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Risk and Return in the 20th and 21st Centuries

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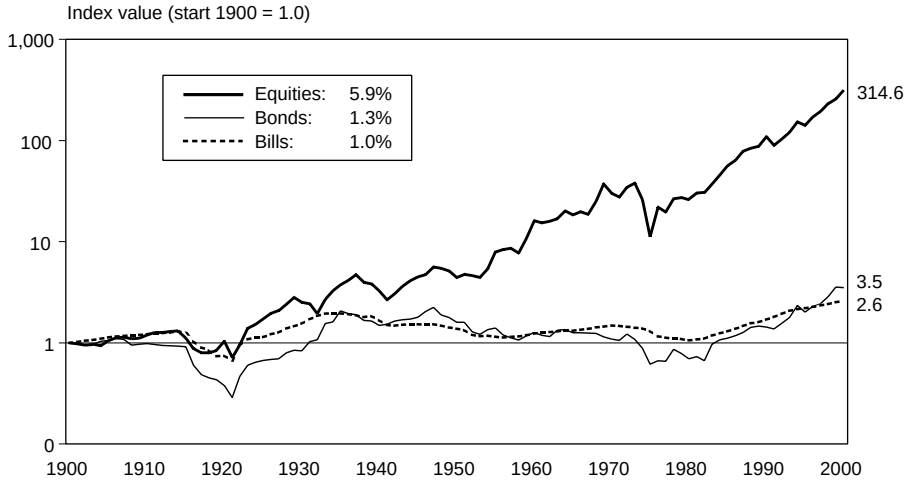
The single most important contemporary issue in finance is the equity risk premium. This drives future equity returns, and is the key determinant of the cost of capital. The risk premium – the expected reward for bearing the risk of investing in equities, rather than in low-risk investments such as bills or bonds – is usually estimated from historical data. This article starts by summarising new evidence on historical returns in twelve major world markets from the authors' recent book, "The Millennium Book: A Century of Investment Returns". The authors show that the historical equity risk premium has been lower than previously believed, and argue that the future risk premium is likely to be lower still. They discuss what this implies for the cost of capital, stock market values, and companies' target rates of return. They suggest that many companies are seeking too high a rate of return and thus run the risk of under-investing.

Today, investors have more cause than ever to ask where the markets are heading. What returns can be expected from equities? How might bonds be expected to perform? What are the risks of stock market investment? And what are the 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.

The recent equity bull run has few, if any, parallels in the 20th century. This makes a long-term perspective on market returns more important than ever before. Measuring what has happened in the past is the starting point for assessing the future. Interpretation of the data and being able to apply it to a modern-day canvas are just as important. But without good quality, consistent data the whole process falls at the first hurdle. In this article we use new indices which we compiled for our recent book, *The Millennium Book: A Century of Investment Returns*. These indices measure the returns on equities, long-term government bonds, treasury bills (short-term risk-free deposits) and inflation in twelve countries over the entire 20th century. Taken together, these twelve countries make up 90% of today's world market capitalisation. Our new indices are more representative than those used

Figure 1
Real returns on UK equities, bonds and bills, 1900-2000



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

in any previous study, and cover a longer time span for a larger number of countries.

The article starts by summarising the main findings about long-term investment returns based on our new index series. These findings challenge some of the accepted beliefs about long-term returns. One notable conclusion is that for much of the 20th century, the risks of equity investment were higher and the rewards lower than is suggested either by past studies or by recent market performance statistics.

Using the findings from *The Millennium Book*, we then focus on the all-important issue of the equity risk premium. We explain why the size of the risk premium is the single most important contemporary issue in finance. We use *The Millennium Book* data to show what the historical risk premium has been in different world markets, and that this, too, has been lower than previously estimated.

We then turn to the future and discuss what the historical risk premium tells us about the future risk premium, and hence the cost of capital. Finally, we speculate about likely future market returns, whether current stock market valuations can be justified, and whether companies are setting excessively high target rates of return, and hence may be under-investing.

Main Findings of *The Millennium Book*

The key findings of the research published in *The Millennium Book* were:

- Equities were the best performing asset class in all twelve countries.
- Equities had highest risk.
- Inflation was a major force in the 20th century.
- Bonds proved a disappointing investment over the 20th century.
- Although equities performed best, equity returns were lower than previous studies have suggested.

Our research approach is summarised in the Appendix.

Equities were the best performers

In every country, equities proved to be the best performing investment over the 20th century. In the UK, £1 invested in the equity market at the end of 1899 would have grown to £16,946 by the start of 2000, before investors' taxes and dealing costs, and with dividends reinvested. This represents an annualised return of 10.2%. Over this same period, UK inflation averaged 4.1%, and so in real terms, equities provided an annualised real return of 5.9%. Figure 1 compares the inflation-adjusted performance of equities with that of bonds and bills. It shows that £1 invested in equities at the start of the 20th century grew to nearly £315 in terms of equivalent purchasing power (ie, a real return of 5.9% pa) by the start of 2000. This compares with just £3.5 for bonds (a real return of 1.3% pa) and £2.6 for bills (a real return of 1.0% pa).

Figure 2 shows annualised real equity and real bond returns over the 20th century for all twelve countries

in our study. There are noticeable variations across countries, with some national markets having provided strikingly good real equity returns, while others turned in more modest results. The worst performing equity market was Italy, with a real return of 2.7% pa, while the best was Sweden, with a real return of 8.2% pa. The average real return across all twelve markets was 5.6%, as shown by the left-hand bar of the paired bars labelled 'AVG' in figure 2.

Figure 2 shows that, despite the variation across countries, equity market returns were ahead of inflation in all twelve countries, including those that experienced major dislocations from wars and economic turmoil. Similarly, figure 2 shows that equities outperformed bonds by a considerable margin in every country.

Equities had highest risk

Although equities gave the highest return in every country, the returns from shares were far more volatile, and hence riskier, than for bonds or short-term deposits. Indeed, equity investors have at times faced large losses. In October 1987, US shares fell 23% in one day, and the crash echoed around the world with even larger one-day losses in some markets. Following the legendary Wall Street Crash in 1929, shares fell 60% in real terms over 1929-31. More recently, in 1973-74, UK investors suffered a still greater loss of 71% in real terms. But the largest losses recorded in our study were in Germany and Japan at the end of World War II, with real returns of –91% in Germany (1945-48), and –97% in Japan (1944-47).

The risk of an investment is usually measured by its volatility (standard deviation) of returns. Assuming investment returns are approximately normally distributed, an investment with a standard deviation of 10% would be one where, in about one year in six, the return was likely to underperform expectations by 10% or more, and vice versa. The volatility (standard deviation) of real equity returns in the UK over the 20th century was 20% pa. This compares with a 14.6% standard deviation for UK bonds and 6.6% for bills. This ranking was common across the world. In every country, equities proved more volatile than bonds, while bonds were more risky than bills.

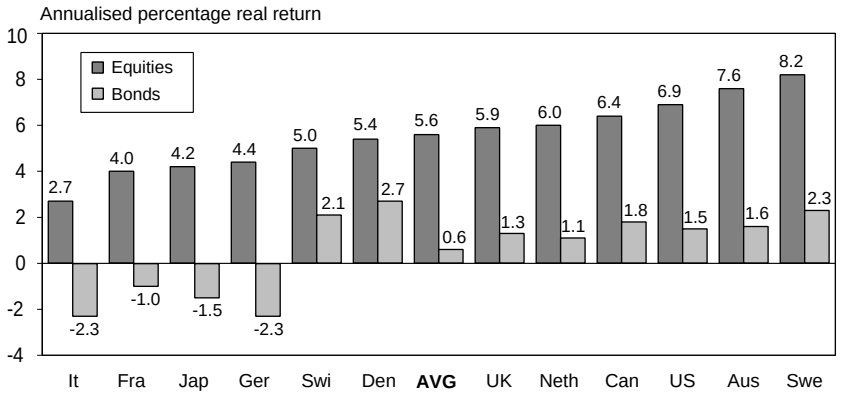
During the 20th century, the UK stock market was less volatile than most others. The average volatility (standard deviation) for the twelve countries was 23%. Germany, Japan and Italy had the highest volatilities; only Australia and Canada were lower than the UK.

Inflation was a major force in the 20th century

UK inflation averaged 4.1% pa over the 20th century. £1 in 1900 had the same purchasing power as £54 today. But while the UK may view itself as having been afflicted by inflation, it was in fact slightly below average for the 20th century taken as a whole. The average inflation rate for all twelve countries was 4.8% pa.

This average figure, however, hides considerable variation across countries. The extreme case was German hyperinflation in 1922/3, which ran at an annual percentage rate in the billions. Three other countries experienced very high inflation around the end of World War II: 344% in Italy in 1944, 317% in Japan in 1946, and 74% in France in 1946.

Figure 2
Real returns on world equity and bond markets, 1900-2000



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

All countries also experienced deflation at some time during the 1920s and early 1930s. UK retail prices rose from £1 in 1900 to £3.13 in 1920, then fell to £1.66 by 1933, and did not regain their 1920 level until 1952.

Inflation and a number of other variables in our study have shown some tendency to regress towards the mean. For example, after being the highest inflation country in the first half-century, Germany enjoyed the lowest rate (2.8%) in the second half (see figure 3). In contrast, the UK had low inflation (2.0%) in the first half century, because the years of higher inflation were partially offset by the deflationary period in the twenties and early thirties. However, in the second half-century, it had the second-highest inflation (after Italy): 6.2% pa from 1950-99, peaking at 25% in 1975.

Bonds proved a disappointing investment

High and unexpected levels of inflation ensured that the 20th century was not the century for bond investors. In the UK, long-term government bonds (gilts) provided a disappointing return of 5.4% pa, or just 1.3% after inflation of 4.1% pa. Risk-free short-dated treasury bills returned 5.1%, or just 1.0% pa in real terms (see figure 1 above).

UK bill and bond returns were around the median of the twelve countries in our study. Four countries – Germany, Japan, Italy and France – experienced negative real returns on both bonds and bills over the 20th century taken as a whole.

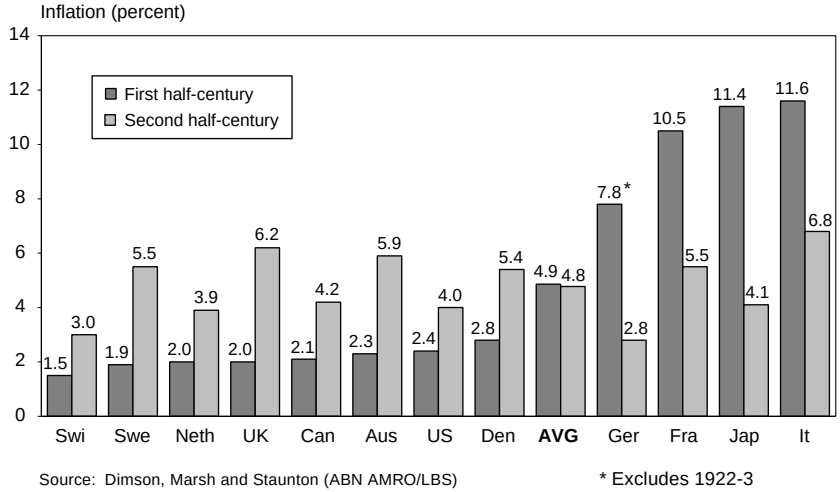
Across all 12 countries, the average real bond return was 0.6% pa, while the bond maturity premium (the difference between long-bond returns and the short-term interest rate) was also 0.6%. Since investment in long bonds is much riskier than investment in short-term deposits, especially at times of high or uncertain inflation, a maturity premium of just 0.6% appears low for the incremental risks involved. It seems highly likely, therefore, that in many markets the returns on bonds fell short of investors' expectations because inflation proved to be higher and more volatile than expected.

The most extreme example of this was naturally during a period of hyperinflation. In 1922/3, German investors who held bonds or even short-term deposits lost everything, reminding us that, although we normally regard government bills as risk-free, and bonds as lower risk than equities, there can be extreme circumstances where this ceases to be true. Over 1922/3, *The Millennium Book* reveals that the real return on German equities was 13%.

Interestingly, the four countries which experienced the lowest bond returns due to high inflation during the first half of the 20th century – Germany, Japan, Italy and France – were amongst the best-performing bond markets over the most recent 50 years (see figure 4). For these countries, bond prices at the mid-point of the century had reflected an expectation of continuing debasement of the domestic currency. Post-war control of inflation typically provided a boost to bond market returns.

Financial market returns thus reflect the turbulence of the 20th century. Through the lens of the markets, we can see the decimating impact of wars and their aftermath, inflation, high interest rates, stock market

Figure 3
International inflation: first *versus* second half of 20th century



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

* Excludes 1922-3

crashes and the great depression. These events have impacted not only on investment returns, but also on the volatility of the financial markets.

Equity returns were lower than previously believed

Although equities performed best in every country, equity returns over the 20th century proved somewhat lower than has previously been believed. There are two main reasons for this. First, several previous studies have over-estimated equity returns by placing reliance on indices constructed using hindsight. Second, most previous studies have focussed on data that was easy to collect, typically taken from the second half-century, when equities performed especially well.

Focusing first on the problem of hindsight, we have taken great pains in *The Millennium Book* to avoid hindsight in the construction of our new indices. Previous research, however, is not always hindsight free. Some researchers have compiled indices based only on surviving or successful companies or industries, and this has led them to overstate equity performance. Within the British stock market one illustration is the omission, from a standard equity index back-history, of the entire railway sector, which in 1900 represented over one third of the entire value of the UK equity market. At the start of the 20th century, investors could not have known that railway stocks were destined to disappear from the market.

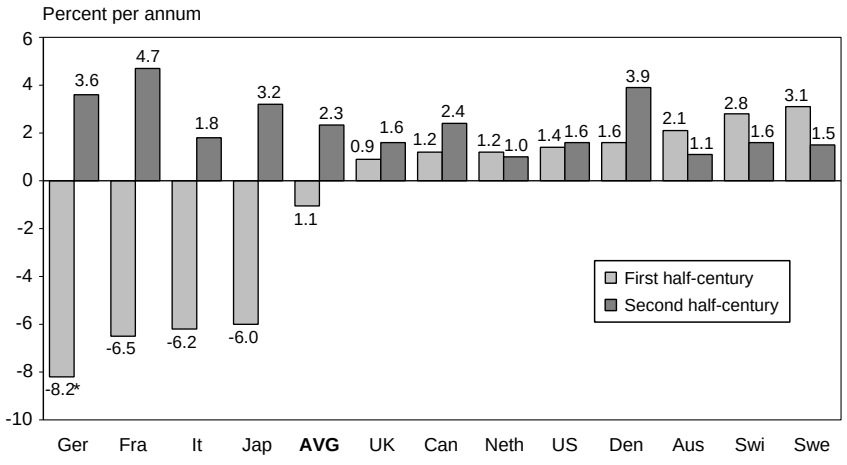
In the UK, the standard reference work on long-run UK equity returns has been the BZW equity index (see Barclays Capital, 1999, and CSFB, 1999), which covers the period from 1919 onwards. This went live in 1955, and provides unbiased estimates of equity returns from 1955 onwards, though with narrower market coverage than our *Millennium Book* indices. For the period 1919-54, however, the BZW equity index is based on a reconstructed backhistory, which included companies that were subsequently incorporated into a large-company index. It was thus constructed with hindsight, since an investor back in 1919 would clearly not have known which companies were destined to be successful, ie, to grow large. This use of hindsight, coupled with other problems in index construction, led to the BZW equity index overstating equity returns by 2.34% pa over the period 1919-54.

The second and even more pervasive reason why previous studies have documented higher returns than *The Millennium Book* is their reliance on easy data. Again, we can illustrate this for UK returns. The BZW index starts after the end of World War I, whereas we select 1900 as the common base date for all our indices. By omitting years of turmoil early in the 20th century, while including the post-war recovery, equity market returns are flattered in the BZW and other studies. The effect of starting the BZW history in 1919 rather than 1900 is to add an additional 2.62% pa to the pre-1955 real return on UK equities. Since post-WWI equity returns are more readily available than older data, the differential performance of the BZW index arose from a focus on data that is relatively easy to obtain.

This problem is quite prevalent. Most studies are based on records that are relatively accessible. By avoiding

Figure 4

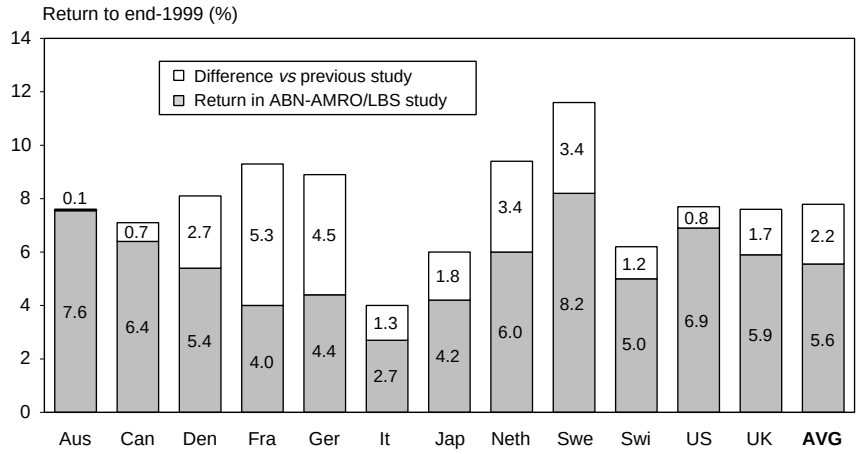
Real bond returns: first *versus* second half of 20th century



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

* Excludes 1922-3

Figure 5
This study *versus* previous research: easy data bias



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

inaccessible, controversial or infrequently-published data, periods of poor market performance are often omitted. This tends to give rise to over-estimates of long-run rates of return. Easy data generally exclude periods with breaks in trading activity or times which are regarded as otherwise unusual, such as periods of unrest and economic upheaval, and wars and their aftermath. Easily available data also typically relates to more recent time periods, when equities have performed especially strongly. This is true of the BZW studies for other countries (France, Germany and the Netherlands) and of the Ibbotson studies of the equity risk premium in other countries (Ibbotson Associates, 1999), all of which span far less than the full century examined in *The Millennium Book*.

Compared to estimates over the periods spanned by other studies, our 100-year estimates of equity returns and equity risk premia are markedly lower. In figure 5 we review twelve studies which, despite covering periods that are sometimes as brief as thirty years, might hitherto have been taken as the standard reference for each country. These references generate a misleading impression of 20th century investment performance. They cover intervals during which equity returns exceed the actual returns for the century by, on average, 2.2% per year.

The Equity Risk Premium and Why It Matters

The equity risk premium is the difference between the return on equities and the return on a risk-free asset, typically treasury bills, but sometimes government bonds. The risk premium is important because it represents the reward for, or price of, bearing risk. Investors do not knowingly take on risk unless there is some expected compensation for their risk exposure. For taking on the risks of the equity market, this compensation takes the form of the equity risk premium. To measure this premium, and establish the price of risk, we need to look at the markets where equity risk is traded, namely the world's leading stock markets.

The risk premium matters because it is central to projecting future investment returns, calculating a company's cost of equity capital, valuing companies and shares, appraising investment projects and determining fair rates of return for regulated utilities. *The Millennium Book* provides extensive direct evidence on the equity risk premium, and this is undoubtedly the most important variable documented in the study. Many finance professionals and financial economists regard the equity risk premium as the single most important number in finance.

By definition, an unbiased estimate of the risk premium required by investors tells us what returns we can expect from the equity market in the future, relative to bills or bonds. A low (high) risk premium automatically implies low (high) future returns from equities. If this were not the case, then the highly competitive conditions prevailing in the world's leading stock markets would ensure that share prices rapidly rose (fell) until promised returns were aligned with required returns.

By combining the risk premium estimate with a forecast of future market volatility, we can also infer

the price of risk, ie, the additional percentage return investors require per unit of market volatility. The price of risk, coupled with estimates of future market returns, provide crucial inputs to investors' asset allocation choices, namely how to allocate funds between stocks, bonds, bills and other asset classes. The risk premium is thus central, either explicitly or implicitly, to asset allocation decisions made by investment professionals, individuals and firms.

At the same time, the equity risk premium is of fundamental importance to company managers and regulators. To company managers, the cost of capital is central to setting minimum target rates of return for proposed investment projects. Finally, many utilities and other companies face a situation where part or all of their business is subject to price or rate-of-return regulation. This is designed to ensure that the firms in question do not abuse their market power, and earn an unfairly-high rate of return. The benchmark for judging whether returns are excessive should be the company's cost of capital, which in turn, depends on the equity risk premium.

Measuring the Risk Premium

The equity risk premium is typically measured in one of two ways. The first uses treasury bills (short-term, default-free, fixed-income government securities) as the risk-free or 'safe' benchmark. The second measures the risk premium relative to long-term government bonds. Of these two, only treasury bills can really be considered risk-free, and even here hyperinflation can cause bill investors to experience large losses in real terms. Long-term government bonds are generally appreciably more risky than bills, since bond prices are sensitive both to changes in real interest rates and to inflationary expectations. Since bonds are riskier than bills, we would expect the equity risk premium relative to bonds to be lower than the premium relative to bills.

Long-term bonds nevertheless have one advantage as a benchmark in that long-bond prices reflect not only today's short-term interest rate, but also future expected interest rates. Thus for valuing shares or projects where the cash flows extend many years into the future, the promised return on long bonds will encapsulate the expected sequence of returns on short-

The Risk Premium and Share Valuation

The risk premium is crucial for valuing shares. It has long been recognised that the value of a share is the present value of the discounted stream of cash flows to the shareholder. This statement can be translated into a dividend discount (or dividend growth) valuation model. Alternatively, it may be reformulated as a model that values the portion of the company's free cash flows which is attributable to shareholders.

All these valuation models require a discount rate, which by definition is the shareholders' required return. This required return will be the risk-free rate plus a premium for risk, where the latter will be the equity risk premium for the market, adjusted for the risk of the share in question. If the Capital Asset Pricing Model is being used to determine discount rates, the risk adjustment will depend on the share's systematic risk, or beta – a measure of the extent to which a share's performance fluctuates with the market. UK share betas are published in the London Business School *Risk Measurement Service*. But whichever pricing or valuation model is used, the size of the equity risk premium will, explicitly or implicitly, play a central role.

Just as the external valuation of a company's shares should be driven by the shareholders' required rate of return (the 'cost of equity capital'), so should internal valuations within the company. When reviewing new projects and investments, acquisitions and divestments, or whether existing businesses are providing an adequate return, the benchmark used by managers should be the return required in the capital markets.

The required return on a company's investments should reflect not only the costs of borrowing money, but the cost of equity capital (see, eg, Brealey and Myers 2000, chapters 7-9, for further details on calculating the cost of capital). Projects that fail to cover the cost of capital should not be undertaken, while those that exceed it will be value enhancing. Once again, therefore, the equity risk premium is vital, since if managers over-estimate the required premium, and hence their cost of capital, this will lead to under-investment, and vice versa. Shareholders will be worse off whenever the premium is under- or over-estimated.

dated bills over the remaining term of the bond. The corresponding disadvantage is that long-bond prices will also encapsulate a maturity risk premium, the magnitude of which is hard to measure.

We cannot observe directly what risk premium investors expect for the future. But we can measure the historical risk premium, and if the measurement interval is long enough, we can use this as a starting point for inferences about what investors might expect. We measure the risk premium by taking the geometric difference between the equity return and the risk-free return. The formula for the equity risk premium is *1 + Equity rate of return* divided by *1 + Riskless return*, minus *1*. For example, if shares with a one-year return of 21% are being evaluated relative to treasury bills yielding 10%, the equity risk premium would be 10%. This is because $(1 + {}^{21}/_{100})$ divided by $(1 + {}^{10}/_{100})$ is equal to $(1 + {}^{10}/_{100})$.

The equity risk premium, measured relative to bill or bond returns, is a ratio. It is hence unaffected by whether returns are computed in dollars or (say) French francs, or whether returns are computed in nominal or real (inflation-adjusted) terms.

The range of premia that are encountered over investment periods of a single year is very broad, reflecting the fact that year-to-year equity returns are volatile. In the US, for example, the one-year equity risk premium relative to treasury bills varied over the 20th century between –45% (in 1931) and +55% (in 1933). No one would suggest on the basis of these observations that investors required a risk premium of either –45% or +55%! The outcomes for these two years simply represent one particularly disappointing, and one especially good, year for equities. To infer investors' expectations for the risk premium requires one to look at realised premia over investment horizons that are much longer than a year, and conventional wisdom suggests one should select the longest period possible.

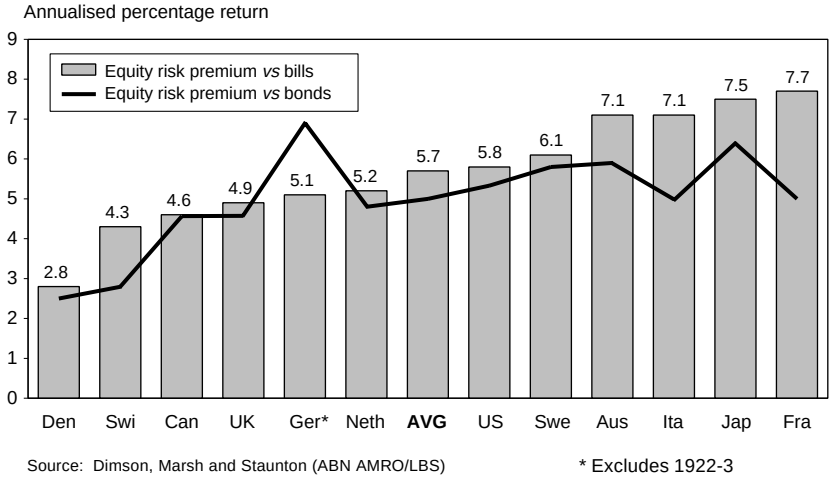
Evidence on the Historical Risk Premium

The twelve countries' equity risk premia over the entire 20th century are shown in figure 6 below. The bars in figure 6 show the risk premium relative to treasury bills, while the line plot shows the premium relative to long bonds. In the case of Germany, the risk premium figures are based on data for 98 years, since we have excluded the hyperinflationary years of 1922/3 when bills and bonds returned –100% in real terms.

While the equity risk premium has clearly varied across countries, the century-long averages fall within a fairly narrow range. Figure 6 shows that, relative to bills, the equity risk premium averaged 5.7%, and ranged from a high of 7.7% for France down to 4.3% for Switzerland, the only outlier being Denmark at 2.8%. We find that the equity risk premium for the US is remarkably close to the middle of the distribution of equity premia, whether the latter are estimated relative to bills or bonds. In particular, the 100-year US equity risk premium relative to bills of 5.8%, was very close to the mean of 5.7% for the twelve countries. The UK experience was also close to the mean, with a 100-year equity risk premium of 4.9%.

The line plot in figure 6 shows the equity risk premium relative to long-term government bonds. As can be seen, this was generally lower than the premium

Figure 6
Annualised equity risk premia relative to bills and bonds



Source: Dimson, Marsh and Staunton (ABN AMRO/LBS) * Excludes 1922-3

relative to bills. This is because, over the century as a whole, the return on government bonds exceeded the return on treasury bills. The average risk premium relative to bonds across the twelve countries was 5.0%, ranging from a high of 6.9% for Germany to a low of 2.5% for Denmark. Once again, the risk premia of 5.3% for the US and 4.6% for the UK are close to the mean for all twelve countries.

As we noted above, the evidence suggests that bond returns over the 20th century proved lower than investors' expectations because of unexpectedly high rates of inflation. If bond performance had been in line with expectations, realised bond returns would have been higher, and equity risk premia would have been lower. This suggests that the historical risk premia relative to bonds, shown in figure 6, are likely to overstate investors' expectations.

Furthermore, the unanticipated losses experienced during the century's worst inflation episodes afflicted bondholders more than shareholders. The risk premia reported in figure 6 are therefore subject to a further caveat in relation to those countries that experienced the worst real bond returns. Germany's appearance at the top of the league table of risk premia relative to bonds is thus attributable much more to the disappointing return on bonds, than to the good performance of German equities (even after excluding 1922/3). This is borne out by the fact that figure 6 shows that Germany was the only country in which the risk premium relative to bonds exceeded the risk premium relative to bills.

The Risk Premium and the Cost of Capital

The risk premia reported above were computed as geometric means. This has intuitive appeal from an investment perspective, since, when past performance is being considered, the geometric mean summarises the annualised rate of return over a historical period. The geometric mean of n returns is the n^{th} root of (*1+the first return*) x (*1+the second return*) x … x (*1+the* n^{th} *return*), minus *1*. When decisions are being taken on a forward-looking basis, however, the arithmetic mean is the appropriate measure, since it represents the mean of all the returns that may possibly occur over the investment holding period. The arithmetic mean of n returns is the sum of all n returns, divided by n.

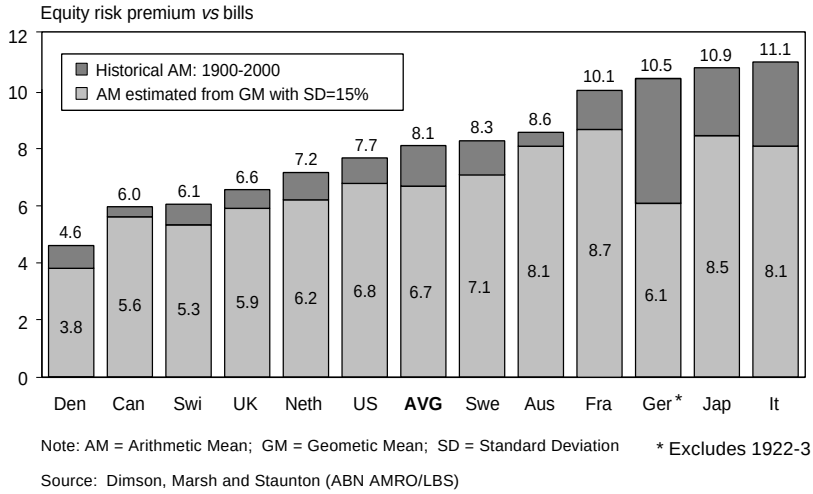
The arithmetic mean of a sequence of different returns is always larger than the geometric mean. To understand this, consider successive returns of +25% in one year, followed by –20% in the following year. The arithmetic mean of these two returns is 2½% (ie, 25 minus 20, divided by 2). The geometric mean of these two rates is zero (since $(1 + {}^{25}/_{100}) \times (1 - {}^{20}/_{100}) - 1 = 0$). The more volatile or risky the sequence of returns, the greater will be the difference between the two means. For very risky investments, the arithmetic mean return can be much higher than the geometric mean.

As we saw above, one of the key uses of the equity risk premium is to determine investors' required returns, and hence the cost of capital for use as the discount rate in valuing shares and in project appraisal. For discounting uncertain future cash flows it is necessary to use the expected risk premium. The expected premium is the arithmetic mean of the one-year premia. In figure 7 (overleaf), the full height of the bars shows the historical arithmetic mean risk premium relative to bills over the last 100 years for each of the twelve countries. The average figure is 8.1%, while the figures for the US and UK are 7.7% and 6.6% respectively. As we would expect, the arithmetic mean risk premium is noticeably higher than the geometric mean premia recorded in figure 6 above. Furthermore, the arithmetic mean is at its largest, both in absolute terms and relative to the geometric mean, for the four countries which experienced the greatest turmoil and hence volatility of returns over the 20th century (see the right-most four bars of figure 7).

The historical arithmetic means in figure 7 are thus clearly influenced by the periods of extreme volatility during the 20th century. All market analysts agree, however, that repetition of certain types of historical event is so implausible that the past must be interpreted with care. Extreme hyperinflation is widely regarded as something that will not again afflict major economies; and a world war would be of a different nature if it were to happen in the future. (If there were another world war, the good news is that we would never again need to concern ourselves with the risk premium.)

We are thus likely to obtain more plausible estimates of the expected future arithmetic risk premium if we adjust the historical estimates in figure 7 downwards to reflect today's best guesses about future equity market volatility levels. The approach we follow here is to take the historical geometric means from figure 6

Figure 7
Arithmetic equity risk premia



Note: AM = Arithmetic Mean; GM = Geometic Mean; SD = Standard Deviation

* Excludes 1922-3

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

as given; that is, we treat them as unbiased estimates of the future geometric mean. We then recalculate the arithmetic means, assuming an illustrative, but more plausible, estimate of early 21st century levels of volatility. To do this, we use the result that with lognormally distributed returns, the geometric and arithmetic means are linked by the standard deviation (or volatility) of returns. (Some statistical assumptions that underpin our calculations, but are glossed over here, are discussed in Cooper 1996 and Dimson and Marsh 2001.) For illustrative purposes only, we have assumed a current volatility level of 15% for all twelve markets.

The resultant arithmetic mean risk premia are shown by the lower part of the bars in figure 7. The premia range from 3.8% for Denmark to 8.7% for France, with a mean of 6.7%. The figure for the US is 6.8%, and that for the UK is 5.9%. Note that even when we use 100 years of data, the standard errors around these risk premia estimates are very high, ranging from 1.7% (for Australia and Canada) to 3.6% (for Germany). The standard error for both the US and the UK is 2%. This means that while the figure of 5.9% for the UK remains our best estimate, we can be only 68% confident that the true mean lies within one standard error of this, ie, within the range 5.9 ± 2%, namely between 3.9% and 7.9%. These high standard errors are the reason why conventional wisdom prescribes that the longest possible series of stock market data should be used to estimate risk premia.

We should sound a cautionary note. Even *The Millennium Book's* estimates of long-run returns – which use the longest-run series and most accurate data available to date – may still be slightly upward biased. This is because our study is restricted to the twelve countries for which total returns can currently be estimated. We omit markets that at some point failed to survive – Russia, Argentina, China, Poland and so on. Some of these experienced returns of –100%, and their exclusion will inflate our estimates, which are based only on surviving markets. Mostly, though, these markets were small, so their omission probably has only a minor impact in market capitalisation weighted terms. Our study also excludes some markets which existed in 1900 and still exist today (eg, Spain), but where a full century of data has so far eluded us. Our research thus suffers from some element of the survivorship and easy data bias to which we referred earlier. This may mean that even our global average historical risk premium is slightly upward biased, though hopefully this is mitigated by the large proportion of world market capitalisation covered by our twelve markets. The important qualitative point is that, insofar as our research too may suffer from data biases, it is in the direction of over-estimating the equity risk premium, not under-estimating it.

To obtain a cost-of-capital estimate for use in discounting future cash flows, we require a forecast of the future arithmetic risk premium. For those who believe that estimates based on a long-run series of historical returns are a good guide to future risk premia, and who are prepared to accept that our data are relatively free of survivorship and easy data bias, then the numbers illustrated in the lower bars of figure 7 are the relevant numbers to employ. This indicates

that for the twelve countries in our sample, the average risk premium (for typical risk equities, in a typical risk market) would be 6.7%. Hence, the current cost of equity would be the current risk-free rate of interest, plus a premium of 6.7%.

What This Means for the Future

The key remaining question is whether this 6.7% global average historical risk premium should be used as our best estimate of the future risk premium. In a recent paper, Goyal and Welch (1999) specifically state that "in the absence of any variable known to robustly predict the equity premium out of sample, the [finance] profession should assume that no variable can predict the equity premium better than its own past average". Certainly, many leading textbooks advocate the use of the arithmetic mean of historical equity premia; these include Brealey and Myers (2000) and Bodie, Kane and Marcus (1999).

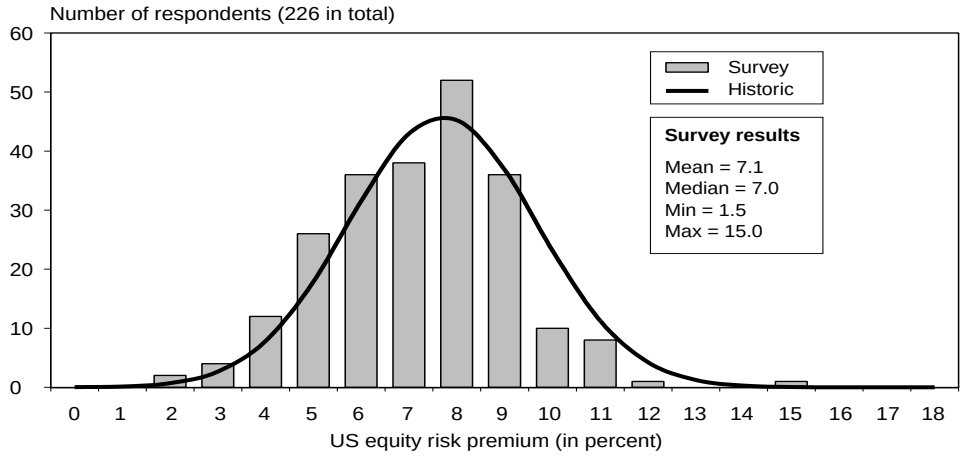
A recent survey by Ivo Welch (2000) casts light on whether academic finance professionals do, in fact, extrapolate from the historical record into the future. Rather than looking at a cross-section of countries, Welch studies the opinions of 226 financial economists who were asked to forecast the arithmetic equity risk premium in the US over a number of time horizons. He finds that the consensus forecast of the arithmetic 30-year equity premium is about 7%. The consensus is that a pessimistic outcome (with a 5% probability of occurrence) would be an equity premium of 2–3%; the consensus regarding an optimistic outcome is for a 12–13% equity premium.

The bars in figure 8 represent the distribution from the Welch survey, while the curved line represents the normal distribution based on the historic mean (7.7%) and associated standard error (2.0%) using the century of observations for the US equity risk premium. An important aspect is the similar spread in both distributions. The uncertainty across financial experts about the risk premium is as large as the uncertainty that arises from statistical analysis of historical returns.

Most respondents to the Welch survey would have regarded the Ibbotson *1999 Yearbook* as the definitive study of the historical US risk premium. The survey mean was lower than the Ibbotson benchmark, and since survey respondents claimed to revise their risk premium forecasts downwards when the equity market rises, this difference may well be explained by the recent strong performance of the market. Consistent with this, the survey respondents also perceived the profession's consensus to be higher than it really was, ie, they thought the mean was ½ to 1% higher than the 7% figure shown in figure 8.

These survey figures represent what is being taught in the world's leading business schools and economics departments. As such, they will also be widely used by finance professionals and corporate executives. Similarly, they will be cited by regulators and used in rate-of-return regulation disputes. Their influence will thus extend from the classroom to the boardroom, the dealing room, and the courtroom.

Figure 8
Views of financial economists *versus* historical results



Source: Welch (2000)

Whether a mean of 7% is correct is quite another matter. As noted above (see figure 5), our new estimate of the annualised 1900-1999 US premium is nearly one percentage point lower than the Ibbotson estimate, which was for 1926-1999. To the extent that survey respondents were calibrating their forecasts relative to the Ibbotson benchmark, these same respondents might now wish to lower their estimates of the equity risk premium to figures based on the new estimates from *The Millennium Book*. This assumes, of course, that they are still content to use historical means as the anchor for their future forecasts.

Interpreting History to Estimate Future Risk Premia

Clearly, history can be no more than a starting point for predicting the equity risk premium. Financial economists may be reluctant to diverge markedly from the historical mean. Decision-makers, on the other hand, cannot rely merely on the average premium observed from past observations. They correctly wish to go beyond using only the past, and to identify the market's implicit expectation for future performance.

There are coherent arguments in favour of going beyond raw historical estimates of the risk premium. First, the whole notion of using the achieved risk premium to forecast the required risk premium depends on having a long enough time period to iron out good and bad luck. Even with a century of data, standard errors are still high.

Second, the equity risk premium could change over time. This might be because the underlying business risk of equities has fluctuated, as the world or the corporate sector became riskier or safer. Or it might be because the risks faced by investors have been transformed, as enhanced diversification opportunities became available, both domestically and internationally. Alternatively, it might be a consequence of systematic changes in investors' levels of risk aversion.

Third, we must take account of the fact that stock market outcomes are influenced by many factors. Some of those that were important in the past may be non-repeatable. If so, projections of the future risk premium should deviate from extrapolations based on the past. The financial history of our twelve stock markets has been so variable over time that it is worthwhile exploring this argument further.

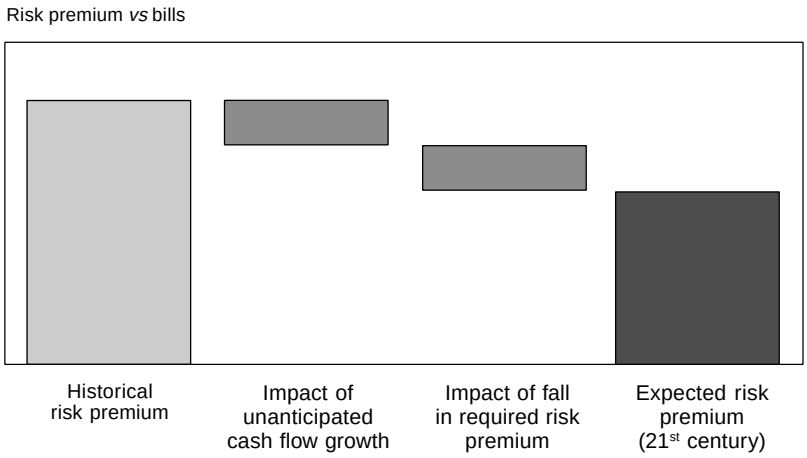
A comparison between the first and second halves of the 20th century makes the point. Over the first half-century the US equity risk premium had an arithmetic average of 6.5%, whereas the second half-century gave rise to a 9.0% risk premium relative to treasury bills. This pattern is common to most of the twelve countries we study in *The Millennium Book*. (The exceptions are Australia, Canada and Italy – and Germany because of its interwar hyperinflation.) The cross-sectional mean for all countries (excluding Germany) in the first half-century was an arithmetic average risk premium of 6.5%, as compared to 9.3% for the twelve-country mean in the second half-century.

The large risk premia achieved during the second half of the 20th century are attributable to two factors. First, there was unprecedented growth in productivity and efficiency, as well as improvements in management and corporate governance, and there was also extensive technological change. As Europe, North America and the Asia-Pacific region emerged from the turmoil of World War II, expectations for improvement were limited to what could be imagined. Reality exceeded investors' expectations. Corporate cash flows grew faster than investors had anticipated. This higher growth is now known to the market, and built into today's higher stock prices.

Second, stock prices have almost certainly also risen because of a fall in the required rate of return, due to diminished investment risk. The economic and political lessons of the 20th century have surely been learned, international trade and investment flows have increased, and the Cold War has ended, leading to a more secure business environment. A further factor that may have lowered required returns is that investors now have much more opportunity to diversify, both domestically and internationally, than they had a century ago. Diversification allows investors to lower their risk exposure without detriment to expected return. Transaction costs are also lower now than a century ago. Factors such as these, which have led to a reduction in the required risk premium, have contributed further to the upward re-rating of share prices.

To convert from a pure historical estimate of the risk premium into a forward-looking projection, we need to reverse-engineer the factors that have driven up stock markets over the last 100 years. This is illustrated conceptually in figure 9. The left-hand bar in figure 9

Figure 9
Historical and expected geometric risk premia



portrays the historical risk premium on the equity market. This includes the impact of unanticipated growth in cash flows and of falls in the required risk premium. We therefore deduct the impact of these two factors. What remains is an indication of the risk premium demanded by investors today (see the right-hand bar in figure 9). The key qualitative point is that it is lower than the raw historical risk premium.

One final point. The use of historical averages as estimates of current required returns implies that France has a very high equity risk premium, while Denmark's risk premium is very low. There may, of course, be differences in risk between markets, but this is unlikely to account for cross-sectional differences in historical premia. Indeed, much of the cross-country variation in historical equity premia is attributable to country-specific historical events that will not recur. When making future projections there is therefore a strong case, particularly given the increasingly global nature of capital markets, for taking a global, rather than a country-by-country, approach to determining the cost of capital.

What Returns Can We Expect over the 21st Century?

The arguments above all lean in one direction, namely that the historical risk premium is likely to exaggerate investors' current required equity risk premium. This has important implications. The bad news is that some investors may have observed these high past returns and assumed they would continue, when in reality they were due to a gradual re-rating that may now be complete. Returns will certainly not persist at the annual level of 16% that was recently cited as the expectation of British private investors (Gallup poll, reported in the *Financial Times* on 15 November 1999). Nor is the premium likely to be as high as the 9.5% arithmetic mean reported in the Ibbotson Associates *2000 Yearbook*. As Siegel (1998) and Shiller (2000) point out, future stock market returns are likely to be lower than many investors are expecting.

If investors continue to require a relatively low risk premium in future, then equities can be expected to outperform risk-free investments, though by a lower margin than over the 20th century. If instead required rates of return rise, share prices will fall, and thus equities will underperform. Perversely, only if the expected equity risk premium is now at a permanently lower level can today's high stock prices be justified.

Readers may now be pondering what our view is of the long-term prospects for equities. As academics, and with investment track records like our own, we are naturally reluctant to forecast investment returns. However, three trends seem likely. First, and uncontroversially, in the 21st century, investment in equities will remain risky. This is because business itself is risky, and because the new century will bring its own forms of turmoil and volatility. Our second prediction follows from our first. If equities remain risky, as must certainly be the case, equity investors should continue to expect a positive risk premium. This implies that, when investors look back 100 years from now, equities should prove to have been the best-performing asset class over the 21st century. Our third prediction is that the risk premium will turn out to be

lower than it has been during the 20th century, even when it is calculated, as in this study, to include the turbulent earlier half of the 20th century.

These are long-term forecasts, the accuracy of which should not be judged for a further one hundred years. Even then, note that with 200 observations the standard error associated with estimates based on historic data will still be of the order of 1.5%.

Are Companies Under-investing?

It has become clear that the current level of the equity risk premium is unlikely to be as high as was considered reasonable in the mid-1990s. The arithmetic mean of 8½% recommended by Ross, Westerfield and Jaffe (1993), the 8-9% suggested (with caveats) by Brealey and Myers (2000), the 7½% recommended by Weston, Chung and Sui (1997), and a similar figure inferred from the Copeland, Koller and Murrin (1995) geometric mean of 5-6%, all look excessive. The market is almost certainly building lower risk premia than this into stock prices.

At the same time, real interest rates have declined. For example, the real yield on UK index-linked government bonds has fallen from well over 4% a few years ago to around 2% today. To compute the expected return on equity investment, we have to add the risk premium to the real interest rate. Since both components have declined, it follows that in real terms, the required rate of return on equity capital is markedly lower than it was. With lower inflation and lower real interest rates, the expected return on conventional bonds has also fallen. So the required return on debt capital is also lower than it was.

The cost of capital has thus fallen substantially in recent years. Moreover, as we show in *The Millennium Book*, most countries share the experience we describe. Many companies, however, are still living in the past. They are seeking a required rate of return on new investment which is simply too high. By ignoring the worldwide fall in the costs of both debt and equity capital, there is a danger that these companies are under-investing, or are waiting too long before embarking on important projects.

Cancellation or deferral of worthwhile projects erodes the competitive position of established companies. The biggest losers are likely to be those firms that risk being overtaken by new competitors who are in a position to exploit new technologies and innovative processes. These losers will experience downgrading of their market ratings and erosion of their share prices. Ironically, this stock market reaction may be misinterpreted as an increase in the cost of capital, and contribute to a vicious circle of continuing under-investment and loss of shareholder value.

Is mis-estimation of the cost of capital the only explanation for the woes of 'old economy' companies? Of course not: it is not that simple. Markets have risen because of lower required rates of return. But they have also responded to a benevolent economic environment and the emergence of new technologies. To share in the improved profits outlook, it has been necessary to be doing the right thing. This means investing in worthwhile projects, rather than simply expanding through projects that fail to cover the cost of capital.

Some companies have been overtaken by the fast pace of change in the economy, and are not in a position to benefit from today's low cost of capital by investing in worthwhile projects. While these firms should be looking for profitable new investments, they may well conclude that the best they can do is to return excess funds to their shareholders. These shareholders then have the option of investing their money in other shares that do offer the normal return from equity investment.

To make the right decision, it is important that managers have insight into the returns that can be expected from investing in the capital market. History can be misleading as a guide to the future, and undoubtedly needs to be interpreted with care. Nevertheless, financial market history provides a starting point. By understanding the capital markets, managers can be empowered to focus on investments that add to the market value of their company.

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Appendix: The Research Approach

Prior to publication of *The Millennium Book*, there was a paucity of reliable, comparable evidence on long-run rates of return in the world's major markets over the 20th century. The US was the exception, since for many years high quality data had been available, at least from 1926 to date. However, America has had a remarkably successful economy, and it would have been dangerous to extrapolate the future from the US experience.

The Millennium Book sought to fill the gap in our knowledge about long-term rates of return. For the UK, this was achieved by constructing an entire new family of equity and bond indices from 1900-2000 especially for the study. For the eleven other markets, we assembled and linked together the best quality indices and returns data available from previous academic studies and other sources.

For our own home market, the UK, there was until now no satisfactory record of long-run equity performance. We therefore used the London Business School Share Price Database to construct an index, starting in 1955, of the total return from investing in the entire UK equity market. This index is described in our forthcoming article in the *Journal of Business* (2001). From 1900 onwards, we constructed an index of the performance of the largest 100 companies. This involved a process of painstaking financial archaeology, collecting original data on share prices, dividends, and other data from archives in the City of London. By linking these two indices together, we have compiled an authoritative record of UK equity performance over the last 100 years. Similarly, for government bonds, we constructed a new returns index from 1900-2000, which tracks the returns on perpetuals until 1954, and thereafter on a portfolio of bonds with an average maturity of 20 years.

The eleven other markets covered are the US and Canada; Denmark, France, Germany, Italy, the Netherlands, Sweden and Switzerland; and Australia and Japan. In each country, we cover the same asset classes: equities, bonds and bills; and inflation. To span the century, for each asset class, we typically needed to link several different studies/index series.

Unlike most previous long-term studies of global markets, all our investment returns include reinvested income as well as capital gains. Many early equity indices measure just capital gains, ignoring dividends, while many early bond indices record just yields, ignoring price movements. Furthermore, our database is more comprehensive and accurate than previous research, spans a longer period, and the common start-date of 1900 aids international comparisons. In contrast, one of the most frequently cited previous studies, Jorion and Goetzmann (1999), identified only four non-Anglo Saxon markets with pre-1970 dividends, and none of these index series started before the 1920s. Finally, as noted above, we have taken pains to avoid any hindsight.

Capital market returns

For each asset class within each country, we have computed a series of annual nominal returns, calculated in local currency, for each calendar year from 1900 to 1999. From these, we compute the annualised (geometric mean) rate of return over the full century, and over any chosen sub-period. These annualised rates are the returns that investors would have earned before personal taxes and dealing costs. When compounded up, they indicate the terminal wealth that would have been generated by the initial investment.

Inflation was a major force in all countries during the 20th century. In addition to nominal returns, we therefore also calculate real, or inflation-adjusted, returns. The real return is defined as *1 + Nominal rate of return* divided by *1 + Inflation rate*, minus *1*. Because real returns are measured in constant purchasing power, they provide a far more meaningful measure of investment performance. Furthermore, real returns can readily be compared across different countries, since they have no obvious currency numeraire.

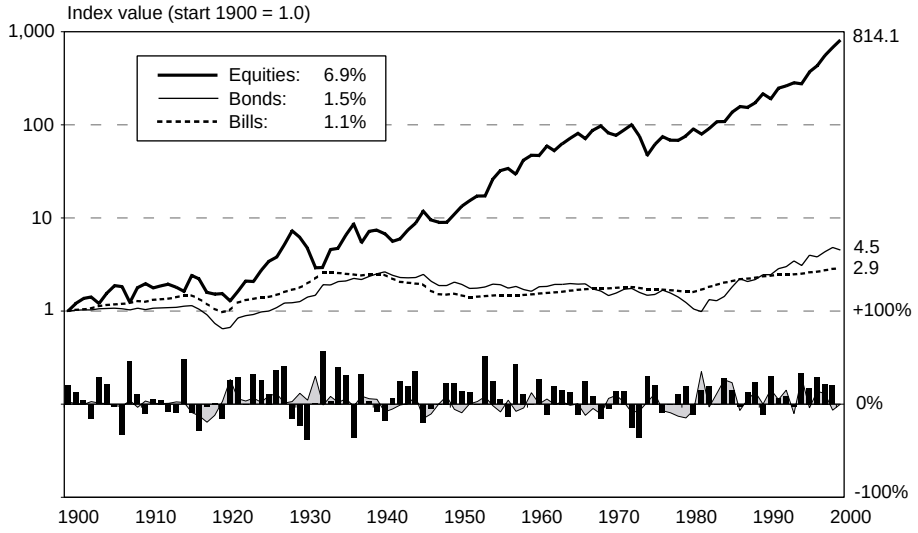
The nature of our underlying returns data is illustrated in the two-page box which shows summary data taken from the second half of *The Millennium Book*. While the first part of the book deals mainly with international comparisons, the second part contains a separate chapter for each country, describing the data sources, and presenting summary charts and statistics of returns data. The data shown overleaf is extracted from the chapter covering the US. A similar template is used for all twelve countries.

Long-run Rates of Return in the United States

In this box we illustrate the process of compiling a long-term performance record for each market. We follow the same procedure – adapting it slightly – for each of our twelve countries. We cover the three main asset categories – equities, government bonds and treasury bills – and inflation. Out of 48 asset/country combinations, 44 have a complete century-long record, while four have an unbroken history that covers nearly ninety years.

For all assets and markets we compile estimates of capital appreciation, income and total return, including reinvested dividends. Occasionally, as for the UK, our research involved assembling a new index from underlying stock price data. But for most countries, we simply identified the highest quality and most authoritative research studies over a sequence of time periods. The least troublesome market, from this point of view, was the US. We use the Schwert (1990) equity market returns for the first 26 years of the 20th century, which we link to the University of Chicago's index of all New York Stock Exchange

Figure 10
Real returns on US equities, bonds and bills, 1900-2000



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

Table 1
Distribution of US asset returns, 1900-2000

Return % pa	Asset	Arithmetic mean	Geometric mean	Minimum return	Maximum return	Standard deviation
Nominal return	Equities	12.2	10.3	-43.9	57.6	20.0
	Bonds	5.0	4.7	-9.2	40.4	8.1
	Bills	4.3	4.3	0.0	15.2	2.8
	Inflation	3.3	3.2	-10.8	20.4	5.0
Real return	Equities	8.9	6.9	-38.1	56.4	20.3
	Bonds	2.0	1.5	-19.3	35.2	9.9
	Bills	1.2	1.1	-15.0	20.0	4.9

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

Table 2
US real rates of return over various periods, 1900-2000

To	From 1 January 1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
1 Jan	**Real return on equities**									
1910	7.1									
1920	2.2	-2.5								
1930	6.2	5.8	14.9							
1940	5.1	4.5	8.2	1.9						
1950	4.9	4.4	6.8	2.9	4.0					
1960	6.6	6.5	8.9	7.0	9.7	15.7				
1970	6.5	6.4	8.3	6.7	8.3	10.5	5.6			
1980	5.6	5.3	6.7	5.2	6.0	6.7	2.4	-0.7		
1990	6.1	6.0	7.3	6.1	7.0	7.7	5.2	5.0	11.0	
2000	6.9	6.9	8.2	7.2	8.1	9.0	7.4	8.0	12.6	14.2
1 Jan	**Real return on bonds**									
1910	0.3									
1920	-2.2	-4.6								
1930	0.8	1.0	7.0							
1940	2.3	3.0	7.0	7.1						
1950	1.4	1.7	3.9	2.4	-2.0					
1960	0.8	0.9	2.3	0.8	-2.1	-2.2				
1970	0.5	0.6	1.7	0.4	-1.8	-1.6	-1.0			
1980	0.3	0.3	1.1	-0.1	-1.8	-1.7	-1.4	-1.7		
1990	1.0	1.1	1.9	1.1	0.0	0.5	1.4	2.6	7.2	
2000	1.5	1.7	2.5	1.8	1.0	1.6	2.6	3.8	6.7	6.3
1 Jan	**Real return on bills**									
1910	2.3									
1920	-0.1	-2.5								
1930	1.9	1.8	6.2							
1940	2.3	2.3	4.8	3.4						
1950	0.9	0.5	1.5	-0.7	-4.6					
1960	0.7	0.4	1.1	-0.5	-2.4	-0.2				
1970	0.8	0.6	1.2	0.0	-1.1	0.6	1.5			
1980	0.6	0.4	0.8	-0.2	-1.1	0.1	0.3	-0.9		
1990	1.0	0.8	1.3	0.5	-0.1	1.1	1.5	1.5	3.9	
2000	1.1	0.9	1.4	0.7	0.2	1.3	1.6	1.7	3.0	2.0
1 Jan	**Inflation**									
1910	2.4									
1920	4.8	7.3								
1930	2.9	3.1	-0.9							
1940	1.6	1.4	-1.5	-2.0						
1950	2.4	2.4	0.7	1.6	5.4					
1960	2.3	2.3	1.1	1.8	3.8	2.2				
1970	2.4	2.4	1.4	2.0	3.4	2.4	2.5			
1980	3.0	3.1	2.4	3.0	4.3	4.0	4.9	7.4		
1990	3.2	3.3	2.7	3.4	4.5	4.3	5.0	6.2	5.1	
2000	3.2	3.3	2.8	3.3	4.2	4.0	4.5	5.1	4.0	2.9

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

stocks (1926-61) and their index of all NYSE, American and Nasdaq stocks (1962-70), and to the Wilshire 5000 index (1971-1999). We follow a similar procedure for assembling the bond, bill and inflation indices.

Inflation-adjusted returns are more comparable across countries, so we focus here on the real returns on US asset categories. Figure 10 shows the cumulative real return from an investment of one dollar in each of equities, long-term government bonds, and short-dated treasury bills made at the end of 1899 and held throughout the 20th century. The bar chart in the lower section of figure 10 displays the year-by-year real returns on US equities and government bonds.

Table 1 summarises the data represented in figure 10, listing the arithmetic and geometric means and the standard deviation of annual returns, and the minimum and maximum returns experienced in the US over the entire 20th century. The returns are shown both in nominal terms (upper panel) and in real, inflation-adjusted terms (lower panel).

Table 2 lists annualised real returns over all possible intervals of duration 10, 9…1 decades, from an initial investment made in 1900, 1910…1990. This table covers equity, bond and bill returns, as well as inflation. The top panel of table 2 reveals the good fortune experienced over recent decades by equity investors. Look at the bottom row of the top panel. The entries towards the right-hand side show that over 1990-2000 the annualised real equity return was 14.2%, as compared to lower levels over longer intervals, such as the 12.6% recorded for 1980-2000, 8.0% over 1970-2000, and 7.4% over 1960-2000. The body of the same panel reveals that the preceding thirty years gave rise to an annualised real return on equities of 7.0% (1930-1960), while the first thirty years of the century yielded real returns of only 6.2% (1900-1930). By taking a long-term perspective, we mitigate the problem of drawing inferences from recent experience that may be unrepresentative of the future.

Figure 10 shows real returns on US assets. The upper section shows the cumulative real returns from an investment of $1 in each of equities, long-term government bonds, and short-dated treasury bills made at the end of 1899 and held throughout the 20th century. The lower section comprises a bar chart of the year-by-year real returns on US equities and government bonds.

It can be seen immediately from both the triangles and the table in the box that, for the US market, the annualised real return on equities over the 20th century was 6.9% per annum. A real return of 6.9% pa on an initial investment of $1 held over 100 years would have resulted in real terminal wealth of $814.1 as shown in figure 10. Real bond and bill returns were a much lower, 1.5% and 1.1% respectively, while inflation averaged 3.2%. Note, however, that the variability (standard deviation) of equity returns has been twice that of bonds, which in turn had twice the variability of bills.

As noted above, the history of US stocks, bonds, bills and inflation has hitherto been far better documented than in any other country, while researchers have been concerned that the US results may be non-typical since the US has been such a successful economy. A major contribution of *The Millennium Book* is that we have been able to assemble comparable 100-year series for the same asset classes for eleven other countries. We can now set this alongside the US data and make international comparisons that help set the US experience in perspective.

References

Barclays Capital (1999) *Equity-gilt Study*, London: Barclays Capital (January)

Bodie, Zvi, A. Kane and A. Marcus (1999) *Investments,* Fourth edition, New York: McGraw Hill

Brealey, Richard, and Stewart C. Myers (2000) *Principles of Corporate Finance,* Sixth edition, New York: McGraw Hill

Cooper, Ian (1996) Arithmetic versus Geometric Mean Estimators: Setting Discount Rates for Capital Budgeting, *European Financial Management* 2: 157-167

Credit Suisse First Boston (1999) *The CSFB Equity-gilt Study*, London: CSFB (Europe) Ltd (February)

Dimson, Elroy, Paul Marsh and Mike Staunton (2000) *The Millennium Book: A Century of Investment Returns*, London: ABN-Amro and London Business School (contact prowham@london.edu)

Dimson, E. and P. Marsh (2001) UK Financial Market Returns 1955-2000, *Journal of Business* 73 (January)

Goyal, Amit and Ivo Welch (1999) Predicting the Equity Premium, Yale School of Management working paper (May)

Ibbotson Associates (1999) *International Equity Risk Premia*, Chicago: Ibbotson Associates

Ibbotson Associates (1999) *Stocks, Bonds, Bills and Inflation 1999 Yearbook*, Chicago: Ibbotson Associates

Ibbotson Associates (2000) *Stocks, Bonds, Bills and Inflation 2000 Yearbook*, Chicago: Ibbotson Associates

Jorion, Philippe and William Goetzmann (1999) Global Stock Markets in the Twentieth Century, *Journal of Finance* 54: 953-980

Ross, Stephen, R.W. Westerfield and J.F. Jaffe (1993) *Corporate Finance,* Third edition, Irwin/McGraw Hill

Schwert, G. William (1990) Indexes of United States Stock Prices from 1802 to 1987, *Journal of Business* 63: 399-426

Shiller, Robert (2000) *Irrational Exuberance,* New Jersey: Princeton University Press

Siegel, Jeremy J. (1998) *Stocks for the Long Run*, Second edition, McGraw Hill

Welch, Ivo (2000) Views of Financial Economists on the Equity Premium and Other Issues, *Journal of Business* 72 (October)

Weston, Fred J., S. Chung and J.A. Sui (1997) *Takeovers, Restructuring, and Corporate Control*, Second edition, Prentice-Hall