minimal credit risk.

For government bond indices, coverage and weighting matter less than for equities, but issues such as maturity, coupon, callability and tax assume special importance. Once a bond index's target maturity has been chosen, the efficiency of the bond markets is such that the prices of all bonds with that maturity will tend to move together, apart from issues relating to coupon, callability and tax. Bond indices are thus usually equally weighted, with constituents chosen to fall within the desired maturity range. In some countries, taxation considerations matter, and we explain in Chapter 7 how this affects which bonds qualify for entry to the ABN AMRO/LBS UK bond indices. Tax considerations relating to the bond indices used for other countries are outlined in the references in the country chapters in Part Two.

2.7 Summary

In this chapter, we have set out the criteria that need to be met by equity and bond indices. The five guiding principles are avoiding bias; focusing on total returns; obtaining good coverage; applying correct methods of weighting and averaging; and maximising the scope for international comparisons. Good measures of long-run returns should accurately reflect the outcome of an investment strategy that could have been set up in advance, followed in real life, and which is representative of the asset class and country in question.

Not all prior studies have adhered to these principles. In particular, before publication of the *Millennium Book*, the previously best-known alternative study cited the real return on shares from 1919-54 as 8.8 percent. In fact, the real return on UK equities over 1900-54 was just 3.8 percent. The discrepancy arose because the index was unrepresentative; subject to survivorship bias; and backdated only to the end of World War 1. Survivorship bias arose because the pre-1935 back-history was based on companies that were large in 1935, and which had therefore tended to outperform in earlier years. The fact that the real return on equities over the first 55 years of the last century was much less than many had previously assumed means that we should now revise downwards our estimates of the equity risk premium (see Chapter 11).

Finally, we highlighted the prevalence, and dangers of, easy data bias. This refers to the tendency of researchers to use data which is easy to obtain, excludes difficult periods such as wars and their aftermath, and typically relates to later periods. We identify fifteen standard sources, one for each country, and show that the equity returns over the periods they cover are higher than the returns over the last 101 years by an average of three percent per year. Easy data bias has undoubtedly led investors to believe that equity returns over this period were higher than was really the case.