

## Irrational Optimism

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Irrational exuberance has run its course. The first three years of the 21st century brought one of the worst bear markets in history, with equity markets around the world falling some 40 percent in real terms. Yet, despite fortunes lost on Wall Street, many investors remain irrationally optimistic about future long-run equity returns: The pervasive belief is that over the long haul, equities are sure to keep up with inflation. Unlike short-lived bursts of exuberance that may burst like a bubble, the excessive optimism of investors has been long term and systematic. In this article, we use the global database from our recent book, *Triumph of the Optimists* (Dimson, Marsh, and Staunton 2002), to confront the optimism of investors with the reality of history.

Equities are risky, so they should offer a higher expected return than cash or government bonds. Historically, they have given a handsome reward for risk. But although continuing to expect a risk premium in the future is rational, many investors overestimate the rewards and underestimate the risks of investing in stocks when the stocks are held over the very long term. U.S. corporations seem especially prone to irrational optimism. Fabozzi and Ryan (2003) reported that for the 380 companies in the S&P 500 Index with defined-benefit plans, projected plan returns averaged around 9 percent in each of the three years 2000, 2001, and 2002. If we assume a classic 60/40 asset allocation to stocks and bonds, average bond yields during this period imply a projected equity return of some 12.5 percent. This percentage, given the implied inflation forecast of 2.0–2.5 percent inferred from conventional and inflation-indexed bond yields, is equivalent to 10 percent in real terms. Note that 10 percent is the *average*: around one half of all plan sponsors may be forecasting real equity returns higher than 10 percent.

Plan sponsors do not necessarily make an explicit assumption that the nominal return on equities will exceed 12.5 percent or that the real return will exceed 10 percent. When formulating their expectations, funds may build in some incremental performance from equity market alphas and may assume superior rewards through alternative assets or through market timing. Of course,

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these assumptions of positive alphas and superior returns from alternative assets and market timing are aggressive. They are ridiculous in the aggregate: Not all plans can be winners; who would be the losers? The assumptions also overlook costs and fees.

Maybe plan sponsors' high projected returns represent not the average expectation for stock market performance but accounting manipulations that reduce pension contributions and hence enhance reported earnings. If high projections reflect willful earnings management, however, such optimism is indeed irrational because it risks litigation and accounting scandal. Anecdotal evidence exists, in fact, that these high expected returns reflect genuine beliefs; they are consistent with the advice given in many corporate finance textbooks. Moreover, irrational optimism is not restricted to corporations. Surveys reveal that investors in defined-contribution pension plans make even more upbeat forecasts about future equity returns. Similarly, surveys of retail investors indicate still higher projections. If, as seems probable, future returns fall short of these projections, individuals' savings will be inadequate and their retirement will be financially insecure.

In forming their optimistic projections, many U.S. investors believe they are anticipating a replay of the past. Their memory of the past is heavily influenced, however, by U.S. stock market experience in the latter part of the 20th century. In this article we show that, historically, annualized long-run equity returns have not been as high as 10 percent in real terms anywhere in the world. Over the past 103 years, a more typical figure has been 4–6 percent. Furthermore, a careful analysis of historical returns indicates that future risk premiums are likely to be lower than in the past. We challenge the widely held view that over an interval of up to 20 years, equity investment is sure to provide a positive real return. Equities are not “safe” in the long run.

### **Stocks for the Long Run?**

Common stocks are thought to provide a return that is much higher than inflation. In his best-selling investment book, Siegel (2002) showed that, historically, there has been a stable level of long-term annualized real return on U.S. common stocks. This stable return has been referred to, somewhat tongue in cheek, as “Siegel’s constant” or  $s$ . Smithers and Wright (2000, p.159) commented, “We cannot know with certainty what the true value of  $s$  actually is, but we know that it cannot lie too far from our best estimate of 6.75 percent. . . . Why  $s$  is, or appears to be, so stable is an important challenge”. Bernstein (2002, p. xvi) wrote, “The most powerful part of Professor Siegel’s argument is how effectively he demonstrates the consistency of results from

equity ownership when measured over periods of 20 years or longer”. Noting that even Germany and Japan bounced back after World War II, Bernstein continued: “Indeed, he [Siegel] would be on frail ground if that consistency were not so visible in the historical data and if it did not keep reappearing in so many different guises”.

Siegel did not invent  $s$  and is among the first to agree that its constancy is an empirical question. We, therefore, present evidence on  $s$  spanning many countries and many decades. We show that the United States has had a higher real equity return and lower stock market volatility than many other countries and, as a result, had a favorable historical record—especially over the long term. From a global perspective and looking toward the future, however, equities are far from risk free for the long-term investor. The reason has nothing to do with a paradigm shift or a switch of regime in the capital markets; it reflects the unreliability of drawing inferences from the experience of a single country. The United States had extraordinary growth for more than a century, with a stock market that grew from an estimated 22 percent of the value of world equities in 1900 to 54 percent at the start of 2003. This record of long-term growth reflects not only the emergence of new companies and the issuance of new shares but also stock market outperformance relative to most other countries, and it cannot simply be extrapolated into the future. If these trends were to persist indefinitely, other markets would eventually pale into insignificance.

To appreciate the directions that might in the future be followed by a particular national market, we must look at the full range of possibilities. These possibilities encompass not only what we can learn from the history of the single country that has become the wealthiest but also the history of stock exchanges that were once relatively large but failed to prosper. We, therefore, test the reliability of equity-based asset allocation strategies by interrogating the data from *Triumph of the Optimists* (Dimson, Marsh, and Staunton 2004). This long time series of returns incorporates reinvested dividends and covers all the main asset categories in sixteen countries—two in North America, two in the Asia-Pacific region, one in Africa, seven in what is now the euro currency area, and four other European countries. Now extended to 103 years for every market, the dataset covers stocks, bonds, bills, inflation, and exchange rates.

### **Long-Run U.S. Returns**

Although stock markets may wobble in the short term, most corporations and investors appear to base return projections on two central assumptions. First, they assume that stocks can achieve

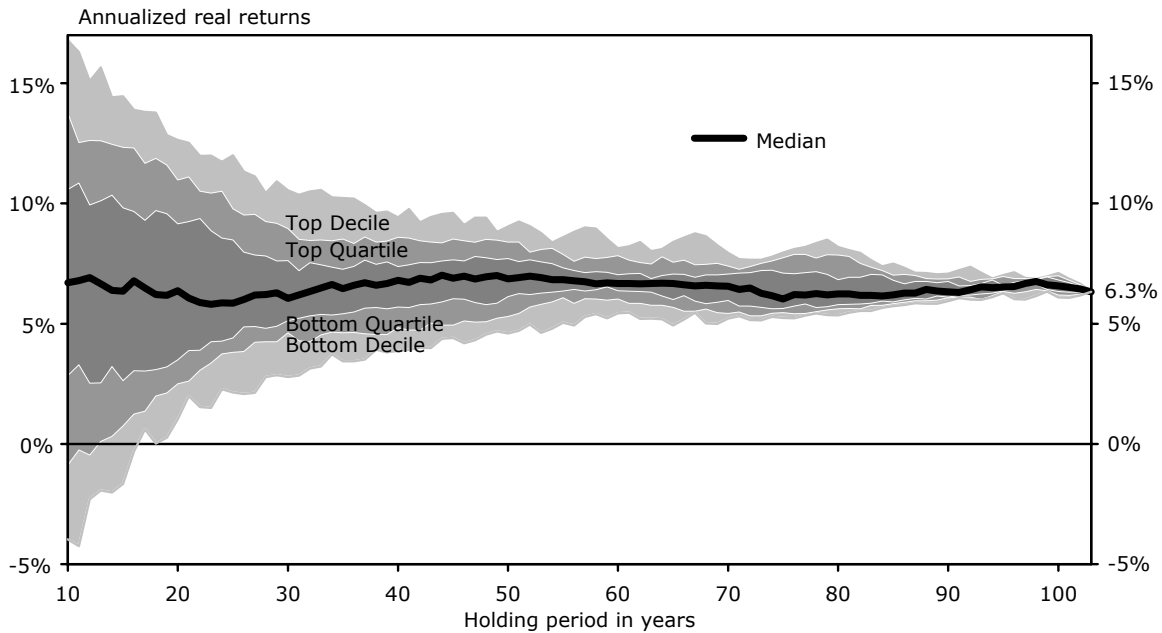
superior long-term returns. And second, because good years will in the long run outweigh bad years, they assume risk can be mitigated by a long holding period. This argument sounds to us like a spurious “get-rich” scheme. If most investors—whose time frame is typically long term—are not exposed to risk over their investment horizons, why should stocks be priced to give investors a large reward for short-term market fluctuations, which would be irrelevant?

In fact, when focusing on long investment horizons, investors often view risk as the probability of experiencing a loss. On this definition, if volatility is held constant but average returns are lowered, then although risk has not changed in terms of standard deviation, the risk of loss is nevertheless higher. This dimension of risk is the one we explore here. For example, if there are two countries with identical volatility but differing average returns, the country with the lower return will be deemed by investors to have been riskier.

Investors’ judgments about average returns often involve extrapolating from history. We thus begin by looking at real stock market returns in the United States from 1900 to the present day. All returns incorporate reinvested dividends and are deflated by using the U.S. Consumer Price Index. Returns are gross of transaction costs, and no deduction has been made for fees or taxes.

Our approach was as follows: For an investment with a time horizon of 10 years, we examined the decades 1900–1909, 1910–1919, and so on, to 1993–2002, which is the 94th of these overlapping 10-year periods. The highest annualized 10-year real return ever experienced from U.S. equities was 16.8 percent, which occurred during 1919–1928; the top one-tenth of these 10-year returns fall in the 13.8–16.8 percent range, and the top one-fourth fall in the 10.6–16.8 percent range. The lowest annualized 10-year real return ever experienced from U.S. equities was –4.0 percent, which occurred during 1965–1974; the bottom one-tenth of all 10-year returns fall in the range of –4.0 percent to –0.9 percent, and the bottom one-fourth fall in the range of –4.0 to +2.8 percent. We examined this distribution of returns to identify the top decile and quartile performance ranges and the bottom decile and quartile performance ranges for holding periods of 10, 11, 12 and more years, up to 103 years.

The results are displayed in Figure 1. The left vertical axis measures the range of real U.S. equity returns, annualized over the corresponding investment interval. Beginning at the left side of the chart, located against a holding period of 10 years is the distribution of annualized 10-year equity real returns as discussed in the previous paragraph. The full shaded area in Figure 1 runs from the maximum (100<sup>th</sup> percentile) down to the minimum (0<sup>th</sup> percentile) of the distribution of estimated

**Figure 1: Annualized real returns on US equities over periods of 10–103 years**

real returns. The depth of the shading in Figure 1 denotes five components of the distribution of returns: The top decile (the highest, light shaded, area) represents favorable returns that occurred one-tenth of the time; the top quartile (the upper two shaded areas) represents favorable returns that occurred one-fourth of the time; the interquartile range (the darkest area in the middle of the figure) represents the middle half of the distribution of returns. The lower two shaded areas represent unfavorable returns that occurred one-fourth of the time, and the bottom decile in the lowest, light shaded, area represents unfavorable returns that occurred one-tenth of the time. The “Median” line indicates the return that was outperformed or underperformed half the time.

Figure 1 reports the distribution of 94 ten-year returns, 93 eleven-year returns, and so on, up to three 101-year returns, two 102-year returns, and one 103-year return. As marked on the right vertical axis, the annualized real return for the entire 1900–2002 period was 6.3 percent. This is what the investment experience would have been, gross of transaction costs, of an investor who had acquired an index-tracking portfolio near New Year’s Day 1900, reinvested all her dividends, and liquidated her entire portfolio at the dawn of 2003.

Two features of Figure 1 appear to support the argument that equities are a safe investment over the long term. First, over the long haul, annualized real equity returns converge toward the 103-

year geometric mean (before costs, fees, and taxes) of 6.3 percent. Not surprisingly, this percentage is close to Siegel's constant,  $s = 6.75$  percent. The small difference arises from our use of different starting and ending dates. Second, as noted by Siegel, for all investment holding periods of at least 20 years, real returns have been positive. Historically, U.S. common stocks have always beaten inflation over the long run when "the long run" is defined as 20 years or more.

The crucial question is, of course, whether investors can rely on such patterns persisting into the future. Prediction is difficult, and a common assumption is that some dimensions of the past will be repeated. We should be cautious, however, about unthinking extrapolation into the future for at least two reasons—survivorship bias and sampling error.

Survivorship bias, or perhaps more correctly, "success bias," relates to the concern that the U.S. market's remarkable success over the last century is typical neither of other countries nor of the future for U.S. stocks. In the next section, we examine the extent to which the United States is special.

The second reason, sampling error, arises because we can observe only a limited number of historical outcomes but, for the future, an infinite number of stock market returns are possible. For example, suppose we are interested in the probable annualized real return of U.S. stocks over a century. Our historical record provides only a few observations: 1900–1999, 7.1 percent; 1901–2000, 6.7 percent; 1902–2001, 6.4 percent; and 1903–2002, 6.1 percent. The range of century-long returns is apparently 1 percentage point. The four estimates of the annualized 100-year real return are similar, however, because they share identical data for 1903–1999. Although there might have been many other historical one-century records, the number of nonoverlapping observations in our database is the length of the research period divided by the investment horizon—in this case,  $103/100 = 1.03$ , or approximately 1 independent observation.

Pension plans and individual investors typically focus on shorter intervals than a century, such as 20 years. If we are interested in a 20-year investment horizon, Figure 1 summarizes no fewer than 84 historical real returns. But of the 84 intervals ending between 1919 and 2002, only five are independent observations: Our sample is too small to provide statistical precision. Extrapolating from only five nonoverlapping 20-year periods allows too much potential error. So, the narrow range of 20-year returns in Figure 1 severely understates the dispersion that might occur in the future.

Figure 1 reveals a wide range of historical 10-year real returns, and this decade-to-decade variation illustrates why analysts often prefer an interval longer than a decade. Corporate advisors typically look at historical returns “to date” and choose among estimates measured from alternative start dates to the present. For example, Stern Stewart & Company analyzes returns over the past 75, 74, . . . , 2, and 1 years, and for estimating the equity risk premium, it has a preference for returns based on data for “the second part of the past century” (see Pettit, Gulic, and Park 2001).

Yet, post-WWII stock market returns and the bull market of the 1980s and 1990s were so strong that most annualized returns estimated to date are flattering to equity markets. The fact that backward-looking real returns converge toward the 103-year geometric mean is no consolation, because that is inevitable with only one 103-year history. The 1980–2002 return exceeds the 103-year average for three-quarters of the countries we studied—all except Australia, Canada, Japan, and South Africa. The 1950–2002 return exceeds the 103-year average for almost every country—all except Australia and South Africa. As Arnott and Bernstein (2002) pointed out, the upward re-valuation of equities in the post-WWII period provided a contribution to equity performance that is unlikely to be repeated in future periods.

### **Is the U.S. Case Special?**

To decide whether the U.S. experience has been anomalous, we need to examine more countries. Table 1 provides summary statistics for real equity returns for the 16 countries in our long-run database. The countries are listed by rank from lowest to highest annualized real return for the 1900–2002 period. The annualized real return on U.S. equities is among the highest, and the standard deviation of U.S. returns is among the lowest. These 16 countries are the only ones for which we have been able to assemble a complete 103-year history of investment returns. Our sample thus omits such countries as Russia, China, and Argentina, whose stock and bond markets have performed poorly and have been highly volatile. Among this wider group of countries, the relative risk and return performance of the U.S. market would appear even more favorable.

Table 1 also shows that the autocorrelation of annual real returns for the U.S. market over the past 103 years was only 0.01. Thus, despite frequently voiced investor beliefs to the contrary, annual returns in the U.S. market have been effectively independent; they show no year-to-year tendency for either persistence or reversal. The mean autocorrelation for the 16 countries shown in Table 1 is 0.07, although there has been considerable variation among the countries.

**Table 1: Summary statistics for annual real equity returns of all 16 markets, 1900–2002**

Country	Geometric mean	Arithmetic mean	Standard deviation	Auto-correlation
Belgium	1.8	4.0	22.1	.23
Italy	2.1	6.2	29.4	.03
Germany	2.8	8.1	32.4	-.17
France	3.1	5.5	22.7	.19
Spain	3.2	5.4	22.0	.33
Japan	4.1	8.8	30.2	.20
Switzerland	4.1	5.9	19.8	.20
Ireland	4.3	6.6	22.2	-.04
Denmark	4.6	6.2	20.1	-.14
Netherlands	5.0	7.0	21.5	.09
UK	5.2	7.1	20.2	-.05
World*	5.4	6.8	17.2	.13
Canada	5.9	7.2	16.9	.17
<b>US</b>	<b>6.3</b>	<b>8.3</b>	<b>20.3</b>	<b>.01</b>
South Africa	6.7	8.9	22.6	.04
Sweden	7.3	9.5	22.7	.13
Australia	7.4	8.9	17.8	-.02

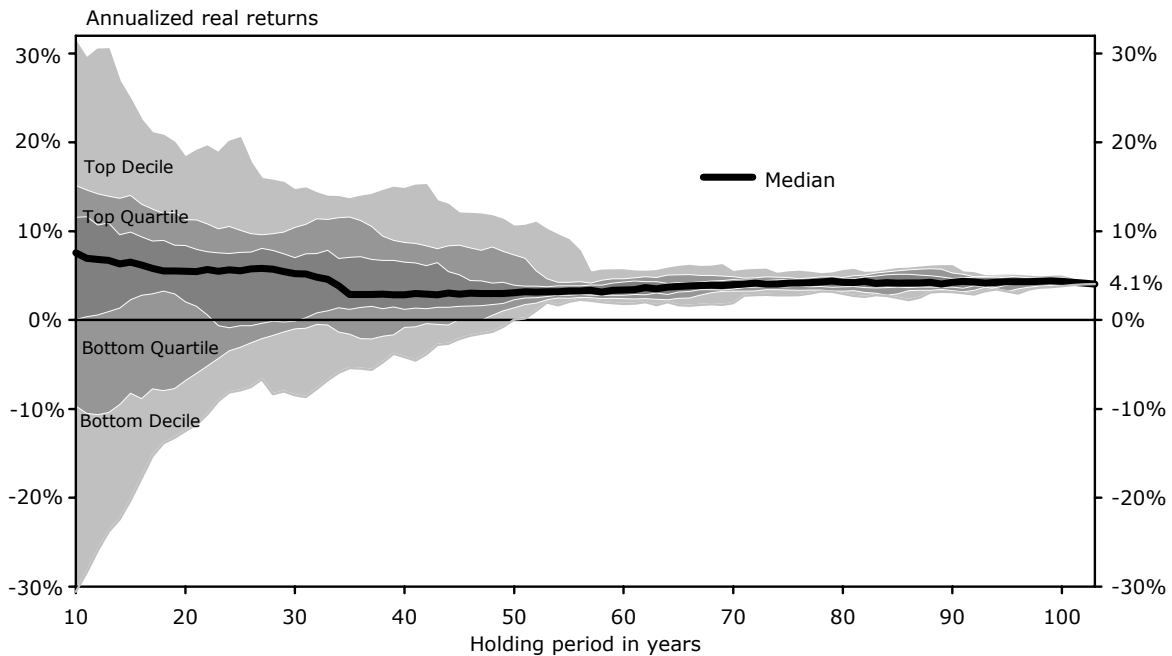
\* The world index is composed of these 16 countries, with each country weighted by its starting-year market capitalization or GDP.

Source: Dimson, Marsh, and Staunton (2002, 2003)

These three attributes of the 103-year historical record of the U.S. stock market—a relatively high historical mean, comparatively low volatility, and the year-to-year independence of returns—help explain why U.S. equities provided a positive real return over all intervals of at least 20 years. Consider these three attributes in turn.

First, if the long-term mean return had been smaller, then all the curves in Figure 1 would plot lower and the lowest returns would have been worse. Second, given the long-term mean, if returns had been more volatile, dispersion would have been greater and the lowest returns would have been worse. Third, if returns had not been uncorrelated over time, more downward-trending intervals might have occurred and the lowest annualized returns could, again, have been worse.

Predictions for the future should account for the complete range of possible stock market outcomes. Thus, we have taken an international perspective, based on the 16 countries in Table 1. We studied each country individually as well as the sample as a whole. Figure 2 shows an analysis for Japan that corresponds to the one for the United States in Figure 1. The Japanese real return is about 2 percentage points (pps) lower than that of U.S. equities, and the standard deviation of annual real returns, at 30.2 percent, is almost 10 pps higher. Over 20-year intervals,

**Figure 2: Annualized real returns on Japanese equities over periods of 10–103 years**

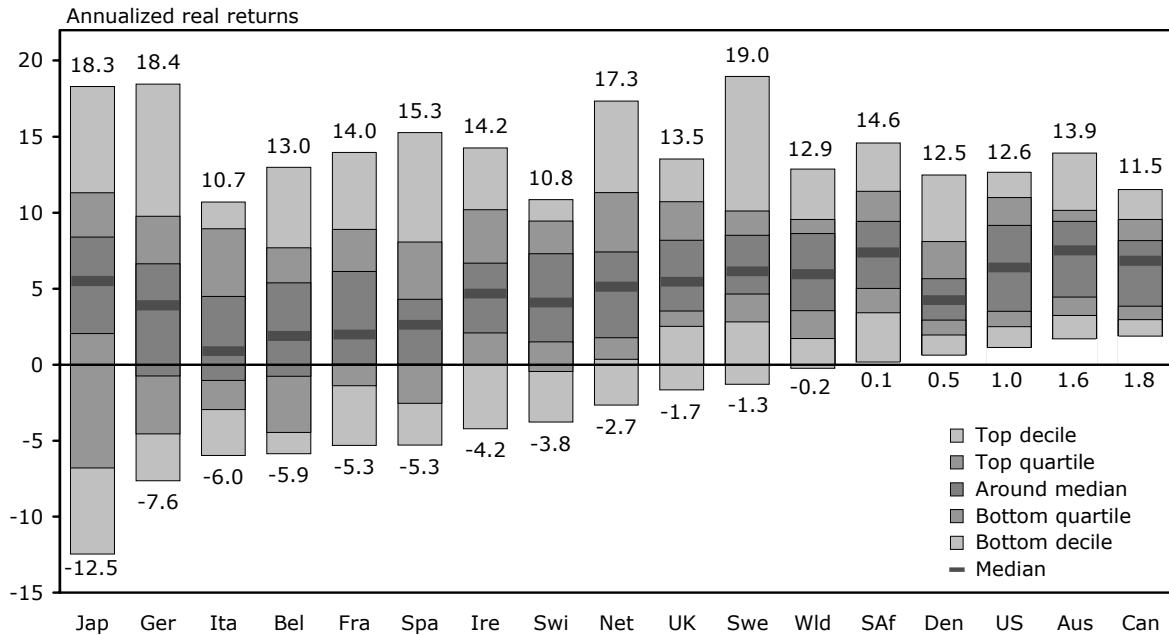
22 percent of all real returns are below zero. Only when we look back at intervals of over 50 years can we say that the real return on Japanese stocks has been consistently positive.

Fifty years is a long time. Could Japan, with its experience of war coupled with high inflation, be exceptional? If Japan is alone in having required an investment horizon longer than 20 years to produce systematically positive real returns, then it has limited relevance for today's investors. In the next section, we check this out by examining the experience of other countries.

### **Inferences from Other Markets**

Global evidence on the extent to which stocks have delivered a positive real return over 20-year periods is in Figure 3. For each country, the shaded bars show the range of 20-year real returns, with the value of the best outcome and the value of the worst. As in Figures 1 and 2, the top decile depicts favorable returns that occurred one-tenth of the time, the top quartile represents favorable returns that occurred one-fourth of the time, and so on. The bold line is the median 20-year real return.

Aside from the United States, only three other equity markets (Canada, Australia, and Denmark) have never experienced a shortfall in real returns (before costs and fees) over 20 years. A fourth

**Figure 3: Percentiles of the distribution of twenty-year real returns, 1900-2002**

country, South Africa, is on the borderline. The worst 20-year real returns of the other 11 countries were negative. For five countries (Germany, Italy, Belgium, France, and Spain), the bottom quartile is close to or below zero, indicating that negative 20-year real returns occurred historically with a frequency of 1 in 4 or greater. For seven countries, the bottom decile was below zero, implying a greater than 1-in-10 occurrence of a negative 20-year return.

For the majority of countries, stocks did not provide a consistently positive real return over the long run, defined as an interval of 20 years. Stocks did, however, provide a positive real return over the very long run. Historically, if they had waited 21–30 years, Swedish, British, Swiss, Irish, and Dutch investors were assured of a positive real return. Japanese, French, German, and Spanish investors, however, would have needed greater patience to be sure of a positive real return; they would have required an investment horizon of 50–60 years. Italian and Belgian investors would have needed an investment horizon of more than 70 years.

Up to this point, we have looked at countries one-by-one, estimating the performance (ignoring costs) of a local stock market investor. Also interesting is the historical experience of a notional investor who held a globally diversified portfolio. We proxied such a portfolio by our “world” equity index—a 16-country index denominated in a common currency (here taken as U.S.

dollars), in which each country is weighted by its starting-year market capitalization or—in years before market capitalizations were available—by its GDP.

As Table 1 shows, over the past 103 years, global diversification via our world index would have lowered the returns earned by a U.S. investor because overseas equities underperformed U.S. stocks and the dollar was strong against most other currencies. At the same time, however, global diversification would have lowered risk.

The bar for the world index in Figure 3 shows the net impact of these factors for our notional U.S.-based global investor. Despite incorporating many countries where investors historically needed horizons much longer than 20 years to avoid losses, the world index nearly met the 20-year test. Although the worst 20-year return was  $-0.2$  percent a year, the annualized real returns were consistently positive over all intervals of at least 21 years.

Initially, and if we focus on global diversification from a U.S. perspective rather than individual national markets, this outcome appears to support the historical case for equities being “safe” over a long run of around 20 years. But the finding that the world index almost meets the 20-year test is not surprising. This test was derived from observations based on U.S. equity returns, and U.S. equities have had a consistently heavy weighting (averaging 52 percent) in the world index.

In addition, our long-run world index is only a theoretical portfolio; in practice, investors could not have held it. Full global diversification was impossible, illegal, or exorbitant during large parts of the last century. It was especially problematic during the world wars, and the world index returns do not include any losses from wartime expropriation. For many investors, international investing was proscribed during periods of exchange control, or it could be accomplished only by buying (at a premium) foreign currency that was designated for this purpose and/or by suffering a larger tax burden than was applicable to domestic investors. Although in more recent decades, many barriers to global diversification were swept aside, investors still show a strong home bias.

Furthermore, our findings for the world index are dependent on being U.S. based. When world index returns are expressed in German marks (now euros) from the perspective of a German citizen, they reveal that a German global investor would have needed to wait 57 years to be assured of a positive real return. Similarly, global investors in the world index from Italy and Japan would have needed horizons of 33 and 34 years. These extended horizons are the result of the historical volatility of real exchange rates.

Financial history has certainly been kind to investors in the United States and many other countries. The stock market boom from WWII to recent times reflected profits in excess of expectations and a fall in investors' required rates of return (see Dimson, Marsh, and Staunton 2003). The key question, of course, is not what investors experienced in the past—whether from national markets or the world index—but what they can expect in the future.

### **Envisioning the Future**

Real returns for 1900–2002 for the United States were 6.3 percent; for other countries they ranged from 1.8 percent in Belgium to 7.4 percent in Australia; and for the world index they were 5.4 percent in real U.S. dollar terms. Taking into account that lower returns were earned in some of the turbulent markets with an incomplete history since 1900, we estimate that the worldwide (all-country) real return on equities averaged close to 5 percent a year before costs, fees, and taxes.

Most countries benefited from an uplift in equity valuations in the past 103 years. Price-to-dividend ratios rose during this period from 23.1 to 63.7 in the United States; from 22.9 to 31.6 in the United Kingdom; and from 22.2 to 50.5 for our 16-country world index. A similar upward shift occurred in P/E multiples (although data are not available for all countries). Because no rationale exists for extrapolating such rising multiples into the future, many writers have noted that today's forward-looking expected equity risk premium must be lower than the historical average. Ibbotson and Chen (2003) estimated a future equity premium that is 1.25 pps below the historical average; Welch (2001) reported a 2 pp drop since 1998 in financial economists' consensus estimate of the equity premium in addition to finding (2000) that these economists expected equities to underperform the historical mean by 1.7 pps; and Bernstein and Arnott (2003) concluded that future real dividend growth will be some 2 pps below GDP growth.

In addition to potentially lower future growth rates of dividends and earnings, the starting point in terms of dividend yield is very different from long ago. The U.S. dividend yield is today only 1.6 percent, and for our 16-country world index, it is just under 2 percent. In 1900, the corresponding dividend yields were around 4.5 percent, and scope was available for rising multiples to enhance returns. Today, P/Es are much higher than they were long ago. The scope for rising valuation levels is greatly curtailed when yields start at a couple of pps and when P/E multiples are high relative to the past (see Campbell and Shiller 2003).

Future real equity returns depend not only on the risk premium but also on the expected real rate of interest. Although we have good reasons to expect a lower risk premium in the future,

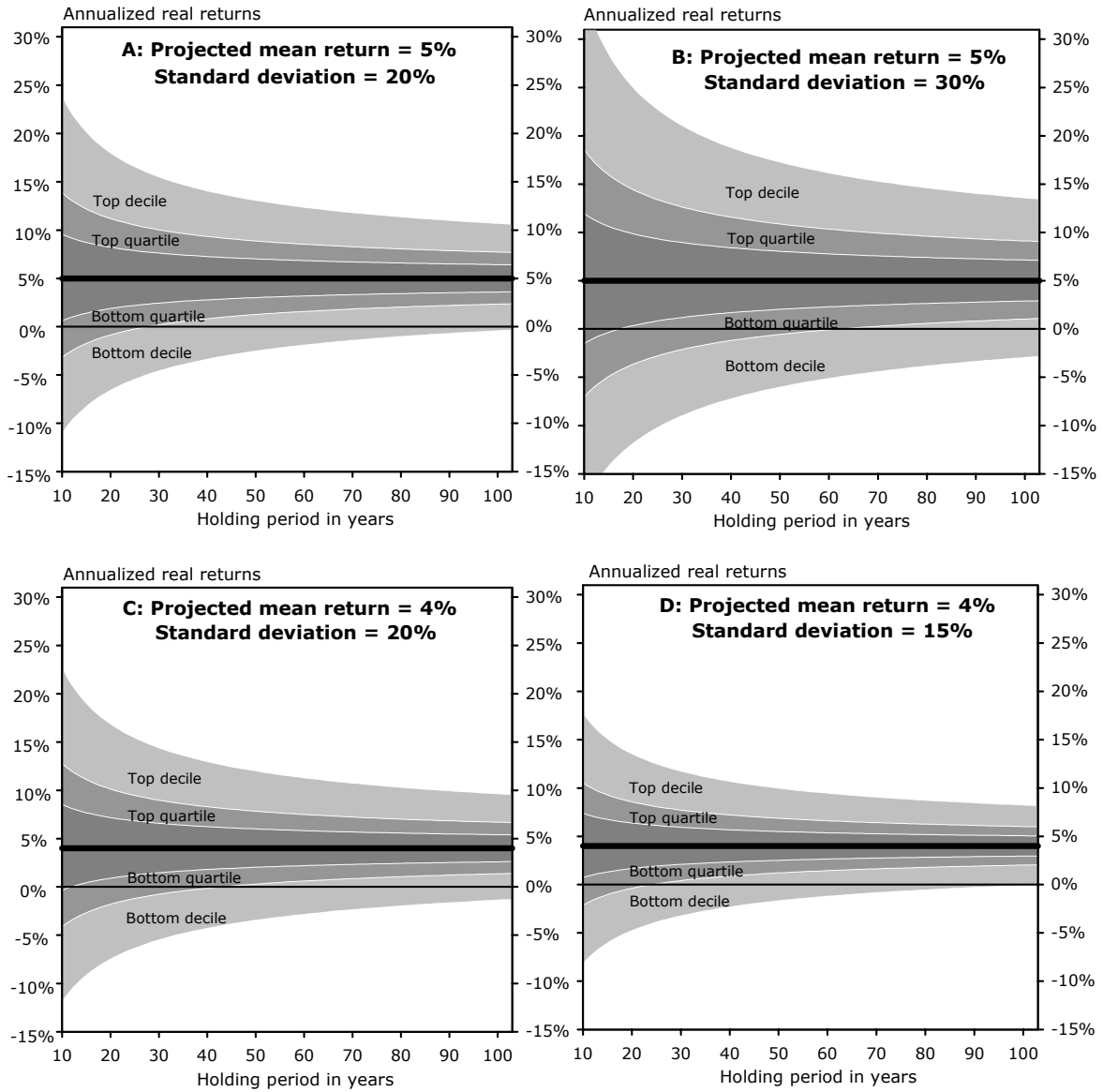
prospective real rates of interest lie above their long-run historical average. For example, for 1900–2002, the U.S. real interest rate averaged 1.0 percent a year, but the rate experienced a breakpoint (as did rates around the world) in about 1980; real rates have averaged 2.6 percent a year since then. Thus, in judging how future real equity returns might differ from their historical worldwide rate of about 5 percent a year, we need to make a downward adjustment for the lower expected risk premium and a (smaller) upward adjustment to reflect projected real rates that are above the long-run historical average.

In Dimson, Marsh, and Staunton (2003), we suggested that a plausible forward-looking equity risk premium for the world's major markets would be approximately 3 percent a year. Relative to Ibbotson and Chen's prediction, we are pessimists, but relative to Bernstein and Arnott, we are optimists. A plausible prospective real interest rate—inferred from the current yields on inflation-protected government bonds—might be about 2 percent. Adding this yield to a risk premium of 3 percent gives a projected real equity return of 5 percent a year, which we used in our first set of projections, shown in Panels A and B of Figure 4. In line with the historical evidence for the United States, we assumed that stock returns have a serial correlation of zero; we further assumed that real returns are lognormally distributed (see De la Grandville 1998).

Figure 4 shows four possible future scenarios for a portfolio invested in U.S. or global equities. To analyze the shortfall risk of this equity portfolio, we considered various levels for the standard deviation of returns. In Panel A of Figure 4, we assumed the 20 percent historical volatility of the U.S. equity index (see Table 1); in Panel B, a 30 percent volatility is assumed (which would be typical of undiversified portfolios, such as many defined-contribution pension plans). We estimated the percentiles of the distribution of annualized returns for investment horizons of 10–103 years. As in the previous figures, we plotted the 10th, 25th, 50th, 75th, and 90th percentiles of the distribution of annual returns. However, we replaced the 0th and 100th percentiles (which, looking to the future, are respectively  $-100$  percent and  $+\infty$ ) by the 1/2th and 99 1/2th percentiles. The shaded area in Figure 4 effectively spans the full range of potential returns; the darker-shaded areas envelop the middle 80 percent of the distribution; the darkest shading contains the middle 50 percent of returns, and the median is the bold line.

Panel A of Figure 4 shows that an investor holding a diversified equity portfolio has a substantial probability of a negative real return even over long investment horizons. For example, over a 20-year horizon, the chance of a negative annualized real return is 14 percent. Over this interval, the bottom decile runs from  $-0.8$  percent to  $-6.4$  percent a year, implying an economically large loss

**Figure 4: Projected distribution of future returns under different assumptions**



in purchasing power over 20 years of between -16 percent and -73 percent. Over 40 years, the probability of a negative real return is 6 percent.

Panel B shows how higher volatility widens the gap between best and worst possible performance. Over 40 years, the probability of a negative real return is 15 percent in this scenario. When expected returns are low and/or markets are volatile, the probability of achieving a negative real return is substantial regardless of the investor's horizon.

The projected shortfall risk in Panel A of Figure 4 exceeds the historical risk of shortfall (see Figure 1)—partly because of the lower real return of 5 percent and partly because, even though we made no change to volatility from its historical level, the focus is on the full range of possible future returns. By construction, historical returns converge on long-term realized performance, but the forward-looking analysis in Figure 4 shows that there is always risk from investing in volatile securities.

We could have also incorporated the impact of uncertainty about the mean and volatility of returns. For instance, suppose we cannot observe the true mean return but are confident that—with equal probability—it is either 4 percent or 6 percent. If so, our estimate of the likelihood of a negative real return would be higher than if we were confident that the true mean return is 5 percent. Similarly, suppose our 20 percent non-time-varying volatility might better be represented by episodes of high and low variability. If so, our estimate of the likelihood of a negative real return would be higher than if we were confident that the volatility is always 20 percent. Incorporating parameter uncertainty would further increase the estimated chance of adverse performance over future periods.

Because some researchers would regard a projected real return of 5 percent to be optimistic, we constructed the bottom two panels of Figure 4 with a real return of 4 percent a year. In Panel C, the standard deviation remains at 20 percent, and in Panel D, we lowered it to 15 percent. Naturally, lowering the mean return as in Panel C leads to a greater probability of loss over all horizons. The probability of a negative real return over 20 years rises to 19 percent (compared with 14 percent when the mean return is 5 percent), and over 40 years, it rises to 11 percent (compared with 6 percent).

Panel D explores the idea that volatility could be lowered by full global diversification (in Table 1, the world index had a historical standard deviation of 17 percent). Panel D shows that although global diversification reduces dispersion and thus the probability of negative returns, an appreciable chance of a negative real return remains—even over long horizons. After 40 years, there is still a 1-in-20 chance of a real loss. Therefore, investors with a relatively strong aversion to downside risk should ensure they have a lower exposure to equities and might think about adopting a time-varying asset mix so as to better control their risk exposure.

Despite the ever-present dangers of losses, the likely rewards from equity investment are worth pursuing over the long haul. Over 20 years, achieving a mean return of 4 percent would mean that

real wealth had increased by a factor of 2.2. Upside potential also is substantial. Panel D shows that a globally diversified investor with a 20-year horizon has a 1-in-10 chance of achieving a return of 8.6 percent or more, equivalent to an increase in real wealth of 5.2 times or greater. The top line in Panel D shows that over this same horizon, there is a 0.5 percent chance of achieving a return of 13.4 percent or more, equivalent to a real wealth increase of at least 12.3 times.

## **Conclusion**

On the one hand, in every country we have examined, equities have beaten bonds, bills, and inflation over the long haul. This outperformance is not simply a pattern from the past; it is consistent with the theory that riskier securities should command a lower price than safer securities. Risky equities can, therefore, be expected to offer a higher expected return. For risk-tolerant investors, that makes equities a desirable long-term investment.

On the other hand, we provided estimates of real returns over the past 103 years that are lower than in previous research. Although stocks have indeed performed well, their margin of outperformance is narrower than was previously surmised. In addition, stock returns were enhanced by upward revaluations that should not be extrapolated into the future. On the evidence of other countries and prospects for a lower equity real return, the apparent superiority of equities will in future years be attenuated. Common stocks cannot be regarded as safe in real terms even when the investor has a horizon of 20 years or more.

Three trends seem likely for the future. First, equity investment will continue to remain risky. Business itself is risky, and the years ahead may well bring new forms of disorder and volatility. The counterparts of international conflict and the Cold War may be new wars on terror, drugs, and the forces of nature. On the upside, business opportunities may arise that are barely reflected in today's stock prices.

Second, given that equities will remain risky, investors should continue to expect a reward for risk. That is, when investors look back a century from now, equities should prove to have been the best performing asset class in the 21st century. Nevertheless, the real return on stocks will turn out to be lower than it was in the 20th century.

Third, stocks do not and cannot offer a guaranteed superior performance over the investment horizon of most investors. To maximize the probability of favorable real returns, equities should be held within a diversified portfolio. Equity exposures should be diversified globally, so as to

dampen domestic stock market volatility. By including multiple asset classes, risk can be brought down still more. If investors fail to diversify efficiently and cost-effectively, they can expect to erode the reward for equity risk exposure.

Equities continue to have an important role in long-term portfolios. However, their prospective returns are lower than the performance that many investors project, while their risk is higher than many investors appreciate. Investors or corporations who assume that favorable equity returns can be relied on in the long term or that stocks are safe so long as they are held for 20 years are optimists. Their optimism is irrational.

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