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Research Institute

Credit Suisse Global Investment Returns Yearbook 2022 Summary Edition

Elroy Dimson, Paul Marsh, Mike Staunton

Thought leadership from Credit Suisse and the world's foremost experts

Summary Edition
Extracts from the Credit Suisse Global Investment Returns Yearbook 2022

Important information

This report contains extracts from the full 268-page Credit Suisse Global Investment Returns Yearbook 2022, which is available in hardcopy upon request – for details, see page 43.

Coverage of 2022 Summary Edition

This Summary Edition contains three extracts from the full Credit Suisse Global Investment Returns Yearbook 2022. The first extract explains the Yearbook's purpose. It describes the DMS Database, which lies at its core and covers all the main asset categories in 35 countries (including three new markets this year). Most of these markets, as well as the 90-country world index, have 122 years of data since 1900.

The second extract addresses two current concerns, rising inflation and the prospect of interest rate rises to combat this. It summarizes the long-run evidence on inflation and shows how stocks and bonds have performed during different inflation regimes and during periods of interest rate hikes. The third extract reproduces in full the Yearbook's new focus chapter on diversification. Finally, there are a selected number of sample "country pages" from the detailed statistical section of the full Yearbook.

The text and charts in the Summary Edition are extracted directly from full Yearbook. The table and chart numbers in the Summary Edition are therefore not always sequential.

Coverage of the full Yearbook

In the full hardcopy 268-page Yearbook, renowned financial historians Professor Elroy Dimson, Professor Paul Marsh and Dr. Mike Staunton assess the returns and risks from investing in equities, bonds, cash, currencies and factors in 35 countries and in five different composite indexes since 1900. The Yearbook has nine chapters. Chapter 1 explains its purpose and coverage. It provides historical perspective on the evolution of equity and bond markets over the last 122 years, and the accompanying industrial transformation.

Chapter 2 summarizes the long-run returns on stocks, bonds, bills, and inflation since 1900.

Chapter 3 focuses on currencies, long-run exchange rate changes, purchasing power parity and the case for hedging.

Chapter 4 looks at risk. It examines extreme periods of history, equity and bond drawdowns, and time-to-recovery. It presents worldwide data on the historical equity risk premium.

Chapter 5 moves from historical to prospective returns. It shows how returns vary with the real interest rate and estimates the prospective equity premium. It provides estimates of expected stock and bond returns, comparing these with returns over recent decades.

Chapter 6 presents evidence on factor investing around the world. It documents the historical premiums from size, value, income, momentum, volatility and multifactor models.

Chapter 7 addresses prospective factor premiums. It reviews the evidence and theoretical basis for premiums and discusses whether they will persist.

Chapter 8 focuses on diversification across stocks, countries and asset classes, and is reproduced in full in this 2022 Summary Edition.

Finally, Chapter 9 presents a detailed historical statistical analysis of the performance of each of the 35 Yearbook countries and five composite indexes, providing three pages of charts, tables and statistics for each country and index. It also documents the data sources and provides references.

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See page 43 for copyright and acknowledgement instructions, guidance on how to gain access to the underlying data, and for more extensive contact details.

Message from the Chairman

We are delighted to publish the 14th edition of the Credit Suisse Global Investment Returns Yearbook produced in collaboration with Professor Elroy Dimson of Cambridge University, Professor Paul Marsh and Dr. Mike Staunton of London Business School. It remains a body of work of which we are exceptionally proud at Credit Suisse, with the unrivalled breadth and quality of its underlying data making it the global authority on the long-run performance of financial assets.

At present, investors are being forced to re-examine the economic parameters that have hitherto shaped much of their investment thinking and professional careers, namely an environment of low inflation and interest rates and abundant liquidity. We believe the Yearbook provides a unique historical perspective to assist asset allocation decisions as we witness a shift from conditions that have proved so supportive for financial assets in the world since the Global Financial Crisis to a potentially less benign backdrop.

To address the key question as to what such a regime shift means for portfolios, the study allows readers to specifically examine stock and bond returns across the full spectrum of inflationary outcomes experienced by the core Yearbook countries stretching across 122 years of history. We can also assess the impact of the associated interest rate hiking cycles. One simple conclusion is that returns deteriorate for both asset classes as inflation rises. This will come as no surprise to bond investors, but there is a firm reminder that equities are not the oft-described "inflation hedge."

While the Yearbook never seeks to provide year-to-year projections for markets, it does help frame appropriate longer-term return assumptions, with the findings shaping the modelling of our own researchers. A halt to the seemingly inexorable fall in real yields and the implicit cost of equity removes a powerful factor that has led to a repricing of equities. It has rewarded "duration" in all its guises. However, being barely positive, risk-free rates still remain exceptionally low historically

and, as the study underlines, should typically serve as an anchor for return expectations for stocks and bonds going forward. With risk free rates close to zero, return projections are essentially a reflection of the reward for risk.

In this year's edition, the authors present a deep-dive into the topic of portfolio diversification or, as the eminent Harry Markowitz once described it, "the only free lunch in finance." Their analysis confirms that the risk-reduction benefits from international and cross-asset diversification remain material over time although they caution against undue complacency. However, in the current environment, a topical question is whether diversification helps in crises. Stock and country diversification does appear to suffer from higher correlation in the short term, though proves less concerning in the longer term. But there is much to be had in crisis periods from cross-asset diversification and in that respect pro-active asset allocation strategies.

We trust you will find this year's edition as insightful as ever and that it helps you navigate through the new investment challenges in 2022.

Axel P. Lehmann
Chairman of the Board of Directors
Credit Suisse Group AG

Introduction and historical perspective

The following is an extract from Chapter 1 of the Credit Suisse Global Investment Returns Yearbook 2022.

This extract explains the purpose of the Yearbook – learning from financial history – and using it to shed light on issues facing investors today, such as rising inflation and rising interest rates. It describes the coverage of the Yearbook – now expanded to 35 countries – and its underlying database. It provides historical perspective on the evolution of equity markets since 1900.

Photo: Buenos Aires, Argentina; Getty Images, Henrik Dolle / EyeEm

Introduction

The Credit Suisse Global Investment Returns Yearbook documents long-run asset returns to help investors learn from the past. Each annual edition adds a further year of data and experience – the long-run is, after all, just a long sequence of short-run periods from the past. Each year brings its own surprises, rewards, setbacks, and inevitably, new investment concerns.

Imagine an investor who slept through 2021, perhaps after reading last year's Yearbook. Awaking on New Year's Day 2022, our investor was told the year had been dominated by new strains of COVID-19, a global supply chain crisis, a surge in energy prices, the rapid return of inflation, the prospect of an end to easy money and a rate hiking cycle, together with concerns that stocks and bonds may no longer be providing a hedge for each other. Against this unpromising background, imagine the investor's surprise when told that global equities gave a return of 18% in 2021, while US stocks returned 25%. In contrast, world bonds fell by 4%.

The American writer Kurt Vonnegut said that "History is merely a list of surprises. It can only prepare us to be surprised yet again." While there is some truth in this, long-run financial history has much more to offer than just to ready us for the next surprise.

The purpose of the Yearbook

The Yearbook documents and analyzes global investment returns over the last 122 years since 1900. Its aim is to use financial history to shed light on issues facing investors today. Various quotes sum up this aim. The philosopher George Santayana said, "Those who cannot remember the past are condemned to repeat it." Historian Niall Ferguson observed, "The past is our only reliable guide to the present and to the multiple futures that lie before us, only one of which will actually happen." Our favorite quotation is from Winston Churchill who said, "The longer you can look back, the farther you can look forward."

Currently, investors have many concerns, but top of the list comes inflation, which rose rapidly in 2021. The worry is not just about inflation, but about the cure for inflation and that this heralds the end of ultra-loose monetary policy and the start of an interest rate hiking cycle.

The Yearbook can enhance our understanding of these issues thanks to its comprehensive and lengthy database. The long period that it spans saw two world wars, civil wars, revolutions, pandemics, crises, slumps, the Great Depression, bear markets, periods of inflation and deflation, and hiking cycles. It also saw times of recovery, growth, and booms; easing cycles and times of looser money; and extended periods of peace, prosperity, and technological advance.

In Chapter 2, we look at the history of inflation around the world and at how stocks and bonds have performed during different inflationary regimes. It is often stated that equities are a hedge against inflation, and we examine this claim. In fact they are not, but over the long run, they have been an excellent inflation beater.

We also examine how stocks, bonds and bills have performed during hiking and easing cycles. There have been stark differences, with hiking cycles proving the more challenging for asset returns. Another topical concern we address is the stock-bond correlation. While over the last two decades investors have grown used to stocks and bonds providing a hedge for each other, we show that this is rather exceptional in the context of the longer-run history.

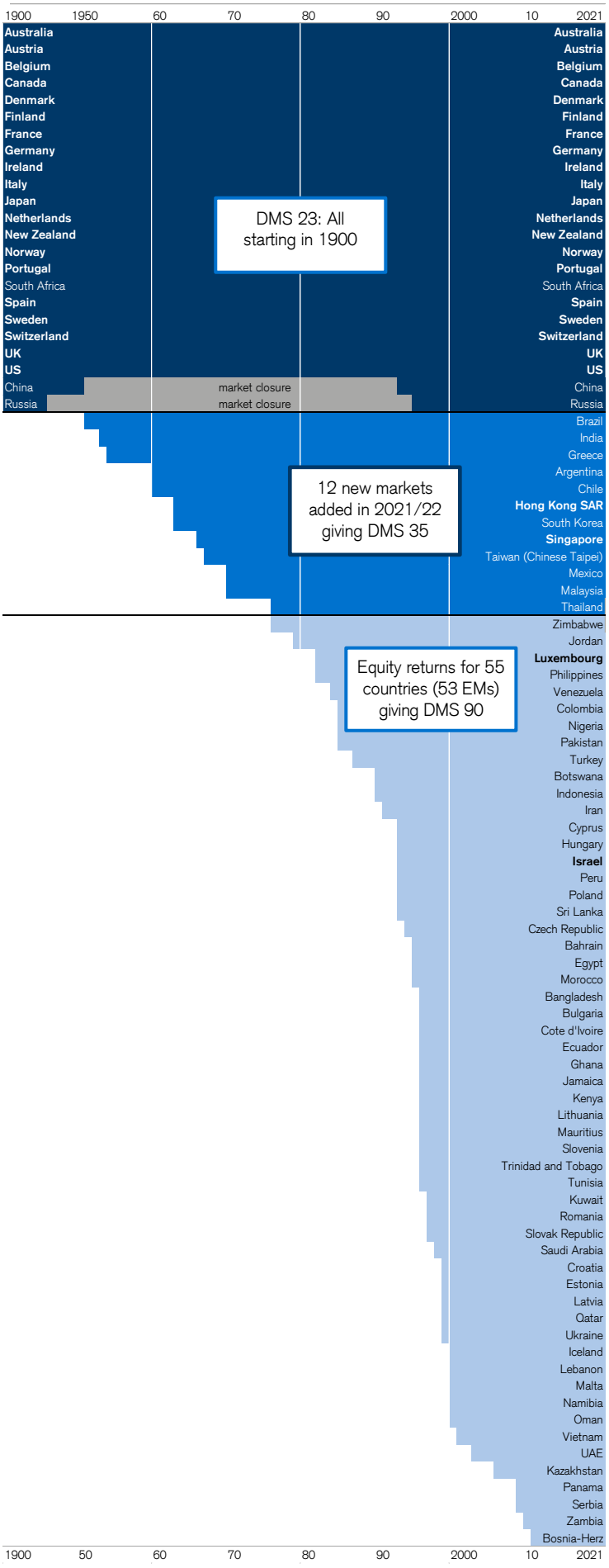
These are the concerns "du jour," but new ones will emerge in 2022. Whatever they may be, the Yearbook provides a rich resource. For example, it provides extensive evidence on the market impact of crises, the duration of market declines and the time to recovery, the impact of fiscal and monetary stimuli on stock and bond prices, the effects of increases and decreases in real interest rates, the impact of low real interest rates on future expected returns, the likely future risk premium, the speed with which we can expect market volatility to revert to "normal", and what the meaning of normal is in financial markets.

The Yearbook database

The core of the Credit Suisse Global Investment Returns Yearbook is the long-run DMS database (Dimson, Marsh, and Staunton, 2022). This provides annual returns on stocks, bonds, bills, inflation and currencies for 35 countries. We believe the unrivalled breadth and quality of its underlying data make the Yearbook the global authority on the long-run performance of stocks, bonds, bills, inflation and currencies. The Yearbook updates and greatly extends the key findings from our book "Triumph of the Optimists."

Of the 35 countries, 23 (the DMS 23) have 122-year histories from 1900 to 2021. Over the last two years, we have added a further 12 markets, with start dates in the second half of the 20th century, with either close to, or more than 50 years of data. Together with the DMS 23, these make up the DMS 35. We feature these 35 individual markets in Chapter 9,

Figure 1: Markets in the DMS long-term dataset, 1900–2021



Source: Elroy Dimson, Paul Marsh and Mike Staunton, DMS Database 2022, Morningstar. Not to be reproduced without express written permission from the authors.

where we present detailed information and historical performance statistics, and list our data sources.

In addition, we monitor 55 additional markets for which we have equity returns data for periods ranging from 13 to 47 years. We also have inflation, currency and market capitalization data, but not yet bond or bill returns. These 55 countries, taken together with the DMS 35, provide a total of 90 developed and emerging markets (the DMS 90), which we use for constructing our long-run equity indexes.

Figure 1 shows the consolidated dataset of 90 markets. The vertical axis lists the markets, ranked by the number of years for which we have data. We include markets only if we have at least a decade of returns. The horizontal axis runs from 1900 to 2021 inclusive. Prior to 1950, the units of time are demi-decades; from 1950 onward, time is measured in years.

The shading in the chart denotes three levels of coverage. The top panel shows the 23 Yearbook countries for which we have data for all asset classes starting in 1900. The DMS 23 comprise the United States and Canada, ten eurozone countries (Austria, Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands, Portugal and Spain), six other European countries (Denmark, Norway, Russia, Sweden, Switzerland and the United Kingdom), four Asia-Pacific markets (Australia, China, Japan and New Zealand) and one African market (South Africa). All have continuous histories except China and Russia. Both had long market closures following total losses to investors after the communist revolutions. They resume when their markets reopened in the early 1990s.

New countries added in 2021/22

The middle panel shows the 12 new markets added in 2021/22, seven from Asia, four from Latin America and one from Europe. Unlike the DMS 23, these markets do not start in 1900, but in the second half of the 20th century. They were added to enhance our emerging market (EM) coverage. All 12 were EMs at their start dates. However, both Hong Kong SAR and Singapore have now long been regarded as developed markets (DMs). In **Figure 1**, we show countries deemed to be DMs today in bold typeface. All the DMS 23 are currently DMs, except for China, Russia and South Africa.

Eight of the new markets have long-established stock exchanges dating back well over a century: Argentina (1854), Brazil (1890), Chile (1893), Greece (1876), Hong Kong SAR (1890), India (1875), Mexico (1894) and Singapore (1911). Unfortunately, we have been unable to obtain total returns data back to the origins of these exchanges. However, we have

assembled 62 years of data for Argentina since1960, 71 years of data for Brazil since 1951, 62 years of data for Chile since 1960, 68 years for Greece since 1954, 59 years for Hong Kong SAR since 1963, 69 years for India since 1953, 53 years for Mexico since 1969 and 56 years for Singapore since 1966.

The other four markets have stock exchanges that were established after World War II, and we have total return series that span almost the entire period since they opened. Thus we have 52 years of data for Malaysia since 1970, 59 years of data for South Korea since 1963, 55 years for Taiwan (Chinese Taipei) from 1967 and 46 years for Thailand from 1976.

The bottom panel of **Figure 1** shows the 55 additional markets. Just two of these are today deemed developed, i.e. Luxembourg and Israel. The remaining 53 markets are all today classified as EMs or frontier markets.

The DMS database also includes five composite indexes for equities and bonds denominated in a common currency, here taken as US dollars. These cover the World, World ex-USA, Europe, Developed markets and Emerging markets. The equity indexes are based on the full DMS 90 universe and are weighted by each country's market capitalization. The bond indexes are based on the DMS 35 and are weighted by gross domestic product (GDP). The five composite indexes all have a full 122-year history starting in 1900.

Together, at the start of 2022, the DMS 35 markets made up 98.7% of the investable equity universe for a global investor, based on free-float market capitalizations. Our 90-country world equity index spans the entire investable universe. We are not aware of any other world index that covers as many as 90 countries.

Most of the DMS 35 and all the DMS 23 countries have experienced market closures at some point, mostly during wartime. In almost all cases, it is possible to bridge these closures and construct a returns history that reflects the experience of investors over the closure period. Russia and China are exceptions. Their markets were interrupted by revolutions, followed by long periods of communist rule. Markets were closed, not just temporarily, but with no intention of reopening, and assets were expropriated.

For 21 countries, we thus have a continuous 122-year history of investment returns. For Russia and China, we have returns for the pre-communist era, and for the period since these markets reopened in the early 1990s.

The expropriation of Russian assets after 1917 and Chinese assets after 1949 could be seen as wealth redistribution, rather than wealth loss. But investors at the time would not have warmed to this view. Shareholders in firms with substantial overseas assets may also have salvaged some equity value, e.g. Chinese companies with assets in Hong Kong (now Hong Kong SAR), and Formosa (now Taiwan (Chinese Taipei)). Despite this, when incorporating these countries into our composite indexes, we assume that shareholders and bondholders in Russia and China suffered total losses in 1917 and 1949. We then re-include these countries in the indexes after their markets re-opened in the early 1990s.

The DMS 23 series all commence in 1900, and this common start date aids international comparisons. Data availability and quality dictated this start date, which proved to be the earliest plausible date that allowed broad coverage with good quality data (see Dimson, Marsh, and Staunton, 2007).

The evolution of equity markets

Although stock markets in 1900 were rather different from today, they were not a new phenomenon. The Amsterdam exchange had already been in existence for nearly 300 years; the London Stock Exchange had been operating for over 200 years; and five other markets, including the New York Stock Exchange, had been in existence for 100 years or more.

Figure 2 shows the relative sizes of equity markets at the end of 1899 (left panel) and how this had changed by end-2021 (right panel). Today the US market dominates its closest rival and accounts for 60% of total world equity market value. Japan (6.2%) is in second place, the UK (3.9%) in third position, while China is in fourth position (3.6%) after underperforming the world index by 46% in 2021. France, Switzerland, Canada and Germany each represent between two and three percent of the global market, followed by Australia, Taiwan (Chinese Taipei), India and South Korea, all with 1.4%–2% weightings.

Note that the right-hand panel of **Figure 2** is based on the free-float market capitalizations of the countries in the FTSE All-World index, which spans the investable universe for a global investor.

In **Figure 2**, 12 of the DMS 35 countries – all those accounting for around 1½% or more of world market capitalization – are shown separately, with the remaining 23 Yearbook markets grouped together as "Smaller DMS 35" with a combined weight of 8.2%. The remaining area of the right-hand pie chart labeled "Not in DMS 35" shows that the 35 Yearbook countries

now cover all but 1.3% of total world market capitalization. This remaining 1.3% is captured within the DMS 90 and is made up almost entirely of emerging and frontier markets.

The left panel of **Figure 2** shows the equivalent breakdown at the end of 1899. At the start of the 20th century, the UK equity market was the largest in the world, accounting for almost a quarter of world capitalization, and dominating the USA (15%). Germany (13%) ranked third, followed by France, Russia, and Austria-Hungary. Again, 11 Yearbook countries are shown separately, while the other 12 countries for which we have data for 1900 are aggregated and labeled "Smaller DMS 23" countries.

In total, the DMS database covered over 95% of the global equity market in 1900. The countries representing the missing 4.7% labeled as "Not in DMS 23" have been captured in later years by the 12 new markets added in 2021/22 and the full DMS 90 database. However, we do not have returns data for these markets back in 1900.

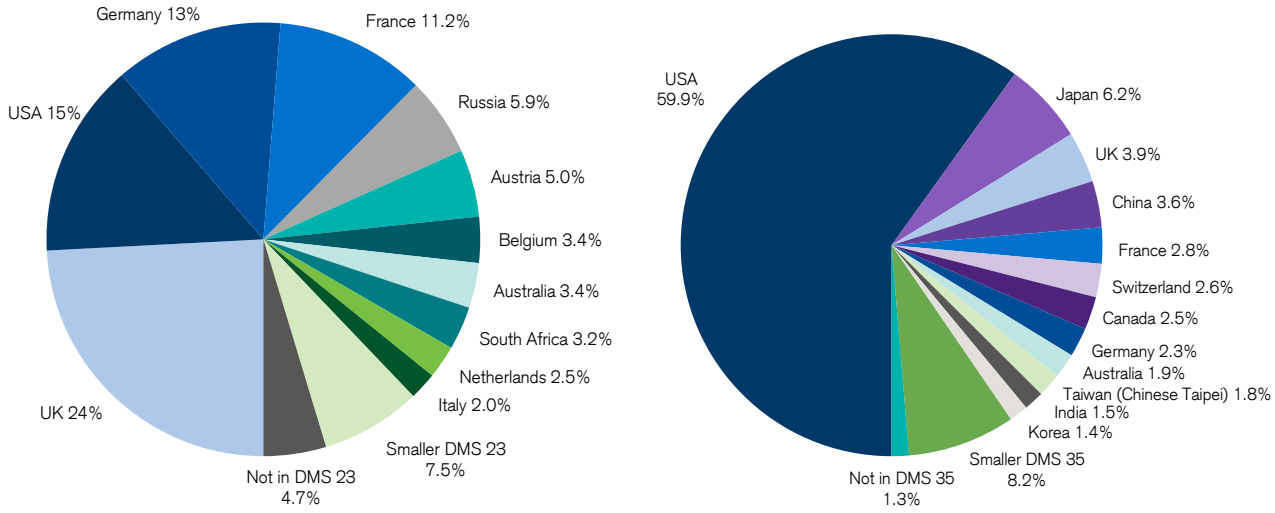
Survivorship bias

A comparison of the left- and right-hand sides of **Figure 2** shows that countries had widely differing fortunes over the intervening 122 years. This raises two important questions. The first relates to survivorship bias. Investors in some countries were lucky, but others suffered financial disaster or very poor returns. If countries in the latter group are omitted, there is a danger of overstating worldwide equity returns.

Austria and Russia are small markets today, accounting for just 0.06% and 0.34% of world capitalization. Similarly, China was a tiny market in 1900, accounting for 0.34% of world equities. In assembling the DMS database, it might have been tempting to ignore these countries, and to avoid the considerable effort required to assemble their returns data back to 1900. However, Russia and China are the two best-known cases of markets that failed to survive, and where investors lost everything. Furthermore, Russia was a large market in 1900, accounting for some 6% of world market capitalization. Austria-Hungary was also large in 1900 (5% of world capitalization) and, while it was not a total investment disaster, it was the worst-performing equity market and the second worst-performing bond market of our 21 countries with continuous investment histories.

Ensuring that the DMS database contained returns data for Austria, China, and Russia from 1900 onward was thus important in eliminating survivorship and "non-success" bias.

Figure 2: Relative sizes of world stock markets, end-1899 (left) versus start-2022 (right)



Sources: Elroy Dimson, Paul Marsh and Mike Staunton, DMS Database 2022, Morningstar; data for the right-hand chart from FTSE Russell All-World Index Series Monthly Review, December 2021. Not to be reproduced without express written permission from the authors.

Success bias

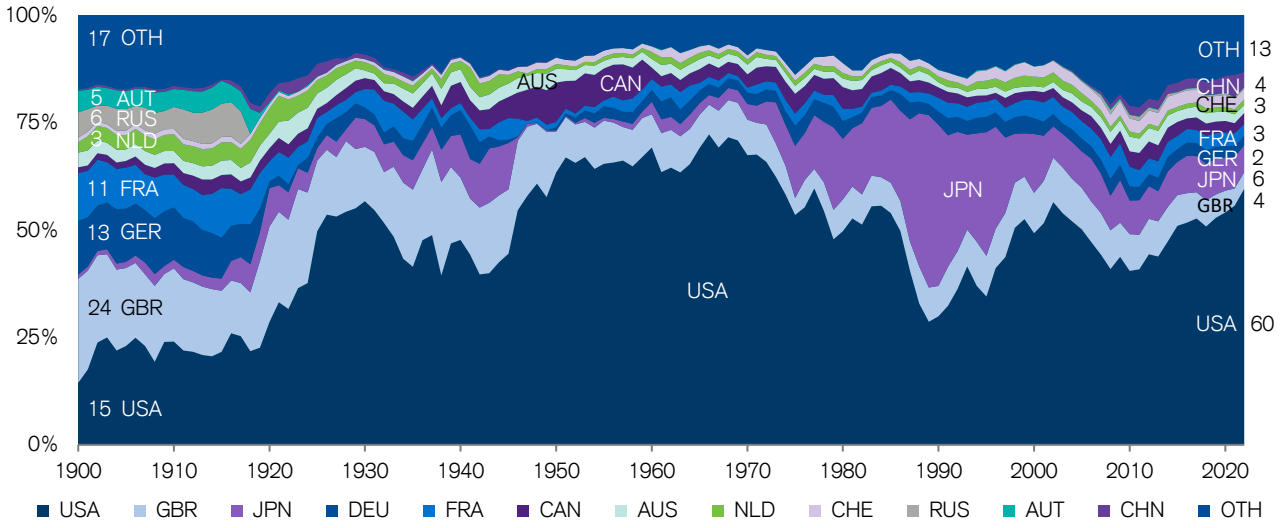
The second and opposite source of bias, namely success bias, is even more serious. **Figure 3** provides insight on this by showing the evolution of equity market weightings for the entire world equity market over the last 122 years. It shows the equity market share for 12 key countries, with other markets aggregated into the "Other" category. In this, and the charts that follow, countries are identified by their ISO 3166 alpha-3 country codes. Mostly, these three-character abbreviations map onto the country's name. For a full list of ISO codes, see page 250.

Figure 3 shows that the US equity market overtook the UK early in the 20th century and has since been the world's dominant market, apart from a short interval at the end of the 1980s, when Japan briefly became the world's largest market. At its peak, at start-1989, Japan accounted for 40% of the world index, versus 29% for the USA. Subsequently, Japan's weighting has fallen to just 6%, reflecting its poor relative stock-market performance. The USA has regained its dominance and today comprises 60% of total world capitalization.

The USA is by far the world's best-documented capital market. Prior to assembly of the DMS database, the evidence cited on long-run asset returns was almost invariably taken from US markets and was typically treated as being universally applicable. Yet organized trading in marketable securities began in Amsterdam in 1602 and London in 1698, but did not commence in New York until 1792.

Since then, the US share of the global stock market has risen from zero to 60%. This reflects the superior performance of the US economy, the large volume of IPOs, and the substantial returns from US stocks. No other market can rival this long-term accomplishment. But this makes it dangerous to generalize from US asset returns since they exhibit "success bias." This is why the Yearbook focuses on global returns.

Figure 3: The evolution of equity markets over time from end-1899 to start-2022



Sources: Elroy Dimson, Paul Marsh and Mike Staunton, DMS Database 2022, Morningstar, and FTSE Russell All-World Index Series weights (recent years). Not to be reproduced without express written permission from the authors.

Inflation and interest rate hikes

The following is an extract from Chapter 2 of the Credit Suisse Global Investment Returns Yearbook 2022 focusing on inflation and its cure.

The winds of change are blowing in financial markets. In recent years, investors have grown accustomed to an environment of low inflation and interest rates and abundant liquidity. Now, at the top of investors' concerns are rapidly rising inflation, and the anticipated cure for this, namely a shift to tighter monetary policy and an interest rate hiking cycle. This extract summarizes the long-run evidence on inflation and shows how stocks and bonds have performed historically during different inflation regimes and during periods of interest rate hikes.

Photo: Paris, France; Getty Images, ElOjoTorpe

Inflation and real interest rates

Inflation was a major force over the 20th century and we clearly need to adjust investment returns for changes in purchasing power. **Table 2** shows inflation rates around the world over the long run. The table is divided into a top panel, showing the 21 countries with continuous histories from 1900 to 2021 and a bottom panel showing the remaining countries in the DMS 35.

In the USA, annualized inflation was 2.9% per year, versus 3.6% in the UK. Thanks to the power of compounding, this apparently small difference meant that, while US consumer prices rose by a factor of 33, UK consumer prices rose 73-fold. Prices did not rise steadily throughout the 122 years and all countries experienced deflation at some stage in the 1920s and early 1930s. In the USA, consumer prices fell almost a third in the years after 1920 and did not regain their 1920 level until 1947.

The top panel of **Table 2** shows that, over the last 122 years, there were seven high-inflation countries: Germany, Austria, Portugal, Finland, France, Japan and Spain. There were two runners-up, Belgium, and South Africa, and one low-inflation country, Switzerland. The other countries fall in between, with inflation of around 3% to 4% per year. Note that the true 122-year mean and standard deviation for Germany are far higher than **Table 2** shows, as the hyper-inflationary years of 1922–23 are omitted. Including these years, the 122-year arithmetic mean inflation rate would be 1.7 billion percent. However, even this massive German figure is dwarfed by Hungarian inflation in July 1946, which reached 42 quintillion percent per month.

Table 2: Inflation rates around the world, 1900–2021

Country	Start year	Geometric mean (%)	Arithmetic mean (%)	Standard error (%)	Standard deviation (%)	Minimum return (%)	Minimum year	Maximum return (%)	Maximum year
Countries and indexes with continuous histories since 1900									
Australia	1900	3.7	3.8	0.5	5.0	–12.6	1921	19.3	1951
Austria	1900	12.2	35.6	23.7	261.4	–4.7	1953	2876.6	1922
Belgium	1900	4.9	5.9	1.5	16.1	–37.9	1919	96.3	1917
Canada	1900	2.9	3.0	0.4	4.4	–15.8	1921	15.1	1917
Denmark	1900	3.6	3.8	0.5	5.9	–15.1	1926	24.4	1940
Finland	1900	6.8	8.4	2.3	25.6	–11.3	1919	241.4	1918
France	1900	6.6	7.2	1.1	11.9	–18.4	1921	65.1	1946
Germany*	1900	4.5	5.3	1.3	14.5	–9.5	1932	209bn	1923
Ireland	1900	4.0	4.2	0.6	6.7	–26.0	1921	23.3	1981
Italy	1900	7.8	10.0	3.0	33.5	–9.7	1931	344.4	1944
Japan	1900	6.4	9.5	3.6	39.9	–18.7	1930	361.1	1946
The Netherlands	1900	2.8	2.9	0.4	4.6	–13.4	1921	18.7	1918
New Zealand	1900	3.6	3.7	0.4	4.5	–12.0	1932	14.7	1980
Norway	1900	3.6	3.8	0.6	7.0	–19.5	1921	40.3	1918
Portugal	1900	7.1	7.9	1.3	14.4	–17.6	1948	80.9	1918
South Africa	1900	4.9	5.2	0.6	7.2	–17.2	1921	47.5	1920
Spain	1900	5.4	5.6	0.6	6.8	–6.7	1928	36.5	1946
Sweden	1900	3.3	3.5	0.6	6.5	–25.2	1921	39.4	1918
Switzerland	1900	2.1	2.2	0.5	5.0	–17.7	1922	25.7	1918
United Kingdom	1900	3.6	3.8	0.6	6.2	–26.0	1921	23.2	1975
United States	1900	2.9	3.0	0.4	4.7	–10.8	1921	20.4	1918
Countries/markets with later start dates or discontinuous histories and hence later re-start dates (China and Russia)									
Argentina	1960	69.6	178.8	82.1	646.3	–1.8	1999	4923.6	1989
Brazil	1951	64.4	169.8	53.5	450.9	1.7	1998	2477.1	1993
Chile	1960	27.7	43.0	13.0	102.4	–1.4	2009	606.1	1973
China	1993	3.6	3.8	1.1	5.7	–1.0	1998	25.5	1994
Greece	1954	7.2	7.5	1.0	8.0	–2.6	2014	30.7	1973
Hong Kong SAR	1963	4.9	5.0	0.6	4.8	–4.1	1999	19.7	1973
India	1953	6.9	7.0	0.7	5.5	–6.1	1975	25.4	1974
Malaysia	1970	3.3	3.3	0.4	3.0	–1.4	2020	17.9	1973
Mexico	1969	19.0	21.8	4.2	30.7	2.1	2015	159.2	1987
Russia	1995	16.3	18.4	5.3	27.5	2.5	2017	131.3	1995
Singapore	1966	2.5	2.6	0.6	4.4	–2.7	1968	27.2	1973
South Korea	1963	7.4	7.6	1.0	7.6	0.5	2020	32.2	1980
Taiwan (Chinese Taipei)	1967	3.6	3.8	0.8	6.3	–1.7	2001	34.0	1974
Thailand	1976	3.8	3.9	0.5	3.7	–0.9	2015	16.8	1980

* For Germany, the means, standard deviation, and standard error are based on 120 years, excluding 1922–23. Sources: Elroy Dimson, Paul Marsh and Mike Staunton, DMS Database 2022, Morningstar. Not to be reproduced without express written permission from the authors.

After experiencing the highest inflation of any Yearbook country in the first half of the 20th century, Germany had the second-lowest inflation rate from 1950 onward (Switzerland had the lowest). Several countries, including the UK, moved in the opposite direction, from having comparatively low inflation to becoming relatively high inflation countries in the second half of the 20th century. US inflation was also higher from 1950 on, but was below the average of other countries in both periods. In many countries, inflation peaked in the 1970s and was gradually brought under control thereafter.

Moving to the bottom panel of **Table 2**, five countries experienced extraordinarily high annualized rates of inflation: 70% in Argentina, 64% in Brazil, 28% in Chile, 19% in Mexico, and 16% in Russia. Argentina was the most extreme and, over a 22-year period from 1970 to 1991, inflation never fell below 20%. It exceeded 100% in 14 years and peaked at 5,000% in 1989. Over the last 15 years, it has been below 20% just once. Brazil came a close second, also experiencing a 22-year period when annual inflation never fell below 20% and six calendar years during which inflation was close to or above 1000%. More recently, Brazilian inflation has been largely under control.

In 17 of the 25 years since 1995, at least one, and, in 2020, as many as eight of the 21 countries shown in the top panel of **Table 2** experienced (generally mild) deflation. Over the last quarter-century, inflation remained very low by historical standards. On average, in each year from 2008 to 2020, over half of the 21 countries had an inflation rate of 2% or less. From 2014 to 2019, an average of 17 of the 21 countries had rates below 2%. In 2020, only one country had an inflation rate above 2% and the average inflation rate across the 21 countries was just 0.42%, its lowest level since 1934.

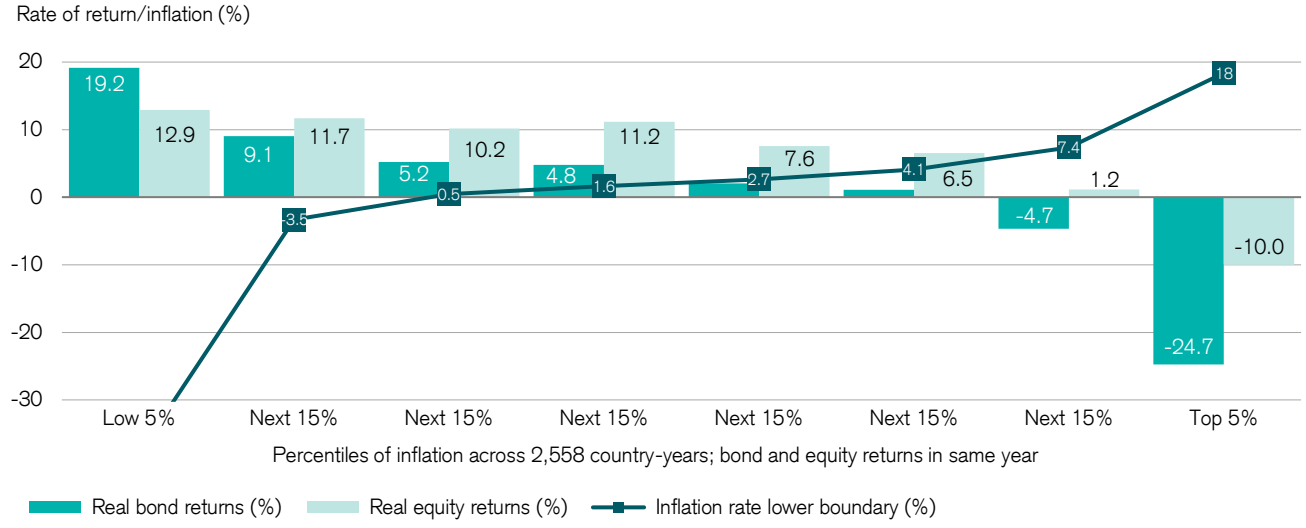
This changed rapidly in 2021 when inflation rose substantially in most of the developed markets in the top panel of **Table 2**. The average inflation rate across the 21 countries rose from 0.42% in 2020 to 4.4% in 2021. Annual inflation rose from 1.4% to 7.0% in the USA (the highest annual figure for 40 years), from 0.6% to 5.4% in the UK (the highest for 30 years), and from –0.3% to 5.3% in Germany (the highest for 40 years). In early 2022, inflation has continued to accelerate.

The resurgence of inflation was triggered by high consumer demand as economies recovered, severe supply chain problems and a poorly anticipated global energy crisis. During 2021, the debate raged between "team transitory" and "team permanent," but central banks and economists now expect inflation to be less transitory than originally expected.

Real bond and equity returns versus inflation

The recent strong uptick in inflation in most developed economies has raised obvious questions about its likely impact on asset returns. Our discussion of bond returns above, showed the major impact that inflation has had on bond returns historically. It is often claimed that equities are a hedge against inflation, but has this been true historically? In **Figure 16**, we compare equity and bond returns with inflation in the same year for the full range of 21 countries

Figure 16: Real bond and equity returns versus inflation rates, 1900–2021



Source: Elroy Dimson, Paul Marsh, and Mike Staunton, DMS Database 2022, Morningstar. Not to be reproduced without express written permission from the authors.

for which we have a complete 122-year history. We exclude the hyperinflationary years of 1922–23 for Germany and 1921–22 for Austria.

Out of 2,558 country-year observations, we identify those with the lowest 5% of inflation rates (i.e. with very marked deflation), the next lowest 15% (which had limited deflation or stable prices), the next 15% (which had inflation of up to 1.6%) and the following 15%; these four groups represent half of our observations, all of which experienced inflation of 2.7% or less.

At the other extreme, we identify the country-year observations with the top 5% of inflation rates, the next highest 15% (which still experienced inflation above 7.4%), the next 15% (which had rates of inflation of 4.1%–7.4%) and the remaining 15%; these four groups represent the other half of our observations, all of which experienced inflation above 2.7%. In **Figure 16**, we plot the lowest inflation rate of each group as a dark turquoise rectangle.

The bars in **Figure 16** are the average real returns on bonds and equities in each of these groups. As one would expect, and as documented in the previous section, the average real return from bonds varies inversely with contemporaneous inflation. In periods of high inflation, real bond returns were particularly poor, while, in deflationary periods, they were excellent. As an asset class, bonds suffer in periods of inflation, but provide a hedge against deflation.

During marked deflation periods, equities gave a real return of 12.9%, greatly underperforming the bond return of 19.2% (see the left of the chart). Over all other intervals, equities outperformed bonds, with an average premium relative to bonds of just over 7%. During marked inflation periods, equities gave a real return of –10.0%, greatly outperforming the bond return of –24.7% (see the right of the chart). Although harmed by high inflation, equities were resilient compared to bonds.

Overall, equities performed especially well in real terms when inflation ran at a low level. High inflation impaired real equity performance, and deflation was associated with deep disappointment compared to government bonds.

Historically, when inflation has been low, the average realized real equity returns have been high, greater than on government bonds and very similar across the different low inflation groupings shown in **Figure 16**.

These results suggest that the correlation between real equity returns and inflation is negative, i.e. equities have been a poor hedge against inflation. There is extensive literature which backs this up. Fama and Schwert (1977), Fama (1981), and Boudoukh and Richardson (1993) are three classic papers, and Tatom (2011) is a useful review article. The negative correlation between inflation and stock prices is cited by Tatom as one of the most commonly accepted empirical facts in finance.

Yet it is widely believed that common stocks must be a good hedge against inflation to the extent that they have had long-run returns that were ahead of inflation. But their high ex-post return is better explained as a large equity risk premium (see Chapters 4 and 5). The magnitude of the equity risk premium tells us nothing about the correlation between equity returns and inflation. It is important to distinguish between beating inflation and hedging against inflation.

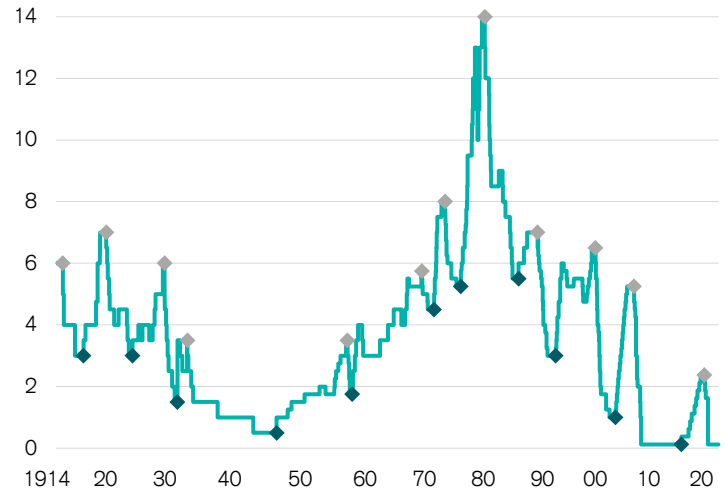
Interest rates and the control of inflation

Periodically, throughout history, there have been times when inflation has flared up – just as it did in 2021. In most countries, central banks are tasked with controlling this. Interest rate hikes are a key tool in controlling inflation. The direct channel of transmission is via bank borrowing costs. Banks pass on rate rises to customers through higher interest rates on credit cards, consumer credit, mortgages, other loans and corporate borrowing. This lowers the amount that consumers can spend, restricts the money supply and helps dampen inflationary pressures.

Financial markets are another key transmission mechanism. Markets rapidly incorporate news, so that rate changes immediately impact stock and bond prices. This alters the value of investors' portfolios, generating a "wealth effect," with lower wealth associated with less future spending and vice versa. Bond price changes reflect changes in the costs of longer-term loans and this impacts real economic activity.

Central banks are reviewing their stance after years of loose monetary policy and their special pandemic support. Several countries have already raised rates in 2021, including the UK, South Korea, Brazil, South Africa, Russia and New Zealand. The US Federal Reserve, European Central Bank and the Bank of Japan are scaling down their emergency support. All eyes, however, are on the Fed, as its interest rate hikes not only affect the USA, but the entire world. Currently, between five and seven rate rises are expected in 2022.

Figure 17: US Fed official interest rates (%), 1914–2021



Source: Elroy Dimson, Paul Marsh, and Mike Staunton, Federal Reserve. Not to be reproduced without express written permission from the authors.

To see what we can learn from history, we examine asset returns over past hiking and easing cycles in the USA and UK. **Figure 17** shows the path of official US interest rates since the Federal Reserve System was created at the end of 1913. It shows the Fed's target rate since 1990 and, before that, the Federal Reserve discount rate. Official interest rates have varied greatly over time, ranging from near zero to a high of 14%. Rates were at their lowest during the Great Depression and World War II, and following the Global Financial Crisis and COVID-19 pandemic. Rates peaked during the high inflation of the late 1970s and early 1980s.

From this chart, we can readily identify periods when interest rates rose – "hiking cycles" or "tightening cycles." Similarly, there are periods of falling rates – "easing cycles" or "loosening cycles." The small dark turquoise diamonds show the start of hiking cycles, while the small gray diamonds show the start of easing cycles.

However, we have identified these turning points visually by ignoring any temporary jaggedness in the pattern of rates over time. So if the chart shows that rates rose from a low to a subsequent high, we define this as a hiking cycle, even though within this there may have been temporary rate cuts that were soon reversed. In real time, however, an investor would observe only the rate cut, not that it was destined to be temporary and be reversed, and that rates would then resume their climb to the high. To have divined the latter would have required clairvoyance.

To circumvent this problem, we adopt a simple trading rule that could be followed in real time. Investing after rate rises involves buying assets on the announcement of an initial rate hike, staying invested as long as rates continue to rise or stay the same, then selling on the announcement of a rate cut. Investing after rate falls involves purchasing after an initial rate cut and then holding until the next rate rise. This is a mechanical way of defining hiking and easing cycles that does not involve hindsight.

By defining cycles in this way, all points in time are designated as either falling within a hiking or an easing cycle. Our US data starts in 1914 and, from 1914 to 2021, US markets were in a rising interest rate mode 45% of the time and in a falling mode 55% of the time. The UK data starts in 1930 and UK markets spent less time in hiking mode (30%) and more time in periods of easier money (70%). The average number of rate hikes during hiking cycles was 4.5 in the USA and 2.5 in the UK. The average number of cuts during easing cycles was 4.7 in the USA and 5.5 in the UK.

Asset returns in hiking and easing cycles

The left-hand chart in **Figure 18** (overleaf) shows the returns from following this strategy. Looking first at the USA, for both stocks and bonds, there were large differences between the returns during rate falls and rises. Equities gave an annualized real return of just 3.0% during rate-rise periods, compared with 9.7% during rate falls. US bonds gave an annualized real return of just 0.2% in the rate-rise regime, compared with 3.7% while rates fell. In contrast, real bill returns were virtually the same under both regimes. The differences in returns between rate-rise and rate-fall periods were statistically significant at the 1% level for both equities and bonds, but insignificant for bills.

The annualized US inflation rate was also higher at 4.2% during hiking cycles compared with 2.3% during periods of easing. This difference was significant at the 0.01% level. Hiking cycles are often triggered by inflation fears and are targeted at bringing it down. To achieve this typically requires multiple rate rises and there are also time lags. So it is unsurprising that inflation tends to be higher during tightening cycles.

The chart shows similar findings for the UK. Stocks gave an annualized real return of just 1.2% during periods of rising rates, versus 8.5% during easing cycles. This difference is statistically significant at the 2% level. UK bonds gave an annualized real return of 1.9% in the rate-rise regime, compared with 2.7% while rates fell, but the difference was not statistically significant. In contrast to the USA, the UK real bill return (real rate of interest) was 1.4% per annum higher during tightening than easing

cycles. As in the USA, the annualized inflation rate during UK tightening cycles was higher (4.9%) than during easing cycles (3.6%), and this was statistically significant at the 1% level.

Premiums in hiking and easing cycles

Earlier in this chapter, we noted that, historically, in both the USA and UK, equities outperformed bonds and bills, providing a substantial risk premium, while bonds, in turn, outperformed bills. **Figure 19** shows that these premiums are elevated during easing cycles and much lower, or even non-existent, during hiking cycles.

During US easing cycles, equities gave a return that was 9.3% per year higher than that on Treasury bills, which was a far higher premium than the 2.7% during tightening cycles. But, even in tightening cycles, investors would have been better off remaining in stocks. During these periods, they would have been marginally better off in cash than bonds as the annualized premium of bonds versus bills was –0.1%. Note that the entire premium from long-term bond returns relative to bills was earned during easing cycles. These differences were statistically significant at the 1% level.

The UK results are very similar, but the chart shows that, in the UK, the entire long-run premiums of equities over Treasury bills, and of equities over bonds, were earned during easing cycles. During tightening cycles, investors would have received 0.6% more per annum from cash, and 0.7% more from bonds. Before transaction costs, investors would have been better off and would have experienced lower risk by selling out of equities during tightening cycles. As in the USA, the premium of bonds over bills was appreciably lower during tightening cycles, although it remained just above zero in the UK.

Volatility and Sharpe ratios

An obvious question is whether the return differences between hiking and easing cycles could be due to risk. The left-hand side of **Figure 20** shows that the volatility of equities and bonds was higher during easing cycles. Equity volatility was 27% higher in the USA and 5% larger in the UK, while bond volatility was 9% higher in the USA and 13% greater in the UK.

The right-hand side of the chart shows the corresponding Sharpe ratios, which measure the reward per unit of volatility. The Sharpe ratio is defined as the real annualized asset return less the real Treasury bill rate, all divided by the standard deviation of the real asset returns. Despite the higher volatility during easing cycles, the Sharpe ratios are still well above the corresponding ratios during hiking cycles. During easing cycles, US equities had a Sharpe ratio of 0.47 compared with 0.18 during periods of rising rates. The figures for the UK, 0.50 and –0.04, show an even larger gap. US bonds had a Sharpe ratio of 0.38 during easing cycles compared with –0.01 during hiking cycles. UK bonds had a Sharpe ratio of 0.26 during easing cycles and 0.02 during periods of rising rates.

Prospective returns in hiking cycles

Historically, the returns on stocks and bonds have been much lower during hiking than easing cycles. Indeed, Dimson, Marsh and Staunton (2016) report that during hiking cycles, it has historically been hard to identify assets that perform well. On average, periods of interest rate rises have been accompanied by inferior industry returns, smaller rewards from many factor investing strategies, and lower price appreciation for a wide variety of real assets.

Figure 18: Asset returns after rate rises and falls

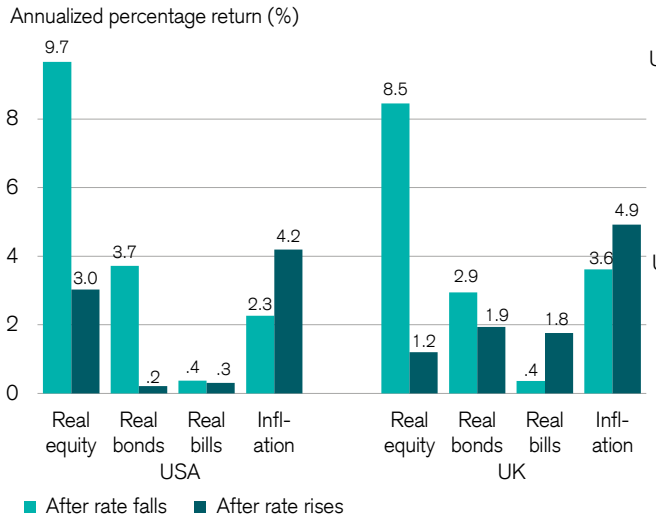
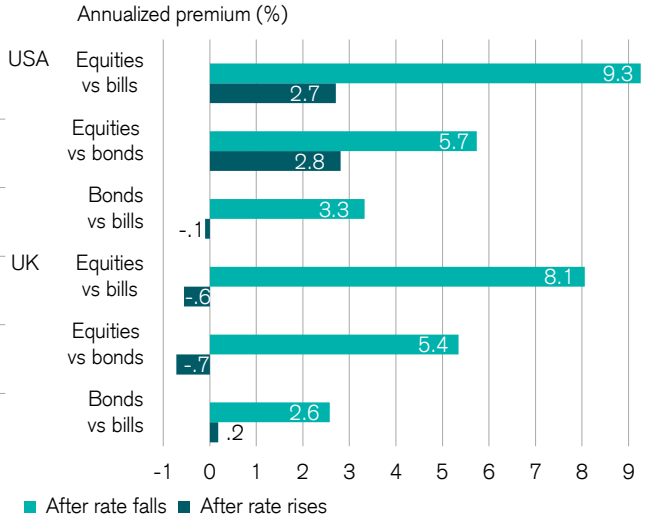
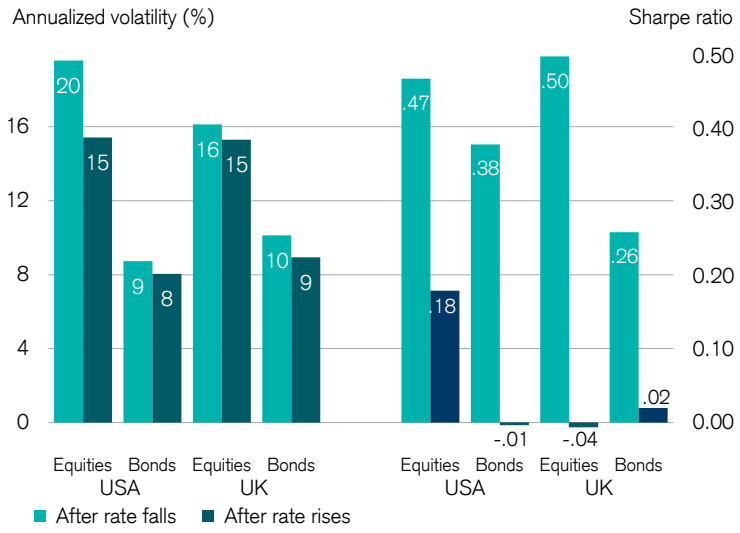


Figure 19: Premiums after rate rises and falls



Sources: Elroy Dimson, Paul Marsh, and Mike Staunton, DMS Database 2022, Morningstar. Not to be reproduced without express written permission from the authors.

Figure 20: Volatilities and Sharpe ratios; rate rises and falls



Source: Elroy Dimson, Paul Marsh, and Mike Staunton, DMS Database 2022, Morningstar. Not to be reproduced without express written permission from the authors.

However, they did find relative outperformance from defensive versus cyclical stocks and from large- versus small-cap stocks. Now that the USA and many other countries appear to be entering a period of rising interest rates, does this imply that prospective asset returns are likely to be low?

While history can undoubtedly provide clues to the future, we should be cautious about any forecasts. The results above are long-term averages spanning many different economic conditions. They conceal considerable differences between cycles. Indeed, during 40% of US hiking cycles, equities performed better than during the easing cycles that preceded them. During the two most recent Fed tightening cycles – from June 2004 to September 2007 and from December 2015 to July 2019 – US and global stocks and bonds performed well.

Furthermore, the prospective rate rises have been well signaled, and should therefore be largely priced in. In addition, central banks and governments will also not wish to choke off the post-pandemic recovery.

Stock and bond returns have been lower during periods of rising interest rates. But these have also been periods of higher inflation. As we saw earlier in this chapter, higher levels of inflation have historically been associated with lower returns from stocks and bonds. It thus remains an open question whether the poorer asset returns during rate hiking cycles are due to the "illness" (inflation) or the "cure" (rate hikes).

Diversification

The following extract is from the Credit Suisse Global Investment Returns Yearbook 2022 and reproduces the entire Chapter 8 on "Diversification," which is this year's new focus topic.

Diversification across stocks, countries and assets reduces risk so investors can earn the same return with lower risk, or a higher return for the same risk. Globalization has lowered the potential risk reduction from international diversification; but although the benefits remain large, they are not guaranteed. Over the last 50 years, US investors would have been better off staying at home, rather than investing globally. Stock-bond diversification has been effective in recent years due to a negative stock-bond correlation, but we caution against relying on it continuing. Finally, we examine diversification during crises. Short-term correlations are higher at such times, but this should not be a major concern to long-run investors.

Photo: Santiago de Chile, Chile; Getty Images, Ruben Earth

The only free lunch in finance

Seventy years ago, Harry Markowitz (1952) published "Portfolio Selection," which laid the foundations of modern portfolio theory and won him a Nobel Prize. He showed that a portfolio's risk is not defined by the average riskiness of its individual assets, but by the extent to which the returns on those assets are correlated or move together.

Markowitz demonstrated that diversification allows investors to increase expected return while reducing risk. He argued that "diversification is the only free lunch in finance." Investors are urged to diversify across stocks, countries and asset classes. We examine each of these in turn.

Diversifying across stocks

Almost every textbook in investments or corporate finance includes a chart like the one on the left in **Figure 66**. It shows the average risk (standard deviation) of portfolios containing different numbers of stocks. The portfolios here were selected randomly from stocks traded on the New York Stock Exchange from 2011 to 2020. As more stocks are added to the portfolio, diversification reduces risk rapidly at first, then more slowly. The risk that it reduces is known as diversifiable risk, or sometimes as unique, specific, or residual risk. The horizontal line shows the risk of an equally weighted portfolio of all stocks. This irreducible risk is known as market or systematic risk.

Charts like this are invariably based on equally weighted portfolios. In aggregate, however, investors hold a value-weighted portfolio. Value-weighted "n-stock" portfolios show even larger levels of diversifiable risk than equally weighted portfolios.

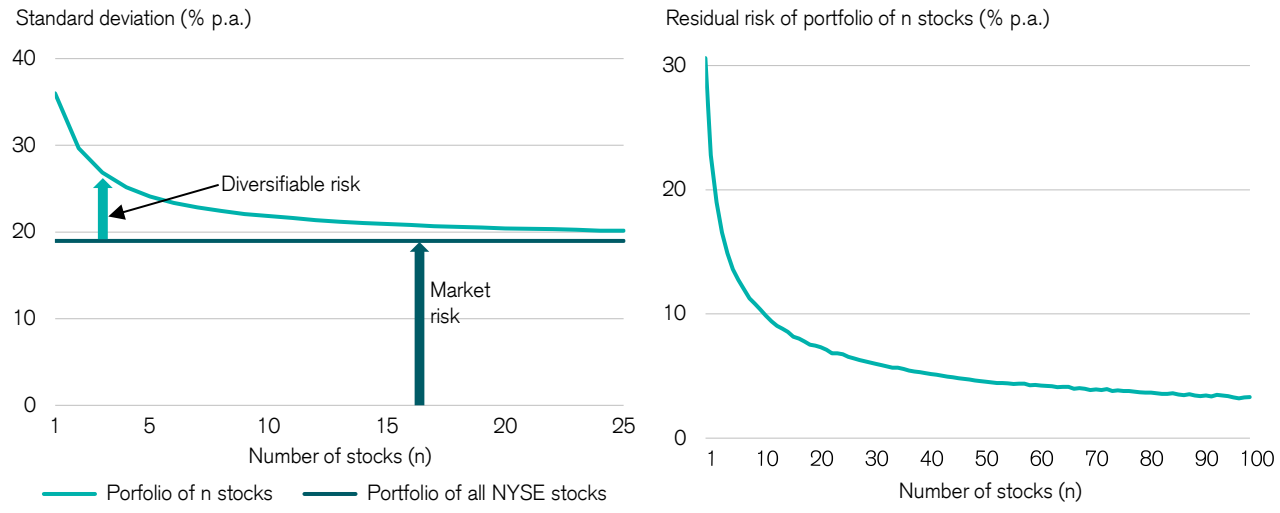
Conventional wisdom is that a small number of stocks – say 10 to 20 – is sufficient to provide market-mimicking returns. That interpretation is misleading, as Bennett and Sias (2011) have pointed out. Many more stocks are needed to create a well-diversified portfolio. It would be more helpful if the standard diversification chart was presented as on the right-hand side of **Figure 66**, which shows the fall in unsystematic risk as the number of stocks is increased. It shows that even with 100 stocks, the tracking error is still 3.3% per annum.

The costs of underdiversification

Despite the longstanding and widespread advice to hold well-diversified portfolios, many studies find that most investors hold very concentrated portfolios. Goetzmann and Kumar (2008), for example, analyzed more than 60,000 investors at a large US discount brokerage house. Their average holding was four stocks (the median was three). Only 5% held fewer than ten stocks. The level of underdiversification was greater among younger, low-income, less educated and less sophisticated investors.

There are large costs to being underdiversified. Bessembinder (2018) shows that the majority of US stocks (57.4%) have had lifetime buy-and-hold returns below that on Treasury bills. Since 1926, the best-performing 4% of companies explain the net gain for the entire US stock market. This is caused by the strong positive skewness in individual stock returns. The positive premium over bills that we observe for overall stock markets is driven by very large returns for

Figure 66: How overall portfolio risk (left) and residual portfolio risk (right) vary with the number of stocks



Source: Elroy Dimson, Paul Marsh, and Mike Staunton using data from Refinitiv. Not to be reproduced without express written permission of the authors.

relatively few stocks. Bessembinder et al. (2021) examined some 64,000 stocks from 42 countries and showed that the same pattern held for non-US stocks. The average individual with a concentrated portfolio is thus likely to receive less than the return on the overall market.

However, the costs of underdiversification are far greater than this. A Danish study by Florentsen, Nielsson, Raahauge and Rangvid (2019) analyzed a database for 4.4 million Danish investors. They showed that investors could increase their expected return by up to 3% a year by moving from the concentrated portfolio they typically held to an index fund with the same overall risk. Investors could have achieved this by decreasing cash or short-term bond holdings and increasing the index fund holding, or via leverage, thus gaining greater exposure to the equity premium. This reinforces a key point made by Markowitz. Diversification allows us to either reduce risk for the same level of expected return or increase expected returns for the same level of risk.

Overdiversification/diworsification

The term "diworsification" was devised by legendary investor Peter Lynch to describe companies that diversified into new businesses where they had little experience or expertise, rather than sticking to their core competencies. The usage of the term has subsequently been expanded to refer to the overdiversification of an investment portfolio in such a way that it reduces the overall risk-return characteristics.

Overdiversification occurs when an investor or fund manager has information or insights that are not being fully exploited because the portfolio is too diversified. You cannot beat the market by holding it. To beat the market, you need the skill to generate alpha – sometimes known as excess return or abnormal return, or return above the benchmark. Assuming you have such skill, you need to take large-enough positions to exploit it. This involves taking on additional unsystematic risk/tracking error and not being too diversified.

Individuals with no ability to predict alpha should hold an index fund. At the other extreme, highly skilled individuals or fund managers should run very concentrated portfolios. To judge whether a fund is overdiversified, we need to know how skilled the manager is. While this is difficult, there is nevertheless strong circumstantial evidence that many funds are overdiversified.

Alexeev and Tapon (2014) report that, according to Morningstar, the number of stocks held by the average domestic US equity fund in 2012 was 176, with an interquartile range of 128 to 583. These numbers seem remarkably high for actively managed funds. Closet index funds are those purporting to be actively managed, but which have portfolios that are sufficiently close to their benchmark to make superior performance unlikely – despite charging active management fees. Closet indexing is increasingly attracting the attention of regulators and even class actions from investors.

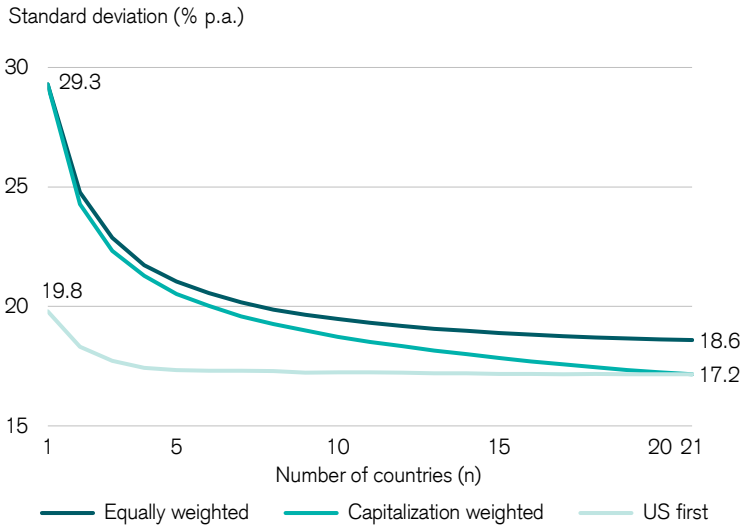
Diversifying across countries

Figure 66 shows how diversification across individual stocks rapidly reduces risk. But what about the question, "Why not diversify internationally rather than domestically?" That was the title of an influential article by Bruno Solnik (1974).

Solnik focused on the USA and seven European countries. For each one, he produced charts like **Figure 66**. He repeated the analysis with stocks selected from all eight countries and found that "In terms of variability of return, an internationally well-diversified portfolio would be … half as risky as a well-diversified portfolio of US stocks (with the same number of holdings)." He concluded that diversifying globally greatly reduces risk. Solnik's analysis was based on stocks, but a focus on diversification across countries supports his conclusion. **Figure 67** is based on the 21 DMS countries with continuous histories since 1900. It shows how risk for a dollar-based investor falls as the number of countries is increased.

The top, darker colored line shows the standard deviation (SD) for portfolios that give equal weight to each country, while the second line down shows the equivalent SDs when countries are weighted by their market capitalizations. For the one-country portfolio, these two lines show the average SD of the 21 countries. For the 21-

Figure 67: Diversifying across countries, 1900–2021



Source: Elroy Dimson, Paul Marsh, and Mike Staunton, DMS Database 2022, Morningstar. Not to be reproduced without express written permission of the authors.

country portfolio, they show the SD of the equally weighted and capitalization weighted 21-country "World". The 2- to 20-country portfolios were selected randomly from the 21 DMS countries, without repeating countries. For these portfolios, the SDs plotted in the chart are averaged across 10,000 random iterations.

Figure 67 shows that the SD of 29.3% for a typical single-country investment falls off to 18.6% for an equally weighted 21-country portfolio. For the capitalization-weighted 21-country world index, it falls to 17.2%. These 37% and 41% risk reductions are large.

These strategies are not very realistic. The assumption of equally weighted investments is pervasive in research on the gains from diversification. However, equally weighted results can be misleading, especially for an investor based in the USA, which today accounts for 60% of world capitalization. It is unrealistic to assume that investors will hold the same amount in small markets as in large ones. Assets must, in aggregate, be held in proportion to their market values.

However, even the capitalization-weighted results are unrealistic. They assume, as do the equally weighted results, that the one-country portfolio could, equally plausibly, be any one of the 21 countries, while the two-country portfolios span all possible two-country pairings and so on. More realistically, we would expect that, for a US investor, the one-country portfolio would be the USA, with other markets then being added to the US core.

The bottom line in **Figure 67** labeled "US first" shows the risk reduction achieved by a US investor who started with a single country holding in the USA and then diversified by selecting the largest foreign markets first, holding each in proportion to its size. Once this portfolio is invested in all 21 countries, it becomes the capitalization weighted 21-country "world" index. This strategy involves a reduction in risk from 19.8% (the SD of the US market over this period) to 17.3% (the SD of the 21-country world).

This 13% reduction in risk, while still worthwhile, is much lower than suggested by the upper two lines in **Figure 67**. This is because the one-country starting point is the USA, which was among the world's lowest risk countries. For most of the period covered, the US market dominated world equities and the size of the US market ensured that it was already very well diversified. The benefits of global diversification are much larger for smaller more-concentrated markets and for higher volatility markets.

Note also that the 13% risk reduction implied by the "US-first" strategy is a far cry from Solnik's claim that global diversification could reduce risk by half for a US-based investor.

A brief history of global investment

Figure 67 assumed that cross-border investment was possible and costless throughout the period from 1900 to date. In fact, full international diversification was not always possible during the 20th century. There was a U-shaped pattern of globalization, with international investment commonplace at both ends of the century. During the period in between, from the First World War through to the 1970s, many barriers and costs inhibited cross-border investment.

At the start of the 20th century, there was extensive cross-border investment. London was then the world's leading financial center and Conant (1908) estimates that, in 1900, at least 23% and perhaps as much as 51% of UK citizens' securities holdings were invested abroad. Paris ranked second after London and 32% of the value of French-owned securities was held in foreign stocks and bonds. For Germany, the figure was 46%.

World War I had a major dampening effect on international investment. Capital controls proliferated and then, in the 1920s, German hyperinflation and the Wall Street Crash crushed confidence. Foreign investment collapsed after 1929 and capital controls and protectionism characterized the period until World War II.

After the war, the tide turned again, but restrictions continued for many years. The United States imposed interest equalization tax from 1963–74; the Japanese financial markets were effectively closed to foreigners until the 1980s, and the United Kingdom, Germany and France all had periods of capital control, some continuing until the 1980s. In addition to restrictions on capital movements, there were constraints on cross-border holdings, complex tax barriers, poor information flows, few derivative instruments for hedging and very limited passive country index investment vehicles. As Cooper (2001) points out, the costs of achieving international diversification may well then have significantly offset the benefits.

Since the 1970s, these barriers and costs have been progressively swept aside. Following the 1971 breakdown of the Bretton Woods system of fixed exchange rates, most major currencies have floated freely, removing the risk of sudden large devaluations. While investors still face exchange-rate risk, currency, interest rate and equity market risk can now all be hedged cheaply. Barriers to international capital movement have mostly been dismantled. Low-fee passive vehicles including ETFs abound. Information is rapidly and widely

available and in ever greater volume. Accounting, tax, governance, trading and issuance systems are being harmonized.

When Solnik began advocating international investment, he remarked that US equity investors "regarded participation in international markets as exotic at best and usually irrational." Yet, wittingly or unwittingly, Americans followed his advice. In 1974, according to Solnik, US pension funds had never invested outside the USA. By 2019, they held 38% of their equities abroad (FTSE Russell, 2019). Overall, US investors increased the percentage of equities held abroad from 1% in 1980 to 12% by end-2000 (Dimson, Marsh and Staunton (2002)) and 18% in 2019 (Wallmeier and Iseli (2021)). But did they benefit from this?

Should US investors have gone global?

To judge how Americans have fared from investing globally, we compare the real return from domestic US investment with the real return they would have achieved from investing in the world index. Initially, we examine an unhedged investment in the world index, where the latter is denominated in US dollars and converted to real terms using US inflation. We ignore all costs and taxes.

The world index is taken as the capitalization-weighted index of all DMS countries with a continuous history over each period examined. Note that the world index includes a holding in the investor's domestic market and, for US investors, this is substantial. At the start of 2022, the US market had a 60% weighting in the world index.

The risk reduction from diversification is a key motive for investing internationally. We thus make comparisons using a metric that captures both risk and return. We use the Sharpe ratio, which measures the reward per unit of risk. It is defined as the excess return – the return minus the US risk-free rate – divided by the standard deviation.

Figure 68 compares the Sharpe ratios for a US investor who diversified domestically and one who invested globally in the world index over five different periods. The first of these, 1974–2021, spans the period since the publication of Solnik's article to the present – reflecting the experience of a pioneer global investor. Disappointingly, over this period, a US investor would have fared better by investing at home with a Sharpe ratio of 0.40 compared with 0.33 from global investment.

The second set of bars in **Figure 68** relates to 1980–2021. Global investment for a US investor in 1980 would have been adventurous, rather than pioneering. Sadly, the outcome is again disappointing, with the Sharpe ratio (0.47) for domestic equities exceeding that for the world index (0.36). The third and fourth sets of bars are for later starters, who initiated global investment in 1990 and 2000. The story is the same: domestic investment outperformed global.

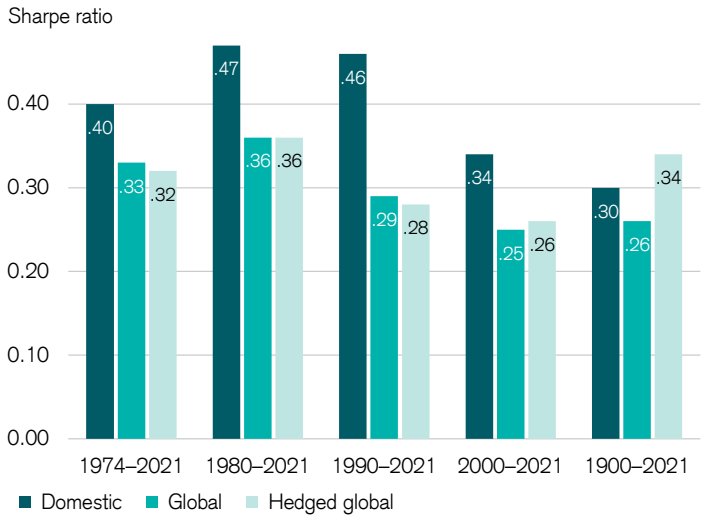
From 1980 onward, US investors made increasingly large investments in overseas equities. However, in risk-return terms, they would have been better off staying at home. With hindsight, following Solnik's advice proved a costly mistake. Moreover, this is before taking account of the higher costs of investing internationally in the earlier part of this period.

For a US investor, domestic investment beat global investment over these four (overlapping) periods for two reasons. First, US equities performed exceptionally well. Over the 48 years from 1974 to 2021, US stocks beat non-US stocks by 1.9% per year. Over the 32 years since 1990, the outperformance was even greater at 4.6% per annum. Dimson, Marsh and Staunton (2021) have documented this continuing outperformance of US equities and describe it as a case of "American exceptionalism."

Second, over this period, global diversification failed to lower volatility for US investors. The US equity market was among the world's least volatile as its size, scope and breadth ensured that it was highly diversified. Over the 1974–2021 period, the equally weighted average SD of non-US countries in the world index was almost double that of the US market. US investors had less to gain from risk reduction than their foreign counterparts.

Global diversification also involves exposure to currency risk. For each country in the world index, the global investor is taking a stake in two assets, the country's equity market and its currency. The

Figure 68: Global diversification for a US investor



Source: Elroy Dimson, Paul Marsh, and Mike Staunton using DMS data. Not to be reproduced without express written permission of the authors.

net effect of the lower risk of the US market and of currency risk in the world index was that, for a US investor, the SD of the world index was marginally higher than the SD of the US market over the first four periods shown in **Figure 68**.

Currency hedging

Currency risk can of course be hedged. Investors can hedge by selling futures/forward currency contracts or by borrowing foreign currency to fund the investment. We do not have access to long-run data on forward rates (if such data were even to exist), so we assume hedging is via back-to-back short-term loans, borrowing in foreign currency and lending in the domestic currency. This is anyway equivalent to a forward contract since arbitrage opportunities force the difference in interest rates to be equal to the difference between the forward and spot exchange rates.

Hedging can reduce, but cannot eliminate risk, as future returns are uncertain and we therefore do not know in advance how much to hedge. Most strategies involve hedging the initial capital over the period until the hedge is rebalanced. We use annual data and annual rebalancing.

The impact of currency hedging on returns (as opposed to risk) is a zero-sum game. The profit a German investor makes on Swiss assets if the franc appreciates against the euro is offset by the loss the Swiss investor incurs on German assets. Jensen's inequality states that the profit from an appreciating currency always exceeds the loss in a depreciating currency, but, in practical terms, this effect is insignificant. Averaged over all reference currencies and countries, the mean return advantage to hedging is zero. For specific currencies and time periods, however, the impact can be appreciable.

Returning to **Figure 68**, the third lighter-shaded bar for each period shows the Sharpe ratio for currency-hedged global investment. For the four post-Solnik periods that we have already examined, hedging has only a minimal impact. The Sharpe ratio for global investment either remains unchanged or else is marginally lower.

This seems surprising, as hedging reduced risk, lowering the SD of the world index by an average of 6.7% over these four periods. However, this risk reduction was counterbalanced by an average fall in return of 36 basis points per annum. Why was hedging costly for the US investor in terms of lowered returns? Hedging causes the reallocation of exposure from a basket of currencies back to the dollar. Over these four periods, US dollar exposure reduced real returns, compared with accepting exposure to the other currencies in the basket. The US dollar was weak against the currencies that mattered most in the world index weightings, most notably the Japanese yen.

Over the last half century, US investors would have been better off investing in their home market than globally, whether or not they hedged foreign currency exposure. These are ex-post results with outcomes observed with hindsight. Markets are uncertain and good decisions made before the event can easily result in disappointing outcomes. The fact that, over this period, US investors did better by staying domestic does not mean that past decisions to go global were misjudged or that domestic investment is the correct decision for the future.

The final set of bars in the chart shows the domestic versus global comparison for the full historical period from 1900 to 2021. Domestic investment once again beat unhedged global investment, but hedged global investment performed best of all. Over the full period, currency hedging reduced the SD of the global portfolio by 11%, while it increased the annualized return by 76 basis points per year. Over the very long run, returns were enhanced by being in the US dollar, rather than a basket of other currencies.

Global diversification gains across countries

Since the 1970s, there has been a gradual, but very substantial increase in international portfolio investment. While Americans would have been better off staying at home, did investors elsewhere gain from investing abroad?

To investigate this, we focus again on the period since Solnik wrote his influential article advocating cross-border investment, namely 1974–2021. In 1974, the DMS world equity index contained 32 countries, including the USA (the DMS 35 countries except for China, Russia and Thailand). We look at each of these to see whether investors were better off staying in their home market or investing globally.

For each of the 32 countries, we compare local real equity returns with the real returns on a holding in the world equity index from the perspective of that country. In all cases, investing in the world equity index involves an investment in the same underlying equities with the same weightings. However, the real returns on the world index differ for each reference country. This is because they are converted into the currency of the country in question and deflated to real terms using that country's inflation rate.

We compare domestic with global investment by computing the difference between the Sharpe ratio for global investment and the equivalent ratio for domestic investment. A positive value indicates gains from global diversification, while a negative value indicates that the investors of that country would have been better off investing domestically. We examine both unhedged and currency-hedged global diversification.

Figure 69 presents the results. The darker bars show the gain from unhedged global diversification. Countries are ranked from left to right in ascending order of these gains. The lighter bars show the gains from currency-hedged global diversification. Bars below the zero line indicate that investors would have been better off – in terms of reward for risk – investing domestically.

Looking first at the USA, the chart repeats what we reported in **Figure 68**. Unhedged global diversification had a Sharpe ratio that was 0.07 lower than domestic diversification, i.e., 0.33 – 0.40 = –0.07; for currency hedged global diversification, the figure was 0.32 – 0.40 = –0.08. **Figure 69** plots these two differences.

There were eight countries, including the USA, where, with hindsight, investors would have been better off staying local. As with the USA, the explanations lie in high (ex post) local real returns, and/or below average riskiness (SD) of local real returns, plus factors linked to currency risk and return.

All eight countries enjoyed exceptionally high local real returns, except Switzerland, where returns were average. However, unhedged global diversification for a Swiss investor involved moving out of the very strong Swiss franc, thereby lowering returns. When currency risk was hedged, **Figure 69** shows that Swiss investors were better off investing globally.

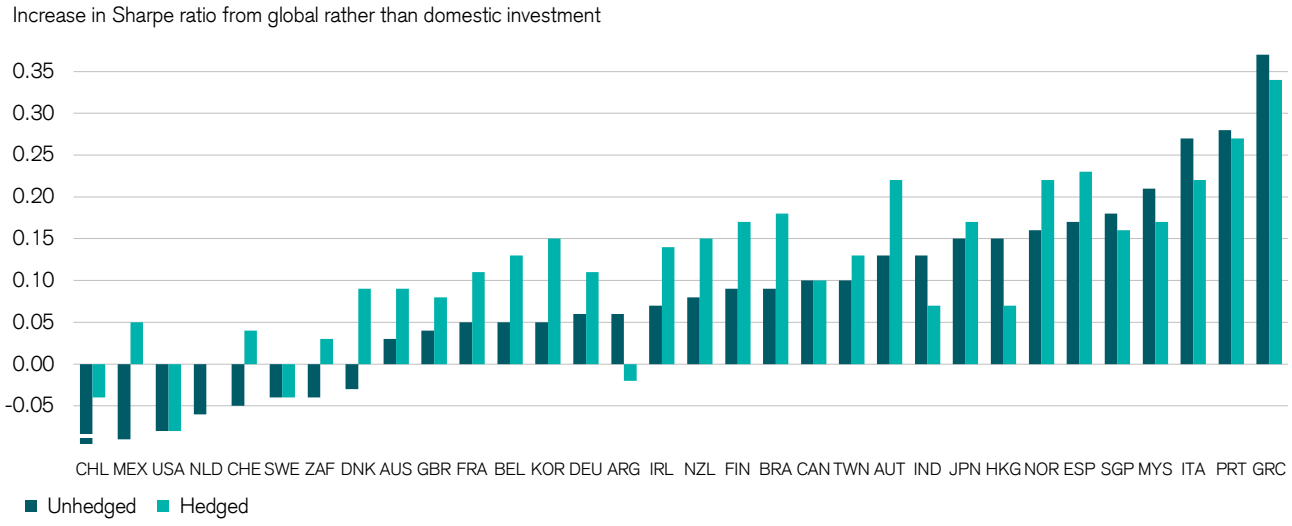
Similarly, except for Chile and Mexico, the equity markets for these eight countries had below average risk. Four had especially low SDs, thereby restricting the potential risk reduction from global diversification. Mexican real returns had a high SD, but the volatility of the Mexican peso meant that the SD of the world portfolio for a Mexican investor was marginally higher than that of local returns.

This was unusual. Across all 32 countries, the SD of the unhedged world portfolio was, on average, 26% below that of domestic investment (37% on a hedged basis). However, for four countries, unhedged global diversification proved riskier than domestic investment. For Mexico, the USA and Switzerland, the difference was small, but, for South Africa, unhedged global investment was much riskier (SD of 27%) than domestic investment (SD of 21%) due to the volatility of the South African rand.

Figure 69 shows that, when currency risk was hedged, investors in only the USA, Sweden, Chile and Argentina were better off staying domestic rather than investing globally. Although Swedish and Chilean investors could both have reduced risk by 36% by investing globally, this was not enough to compensate for these two countries' world-beating domestic returns over this period. For Argentina, although hedging modestly reduced the risk of global investment, it led to lower returns. For The Netherlands, domestic and global were level-pegging, while, for the remaining 27 countries, hedged global beat domestic investment.

The USA was thus an outlier, albeit a very important one. However, we are observing these results with hindsight. Ex ante, it is hard to predict which countries will perform best or where domestic investment might beat global. There is no obvious reason to expect continued American exceptionalism. Surely, US corporate superiority should by now be priced in?

Figure 69: Domestic versus global investment for the 32 countries in the world index, 1974–2021



Source: Elroy Dimson, Paul Marsh, and Mike Staunton, DMS database 2022, Morningstar. Not to be reproduced without express written permission of the authors.

Prospectively, therefore, the advice to investors from all countries, including the USA – despite its historical record – is that they should invest globally. This is very likely to reduce risk and increase the Sharpe ratio, although this is not guaranteed. However, the benefits will not be uniform. Many smaller countries have highly concentrated stock markets. Even some larger markets, such as Japan, the UK, Germany and France have limited domestic exposure to key sectors such as technology. These countries have potentially more to gain from international diversification than US investors as the US market is already very large, broad and highly diversified.

Have correlations changed over time?

The scope for risk reduction from global diversification depends on the magnitude of the correlations between the returns from different countries. Low correlations imply greater scope for risk reduction. Have correlations changed over time?

Goetzmann, Li, and Rouwenhorst (2005) show how correlations between equity markets changed between 1872 and 2000 over seven successive subperiods representing distinct economic and political conditions. Their estimates for four core countries – the United States, the United Kingdom, France and Germany – are shown in **Figure 70**. We have updated their analysis by adding correlations for an eighth period, 2001–2021.

Correlations have clearly changed over time. For example, the US:UK correlation has varied from near zero (–0.01) to 0.81, while the US:Germany correlation has ranged from –0.28 to +0.88. During the two world wars, several correlations were negative as one might expect between opposing sides. While low correlations imply higher diversification benefits, wars are precisely the times when international investment is hardest and ownership claims most likely to be rescinded.

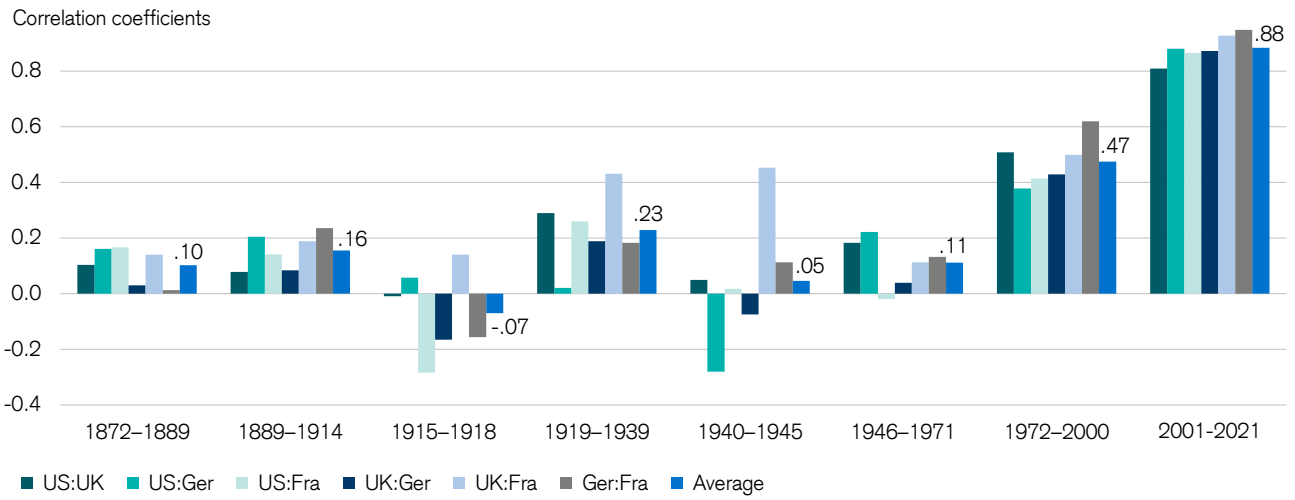
The final (blue) bar for each sub-period in **Figure 70** shows that the average correlation level also varied over time. Goetzmann, Li, and Rouwenhorst show that these differences in both the level and structure of correlations were statistically significant. The two "early integration" periods before World War I were statistically indistinguishable. The war periods were quite different, with low average correlations of –0.07 in World War I and 0.05 in World War II.

Equity returns in all other periods showed appreciable inter-linkages. Returns were modestly correlated before World War I, between the wars, and in the 1946–71 Bretton Woods period, and strongly correlated in the post-Bretton Woods period of growing international investment and highly correlated in what we might label the globalization period from 2001.

But, while there were some similarities between the "early integration" and Bretton Woods periods, the correlation structures otherwise differed considerably. The inter-war period, with its post-war boom, hyperinflation in Germany, the Wall Street Crash, and the Great Depression, was unique. Correlations were quite high due to common factors such as the crash and Depression, but the correlation structure differed from all other periods.

Broadly, we can view the two early periods from 1872 to 1914, plus the two later periods from 1972 to 2021 as the era of integrated global markets. In the in-between years from 1915 to

Figure 70: Correlations coefficients between four countries over eight successive subperiods, 1872–2021



Source: Goetzmann, Li and Rouwenhorst (2005), first seven periods; Dimson, Marsh and Staunton using MSCI data for the eighth period (2001–21). Not to be reproduced without express written permission of the authors.

1971, markets were more segmented. **Figure 70** strongly suggests that, post Bretton Woods, correlations have been much higher and have been increasing. We now examine this and its implications more closely.

Falling benefits from global diversification?

Figure 71 provides a more comprehensive look at how correlations have changed over time since the 1970s. In **Figure 70**, this period was divided into two and just four countries were considered. In contrast, **Figure 71** examines ten subperiods and is based on data for up to 52 countries.

Figure 71 uses monthly returns data from MSCI over the 52 years from 1970 to 2021. The ten consecutive subperiods shown in **Figure 71** each span 60 months (five years), except for the first and last, which cover 72 months (six years). Our analysis covers 21 developed markets (DMs) and 31 emerging markets (EMs) (which, in terms of MSCI classifications, are a mixture of EMs and frontier markets, but which we refer to generically as EMs). By no means all countries start at end-1969, so the sample expands as data accumulates for more countries. By end-1987, we have returns for 21 DMs and 18 EMs and, by mid-2002, the coverage expands to 21 DMs and 29 EMs.

The darker bars in the left-hand panel show how the average correlation between DMs has changed over time. In each period, we compute the average correlation between USD-denominated equity returns for every pairing of DMs for which data is available. Correlations have risen, but not monotonically. They are higher than would be expected from the general upward trend in the periods 1986–90 and 2006–10. The first of these saw the October 1987 Crash, while the second included the Global Financial Crisis. It is well known that correlations tend to be elevated during crises, a topic we will examine in greater detail below.

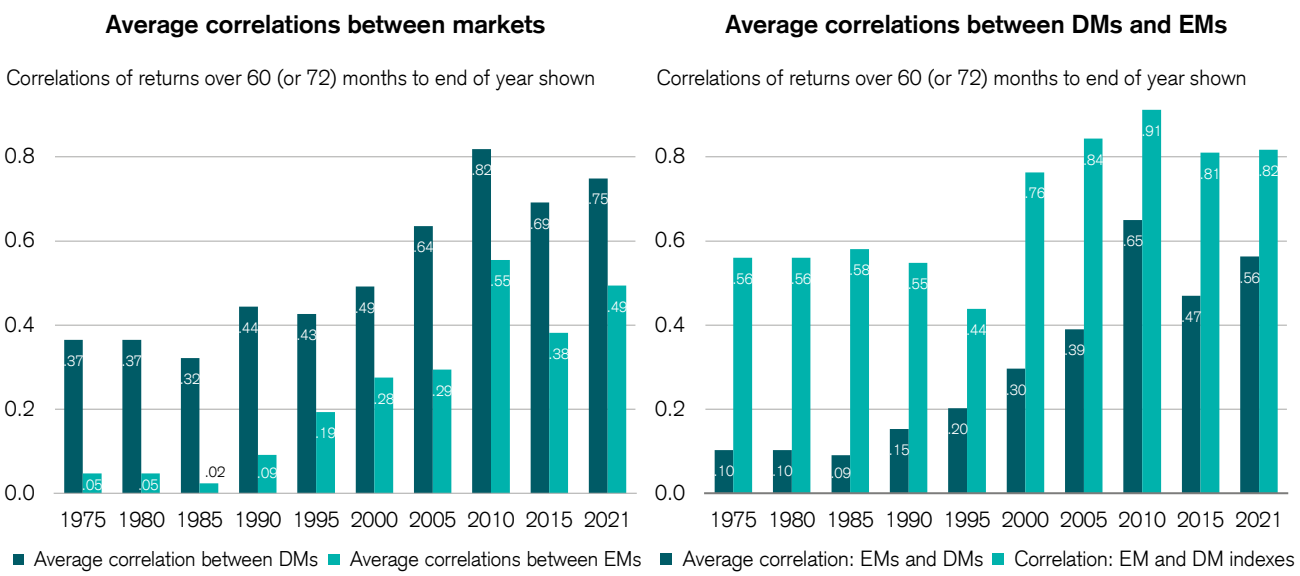
The lighter bars in the left-hand panel show the same pattern for the average correlation between all pairs of EMs. While these were well below the averages for DMs, they increase markedly over time. Again, the average correlation is higher than would be expected from the overall upward trend during the period including the Global Financial Crisis.

The average correlation between DMs more than doubled from 0.37 in the early 1970s to 0.75 in the most recent period. The corresponding increase for EMs was from a very low base of 0.05 to 0.49. These increases have coincided with and been driven by the removal of barriers, and by the increased globalization of economies and markets. Ironically, with correlations now at a level unmatched in the past, this has reduced the potential gains from diversification. Despite this, some textbooks still cite quite high potential gains, based perhaps on old data or unrealistic assumptions. Our estimates suggest that global investors in most DMs can now expect a more modest, but still useful level of risk reduction from global diversification.

Diversification into emerging markets

Goetzmann, Li and Rouwenhorst (2005) argue that globalization has had drawbacks and benefits. The higher correlations have attenuated the risk reduction benefits, but the opportunity set

Figure 71: Correlations between developed and emerging market returns over ten subperiods, 1970–2021



Source: Data from MSCI and DMS Database 2022, Morningstar; analysis by Dimson, Marsh and Staunton; periods are of 60 months (5 years), except for the first and last, which are for 72 months (6 years). Not to be reproduced without express written permission of the authors.

has expanded dramatically with many new emerging, re-emerging and frontier markets now open to the investor. For those willing to invest in EMs, the risk reduction benefits may be greater.

We have already noted that the average correlation between pairs of EMs is much lower than that between DMs, suggesting greater scope for diversification within EMs. The right-hand panel of **Figure 71** focuses on the scope for diversification between DMs and EMs. It uses the same data, countries and time periods as the left-hand panel. We compute the average correlation between USD equity returns for every pairing of each EM with each DM. We also estimate the correlation between the EM and DM indexes.

The darker colored bars display the average correlations between all pairs of EMs and DMs. As we saw in the left-hand panel, correlations have risen over time, indicating that the scope for diversification has declined. However, for each period, the average EM:DM correlation is lower than the corresponding DM:DM average in the left-hand panel of **Figure 71**. A DM investor will thus typically find more scope for diversification by investing in an EM than another DM.

However, investors do not generally invest in single pairs of developed and emerging markets, but instead view markets as broad asset classes. The lighter-colored bars show the correlation between the EM and DM indexes. These are the correlations that would apply to a US investor who already held a portfolio like the MSCI World Index (which is DM-only) and was considering diversifying into EMs.

These bars tell the same story of rising correlations and declining diversification benefits. Even for the most recent period, the average correlation between the EM and DM index remains well below one: there is still an appreciable benefit from risk reduction. For a DM investor, EMs continue to offer superior diversification.

Diversifying across asset classes

Investors also reduce risk by diversifying their portfolios across asset classes. Two assets dominate – stocks and bonds. At the end of 2021, the total (full float) value of listed equities was around USD 105 trillion, compared with around USD 150 trillion for bonds. Some two-thirds of bonds were issued by governments (central and local, as well as international bodies), while the rest were corporate bonds. While the value of world real estate is estimated to be even larger than the combined value of equity and bonds (see Dimson, Marsh and Staunton, 2018), the bulk of this relates to residential housing stock.

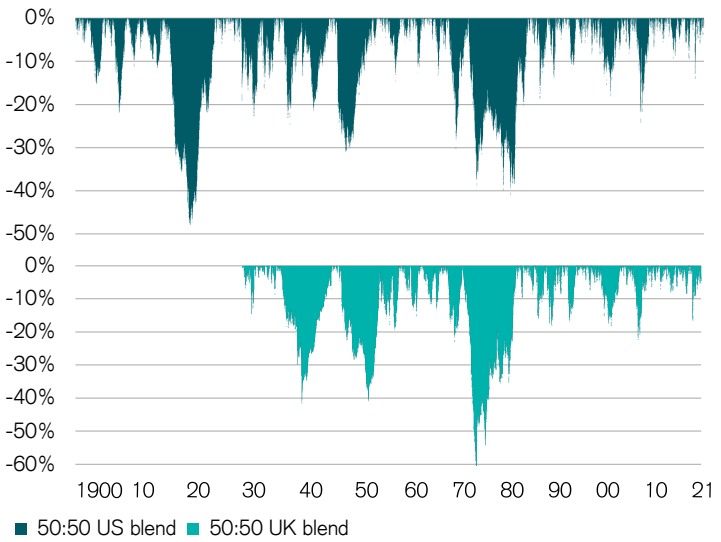
Many investors hold both stocks and bonds, as well as cash and other assets. Our focus here is on diversification between stocks and bonds and the risk reduction benefits investors enjoy from holding both asset classes.

In Chapter 4 we presented charts for the USA and UK showing historical drawdowns from stocks and bonds from 1900 to 2021 (**see Figures 30 and 32**). These showed that, for equities, there had been periods of deep and protracted losses. However, they also showed that bond market drawdowns have been larger and/or longer. At first sight, this seems odd as equities are riskier than bonds. However, the long-run returns from government bonds were substantially lower than for equities. This increased the likelihood of lengthy periods of negative real bond returns.

Figure 72 presents the drawdown on an illustrative balanced portfolio of 50% equities and 50% bonds. The drawdown is plotted for both the USA (in darker shading, upper panel) and the UK (in lighter shading, lower panel). Individually, the charts displayed earlier in Chapter 4 show that equities and bonds have on several occasions lost more than 70% in real terms. But, since 1900, this 50:50 blend has never (USA) or virtually never (UK) suffered a decline of over 50%. Furthermore, the duration of drawdowns is briefer for the blend portfolio than for the supposedly low-risk fixed income asset.

Measured in local currency adjusted for inflation, the long-term annualized real return on US equities was 6.6% (6.1% in the UK, from 1930).

Figure 72: Real drawdown: stock-bond blend, 1900–2021



Source: Elroy Dimson, Paul Marsh, and Mike Staunton, DMS Database 2022, Morningstar. Not to be reproduced without express written permission of the authors.

Meanwhile, US government bonds had a real return of 2.0% (2.6% in the UK from 1930 onward). The 50:50 blend portfolio returned an annualized 4.9% in the USA (4.0% in the UK).

While the 50:50 equity/bond blend experienced a lower return than the all-equity portfolio, it also had a lower volatility. Since 1900, the standard deviation of real equity returns has been 19.8% in the USA and 20.7% in the UK (since 1930), compared with bonds, which have a standard deviation of 10.4% in the USA and 12.8% in the UK. For the blend portfolio, the standard deviation has been attractively low: 11.9% in the USA and 14.3% in the UK.

There is nothing special about a 50:50 asset mix and investors should and do diversify across more assets than just local stocks and bonds. However, this example serves to highlight the risk-reducing potential of a balanced portfolio of bonds and stocks.

Bonds as a diversifier

Why is the downside risk of the blended stock/bond portfolio lower? There are two reasons. First, bonds are less volatile than equities. A comparison of **Tables 1 and 2** in Chapter 2 shows that, in 34 of the DMS 35 countries, bonds had a lower standard deviation than equities. The exception was Austria, where bond returns were exceptionally volatile due to the hyperinflation in 1921–22 and the turmoil of the two world wars. Across the 21 countries with continuous returns histories since 1900, but excluding Austria, the average standard deviation of real bond returns was 13.0% compared with 23.2% for real equity returns.

Second, bonds are imperfectly correlated with stocks. **Figure 73** plots the long-run pattern of correlations between real stock and bond returns for the USA and UK over a rolling window of 60 months. The stock-bond correlations as at end-2021 are negative: for the USA, a correlation of –0.27 and for the UK –0.09.

In contrast to recent experience, **Figure 73** shows that the stock-bond correlation in the USA and UK has been positive over much of the long term. In the USA, it averaged +0.15 over the period 1900–2021 with a range of –0.63 (in March 2014) to +0.67 (in October 1924). In the UK, it averaged +0.27 over the period 1930–2021 with a range of –0.34 (in August 2014) to +0.74 (in December 1939). These positive, but low correlations, provide good scope for diversification between stocks and bonds. Negative correlations are even better, as stocks and bonds then act as a hedge for each other.

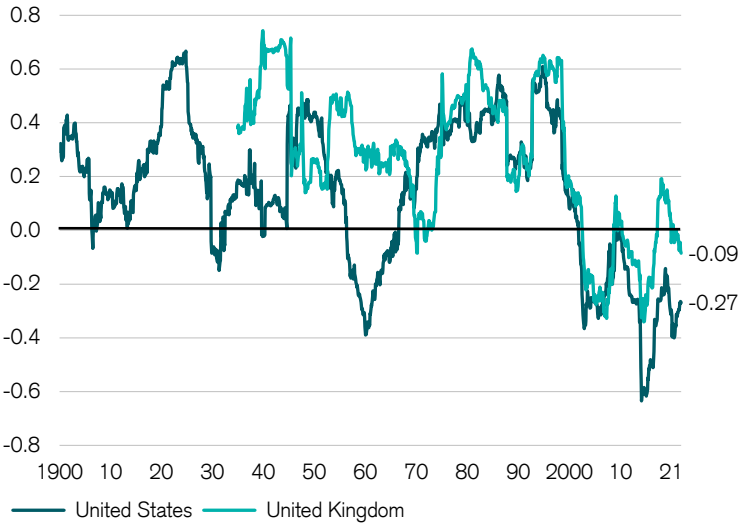
Negative correlations were unusual in the 20th century. In the USA, the stock-bond correlation was mildly negative for three months in 1906, briefly negative around the 1929 Crash and then more sharply negative for a decade in the late 1950s and early 1960s. In the UK, the correlation was always positive except for a few months in the early 1970s.

During the 2000s, however, the correlation became negative in both countries and strongly negative in the USA. Much of the research and commentary on the stock-bond correlation focuses on the USA. In **Figure 74**, we compare the USA with other countries. The chart shows rolling 60-month stock-bond correlations over the period from end-1992 to end-2021. For monthly bond returns, we employ the bond index series used in the DMS database (see Chapter 9), while, for monthly equity returns, we use the DMS series for the USA and UK, and MSCI indices for all other countries. These local currency indices are converted to real terms using the local CPI indices.

In **Figure 74**, the lightest of the three lines shows the correlations for the USA already reported in **Figure 73**. The second line shows the average correlation across the DMS 35 countries (but excluding the three newest additions to the DMS Database – Argentina, Chile and Greece), while the darkest line focuses on the average for the G7 countries plus China.

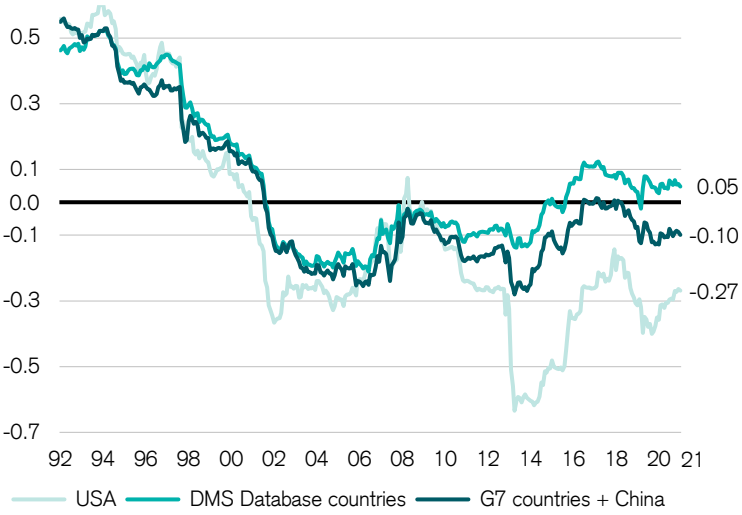
Figure 74 confirms that the broad pattern of stock-bond correlations we saw in **Figure 73** for the USA and UK was prevalent worldwide. Correlations everywhere were lower after 2000. However, the pattern for the USA was more extreme. The US 60-month correlation turned negative in late 2001, ahead of the global average. Higher frequency data shows that the turning point came earlier at the start of 1998.

Figure 73: Rolling 60-month stock-bond correlations, 1900–2021



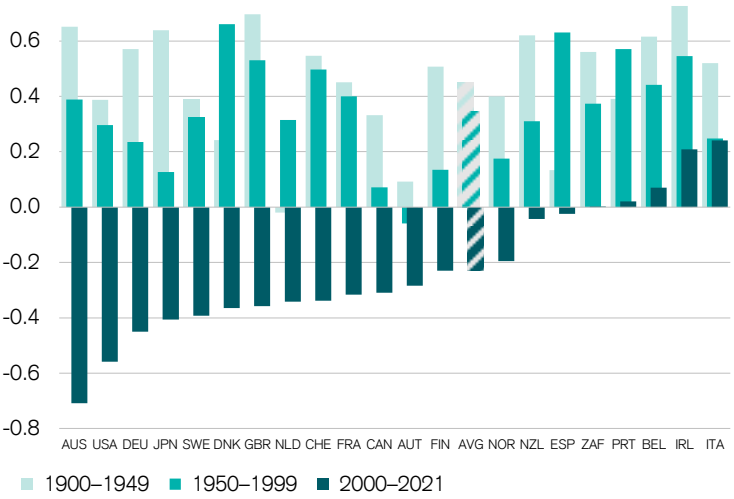
Source: Elroy Dimson, Paul Marsh, and Mike Staunton, DMS Database 2022, Morningstar. Not to be reproduced without express written permission of the authors.

Figure 74: Global average of rolling 60-month stock-bond correlations



Source: Elroy Dimson, Paul Marsh, and Mike Staunton; MSCI, FTSE Russell and DMS Database 2022, Morningstar. Not to be reproduced without express written permission of the authors.

Figure 75: Stock-bond correlations – subperiods, 1900–2021



Source: Elroy Dimson, Paul Marsh, and Mike Staunton, DMS Database 2022, Morningstar. Not to be reproduced without express written permission of the authors.

From 1998, the US stock-bond correlation was almost always lower than the world average, and in some periods markedly so. The global average stock-bond correlation turned positive from the summer of 2016, but remained low, with a value of +0.05 at the end of 2021. This contrasted with a value of –0.27 for the USA.

The 32-country average gives equal weight to all countries and is thus impacted by many smaller markets punching above their weight. The darker line in **Figure 74** focuses just on major world markets. These account for 80% of the capitalization of world equities and over 90% of world government bonds. The average stock-bond correlation for these larger countries has mostly been negative for almost 20 years now, with an end-2021 value of –0.10.

Note that, during the Global Financial Crisis, the US stock-bond correlation briefly turned positive, while the global and the G7+China averages approached zero. Over this period, the stock-bond correlation was impacted by the introduction of unconventional monetary policies, particularly in the USA, the Eurozone and UK. These asset purchase programs helped to boost bond prices, and this was matched by a stock market recovery.

Finally, we examine how stock-bond correlations behaved over the very long term in all 21 Yearbook countries with a continuous history since 1900. Our aim is to see whether the broad pattern of correlations over time that we have found for the USA and UK – and for other countries more recently – has been repeated elsewhere and to see which countries have proved exceptions.

We therefore compute stock-bond correlations for all 21 countries, based on annual real returns for three periods: 1900–49, 1950–99 and 2000–21. These correlations are shown in **Figure 75**, with the averages for the three periods shown in striped shading. The correlations are generally positive over the first and second halves of the 20th century, with averages of +0.42 (first half) and +0.30 (second half) and mostly negative since 2000 with an average of –0.23.

However, four countries had positive stock-bond correlations over 2000–21. These countries – Portugal, Italy, Ireland and Belgium – were among the countries most impacted by the Eurozone crisis in the early 2010s. During the crisis, concerns about bank solvency and even potential sovereign defaults negatively affected both bond and equity markets. During the subsequent recovery, stocks and bonds rose in tandem.

For every country featured in **Figure 75**, the stock-bond correlation estimated over 2000–21 is lower than the average of the correlations estimated over the longer intervals of 1900–49 and 1950–99. On average, the post-2000 stock-bond correlations are 0.66 lower. With a low correlation to equities, bonds offer significant diversification opportunities.

Bonds as a hedge

The stock-bond correlation plays an important role in institutional portfolio construction. It is central to forming optimal portfolios, designing hedging strategies and assessing risk. Stock-bond correlations have now been mostly negative in major world markets for some 20 years. This negative correlation means that stocks and bonds have served as a hedge for each other, enabling investors to increase stock allocations while still satisfying a portfolio risk budget.

To illustrate the value of this hedge, we analyze the impact of different levels of stock-bond correlations on portfolio risk and Sharpe ratios. We assume an expected annualized real return of 0.5% on bonds and 4.0% on stocks – broadly in line with our estimates in Chapter 5. Similarly, we assume an annual standard deviation of 10% on bonds and 20% on equities.

Figure 76 shows the impact of varying the stock-bond correlation on both portfolio standard deviation (left-hand panel) and Sharpe ratio (right-hand panel). We examine regimes in which correlations are –0.3, broadly consistent with the period since 2000, zero and +0.3, which is broadly in line with the period from 1950 to 1999. The horizontal axis runs from a zero allocation to equities through to 100% in stocks.

Figure 76 shows that the different correlation regimes significantly impact volatility and the Sharpe ratio. Consider the case of an investment institution with a (lowish) risk budget of 10%. When the stock-bond correlation is –0.3, a 10% standard deviation could be achieved with 52% in equities and 48% in bonds. This would provide an expected return of 2.31% per annum and a Sharpe ration of 0.23.

If the correlation were to rise to zero, the stock allocation would need to fall to 40% to come within the risk budget. This would reduce the expected return to 1.90% p.a., a reduction of 41 basis points. However, if the correlation rose to its approximate 1950–99 average of +0.3, the equity allocation would need to be reduced to 21%. The expected return would decline to 1.24% p.a., a reduction of a further 66 basis points, while the Sharpe ratio would fall to 0.12.

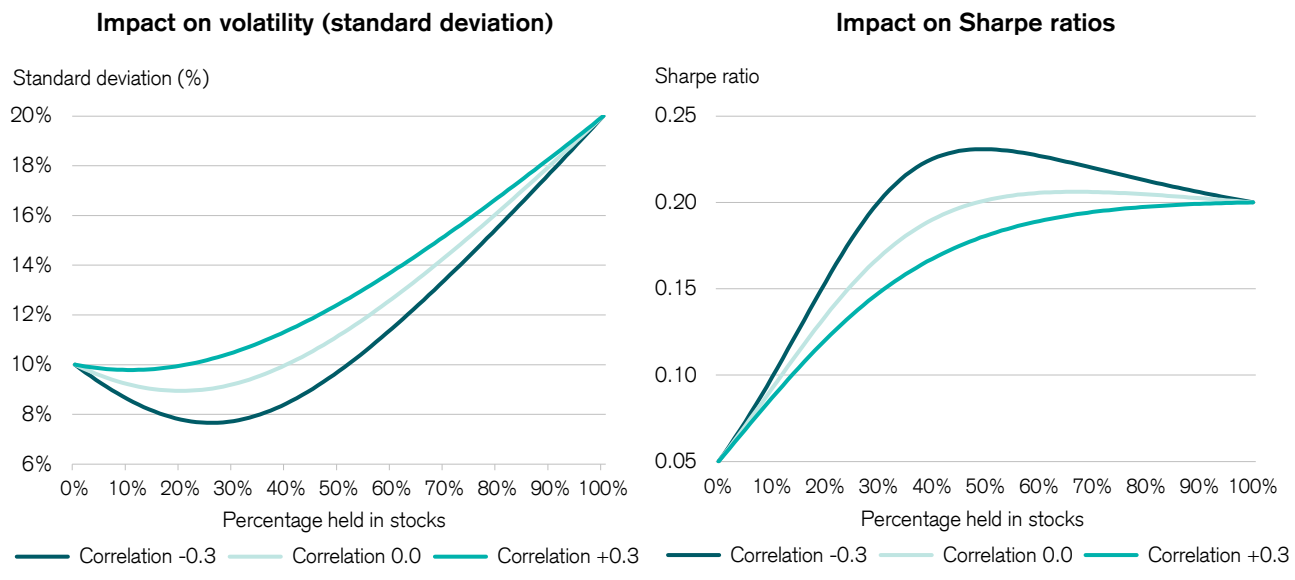
Drivers of stock-bond correlations

The stock-bond correlation is clearly important, and the future of the stock-bond correlation therefore matters. While we cannot predict the future, we can seek to illuminate it by understanding what drives the correlation. To do this, we look at the theory and the results of empirical research. The aim is to understand what factors determine the stock-bond correlation.

The value of bonds depends on interest rates and the bond risk premium (the maturity premium plus any premium for credit risk). The value of stocks depends on expected cash flows and their likely growth, as well as interest rates and the equity risk premium. Stock and bond returns – and hence also the stock-bond correlation – arise from (unexpected) changes in these variables.

The interest rate is a common variable for both stocks and bonds as it impacts the discount rate. Other things equal, a rise in interest rates should lead to a fall in stock and bond prices and vice versa. This should lead to a positive correlation between stocks and bonds. The interest rate can be further decomposed into the real rate of interest and the inflation rate. Both stocks and bonds are sensitive to changes in real interest rates, but (nominal) bonds are far more sensitive to inflation as their payoffs are fixed in nominal terms (see Chapter 2). Companies have far more scope to adjust cash flows for the impact of inflation.

Figure 76: Stock-bond portfolio performance assuming different stock-bond correlations



Source: Analysis by Dimson, Marsh and Staunton. Not to be reproduced without express written permission of the authors.

The common dependence of both stocks and bonds on interest rates helps explain why the stock-bond correlation was consistently positive between 1965 and 1997 during a period of large gyrations in real interest rates and expected inflation. Over this period, changes in real rates and expected inflation drove stock and bond returns in tandem (see Ilmanen, 2011). However, this does not explain the much lower/ negative correlations since the end of the 1990s.

However, other factors also matter. First, there is the interplay (covariance) between expected equity cash flows and interest rates. If these rise together, the stock-bond correlation will tend to be negative as stock prices alone benefit from the higher cash flows, but both stocks and bonds suffer from the higher interest rates. However, if they move in opposite directions, the stock-bond correlation will tend to be positive. Second, there is the interaction of the equity and bond risk premiums. If these move together, stock-bond correlations will tend to be positive, but, if they move in opposite directions, they will tend to be negative.

The main problem in seeking to understand the drivers of the stock-bond correlation is that there are many relationships in play, and hence a lot of "moving parts." Over any given period, some relationships may indicate lower correlations, while others will favor higher correlations. Furthermore, key variables, such as the expected future corporate cash flows and the equity and bond risk premiums, are not observable and have to be inferred. This is challenging for researchers, especially if the period in question in relatively brief.

What explains recent low correlations?

In recent years, much research has focused on why the sign of the stock-bond correlation flipped in the late 1990s. What was different about the period before and afterwards? From the late 1990s on, there were more frequent crises, including three major bear markets, much lower/falling real and nominal interest rates, far lower and more stable inflation, somewhat slower economic growth, a more accommodative monetary policy (especially from 2008), somewhat more volatile and lower real equity returns, and less volatile and higher real bond returns.

The period since the late 1990s is relatively short, making it hard to establish statistically significant results. Furthermore, when researchers are seeking to explain a change that dates from a specific point in time, there is a danger that data mining will find explanations that fit "in sample," but have no predictive ability.

Ilmanen (2003) argues that the stock-bond correlation is likely to be negative in a world of low and stable inflation as well as during financial crises. The latter is borne out by Connolly, Stivers and Sun (2005) and Baur and Lucey (2009) who show that flight-to-safety (FTS) episodes occur during market stress and are characterized by high stock market volatility, large negative equity returns, large positive bond returns and hence negative stock-bond correlations.

FTS episodes are driven by a rise in the equity risk premium and a fall in the bond risk premium. Baele, Bekaert, Ingelbrecht and Wei (2020) examine the years 1980–2015 and find that FTS episodes were less common before 1997, and highly prevalent thereafter. However, 94% of FTS episodes lasted less than three days, so this cannot be a full explanation for the longer period of negative stock-bond correlations.

Other researchers have focused on macroeconomic models and variables. Campbell, Pflueger and Viceira (2020) estimate that the correlation between the US output gap and inflation switched from negative to positive at the end of 2000. Higher inflation lowers real bond returns, while higher economic output raises stock returns, so this would explain the move to negative stock-bond correlations. The argument is that inflation has become procyclical, tending to increase in expansions, whereas, before 2001, it tended to increase in periods of lower output.

While plausible, macro models of this kind inevitably suffer from measurement issues. For example, the output gap is not measurable, so is proxied by detrended consumption, which in turn is proxying for expected corporate cash flow changes. Moreover, the results from macro models are typically only borderline significant.

Baele and Van Holle (2017) conclude that pure macro regimes explain relatively little of the variation in stock-bond correlations. Their research examines the impact of monetary policy. They conclude that stock-bond correlations tend to be strongly negative when monetary policy is accommodating, but only in times of low inflation. Irrespective of the inflation or output regime, stock-bond correlations turn positive as soon as monetary policy turns restrictive.

Will stock-bond correlations stay negative?

The hedging properties of bonds have proved valuable to investors and the future of the stock-bond correlation clearly matters. The stock-bond correlation is manifestly not immutable. A key question therefore is whether negative correlations will persist. To answer this, we have looked at the evidence to try to understand what has caused the negative correlations.

Despite the volume of research, neither theory nor empirical studies point to a single or clear explanation for the negative stock-bond correlation. Those who claim to have found

explanations largely replace one puzzle with another. For example, why have crises been more frequent or why has the correlation between the output gap and inflation changed signs?

Anticipating changes in the stock-bond correlation requires not only a clear understanding of the past (which we do not have), but also good forecasts of how the economy will move, how policymakers will react and how economic data will evolve in response to policy moves.

During 2021, there have been several occasions where stock and bond returns have moved in tandem, causing investor unease. Based on daily data, the US stock-bond correlation from the end of 2020 until early 2022 has been closer to zero at –0.09. The rapid resurgence of inflation in North America and Europe, greater inflation uncertainty and the prospect of less accommodative monetary policies add to a sense of impending regime change. This seems likely to impact the stock-bond correlation.

Historically, the long-run stock-bond correlation across countries from 1900 to 2021 has been +0.32. Based on a reading of the empirical evidence and the tea leaves of history, we would not recommend placing reliance on a continuation of negative stock-bond correlations.

A return to positively correlated stock and bond returns and the loss of hedging benefits would require investors to rethink their asset allocation, portfolio risk and long-term capital market assumptions. Such a regime shift could also impact valuations, particularly of bonds, if investors prove less willing to pay for correlated portfolio assets and seek higher expected returns to compensate for greater cross-asset risk.

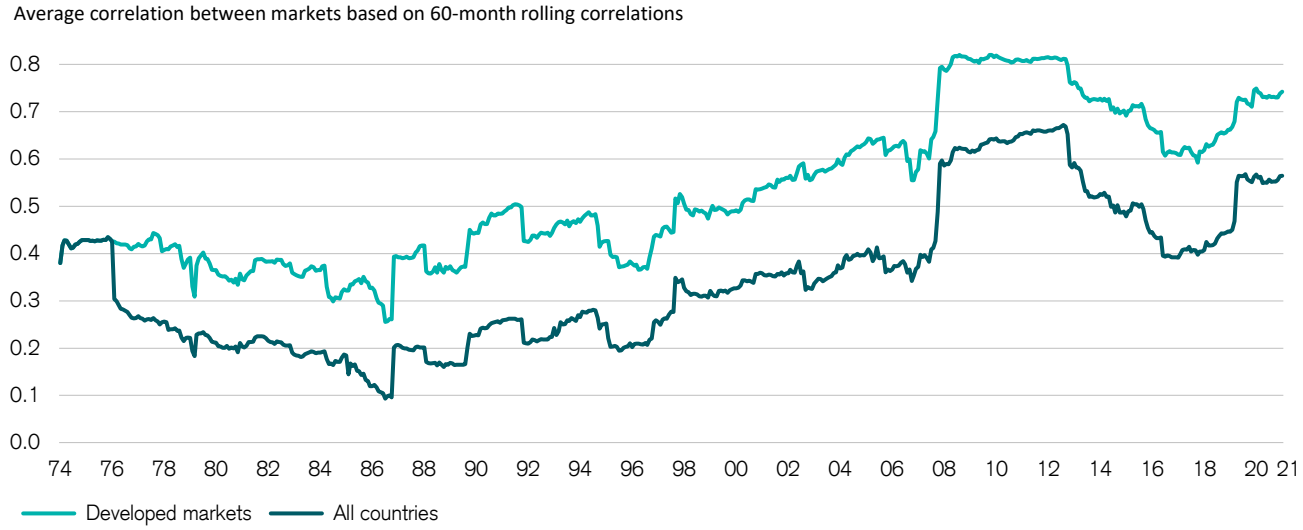
Diversification during crises

There is a concern that diversification across stocks and countries proves disappointing to investors just when they need it most – in times of crisis. Early evidence that this is the case is provided by Longin and Solnik (1995). They found that markets became more closely correlated during turmoil, thereby making diversification less effective. The episodes they highlighted were the 1974 oil shock, the October 1987 crash, the 1990 invasion of Kuwait and the ensuing Gulf War in 1991.

Figure 77 helps illustrate this. It shows the monthly average correlation between all possible pairs of countries' equity markets. The computations are based on returns for MSCI indices using the same set of 52 countries employed in **Figure 71** above. The initial estimate (on the left) is for December 1974, based on data for 1970–74, while the final estimate (on the right) is for December 2021. The darker of the two lines shows the average correlation between all pairs of markets, while the lighter line shows the average for developed markets only. Both lines in **Figure 77** show the secular upward trend in average correlations that we discussed earlier.

Both lines also show upward jumps that take place when a crisis hits. In addition to the episodes noted by Longin and Solnik, jumps can be seen at the time of the 1997 Asian financial crisis, the 1998 Russian debt default and LTCM,

Figure 77: Average correlations between equity markets over time, 1974–2021



Source: Dimson, Marsh and Staunton analysis using MSCI data. Not to be reproduced without express written permission of the authors.

the Global Financial Crisis and the COVID-19 crisis. The largest jump was during the Global Financial Crisis when the average correlation across all countries rose from 0.38 to 0.59. The jumps tend to reverse themselves five years later, as the crisis months drop out of the computations. However, in some cases, new crises have arisen during the five years, which obfuscate the reversion.

In a subsequent paper, Longin and Solnik (2001) explore the relationship between correlation and volatility. Their results contradicted the then-established wisdom that international correlations are much higher in periods of market volatility. They show that correlation is not related to volatility per se, but to the market trend. They find that correlation increases in bear markets, but not in bull markets. While noteworthy, this is of little consolation to investors since it is bear markets that they are concerned with.

Do higher crisis correlations matter?

Das and Uppal (2004) confirm that systemic risk arises in crisis periods from the jumps that occur at the same time across countries. Furthermore, they verify that this does indeed reduce the gains from international diversification. However, their analysis leads them to conclude that the loss from reduced diversification is not substantial.

The cost of elevated correlations depends on their duration. Charts like **Figure 77** can give a misleading impression of lengthy periods of higher correlations. This is because they show rolling 60-month correlations, where the extreme returns from the crisis do not drop out of the estimation until 60 months later. The duration of higher correlations is clearly far shorter than this. Yet we cannot demonstrate this by estimating correlations between international stock markets using rolling 60-day estimates. This is because markets around the world are open at different times of the day and trading hours often do not even overlap.

There is evidence that the higher correlations arising from crises are quite short-lived. This comes from the research on FTS episodes (see Baele, Bekaert, Ingelbrecht and Wei (2020) and the discussion above). This is supported by the rapidity with which spikes in the VIX revert to the mean (see **Figure 45** and the associated discussion in Chapter 5). The extent to which international diversification can fail investors in a crisis is thus limited to quite short intervals, and then only if these coincide with the timing of realizations where the investor is effectively a forced seller. For long-term investors, the enhanced correlations are of less consequence.

Finally, we note that, while stock and country diversification may be less effective during immediate crisis periods, cross-asset correlation can be more effective. We have seen that the stock-bond correlation tends to be negative during crisis periods. This makes government bonds extremely valuable diversifiers that raise the power of portfolio diversification when most needed.

Concluding remarks

Diversification reduces risk. It allows investors either to earn the same expected return, with lower risk, or a higher expected return for the same level of risk. It is often described as a free lunch – or even the only free lunch in finance. However, diversification should be the default, so perhaps we should instead think of a failure to diversify as a self-imposed tax.

At the start of 2022, the winds of change are blowing, indeed gusting. It is therefore more important than ever to review portfolio diversification. Investors can easily be misled by claims that only 10 to 20 stocks are needed for a diversified portfolio. We have seen that far more are required for effective diversification, especially for a global portfolio.

The start of 2022 has brought an uptick in volatility, continued rises in inflation, the prospect of a decisive hiking cycle to cure this, and hence rising real and nominal interest rates, all accompanied by sector and factor rotation. The environment is therefore potentially more promising for active managers. We have seen that to exploit this would require more concentrated portfolios. Crucially, it also requires genuine stock selection and timing skills. Caution is required, as these skills are widely claimed, but rare in practice.

There is a compelling case for global diversification, especially at the current time. While we have seen that globalization has increased the extent to which markets move together, the potential risk reduction benefits from international diversification remain large. Global diversification can be oversold, however, if it is presented as a surefire route to a superior return-risk tradeoff. It should certainly lead to a higher *expected* level of return for risk, but this is not assured.

We have seen that over the last 50 years, global investment led to higher Sharpe ratios than domestic investment in the vast majority of countries. While there were few exceptions, one of these was the world's most important market, the USA, where investors would have been better off remaining in US stocks. This is a cautionary tale. It is a reminder that investment is subject to considerable

uncertainty. Good investment decisions, based on sensible criteria, can sometimes have disappointing outcomes.

Prospectively, our advice to investors from all countries, including the USA, is that they should invest globally. This is very likely to reduce risk and increase the Sharpe ratio, but it is important to recognize that this is not guaranteed.

The benefits of global diversification are not uniform, however. Smaller countries often have concentrated stock markets that are dependent on a small number of business activities. Their stock markets are concentrated not only by company but also by sector. As we showed in the 2015 Yearbook, many countries have the majority of the value of their stock market invested in only three industrial sectors. As countries increasingly focus on specific sectors, globalization can leave them more – not less – exposed to success or disappointment.

When a large proportion of a nation's corporate earnings come from a particular natural resource, a specific manufacturing capability or a distinct technology, global diversification can ensure that investors are not solely reliant on its success. Investors in such countries have potentially much more to gain from international diversification than US investors, with their large, highly diversified domestic market.

The reduction in risk from international diversification is of particular value to investors whose portfolios have a pronounced home bias. Investors from emerging markets also have more to gain from international diversification than those from developed markets. For developed market investors, emerging markets continue to offer better diversification prospects than other developed markets.

Selected individual markets

The following four pages are extracted from Chapter 9 of the Credit Suisse Global Investment Returns Yearbook 2022.

The Credit Suisse Global Investment Returns Yearbook covers 35 markets and five composite indexes, namely the world, the world ex-USA, Europe, developed markets and emerging markets. Twenty-three of the countries and all five composite indexes start in 1900. The other 12 markets, which are new to the Yearbook in 2021/22, start later than 1900, but have long histories ranging from 46 to 71 years. In Chapter 9 of the full Yearbook, each country and index has three pages of descriptive data, charts, tables and statistics. We show here only the initial page for a small selection of three countries and one composite index.

Photo: Athens, Greece; Getty Images, George Pachantouris

Switzerland

For a small country with just 0.1% of the world's population and less than 0.01% of its land mass, Switzerland punches well above its weight financially and wins several "gold medals" when it comes to global financial performance.

The Swiss stock market traces its origins to exchanges in Geneva (1850), Zurich (1873), and Basel (1876). It is now the world's sixth-largest equity market, accounting for 2.6% of total world value. Since 1900, Swiss equities have achieved a real return of 4.7% (equal to the median across our countries).

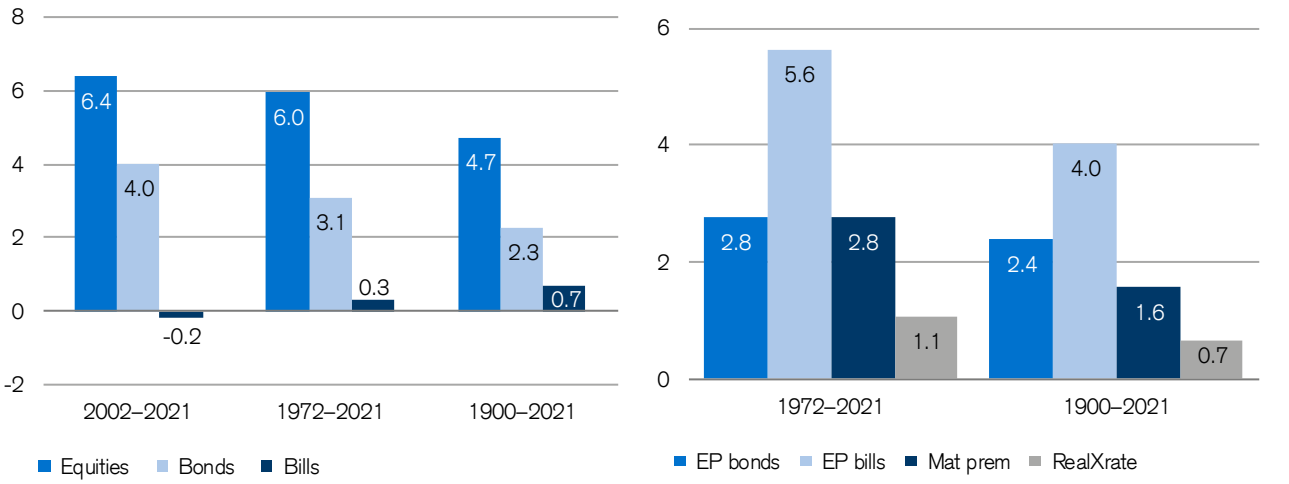
Meanwhile, Switzerland has been the world's best-performing government bond market, with an annualized real USD return of 3.0% (it ranks second in real local currency return terms, with an annualized return since 1900 of 2.3%). Switzerland has also had the world's lowest 122-year inflation rate of just 2.1%.

Switzerland is one of the world's most important banking centers, and private banking has been a major Swiss competence for over 300 years. Swiss neutrality, sound economic policy, low inflation and a strong currency have bolstered the country's reputation as a safe haven.

A large proportion of all cross-border private assets invested worldwide is still managed in Switzerland.

Switzerland's healthcare industry accounts for over a third (36%) of the value of the FTSE World Switzerland Index. Nestle (21%), Roche (17%), and Novartis (10%) together account for half of the index's value.

Figure 1: Annualized real returns and risk premiums (%) for Switzerland, 1900–2021



Note: The three asset classes are equities, long-term government bonds, and Treasury bills. All returns include reinvested income, are adjusted for inflation, and are expressed as geometric mean returns.

Note: EP bonds and EP bills denote the equity premium relative to bonds and to bills; Mat prem denotes the maturity premium for bonds relative to bills; RealXRate denotes the inflation-adjusted change in the exchange rate against the US dollar.

Source: Elroy Dimson, Paul Marsh and Mike Staunton, DMS Database 2022, Morningstar. Not to be reproduced without express written permission from the authors.

United Kingdom

Organized stock trading in the United Kingdom dates from 1698, and the London Stock Exchange was formally established in 1801. By 1900, the UK equity market was the largest in the world, and London was the world's leading financial center, specializing in global and cross-border finance. Early in the 20th century, the US equity market overtook the UK and, nowadays, New York is a larger financial center than London. What continues to set London apart, and justifies its claim to being the world's leading international financial center, is the global, cross-border nature of much of its business.

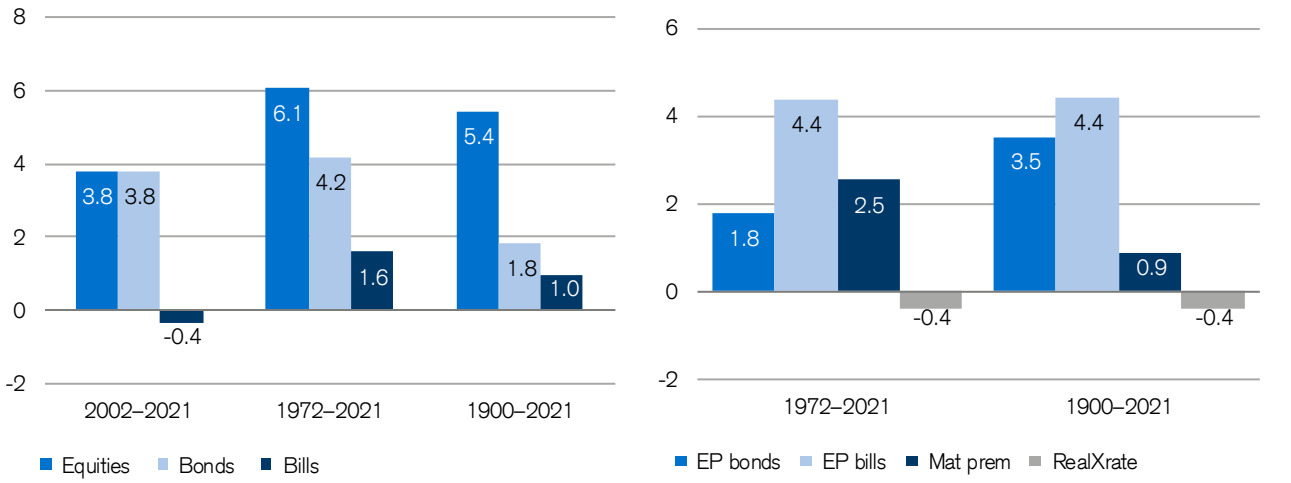
Today, London is ranked as the second most important financial center (after New York) in the Global Financial Centers Index. It is the world's banking center, with 550 international banks and 170 global securities firms having offices in London.

The UK's foreign exchange market is the biggest in the world, and Britain has the world's number-three stock market, number-three insurance market, and the fourth-largest bond market.

London is the world's largest fund management center, managing almost half of Europe's institutional equity capital and three-quarters of Europe's hedge fund assets. More than three-quarters of Eurobond deals are originated and executed there. More than a third of the world's swap transactions and more than a quarter of global foreign exchange transactions take place in London, which is also a major center for commodities trading, shipping and many other services.

AstraZeneca is the largest UK stock by market capitalization. Other major companies include Unilever, Shell, Diageo, HSBC Holdings, Glaxo SmithKline, and BP.

Figure 2: Annualized real returns and risk premiums (%) for the UK, 1900–2021



Note: The three asset classes are equities, long-term government bonds, and Treasury bills. All returns include reinvested income, are adjusted for inflation, and are expressed as geometric mean returns.

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Source: Elroy Dimson, Paul Marsh and Mike Staunton, DMS Database 2022, Morningstar. Not to be reproduced without express written permission from the authors.

United States

In the 20th century, the United States rapidly became the world's foremost political, military, and economic power. After the fall of communism, it became the world's sole superpower. It is also the world's number one oil producer.

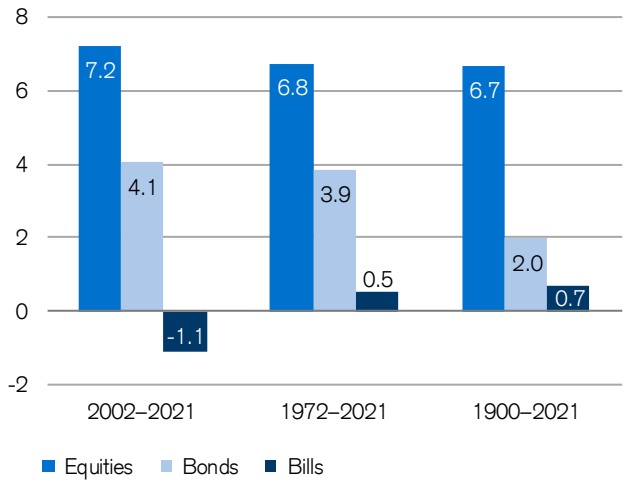
The USA is also a financial superpower. It has the world's largest economy, and the dollar is the world's reserve currency. Its stock market accounts for 60% of total world value (on a free-float, investible basis), which is almost ten times as large as Japan, its closest rival. The USA also has the world's largest bond market.

US financial markets are by far the best-documented in the world and, until recently, most of the long-run evidence cited on historical investment performance drew almost exclusively on the US experience. Since 1900, the US equity market has given an annualized real return of 6.7%, the highest common-currency return for any Yearbook country.

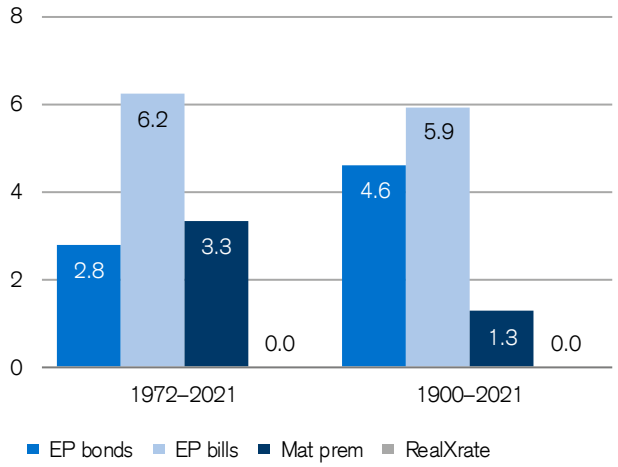
There is an obvious danger of placing too much reliance on the impressive long-run past performance of US stocks. The New York Stock Exchange traces its origins back to 1792. At that time, the Dutch and UK stock markets were already nearly 200 and 100 years old, respectively. Thus, in just a little over 200 years, the USA has gone from zero to a 60% weighting in the world's equity market.

Extrapolating from such a successful market can lead to "success" bias. Investors can gain a misleading view of equity returns elsewhere, or of future equity returns for the USA itself. That is why this Yearbook focuses on global investment returns, rather than just US returns.

Figure 3: Annualized real returns and risk premiums (%) for the USA, 1900–2021



Note: The three asset classes are equities, long-term government bonds, and Treasury bills. All returns include reinvested income, are adjusted for inflation, and are expressed as geometric mean returns.



Note: EP bonds and EP bills denote the equity premium relative to bonds and to bills; Mat prem denotes the maturity premium for bonds relative to bills; RealXRate denotes the inflation-adjusted change in the exchange rate against the US dollar.

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World ex USA

In addition to the World indexes, we also construct World indexes that exclude the USA, using exactly the same principles. Although we are excluding just one country, the USA today accounts for 60% of the total stock market capitalization of the 90 countries included in the DMS World equity index. Our 89-country, World ex-USA equity index thus represents just 40% of today's value of the DMS World index.

The charts below show the returns for a US global investor. The indexes are expressed in US dollars, real returns are measured relative to US inflation, and the equity premium versus bills is relative to US Treasury bills.

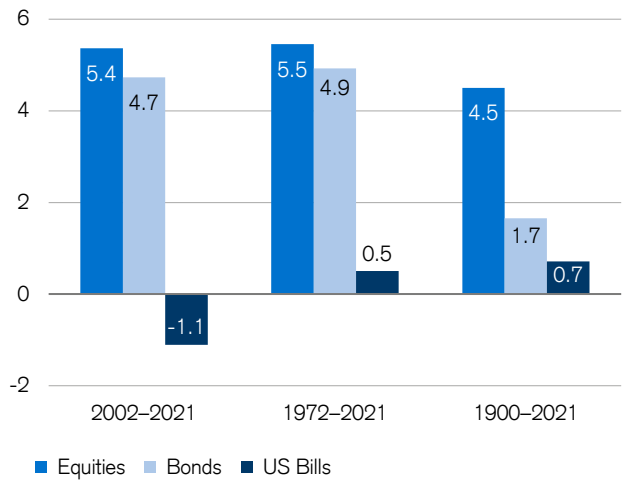
We noted in Chapter 1 that, until relatively recently, most of the long-run evidence cited on historical asset returns drew almost exclusively on the US experience. We argued that focusing on such a successful economy can lead to "success" bias. Investors can gain a misleading view of equity returns elsewhere, or of future equity returns for the USA itself.

The chart below confirms this concern. It shows that, from the perspective of a US-based international investor, the real return on the World ex-USA equity index was 4.5% per year, which is 2.1% per year below that for the USA.

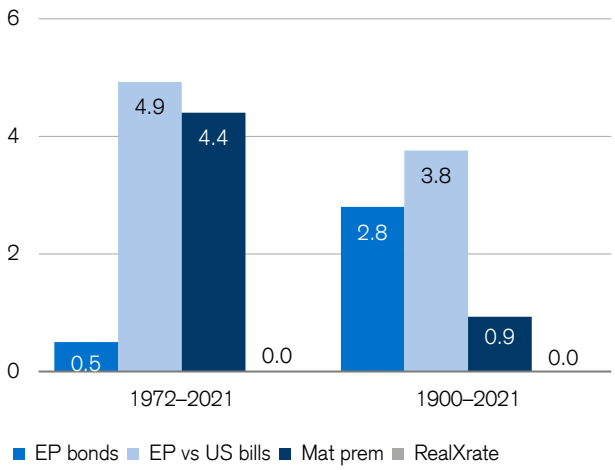
This differential of 2.1% per annum leads to very large differences in terminal wealth when compounded over 122 years. A US-based investor who invested solely in their domestic market would have enjoyed a terminal wealth more than ten times greater than from investing in the rest of the world, excluding their own country. This does not, however, take account of the risk reduction from diversification that they would have enjoyed from diversifying abroad.

Our World index ex-USA thus stresses the importance of looking at global returns, rather than focusing on, and generalizing from, the USA.

Figure 4: Annualized real USD returns and risk premiums (%) for the World ex-USA, 1900–2021



Note: The three asset classes are equities, long-term government bonds, and US Treasury bills. All returns include reinvested income, are adjusted for inflation, and are expressed as geometric mean returns.



Note: EP bonds and EP bills denote the equity premium relative to bonds and to US bills; Mat prem denotes the maturity premium for bonds relative to US bills; RealXRate denotes the inflation-adjusted change in the exchange rate against the US dollar.

Source: Elroy Dimson, Paul Marsh and Mike Staunton, DMS Database 2022, Morningstar. Not to be reproduced without express written permission from the authors.

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To gain access to the underlying data
The Dimson-Marsh-Staunton dataset is distributed by Morningstar Inc. Please ask for the DMS data module. Address requests to Ms Quan Domaleczny, email: quan.domaleczny@morningstar.com, tel. +1 312 696-6848, or to Ms Julie Petitjean-Freytet, email: julie.petitjean-freytet@morningstar.com, tel. +31 (0)20 560 2930. Further information on subscribing to the DMS dataset is available at www.tinyurl.com/DMSdata.

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