Does hiking damage your wealth?

by Elroy Dimson, Paul Marsh, and Mike Staunton

Main Results and Relevance to the Q Group Mission

On this 50th anniversary year of the Q Group, it is especially appropriate to inform long-horizon investment policy by interrogating long-term financial history. Recently, one of the hottest issues has been the impact on asset prices of changes in the central bank interest rates. A long and granular dataset on central-bank interest rates is available, yet most previous research on investment strategy has been limited to a relatively short sample period. In this paper we use over a century of daily US returns, together with 85 years of UK data, to examine the immediate influence of rate hikes and cuts on stock and bond markets.

As well as having a long investment horizon, members of Q Group have an investment focus that is truly global. In this paper, we take an international perspective by looking at the impact of interest rate changes on equity and bond returns using annual data for 21 countries from start-1900 to end-2015. Adopting a trading strategy that avoids look-ahead bias, we compare returns over entire interest rate hiking and easing cycles for equities, bonds, bills, currencies, and risk premia.

Based on a simple strategy that investors could follow, we find marked and statistically significant differences in stock and bond returns between periods following interest rate rises and periods after rate cuts. In the USA, annualized real equity returns were just 2.3% during tightening cycles and 9.3% during loosening periods. Real bond returns were 0.3% in hiking cycles and 3.6% during periods of easing. Our findings for the UK were broadly similar. In the UK, the entire long-run equity risk premium was earned during easing cycles, and there was no realized reward whatsoever for stock market risk during hiking cycles.

These patterns are not confined to equities and bonds. In this paper, we also analyze long-term returns from industry sectors and from factor exposures such as size, value, carry and momentum. In addition, we study real asset returns since 1900 on a variety of precious metals, collectibles and real estate. In all cases, hiking cycles damage investors' wealth compared to easing cycles.

This discovery has relevance to the work of members of Q Group on several dimensions. First, it contributes to the debate on the policy merits of raising US interest rates while other nations are moving in the opposite direction. Second, it provides new insights into the time-variation in expected returns – a topic that has for many years intrigued members of this organization. Third, at a time of heightened attention to factor investing, our results reveal an under-recognized but pervasive factor in the asset return generating process. Last, our study suggests some new directions for empirical research that we hope will excite members of Q Group and the wider investment community.

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Does hiking damage your wealth? [*]

Elroy Dimson[†‡] Paul Marsh[‡] Mike Staunton[‡]

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Abstract: Investors are preoccupied with the impact on financial markets of changes in central-bank interest rates. We use over a century of daily US returns together with 85 years of UK data to examine the immediate effect of rate hikes and cuts on stock and bond markets. We also look globally at the impact of interest rate changes on equity and bond returns using annual data for 21 countries from 1900 to 2015. Using a trading strategy that avoids look-ahead bias, we compare returns over entire interest rate hiking and easing cycles for equities, bonds, bills, currencies, and risk premia. We analyze long-term returns from industry sectors and factors such as size, value, carry and momentum, and also study real asset returns since 1900 on precious metals, collectibles and real estate. In all cases, hiking cycles damage your wealth compared to easing cycles.

JEL codes: E43, E44, E58, G12, G18, N20.[¤]

Keywords: Interest rates; central bank; monetary policy; Federal Reserve; hiking/easing; cyclical/defensive.

Until late last year, no American or British investment professionals in their 20s (and only a few in their early 30s) had experienced a rise in their domestic interest rate during their working lives. This changed in December 2015 when the Federal Reserve raised rates for the first time in almost a decade, thus ending the longest run of unchanged rates (which were also the lowest on record) since the Fed was established in 1913. Over the next half-year, the Bank of England's official bank rate remained at 0.5%, its level since early 2009 and also the lowest on record. The last UK rate rise had been in October 2007.

In 2015, the news had been dominated by speculation about whether, when, and how many times the Fed would raise rates. Commentators attributed a high proportion of the moves in asset prices, globally as well as in the USA, to changing perceptions about Fed policy and timing, as well as the likelihood of other countries (especially the UK) following the Fed's lead. When rates were finally increased by ¼% on 16 December 2015—a move that had been widely anticipated in timing and magnitude—the market's initial reaction was a strong rally, followed next day by a discernable retreat in US Treasury yields.

In 2016 sentiment switched. By 10 February, the *Financial Times* reported that, based on analysis of options on Eurodollar future contracts: "*The probability of negative rates by the end of 2017 has jumped from 3 per cent in January to 17 per cent today.*" The next day, the *Wall Street Journal* wrote that: "*Central banks in Europe and Japan have turned to the once-radical idea of negative interest rates... The idea that their US counterpart might follow suit is unlikely but not impossible*" (underline added).

By July 2016, approximately $13 trillion of global government debt (representing 36% of all outstanding debt) had a negative yield, as compared to almost zero dollars of debt with a negative yield in 2014 (BAML, 2016). At its post-Brexit meeting ending 3 August 2016, the Bank of England cut its base rate to ¼%, triggering a further fall in bond yields. On 11 August, the *Wall Street Journal* wrote that: "*The rally in gilts has been extraordinary, with the yield on the U.K.'s longest-dated bond, the 2068 maturity, almost halving from 2% on the day of the referendum to 1.06%.*"

It is scarcely surprising that investors and markets remain obsessed by actual and imagined changes in the official interest rate. In Section 1, we therefore analyze interest rate changes in both the USA and the UK over a long period to assess the typical impact of rate changes on equities, bonds, and currencies. We also look globally at the impact of interest rate changes on equity and bond returns using 116 years of data for 21 countries.

In Section 2, we compare asset performance over entire interest rate hiking and easing cycles, using a trading strategy that could in principle have been implemented in real time. We examine the performance of equities, bonds, bills, currencies, and equity and bond risk premia. We then analyze industry and factor returns, notably the size, value, carry, and

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[†] Newton Centre for Endowment Asset Management, Cambridge Judge Business School, Cambridge CB2 1AG, U.K. Email: ed351@cam.ac.uk.

[‡] London Business School, Regents Park, London NW1 4SA, U.K. Email: edimson@london.edu, pmarsh@london.edu, mstaunton@london.edu.

[¤] Definition of JEL codes: E43 (Interest Rates: Determination, Term Structure, and Effects), E44 (Financial Markets and the Macroeconomy), E58 (Central Banks and their Policies), G12 (Asset Pricing, Trading Volume, Bond Interest Rates), G18 (Government Policy and Regulation), N20 (Financial Markets and Institutions: General, International, or Comparative).

momentum premia. Finally, we examine the returns on real assets (including precious metals such as gold and silver), collectibles (including art, stamps and wine), and real estate (including housing and farmland). In all cases, we find substantial differences between returns during hiking and easing cycles. Section 3 concludes.

1. Long-run evidence on market responses to interest-rate changes

In the United States, the Federal Reserve System oversees the interest rate at which banks and other depositary institutions lend money to each other. The Federal Open Market Committee (FOMC) sets a target rate in meetings that normally take place on eight occasions per year. In the United Kingdom, the Monetary Policy Committee (the MPC), which meets on twelve occasions a year, determines the official interest rate at which the central bank lends to banks.

The Federal funds target rate and the Bank of England official bank rate are the key interest rates used by the American and British governments to enact monetary policy. These official rates act as the benchmark rates for all other short-term interest rates in the economy.

Figure 1 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. Figure 2 shows the corresponding data for the UK's official bank rate (and its predecessors) since 1900.

Official interest rates have varied greatly over time, ranging from near zero in both countries to a high of 14% in the USA and 17% in the UK. The broad pattern over time is similar since the two countries have experienced many of the same crises, as well as parallel bouts of inflation. Rates were at their lowest during the Great Depression, World War II and following the recent financial crisis. Rates peaked during the high inflation of the late 1970s and early 1980s, with the UK more affected.

From these charts, we can readily identify periods when interest rates rose, known as "hiking cycles" or "tightening cycles." Similarly, there are periods of falling rates – "easing cycles" or "loosening cycles." The small yellow diamonds show the start of hiking cycles, while the small turquoise diamonds show the start of easing cycles. Sometimes, there is a plateau following a hiking cycle, or a floor following an easing cycle, but with only a few exceptions (the recent period from 2008–15 being one of them), these interludes are brief. More typically, hiking cycles have been rapidly followed by easing cycles and vice versa.

Hiking or easing cycles can be quite jagged. The large spike in Figure 1 shows that US rates rose from 5.25% in 1977 to 14% in 1981. However, rates fell from 13% to 10% during the first half of 1980 before climbing again to their 14% peak. With hindsight, this looks like a single hiking cycle, but it could also be viewed as a tightening cycle, then an easing cycle, followed by a further tightening cycle. We return to this issue in the following section when we examine returns over interest rate cycles.

1.1 How should markets react to rate hikes?

Interest rate changes are a major instrument of monetary policy and 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, variable rate mortgages and 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 important transmission mechanism. Markets rapidly incorporate news, so official rate changes have their first and most immediate impact on 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 for individuals and corporations. This also impacts real economic activity.

The conventional wisdom is that rate hikes lead to falls in both bond and stock prices. Central banks in market economies set only the short-term policy rate. They can seek to influence, but do not control, longer-term rates. However increases in the policy rate often signal (or are accompanied by guidance on) the expected path of future short-term rates. A rise in the policy rate thus has knock-on effects on longer-term rates. An increase in longer-term rates will trigger a fall in the prices of government bonds, corporate bonds, and fixed rate mortgages and loans.

In principle, stock prices are the discounted value of companies' expected future cash flows.

If a rate rise reduces consumer spending, this will lower corporate revenues, profits and cash flows, and hence stock prices. But an increase in the denominator of the discounting formula, i.e. the discount rate, will also lower stock prices. A higher short-term interest rate will increase the discount rate on near-term cash flows, but any knock-on effect on longer-term interest rates will have a much larger effect by lowering the present value of medium- and longer-term cash flows. The discount rate might also rise because of an increase in the risk premium.

Numerous studies confirm the conventional wisdom. US evidence that rate rises on average lead to stock price falls (and vice versa) is provided by Waud (1970), Jensen and Johnson (1995), Bernanke and Kuttner (2005) and others. Bredin, Hyde, Niztsche and O'Reilly (2007) provide UK evidence, while Bohl, Siklos and Sondermann (2008) document the impact of European Central Bank rate changes on Eurozone stocks. For the USA, Kuttner (2001) shows that rate changes lead to higher yields (and thus lower prices) for instruments ranging from 3-month treasury bills up to 30-year bonds.

Market participants, however, are sophisticated: they do not simply view all rate rises as bad news. They also look at any implications or signals that a rate change conveys. For example, central banks tend to raise rates only when they believe the economy is strong enough. Rate rises can thus be viewed as a positive signal about the economy. Conversely, a rate cut might be seen as bad news, especially in a crisis. Similarly, there is much evidence that high inflation is bad for stocks and bonds (see Dimson, Marsh and Staunton, 2012). So when inflation is high, rate rises may be welcomed as evidence of a resolve to drive inflation down.

More generally, markets will react only to the surprise element of a rate change. Central banks go to great lengths to provide guidance on their criteria, thinking and intentions. The minutes of their meetings are carefully scrutinized for clues and textual subtleties (see Rosa, 2011). Furthermore, their decisions are data dependent, and there is a constant flow of relevant economic data on employment, GDP and so on that helps guide markets on the central bank's likely next move.

Rate changes, or indeed, their failure to happen at a particular meeting, are seldom likely to be major surprises. Thus when we estimate the impact of rate-change announcements, the signal-to-noise ratio will be low. Many other factors impact market prices, and there is also uncertainty about how to interpret signals about timing and importance when these vary over time. This explains why Bernanke and Kuttner (2005) found that, even on days when rates changed or when there was a no-change FOMC meeting, only 17% of the variance in equity prices was associated with surprises about monetary policy.

1.2 The distribution of rate changes

The scatter diagram in Figure 3 shows the relationship between both US and UK rate changes and stock market returns on the corresponding announcement days. The rate changes plotted are those shown in Figures 1 and 2. Rate changes mostly occur in "round" amounts, so there is clustering around ±¼%, ±½% and ±1%. Figure 3 displays 221 US rate changes and 316 UK changes, an average of 2.1 changes per year for the US and 3.7 for the UK. In the USA, rate changes ranged from −1% to +1¼%; in the UK, the dispersion was wider, from −2% to +3%.

At least by eye, there appears to be little relationship between interest rate changes and stock market returns. For both countries, however, there is a statistically significant relationship. The coefficients on a regression of stock returns on rate changes are −0.43 (t-value −2.3) for the USA and −0.36 (t-value −3.4) for the UK. This implies that stock prices tend to fall by 0.43% in the USA and 0.36% in the UK for every 1% rise in the official interest rate. The adjusted R-squareds are 0.02 and 0.03, respectively.

The effects, while quite modest, are in the predicted direction. But, as anticipated, the noise-to-signal ratio is high. We are looking here, however, simply at the impact of the raw rate change, with no attempt to extract the surprise element. Furthermore, Figure 3 shows just the announcement-date impact. It is also of interest to investigate what happens not only on the announcement day, but also before and afterwards.

1.3 Event study of interest rate changes

To look at the market's behavior around the time of the announcement, we carry out an event study. We focus on three windows. First, we examine investment returns over the announcement day (from the market close prior to announcement to the market close following the announcement). Next, we estimate the performance of each asset class from

20 trading days before the announcement to the pre-announcement market close. Last, we measure performance from the post-announcement market close to 20 days later.

We average returns in “event time” across all rate-change announcements. We include only dates on which rates changed, ignoring all potential announcement days on which there was no rate change. The latter can, of course, also impact market prices, depending on prior expectations.

We analyze equities, bonds and currency. Our analysis obviously needs daily returns data. Daily equity data is available for the full period covered by Figures 1–3 from the Dimson-Marsh-Staunton (DMS) US and UK equity series. For bonds, the DMS series has daily data starting in 1962 for the USA and 1967 for the UK, so these are the starting dates for the bond event study. For currencies, we look only at the post-Bretton Woods period. For the USA, we use the Federal Reserve trade-weighted index of the dollar against other currencies starting in 1973. For the UK, we use the sterling-dollar exchange rate from 1972.

Our cumulative event time returns are converted to abnormal returns using a simple autoregressive model to de-mean them and adjust for the very small degree of serial correlation. This ensures that the returns we observe over the entire 41-day event window (from 20 days before to 20 days after the announcement day) are not impacted by the tendency of stocks and bonds to rise over time. By construction, the mean daily abnormal return outside of the event window is zero.

The impact of converting to abnormal returns is modest when it comes to the full 41 days, and over a 1-day window it makes a particularly small difference. However, for consistency, performance measures employ the same procedure even when we are estimating returns over the announcement day.

Figure 4 reports the 1-day performance of the three asset categories over the course of the announcement day. In this and the following charts, we present results for both the USA and the UK, looking separately at the impact of rate rises and rate falls.

The first four bars of this chart report announcement-day returns on the equity markets. On rate rises, equities fell by an average of 10 basis points (bp) in the USA and by 49 bp in the UK. On rate falls, equities rose by 31 bp in the USA and by 1 bp in the UK.

The middle four bars report performance in the bond markets. On the day in which a rate rise was announced, bonds fell by an average 8 bp in the USA and by 31 bp in the UK. On announcement of rate falls, bonds rose by 23 bp in the USA and by 12 bp in the UK.

The last four bars report the reaction of the currency markets on the day of the announcement. On interest rate rises, the home currency rose by 12 bp (US dollars) or 5 bp (UK pounds). On interest rate falls, the home currency fell by 26 bp (US dollars) or 5 bp (UK pounds). The announcement-day returns were as one would predict from a change in the cost of funds. For each of the three asset categories, given the interest rate announcement, market behavior was similar in direction in the USA and the UK.

A rate change could be triggered by pre-announcement market conditions, so the behavior of the market over the preceding 20-day period depends on a variety of factors. It seems unlikely that declining equity markets would trigger a rate hike (as we see mainly in the UK), so it is more likely that equity and bond markets anticipated the policy tightening – e.g. through central bank communication or some data events – which caused the losses in the run-up to tightening. In an efficient market, we would expect the implications of the rate change to be fully impounded in asset prices by the end of the announcement day. This would imply cumulative abnormal returns that were close to zero (i.e. flat-lining) in the subsequent 20-day period. We turn next to examining the pre- and post-announcement performance of equities and bonds.

The next two graphs (Figures 5 and 6) display the cumulative abnormal return on equities and on bonds. The left half of each chart shows performance in event time from 20 days before the rate change up to the market close immediately before the announcement. The right half of each chart shows performance in event time from the market close after the announcement till 20 days after the announcement. The solid lines show asset performance before and after rate rises, while the dashed lines relate to rate falls. As before, blue denotes the USA and turquoise denotes the UK.

The blue lines on the left of Figure 5 show that, in the USA, equities barely moved over the 20 days before rate changes. The turquoise lines show greater pre-announcement divergences for UK equities. For rate rises, equities fell by 0.8% in the 20 days before the announcement, while for rate falls they rose by 1.7%. Perhaps surprisingly, in the UK (but not in the USA), rate rises were on average announced after a period of stock market weakness, while falls were announced after a period of stock market strength. The focus of investors is likely to be on what has tended to happen after a rate change is announced. On the right side of Figure 5, we see that rate rises have been followed in the next 20 days by stock market underperformance averaging –0.4%. Rate falls have been followed in the next 20 days by outperformance averaging 1.3%. Adding in the announcement-day returns in the previous chart, stock market performance from the pre-announcement market close to 20 days after was as follows: for a rate rise –0.6% (USA) and –0.8% (UK), and for a rate fall 1.7% (USA) and 1.4% (UK). Interest rate rises proved to be somewhat painful for equity investors, whereas rate cuts were beneficial.

The lines on the left of Figure 6 show that, in both the USA and the UK, bonds moved more substantially than equities over the 20 days before rate changes. The solid lines show that for rate rises, bonds fell by an average –1.1%, while for rate falls, the dashed lines show that bonds rose by an average 2.0% in the 20 days before the announcement. Either rate changes were a response to recent changes in bond yields, or bond markets were anticipating the interest rate change that was going to be announced.

Turning to what happened post-announcement, the right side of Figure 6 shows that rate rises have been followed in the next 20 days by bond market returns that were close to neutral, while falls have been followed in the next 20 days by bond market outperformance averaging 0.5% (with a marginally positive return after US rate rises, and a larger 1.0% return in the UK).

Adding in the announcement-day returns from Figure 4, bond market performance from the market close before a rise to 20 days after was –0.3% (US) and –0.2% (UK). Bond market performance from the market close before a fall to 20 days after was 0.4% (US) and 1.1% (UK). Interest rate rises had a neutral impact for bond investors, while rate cuts were neutral for US investors, but, in retrospect, were beneficial for UK bond investors.

The reaction of the currency markets is more nuanced. Other things equal, we would expect rate rises to lead to a stronger domestic currency and vice versa, and the evidence is broadly consistent with this. After the announcement-day currency returns shown in Figure 4, subsequent movements were small. Having risen by 12 bp on announcement of a rate rise, the dollar declined by 9 bp over the next 20 days, and having risen by 5 bp on rate rises, the pound weakened by 27 bp afterwards. Similarly, having declined by 26 bp on rate cuts, the dollar recovered by 22 bp afterwards. In slight contrast, having declined by 5 bp on rate cuts, the pound fell afterwards by 66 bp, but there was also some weakening over the period following rate rises (we do not portray the currencies in event time).

In summary, all the announcement-day effects in the USA and the UK for all three asset classes, and for rate falls as well as rises, were in the direction predicted, but their magnitude was quite small. For US and UK bonds and for UK (but not US) equities, however, returns over the 20 days before the announcement were also in the predicted direction and much larger in size. This is consistent with central banks preferring to avoid surprising the markets and with markets correctly anticipating the direction, magnitude and timing of rate changes. Markets will have been assisted by guidance from the central bank and the release of relevant economic data in the run-up to the rate change.

1.4 Do markets influence central banks?

Clearly, rate changes impact asset prices, but the relationship also works in reverse. In deciding when and by how much to change rates, central banks will be influenced by recent market movements. Rigobon and Sach (2003) analyzed US stocks over 1985–99 and concluded that rising stock prices tended to drive short-term interest rates in the same direction. This is in part because central banks are concerned about the wealth effect, which is positive in a bull market and negative when markets fall sharply, and is one reason why central banks lowered rates and loosened policy in reaction to the 1987 crash and the more recent financial crisis.

Volatility can play a similar role. When contemplating rate rises, central banks may choose to delay if markets seem too volatile. We compute volatilities over the pre-announcement period by taking the standard deviation of all daily returns during the 20-day pre-announcement period, first across all rate rises, and then across all rate falls. We compute the announcement-day volatility in the same way, using data for the 3-day period from the pre-announcement day to the post-announcement day.

Figure 7 provides some support for the view that central banks' interventions may be influenced by market volatility. The left-hand side of the chart relates to rate increases. It shows the extent to which volatility is heightened relative to normal (i.e. non-event periods) during the 20 days before the announcement (turquoise bars) and over the announcement period (the blue bars show average volatility over the 3-day period centered on the announcement day). The first set of four bars is for equities, the next for bonds and the third for currency.

The first bar on the left thus shows that, for US equities, volatility prior to rate rises was 6% higher than normal during the pre-announcement period and 45% higher over the announcement itself. As one would expect, volatility is mostly appreciably higher than normal over the announcement period, the only exception being US bond volatility. Furthermore, the blue bars are always higher than the turquoise bars, indicating that volatility is always higher over the announcement period than beforehand.

The surprising feature of Figure 7 is that, prior to rate rises, volatility is fairly subdued in the pre-announcement period. In the USA, for example, it is 6% higher than normal for equities, 28% lower for bonds and the same as normal for currency. The right-hand side of Figure 7 shows the corresponding data for rate falls. Before rate falls, volatility is noticeably higher in all cases than before rate rises. This is consistent with the notion that when volatility is high, central banks tend to defer rate rises. In the case of rate cuts, it is consistent with central banks tending to loosen policy following crises.

1.5 The market reaction to rate surprises

We noted above that markets react only to the surprise element of a rate change. Our event studies focused just on the raw rate change, and did not seek to isolate the surprise element. They are useful in providing guidance on what to expect from a rate change. For example, the muted reaction over the actual announcement period of the important US rate change in December 2015 was entirely consistent with the typically small reactions we have observed historically.

Rate changes are widely anticipated, however, not least by the Fed funds futures market. A number of researchers, including Kuttner (2001) and Bernanke and Kuttner (2005) have isolated the surprise element of announcements by defining the surprise as the actual rate change minus the rate change inferred from Fed funds futures prices. Using this definition, even "no change" meeting days become important, as the lack of a change can itself be a surprise. Others, such as Cieslak and Pavol (2014) use survey evidence to extract the surprise part in a rate change. These studies demonstrate persuasively that the market response to the surprise component is significantly stronger than the response to the raw change.

Figure 8 summarizes the US evidence on the impact of a 25 bp surprise interest rate rise. The impact on equities (the blue bar) is taken from the Bernanke and Kuttner (2005) study which covered the period from 1989 to 2001. They found that equities typically fell by almost 1.2% for every 25 bp of "surprise" rate increase.

The impact on fixed income securities (the turquoise bars) is from Kuttner (2001) who analyzed the period from 1989 to 2000, expressing his results as the impact on yield, rather than returns. A 25 bp surprise rate increase leads to a 20 bp increase in 3- month Treasury bill rates, a 15 bp increase in 2-year Treasuries, an 8 bp rise in 10-year bonds, and a 5 bp rise in 30-year Treasury bond yields.

Finally, the impact of surprise rate rises on the dollar (the green bar) is taken from a study by Rosa (2010) spanning 1999–2007, which investigated the impact of rate changes on currencies using an event study with intraday data for five exchange rates (the US dollar versus the euro, the Canadian dollar, the British pound, the Swiss franc, and the Japanese yen). Rosa found that a 25 bp surprise rate rise led, on average, to a 48 bp appreciation of the dollar against the other major currencies.

1.6 Long-run global evidence

We have seen that, historically in the USA and the UK, rate rises have on average been viewed as bad news for stocks and bonds, while rate falls have been greeted favorably. The extensive *Yearbook* database enables us to investigate whether this has also held true for other countries over even longer periods, and to study predictive patterns in contrast to contemporaneous ones. The database now covers asset returns in 23 countries since 1900.

Our focus up to this point on the USA and the UK partly reflects the importance of these two countries' financial markets, but it is also driven by data availability. For these two countries, we have a long sample of daily returns data, as well as a record of all their official interest rate changes and when they happened. We do not have the equivalent data on rate changes for other countries, and the *Yearbook* database provides only annual data. Our global analysis of the impact of interest rate changes on stock and bond returns is therefore, of necessity, much coarser.

For each of the 21 countries for which we have a continuous returns history since 1900, we identify "rate fall" and "rate rise" years. A year is deemed to be a rate fall year if the Treasury bill return is at least 25 bp lower than in the previous year. It is categorized as a rate rise year if the bill return is at least 25 bp higher than the year before. Years in which there is only a very small or no change from the year before are ignored. We then compute the average returns in the year following (1) rate fall years and (2) rate rise years and report the difference between the two.

Figure 9 presents the results of this predictive analysis for equity returns. It shows that, for every country other than Japan and New Zealand, real stock returns were on average higher in the year following rate fall years than in the year after rate rise years. The average of the 21 countries is given by the bar in the center of the chart with a green border. This shows that, for the average country, real returns were 8.4% higher in years following rate falls compared with years following rate rises. As well as looking at return differences over a 1-year subsequent period, we also computed the differences over a 5-year period, and the results were very similar.

Of the 19 countries for which there was a positive difference in returns, Figure 9 shows that the magnitude was smallest for the USA and the UK. This observation – that the USA and the UK experienced no effective impact on real equity returns from interest rate changes – may be important as a message for the future, now that other markets are more mature. On the other hand, we saw above that when we utilize higher frequency data and the actual dates of official rate rises, both the USA and the UK experienced large positive effects. This suggests that the results in Figure 9, which are based on a much less granular analysis, may understate the extent to which real stock returns were higher during periods of easing rather than tightening.

Many of the countries plotted in Figure 9 had a troubled history during the first half of the 20th century, largely due to the world wars and the episodes of high inflation that often followed in their wake. We have therefore rerun the analysis for the period from 1950 onward. The results were very similar, but slightly stronger. In 20 of the 21 countries, real stock returns were on average higher following rate fall years than rate rise years (the exception was New Zealand). The average difference over the period from 1950 on was 8.9%.

Figure 10 shows the identical analysis for bond returns. For two-thirds of the countries, real bond returns were on average higher in the year following rate fall years than in the year after rate rise years. The average of the 21 countries is given by the bar in the center of the chart with a green border. This shows that, for the average country, real bond returns were 1.5% higher in years following rate falls compared with years following rate rises.

From 1950 onward, the results were very similar, with all but five countries showing a positive effect, and the average difference again being 1.5%. If we look out over five years rather than just one, then all but one country (South Africa) showed a positive difference and the average annualized difference was 1.6%.

Our detailed analysis of the market's reaction to interest rate change announcements was limited to the USA and the UK since these are the only two countries for which we have long-run historical daily returns data, as well as a comprehensive record of all official rate changes. However, when we conducted a coarser analysis based on annual data, but extended now to 21 countries over the period from 1900 to date, our findings were consistent with our finer-grained event-study analysis. Real equity and bond returns both tended to be higher in the year following rate falls than in the year after rate rises. This relationship also held for subsequent periods longer than a year.

This raises an obvious question: How do different asset classes perform over entire hiking and easing cycles? In the following section, we shift our focus away from the immediate impact of rate changes, and instead compare asset performance over entire interest rate hiking and easing cycles. We find substantial differences between the two.

2. Cycling for the good of your wealth

When the Fed raised rates in December 2015, its intention was that this would be the first of a series of such hikes. The last hiking cycle, which began in June 2004, also started with a 25 basis-point rise, taking rates from the floor at that time of 1% to 1.25%. It was followed by a further 16 rate rises, and a hiking cycle that lasted over three years. While no one today expects 16 further rises, no one expected such a prolonged cycle back in June 2004 either.

At the other extreme, the December rate rise could turn out to be a one-off. 2016 has not started well, and a fresh crisis could cause the Fed to reverse policy. Indeed, there have been seven instances of a single-rate-rise US hiking "cycle" over the last 100 years. On average, hiking cycles have lasted just under two years (1.9) and involved 4.3 rate rises. Easing cycles have lasted slightly longer (2.2 years) with an average of 4.7 rate cuts.

Since the financial crisis, US monetary policy has been very loose with ultra-low interest rates plus quantitative easing. Over the seven years since the start of 2009, US stocks have performed strongly with a real return of 12.6% per annum, while long bonds have enjoyed an annualized real return of 2.4%. Does the start of a new hiking cycle and the move to a somewhat tighter policy herald the end of good returns? In the previous section, our focus was on the immediate impact of rate changes. In this section, our focus is on examining asset performance over entire hiking and easing cycles.

A simple approach to measuring performance over interest rate cycles in the USA and the UK would be to utilize the cycle start and end dates depicted in Figures 1 and 2 of the previous section. Investment over hiking cycles involves buying assets on the date corresponding to each of the small yellow diamonds, which denote the start of the up-cycle, and selling on the date of the next turquoise diamond, which marks the reversal point and the start of the down-cycle. Similarly, investment over easing cycles involves investing at each turquoise diamond date and selling at the next yellow diamond.

We follow this procedure for the USA and the UK – the two countries for which suitable data is available – measuring returns in real terms since our main concern is with the impact of rate changes on the purchasing power of investment assets. The use of real returns is also important when making comparisons here, as the average inflation rate is likely to have differed between periods of tightening and easing.

We find large differences in real asset returns between tightening and loosening cycles. During all tightening cycle periods, US stocks achieved an annualized real return of 4.9%, while during easing cycles they enjoyed a much higher return of 8.8%. Similarly, the annualized real return on US bonds over all tightening cycles was –0.2%, while the corresponding return over easing cycles was 5.0%. For the UK, the differences were in the same direction, but even larger.

This strategy could not, however, have been followed in real time as hindsight was used to define the cycles. The turning points in Figures 1 and 2 were identified visually and we ignored any temporary jaggedness in the pattern of rates over time. Thus 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.

2.1 Asset returns during hiking and easing cycles

To circumvent this problem, we adopt a simple trading rule that could be followed in real time. It entails investing (1) after unbroken runs of rate rises, and (2) after unbroken runs of rate falls. Investing after rate rises involves buying assets on the announcement of an initial rate hike (e.g. the December 2015 US rate rise), staying invested as long as rates continue to rise or stay the same, then selling on the announcement of the first rate cut. Investing after rate falls involves purchasing after an initial rate cut then holding until the next rate rise. Essentially, this is a mechanical way of defining hiking and easing cycles.

By defining cycles in this way, there are no "left-over" periods. All points in time are designated either as falling within a hiking cycle or an easing cycle. Our US data starts in 1913, and from 1913 to 2015, US markets were in a rising interest rate mode 44% of the time, and in a falling rates mode 56% 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%).

Figure 11 shows the results of following this strategy. The left side of the chart refers to the USA and the right-hand side to the UK. Each group of three bars relates to a different asset class, with the green bar in each grouping showing the returns over the entire period, the blue bar showing returns after rate falls (easing cycles) and the turquoise bar showing returns after rate rises (hiking cycles).

Looking first at the USA, there are large differences between the returns following rate rises and those after rate falls, especially for stocks and bonds. Equities gave an annualized real return of 6.2% over the entire period, but just 2.3% during rate-rise periods, compared with 9.3% during rate falls. US bonds gave an annualized real return of 2.2% over the full period, but just 0.3% in the rate-rise regime, compared with 3.6% while rates fell. In contrast, real bill returns (the short-term risk-free real interest rate), 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 4.3% during hiking cycles compared with 2.2% 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.

Finally, the performance of the dollar is a somewhat counter-intuitive result. We might expect the dollar to be strong during periods of rate rises, but in fact it has been weaker. Over the entire period covered by our analysis, the annualized depreciation of the dollar against other major currencies was 0.3%. During hiking cycles, it depreciated at an annualized rate of 1.7%, while during easing cycles, it appreciated by 0.6% per annum. This may reflect the higher inflation rate during tightening cycles or perhaps the stronger US economy that tends to prevail during easing cycles.

The right-hand side of Figure 11 shows similar findings for the UK. UK stocks gave an annualized real return of 6.2% over the entire period, but just 1.7% during periods of rising rates, versus 8.2% during easing cycles. This difference is statistically significant at the 3% level. In contrast to the USA, UK bonds gave very similar returns during hiking and easing cycles, while the UK real rate of interest (real bill return) was 1.3% per annum higher during tightening than easing cycles. As in the USA, the annualized inflation rate during UK tightening cycles was much higher (5.5%) than during easing cycles (3.7%), and this was statistically significant at the 1% level. Finally, the pound strengthened against the dollar by 1% per year during tightening cycles, but weakened by 2.3% per year during easing periods. This contrasts with the findings above for the USA.

2.2 Risk and risk premia after interest-rate increases and cuts

An obvious question is whether the higher returns during easing cycles could be due to risk. To investigate this, we computed the annualized volatilities of real returns over both easing and hiking cycles. As the left-hand side of Figure 12 shows, the volatility of equities and bonds in both countries was indeed greater during easing cycles. Equity volatility was 25% higher in the USA and 6% larger in the UK. Bond volatility during easing periods exceeded volatility during hiking cycles by 9% in the USA and 11% in the UK.

The right-hand side of Figure 12 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 0.45 compared with 0.12 during periods of rising rates. The ratios for the UK, 0.47 and 0.00, are similar. US bonds had a Sharpe ratio of 0.36 during easing cycles compared with –0.01 during hiking cycles. In the UK, the margin of outperformance for bonds was more slender, with a ratio of 0.20 during easing cycles and 0.08 during periods of rising rates.

Figure 13 shows annualized risk premia over tightening and easing cycles. The top half of the chart relates to the USA and the bottom half to the UK. For each country, three premia are shown: the equity risk premium (ERP) relative to bills, ERP relative to bonds, and the maturity premium (the long-term bond return expressed as a premium over the three-month Treasury bill return). The green bars refer to the entire period, the turquoise bars to tightening cycles and the blue bars to easing cycles.

Figure 13 shows that, during US easing cycles, the ERP relative to bills was 8.8% per year, far higher than the 1.8% during tightening cycles. But, even in tightening cycles, investors would have been better off remaining in equities, as the ERP relative to bills and bonds stayed positive. During these periods, they would have been marginally better off in cash than bonds, as the annualized maturity premium was −0.1%. Note that the entire maturity premium from long-term bond returns relative to bills was earned during easing cycles. The differences in both the ERP relative to bills and the maturity premium between tightening and easing cycles were statistically significant at the 1% level.

The UK results are broadly similar, but Figure 13 shows that, in the UK, the entire long-run ERP was earned during easing cycles. The difference in the ERP relative to bills during easing and tightening cycles was significant at the 1% level. During tightening cycles, cash performed slightly better than stocks, while bonds outperformed by 0.8% per year. 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 maturity premium was appreciably lower during tightening cycles, although it remained positive in the UK.

2.3 Cyclical and non-cyclical industries

Investment assets are often classified as cyclical or non-cyclical (sometimes labeled defensive), or as sensitive or insensitive to interest rates. Cyclical investments are more exposed to the state of the economy. For example, they may be manufacturers or distributors of discretionary items that consumers demand when they feel wealthier and cut back on in recessionary times, or they may be producers of durable goods such as raw materials and heavy equipment. Cyclical businesses include cars, airlines, hotels, fine dining, furniture, luxury goods, technology, machinery and tooling.Non-cyclical businesses may provide necessities that are in demand even during a downturn or they may even be contracyclical, moving in the opposite direction from the overall economy. Non-cyclical companies include household non-durables, pharmaceuticals, tobacco, insurance or public utilities. True contracyclical sectors are rare, but might be illustrated by outplacement specialists, whose services in finding alternative employment for redundant workers may be in particular demand in times of recession.

A common investment doctrine is to seek market-beating performance from non-cyclicals during bad economic times, and to harvest an upswing from cyclicals when the economy enters a recovery. However, there is little hard evidence to indicate that such strategies can be successfully implemented in practice (see Stangl, Jacobsen and Visaltanachoti, 2009), not least because the right times for investing and switching may be apparent only with hindsight. It is hard to predict economic booms and recessions, and, given the state of the economy, it is uncertain how sensitive company earnings are to economic conditions.

An illustration is when Caterpillar Inc. researchers once found a leading indicator that predicted the state of the US economy by several months, and shared their findings with the firm's CFO: "We've got good news and bad news," they explained. "The good news is we found an indicator that predicts shifts in US GDP with a lead time of six to nine months. The bad news is it's our own sales to users" (reported in Colvin, 2011). Using that criterion, Caterpillar anticipated the US recession coming in the third quarter of 2007 and, when publicized, their prediction triggered a one-day fall in the S&P 500 of 2.6%.

As the Caterpillar anecdote illustrates, the timing and magnitude of economic growth can be hard to judge. We do, however, have information on the interest rate cycle, and can identify unambiguously the date (and size) of interest rate rises (hiking cycles) and rate falls (easing cycles). In earlier studies, James, Kim, and Cheh (2014) found that over the period 1949–2012, the US monthly prime loan rate could underpin a profitable sector-rotation strategy, and Conover, Jensen, Johnson, and Mercer (2008) found that, over the period 1973–2005, a sector-rotation strategy generated an annualized outperformance of 3.4% compared to a buy-and-hold benchmark. A limitation of the Conover et al study is that it covered only seven rate rise and seven rate fall episodes.

Motivated by this literature, we examine the impact of rising and falling rates using a larger sample spanning the 90-year period since 1926. We identify periods after a US rate rise or fall and measure the performance of each industry index. We estimate industry factor returns, where the latter are the annualized returns on each industry index measured relative to the contemporaneous return on the overall equity market index.

The US results are summarized in Figure 14. The vertical axis shows the industry factor return following an interest rate rise (blue bars) and following an interest rate fall (turquoise bars). The horizontal axis shows the industries, which are described below. The underlying data are from Ken French's 12 Industry Portfolio daily series, from July 1926 to July 2015.

The industries are ranked loosely from defensive to cyclical. On the left are utilities and telecoms. They are followed by engineering, healthcare and drugs, business equipment (including software), financials, and chemicals. Towards the right are consumer non-durables, manufacturing, other industries (those not covered by the other 11 groups, such as business services, construction, hotels, entertainment, mining, and transport), retail and wholesale, and consumer durables. The ranking is based on the average responsiveness of these industry groups over the very long term to changes in interest rates in the USA and (using the same industry groupings) in the UK.

Interestingly, cutting-edge publications on investment provide little evidence on whether stock market returns are robustly related to industry cyclicality. As we wrote a year ago in the *Global Investment Returns Yearbook* (Dimson, Marsh and Staunton, 2015), "In research terms… industries are the Cinderella of factor investing."

Yet as we noted then, industry factors are a key organizing concept in investment, and there is an enduring emphasis in portfolio management on getting industry exposures right. Industry membership is the most common method for grouping stocks for portfolio risk management, relative valuation and peer-group valuation. Much of that is founded on a belief that industries respond to the economic environment in a consistent way.

Figure 14 confirms what practitioners knew all along. Not only do US investment returns correlate with broad perceptions about industry cyclicality, but there is a systematic relationship between performance in tightening and easing cycles. Industry factor returns during declining interest rates are systematically in the opposite direction to industry factor returns during rising interest rates.

There are three small exceptions to this feature of Figure 14, namely chemicals, manufacturing, and the "other" category. For these three groups, industry factor returns tend slightly to be in the same—rather than the opposite—direction during tightening and easing cycles. Why might this be? In part, the industries in Figure 14 are aggregate groupings and the "other" category contains a somewhat unconnected selection of leftover fields of business. We gain additional insight by analyzing the "other" group in more detail later in this section.

For each industry our performance indicator is the difference between the industry factor return during hiking cycles and easing cycles. We portray the difference in the green line plot in Figure 14. This exposure to monetary conditions varies markedly across industries. Although the pattern shown in Figure 14 as a whole is persuasive, the difference in returns for individual industries between hiking and easing cycles is statistically significant only for consumer durables, retail and wholesale and healthcare.

Remember that the timing rule depicted in Figure 14 could have been followed in real time, and does not rely on hindsight. Our research design thereby avoids look-ahead bias. In addition, we have taken steps to reduce the likelihood that our findings are valid in-sample but not out-of-sample. We have done this by evaluating an executable trading rule that is simple, intuitive and not ad hoc. The periods in which we are exposed to specific industries are spread out over time and do not reflect just one episode in history. And crucially, we have analyzed and reported just one trading rule, and not selected a particular scheme that worked well, while ignoring others that proved less successful.

Another way to evaluate the robustness of the US evidence reported above is to investigate the UK. We therefore use the London Share Price Database (LSPD) to construct industry indices over the period 1955–2015, based as closely as possible on the definitions used by Ken French for the 12 Industry Portfolios used for the USA above. Because of earlier nationalization, two of the 12 industries, telecoms and utilities, were not represented within the UK stock market in 1955. The UK telecoms index started life in 1981, when the first telecom company was privatized, while the utilities index began in 1989, when the UK government sold off the first batch of utilities.

Our findings are reported in Figure 15, which has the same format as Figure 14. The industries are also presented in the same sequence so as to facilitate comparisons with the USA. Figure 15 reveals the same general pattern for the UK as we saw in the USA. Factor returns in different interest rate regimes correlate with perceptions about industry cyclicality, and there is an inverse relationship between stock market performance in tightening and easing cycles. Industry factor returns during periods of declining interest rates are systematically in the opposite direction to industry factor returns during rising interest rates.

Apart from utilities, for which there are very few observations, and where we have truncated the post-interest rate-rise factor return, the only exceptions in Figure 15 are healthcare, for which the industry factor return was similar during tightening and easing cycles, and consumer nondurables, for which the post-rate-rise industry factor return was close to zero.

Analyzing these UK industry indexes provides a complementary body of evidence on the response of industry stock market indexes to interest rate changes. Since these successive, non-overlapping episodes are not a product of hindsight or look-ahead selection bias, there is some reliability in the relationships we have uncovered, though naturally the magnitudes of the responses vary considerably. When we focus on individual UK industries, the differences we observe between returns in hiking and easing cycles were statistically significant for consumer durables, retail and wholesale (as in the USA), and manufacturing.

One should not conclude that there is a clear cause-and-effect relationship between changes in short-term interest rates, on the one hand, and ensuing longer-term industry returns on the other hand. The relationship between interest rate changes and stock market performance is difficult to disentangle – the more so since monetary policy is predicated on forecast economic conditions. To dig deeper into stock market responses to rate hikes and cuts, we look next at some of the other underlying factors that drive equity returns.

Before moving on from focusing on industry groupings, we should look inside the "other" category for the US and UK markets. For the leisure subgroup (which Ken French labels as "Fun") the difference between the industry factor return during hiking cycles and easing cycles averages 7.4% (a statistically significant 10.9% in the USA, versus 3.8% in the UK), so that "other" contains a very cyclical consumer subsector.

"Other" also contains a construction subsector, which bears comparison with the property subsector of financials. Property and construction, taken together, have an average industry factor return difference between hiking and easing cycles of 3.4% in the USA and of 7.5% in the UK, the latter being statistically significant. Listed companies exposed to the real estate market tend to be beneficiaries when interest rates are cut and tend to be hurt when interest rates rise.

2.4 Factor risk premia

Portfolio returns are impacted by industry exposure. But, as we note in Chapter 3 of the *Global Investment Returns Sourcebook 2016* (Dimson, Marsh and Staunton, 2015), investment performance is also influenced by whether a portfolio favors large or small companies, value or growth stocks, higher- or lower-yielding securities, or momentum or reversal strategies. These factors—size, style, income, and momentum—are the longest established and best-documented regularities in the stock market, sometimes referred to as smart beta factors. We refer readers to the *Sourcebook* for our review of over a century of financial market history, and what it reveals about the long-term risks and returns from factor-tilted portfolios.

It is well known that stock market risk exposures can be associated with both superior and inferior performance. There has been a resurgence of interest in these contributors to stock market returns since publication of the five-factor model of Fama and French (2015abcd, 2016). Our emphasis in this paper is on factors that, in addition to the overall market, have a particular influence on stock returns in both the USA and the UK and can be estimated for both markets.

We examine the value premium (value stocks relative to growth stocks), the income premium (high yield stocks relative to low (but non-zero) yielders), the size premium (small-caps relative to large-caps), and momentum premium (past winners relative to past losers). The US value premium is based on Fama and French's division of stocks into the top 30% of "value" stocks and bottom 30% of "growth" stocks according to their ratio of book value to market value of equity. The UK value premium is based on an update to the study by Dimson, Nagel and Quigley (2003), in which value is based on the top and bottom 40% of stocks ranked according to their ratio of book value to market value of equity.

The US income premium is based on the "Univariate sorts on D/P" data from Ken French's website, and is the premium provided by the 30% of stocks with the highest yield relative to the 30% with the lowest yield. Zero dividend stocks are excluded from this premium. The UK income premium is calculated in the same way from LSPD data, using the same definitions.

The US size premium is based on the returns from small-cap stocks (the smallest 30% in the market) and large-cap stocks (the largest 30%) taken from "Portfolios based on size" on Ken French's website. The UK size premium is based on an update of the Dimson, Nagel and Quigley (2003) study. Large-caps are defined as the 30% of stocks with the largest capitalizations, while small-caps are taken to be the remaining 70%.

The momentum premium is based on Griffin, Ji, and Martin's (2003) 6/1/6 strategy in which stocks are ranked by their 6-month performance and, after 1 month, the top quintile ("winners") is bought and the bottom quintile ("losers") is sold short. The portfolio is held for six months and then rebalanced. We have updated their US study to 2015, and replicated this strategy in the UK using data from LSPD. We report the performance of the winner-minus-loser portfolio, which measures the results from running a notional long-short fund. Further details are provided in Chapter 3 of the *Global Investment Returns Sourcebook 2016*.

Our US factor data runs from 1926 (1927 for income) to late 2015, while our UK data starts in 1955 (1956 for income) and runs to late 2015. In Figure 16, the green bars portray these four premia over the entire sample period. Value, income and size all generated annualized premia of several percentage points, while momentum generated a substantially larger premium (albeit at the expense of high turnover and costs). More details on these premia are provided in the *Sourcebook*.

The remaining bars on the chart show how the premia behave after rises or falls in interest rates. The blue bars show the magnitude of the premia during periods after interest rate falls, while the turquoise bars show what happened during periods of rising interest rates. Falling interest rates underpinned an expansion of the value, income and size premia in the USA and the UK. The momentum premium was elevated in the UK during periods in which interest rates fell, but that was not the case in the USA. The transatlantic difference in momentum premia during hiking and easing cycles is a reminder of the volatile nature of the momentum premium, which is highly sensitive to reversals in the stock market.

The value and income premia stayed positive even during periods of rising interest rates, although they got smaller, and in the case of income in the USA, almost disappeared. The size premium, however, not only disappeared during periods of rising rates, but turned negative. Indeed, the size premium was the only factor where the difference in returns between hiking and easing cycles was statistically significant in both the USA and the UK.

We can speculate about the reasons for this. First, small-caps in both the USA and the UK tend to have a higher proportion of their assets, sales and profits in their home country. Since we are looking at the impact of domestic interest rate rises, and since central banks use rate rises to dampen domestic inflationary pressures, small-caps are likely to be affected more than their larger, more international large-cap counterparts.

Second, smaller companies are generally in a weaker position during hiking cycles in terms of funding. They have less easy access to bond markets, tend to be reluctant to raise equity when markets are weaker, and are more dependent on domestic bank lending. Many large-caps are multinationals that can shop around globally for finance. Third, the sector profile of small caps may also be part of the explanation. They have greater exposure to domestic, consumer facing businesses and to more cyclical industries.

The Fama-French five-factor model adds two quality factors to the size and value effects they had popularized in their early work. They are a profitability factor (stocks with a high operating profitability perform better) and an investment factor (companies with high growth in assets have inferior returns). In their empirical research, Fama and French find that these two factors largely explain the traditional value factor (based on the market-to-book ratio). We investigate the two quality factors using data from Ken French's website, and find that the premia associated with quality are elevated during expansionary periods.

Fama and French (2015abcd, 2016) omit from their new model two other factors that make a documented contribution to stock market performance. They are momentum, which we have addressed above, and the low-volatility anomaly (portfolios of low-vol stocks have produced higher risk-adjusted returns than portfolios comprising high-vol stocks). Using US and UK data, we therefore examine the low-volatility premium in the same way as the other factors represented in Figure 16. We confirm that stocks with low betas, low specific risk and low variance achieved higher returns than their higher-risk brethren. Consistent with our other results, we find that falling interest rates underpinned an expansion of the low-volatility premia in both countries.

2.5 Real asset returns and interest rate changes

We use the term “real assets” to refer to durable stores of wealth such as farmland, artworks, and precious metals, while excluding financial securities such as public or private equity. Capgemini/RBC (2015) and Barclays (2012) report that, in aggregate, real assets represent a larger proportion of household and high-net-worth individual wealth than fixed income or public equity.

Real assets can in principle be divided into two groups. There are those that provide a financial cash flow to owners, and those that provide an intangible income. The former may be illustrated by real estate, while the latter are sometimes referred to as “treasure assets.” The distinction is not black and white, and many assets share both attributes. For example, housing offers an imputed rental value, but it can also provide the owner with non-financial personal utility; art may provide a warm feeling to collectors, though it is sometimes perceived as a store of value and as a form of protection against high inflation. Housing is often regarded as an investment, whereas art collecting is typically viewed as a hobby – yet the distinction is moot.

Real assets therefore offer the prospect of long-term price appreciation (or depreciation) plus non-financial utility that is difficult to estimate. We researched the long-term price performance of real estate and gold in Dimson, Marsh and Staunton (2012). Our current focus, however, is not on long-term returns, but on the shorter-term responses of real asset values to changes in the interest rate. Income is rarely available for these investments, but omission of income fortunately has a limited impact on measuring sensitivity to financial market conditions. To illustrate this in a different context, it is well known that omission of dividends has little impact on estimates of equity betas or volatilities.

In contrast to listed securities, real assets are traded infrequently and in illiquid markets. Consequently, real asset indices are often annual, and only occasionally quarterly or monthly. Furthermore, intra-year index values generally suffer from smoothing bias, and are notorious for giving the misleading impression of having low risk and low correlation with financial assets. By investigating assets with annual observations, we benefit from enlarging the number of series we can study, lengthening the period of observation to over a century, mitigating the concern that our findings might be specific to particular episodes, and reducing the impact of smoothing bias from appraisal-based indices. We examine three sets of real assets for which long-term returns have been estimated: collectibles, precious metals and real estate.

The collectibles comprise artworks, investment-quality postage stamps, first growth Bordeaux wine, and musical instruments (violins), all of which were analyzed in Dimson and Spaenjers (2014). The art price series is estimated by Goetzmann, Renneboog and Spaenjers (2011), and extended by linking it to the Artprice (2015) index. The stamp price series is for British postage stamps from Dimson and Spaenjers (2011), linked to the Stanley Gibbons GB250 Index. The wine price index is for premier cru Bordeaux from Dimson, Rousseau, and Spaenjers (2015). The violin price index is derived from the studies by Graddy and Margolis (2011, 2013).

The precious metals data comprises series for gold and silver; we studied gold in Dimson, Marsh and Staunton (2012) and silver prices are inferred from the silver-to-gold price ratios in Officer and Williamson (2015). We also study the diamond price series provided by Spaenjers (2016). The data on real estate is for the USA and the UK. The annual US house price index is from Shiller (2015a, 2015b) and the farmland index is from the US Department of Agriculture (1973, 2015). The UK house price index is from Monnery (2011) and Nationwide (2015), and the farmland index is from Savills (2015).

All series begin in 1900 except US farmland, which starts in 1910. Where the source data was in nominal terms, it is inflation-adjusted using inflation rates from Dimson, Marsh and Staunton (2016). For consistency with our earlier work, we focus on returns denominated in US dollars and British pounds. We converted returns to both inflation-adjusted USD and inflation-adjusted GBP using real exchange rates from Dimson, Marsh and Staunton (2016). The underlying data uses materials compiled by Spaenjers (2016), to whom we express our thanks. The index series do not necessarily run from end-year to end-year, and so it is important to examine the change in asset value in the years following a change in the interest rate. In our reported results, we focus on an interval of two years following the change in interest rates. This allows for the possibility that asset values are slow to respond to tightening or loosening monetary conditions.

We have found that financial asset returns and risk premia have been lower during periods of rising interest rates than during periods of declining rates. We can now examine whether that carries over to real asset returns. For each of the real asset return series, we identify US and UK rate fall and rate rise years.

As before, when we examined equities and bonds around the world, a year is deemed to be a rate-fall year if the Treasury bill return is at least 25 bp lower than in the previous year. It is categorized as a rate-rise year if the Treasury bill return is at least 25 bp higher than the year before. Years in which there is only a very small or no change from the year before are ignored. We then compute the average inflation-adjusted annualized asset return in the two years after rate-fall years and in the two years after rate-rise years.

In investigating the impact of interest rate changes, we need to decide which country's interest rate is likely to be more relevant to the asset in question. In the case of real assets that are permanently physically located in a particular country, we measure the impact of that country's interest rate. So we examine the sensitivity of US housing and farmland returns (in real USD terms) to US interest rates, while UK housing and farmland returns (in real GBP terms) are analyzed relative to UK interest rates.

The other "treasure assets" are portable, not restricted to a particular country, and are of interest to global buyers and investors worldwide. In our analysis, we measure the returns on these assets in both GBP and USD terms, and analyze them against both UK and US interest rate changes. However, the results that we report below treat these assets as global assets, measuring their returns in real USD, and analyzing their sensitivity relative to US interest rate changes.

Figure 17 presents our results. The bars show the difference in the average annualized 2-year return after interest rate falls, compared with interest rate rises. Thus, for example, diamonds have on average given a real USD return that is 6% per year higher over the two years following an interest rate fall than after an interest rate rise. Quite clearly, all of the real assets perform better following interest rate falls than interest rate rises. This is as we would expect, and consistent with all of our analysis above on publicly traded assets.

3. Conclusion

We have examined all changes in the official interest rate in the USA for over 100 years and in the UK for 85 years. The announcement-day impacts are on average small, but in the predicted direction. Rate rises are on average bad news for stocks and bonds, while rate falls are greeted favorably.

When we look over the 40-day period around rate changes, the relationship is more obvious, and the effects are much larger. This is consistent with markets correctly anticipating the direction, timing and magnitude of rate changes. They are helped in this task by central bank guidance and macroeconomic data announcements. Researchers who have controlled for the surprise element of rate changes, typically using futures market rates, also find that the announcement effects are much larger. Rate changes matter, even though the reaction on the day itself often seems muted.

The relatively small announcement-day reaction is a tribute to the fact that markets are effective in anticipating rate changes and their likely impact. Public knowledge, such as current central bank policies and pronouncements, is already impounded in stock and bond prices. It is surprises in central bank policy and actions that impact asset prices. So investors with a superior understanding of central bank policy, or who are better able to forecast the macroeconomic variables that condition central bank decisions, should have an edge.

Besides rate changes impacting asset prices, asset prices and volatility themselves influence rate changes. There is a tendency for rising stock prices to drive short-term interest rates in the same direction, while sharply falling prices can provoke monetary easing. This effect may partly be driven by policymakers' concern with wealth effects. There is also evidence that, when volatility is high, central banks tend to defer rate hikes.

We have looked at asset returns over hiking and easing cycles. Based on a simple strategy that investors could follow, we have found marked and statistically significant differences in stock and bond returns between periods following interest rate rises and periods after rate cuts. In the USA, annualized real equity returns were just 2.3% during tightening cycles and 9.3% during loosening periods. Real bond returns were 0.3% in hiking cycles and 3.6% during periods of easing. Our findings were broadly similar for the UK.

Our results are a record of what has happened over a long period of capital market history. They do not address the risks of pursuing particular strategies. For example, asset returns are generally higher if investors buy securities after a cut in interest rates; yet these economic conditions may coincide with the very times at which investors are reluctant to invest and are hence more risk-averse. In an efficient market, the elevated rewards from buying during rate cuts may simply be the compensation required to draw as many buyers as sellers into the market at those times.

Stock and bond returns have been lower during periods of rising interest rates. But these have also been periods of higher inflation. Inflation has 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).

If the US Fed is simply pausing on its plan to maintain a path of rising interest rates, does this imply that prospective stock returns are likely to be low? Should we be similarly pessimistic about asset returns in the UK, where tightening might start well beyond the end of this calendar year? If the Fed reverses its late-2015 intentions and cuts interest rates, will this be grounds for investor optimism? Meanwhile, should we be optimistic now about Eurozone, Japanese and Chinese returns, where central banks are continuing to loosen or cut interest rates? Will what has been dubbed the “Great Divergence” between central bank policies around the world translate into sharply differing asset returns?

First, asset returns around the world tend to be quite highly correlated, and we would expect this to persist. Second, while history can undoubtedly provide clues to the future, we should be cautious about any forecasts. The results we have presented are based on long-term averages spanning many different economic conditions. The averages conceal considerable differences between cycles. Indeed, during 40% of US hiking cycles, equities actually performed better than during the easing cycles that preceded them. Markets are frequently humble us and confound our beliefs, especially if they are consensus positions.

The expected return from financial assets is low, and we have been unable to find any evidence that returns are on average elevated as a consequence of actual or anticipated interest rate rises. So is this the right time to seek exposure to other sources of reward in the financial markets? In other words, can other asset categories offer us contracyclical returns in relation to interest rate changes?

History tells us that the broad answer is no. While some sectors and asset classes are less sensitive than others to tightening cycles, interest rate rises are accompanied by lower risk premia, inferior industry returns, smaller rewards from many factor-investing strategies, and reduced price appreciation for a wide variety of real assets. It is hard to identify assets that perform well in absolute terms during hiking cycles, although we do detect relative outperformance at such times from defensive versus cyclical stocks and from large-cap versus small-cap stocks.

The case for diversification remains important because different assets generate returns that are imperfectly correlated. Whenever assets do not move in lockstep with each other, there is scope to benefit from risk reduction. Provided the costs of diversifying are not disproportionate, portfolios can enhance their expected reward-to-risk ratios by adopting a multi-asset, multi-national, multi-strategy approach to investment. Diversifying for the long-term makes sense. Tactical switches in anticipation of interest rate changes are less likely to contribute to long-term portfolio returns.

Furthermore, markets anticipate and public knowledge, such as current central bank policies, will surely already be impounded in stock and bond prices. It is future surprises in policy that will drive asset prices. So investors with a superior understanding of central bank policy, or who are better able to forecast the macroeconomic variables that influence central banks, may have a potential edge. But a wealth warning is in order: superior predictive skill is rare.

Finally, any concerns about lower prospective US and UK returns should be extended globally. We continue to live in a low-return world. Long-term bond yields remain extremely low throughout the developed world, so that future bond returns are likely to be much lower than over the last few decades. Future real equity returns will depend on the expected real risk-free interest rate plus the expected equity premium. Real interest rates remain low everywhere, and there is no reason to believe that the equity risk premium is unusually elevated. Prospectively, therefore, the real returns on bills, bonds, equities, and indeed all risky assets, seem likely to be relatively low.

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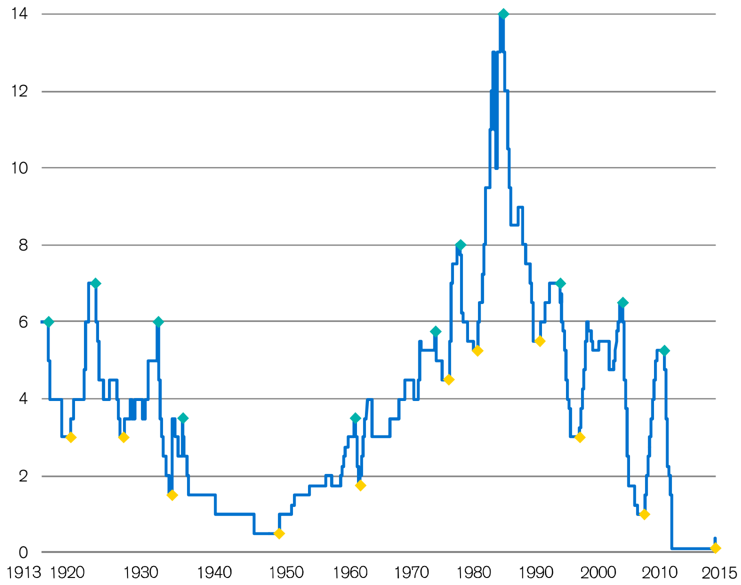
Figure 1

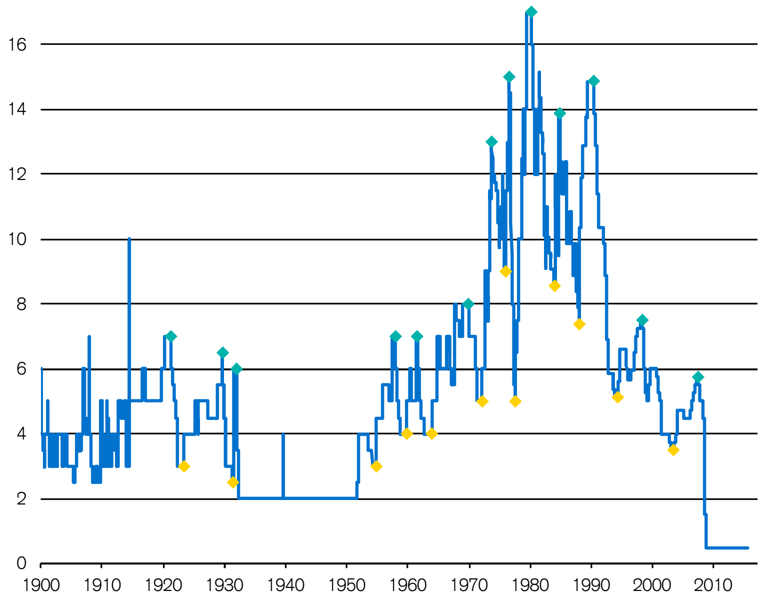
US: Federal Reserve official interest rates (%), 1913–2015



Source: Elroy Dimson, Paul Marsh and Mike Staunton, Federal Reserve, Global Financial Data

Figure 2

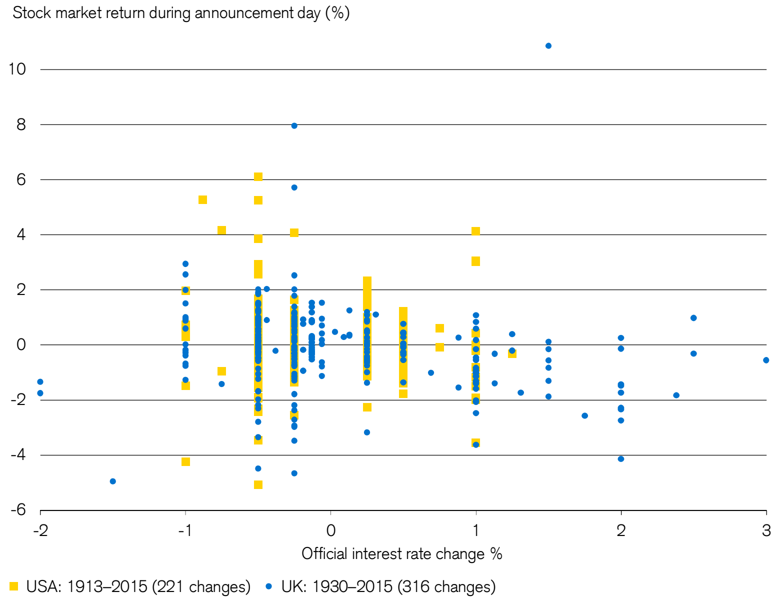
UK: Bank of England official interest rates (%), 1900–2015



Source: Elroy Dimson, Paul Marsh and Mike Staunton, Bank of England

Figure 3

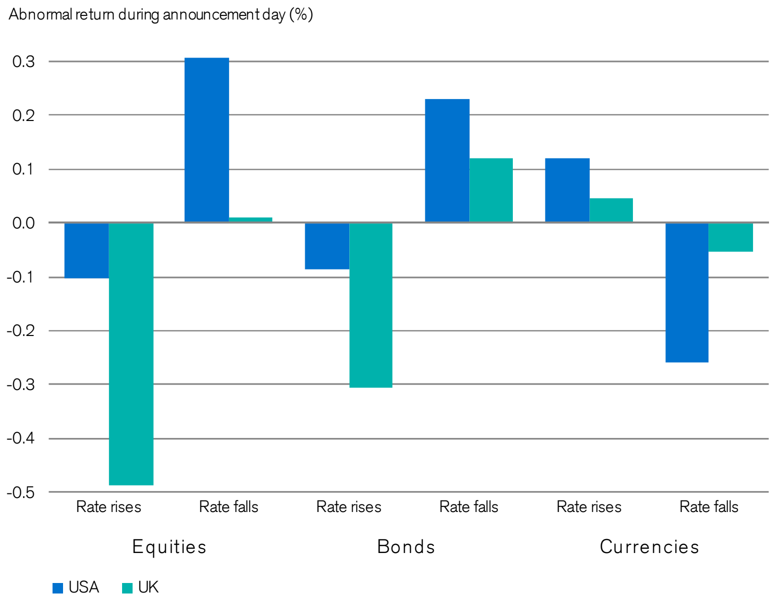
US & UK rate changes and stock market returns (%), 1913–2015



Source: Elroy Dimson, Paul Marsh and Mike Staunton; Dimson-Marsh-Staunton (DMS) database; Bank of England, Federal Reserve, Global Financial Data, Thomson-Reuters Datastream.

Figure 4

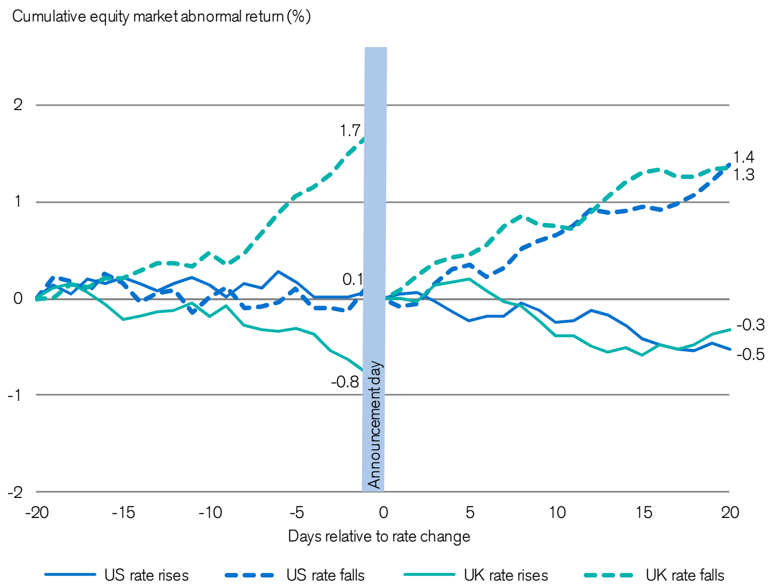
Market reaction to rate changes on the announcement day



Source: Elroy Dimson, Paul Marsh and Mike Staunton; Dimson-Marsh-Staunton (DMS) database; Bank of England, Federal Reserve, Global Financial Data, Thomson-Reuters Datastream.

Figure 5

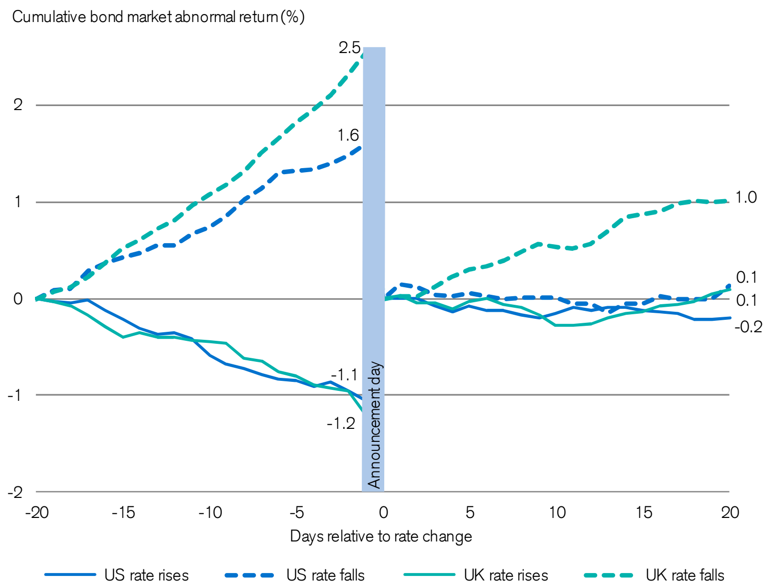
Equity market performance before and after rate changes



Source: Elroy Dimson, Paul Marsh and Mike Staunton; Dimson-Marsh-Staunton (DMS) database; Bank of England, Federal Reserve, Global Financial Data, Thomson-Reuters Datastream.

Figure 6

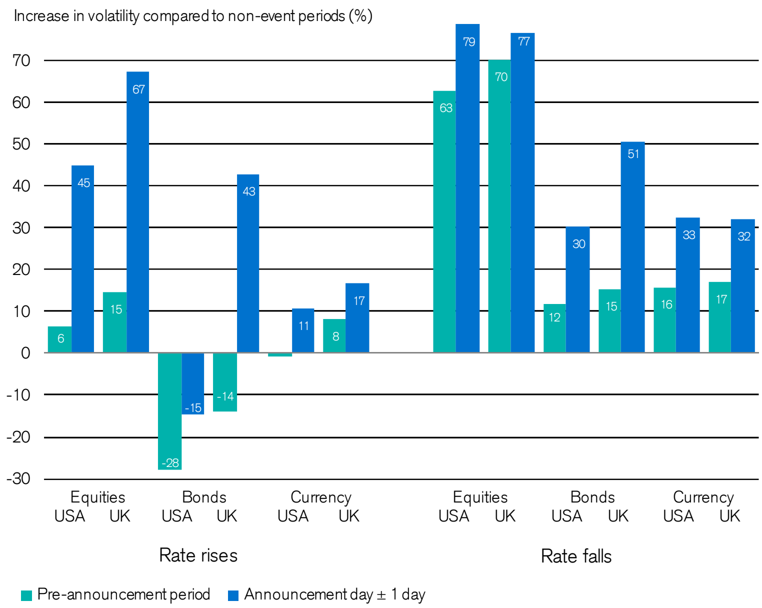
Bond market performance before and after rate changes



Source: Elroy Dimson, Paul Marsh and Mike Staunton; Dimson-Marsh-Staunton (DMS) database; Bank of England, Federal Reserve, Global Financial Data, Thomson-Reuters Datastream.

Figure 7

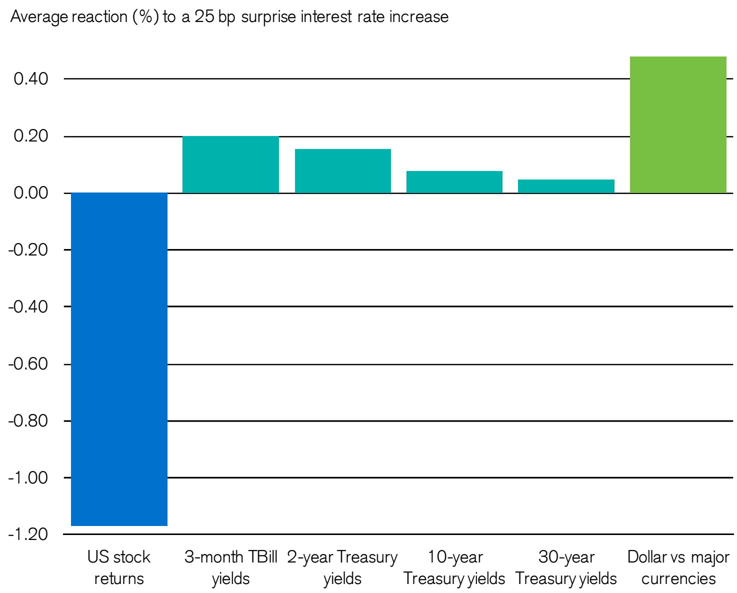
Market volatility before and around the time of rate changes



Source: Elroy Dimson, Paul Marsh and Mike Staunton; Dimson-Marsh-Staunton (DMS) database; Bank of England, Federal Reserve, Global Financial Data, Thomson-Reuters Datastream.

Figure 8

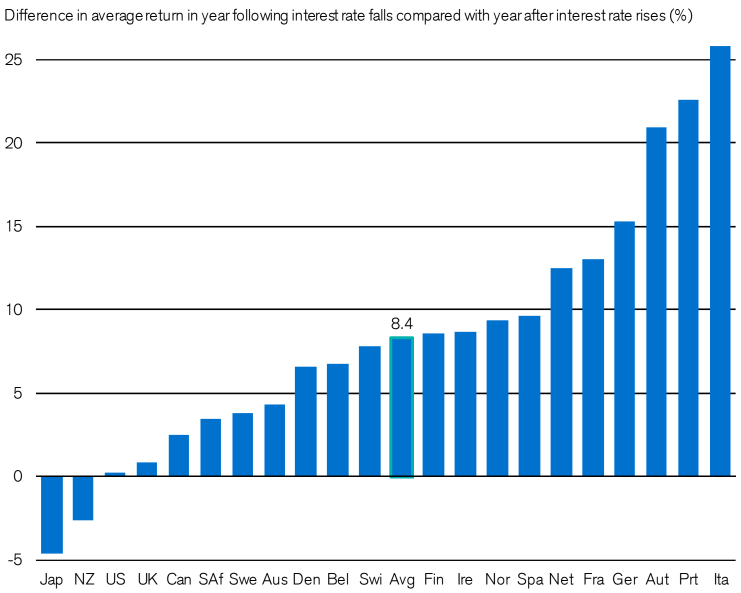
Reaction to US rate change surprises



Source: Bernanke and Kuttner (2005), Kuttner (2001), Rosa (2010)

Figure 9

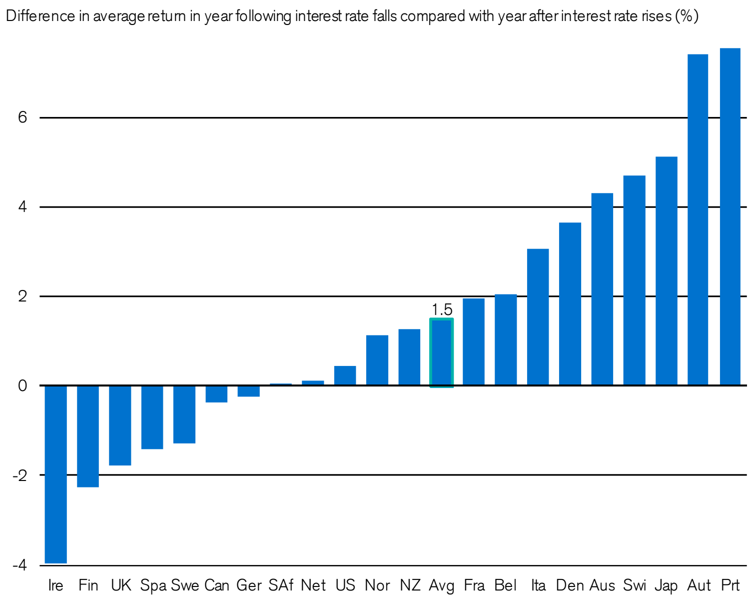
Impact of rate changes on real equity returns, 1901–2015



Source: Elroy Dimson, Paul Marsh and Mike Staunton; Dimson-Marsh-Staunton (DMS) database

Figure 10

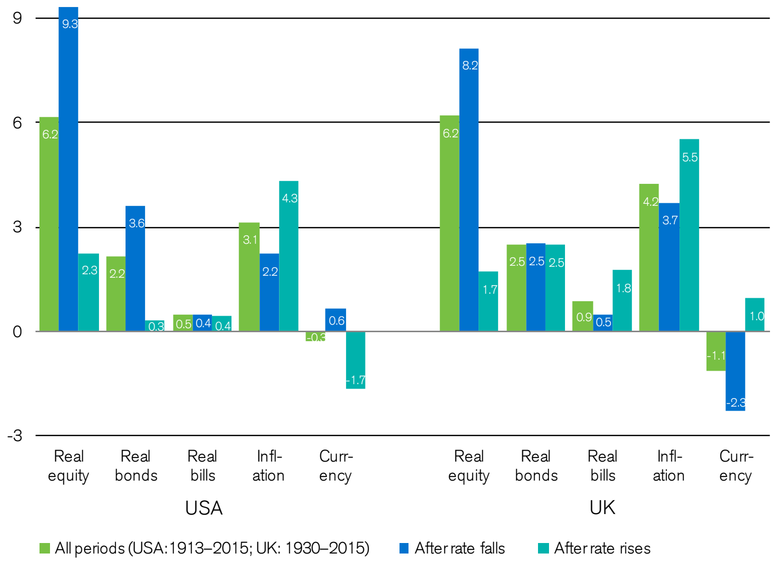
Impact of rate changes on real bond returns, 1901–2015



Source: Elroy Dimson, Paul Marsh and Mike Staunton; Dimson-Marsh-Staunton (DMS) database

Figure 1

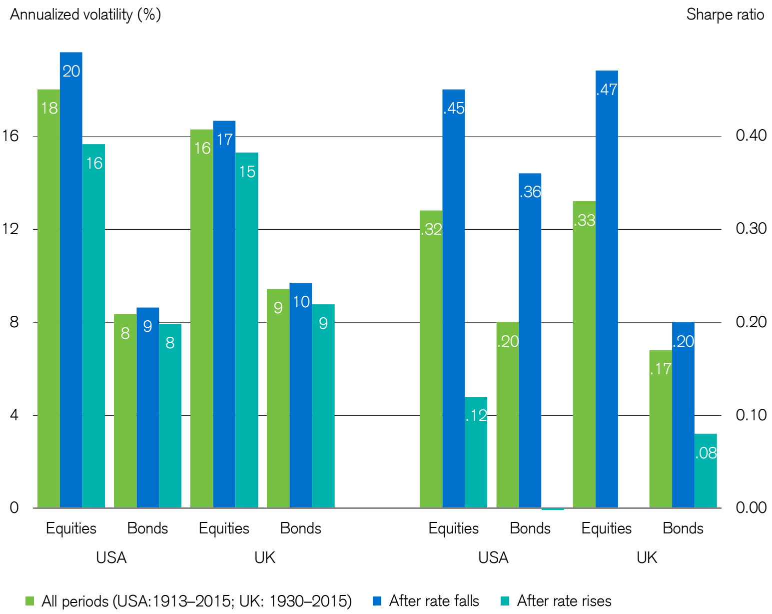
Performance of assets after rate rises and rate falls



Source: Elroy Dimson, Paul Marsh and Mike Staunton; Dimson-Marsh-Staunton (DMS) database; Bank of England, Federal Reserve, Global Financial Data, Thomson-Reuters Datastream.

Figure 12

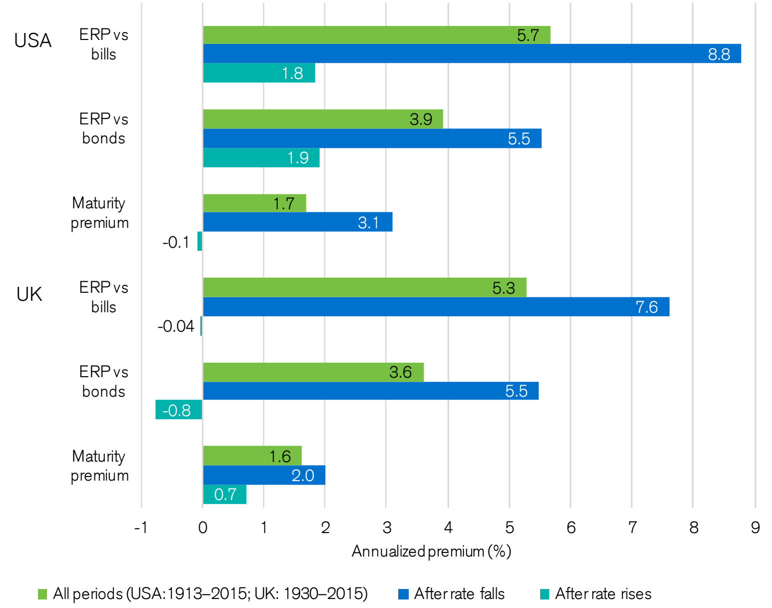
Volatility and Sharpe ratios after rate rises and rate falls



Source: Elroy Dimson, Paul Marsh and Mike Staunton; Dimson-Marsh-Staunton (DMS) database; Bank of England, Federal Reserve, Global Financial Data, Thomson-Reuters Datastream.

Figure 13

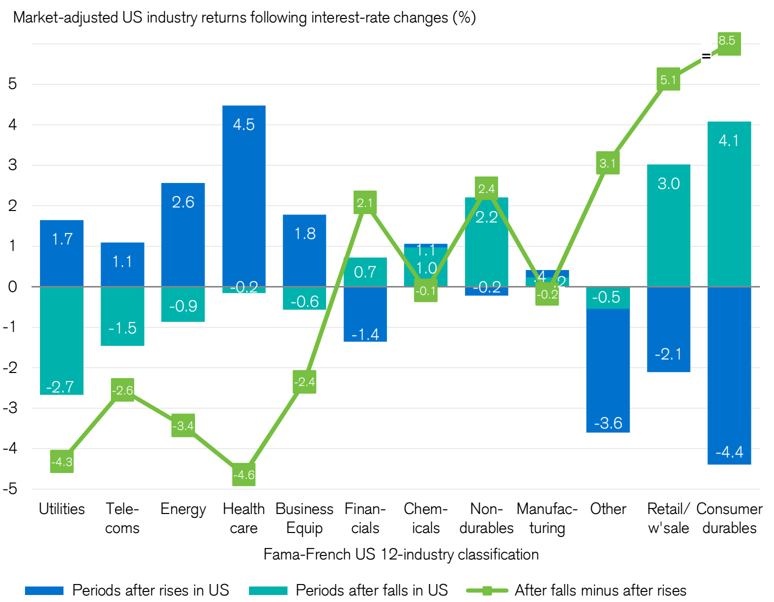
Performance of premia after rate rises and rate falls



Source: Elroy Dimson, Paul Marsh and Mike Staunton; Dimson-Marsh-Staunton (DMS) database; Bank of England, Federal Reserve, Global Financial Data, Thomson Reuters Datastream.

Figure 14

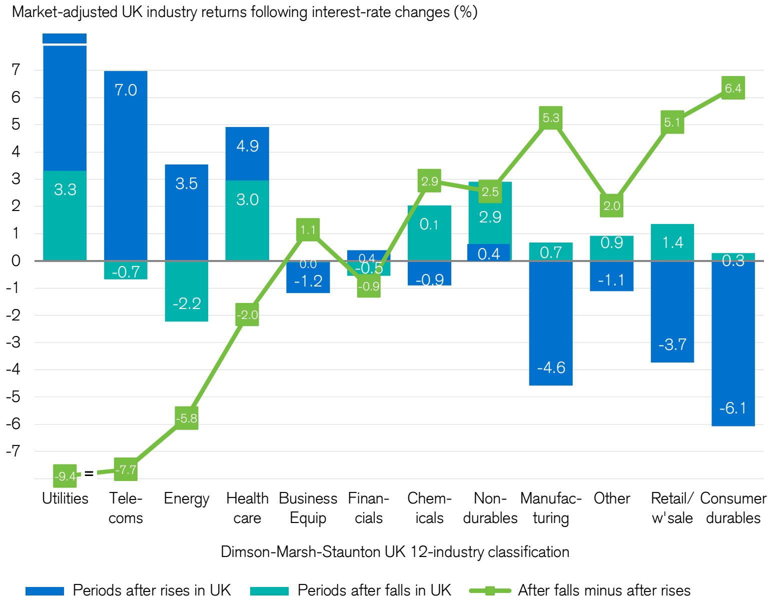
Impact of rate changes on US industry returns, 1926–2015



Source: Elroy Dimson, Paul Marsh and Mike Staunton; Dimson-Marsh-Staunton (DMS) database; Bank of England, Federal Reserve, Global Financial Data, Ken French's website.

Figure 15

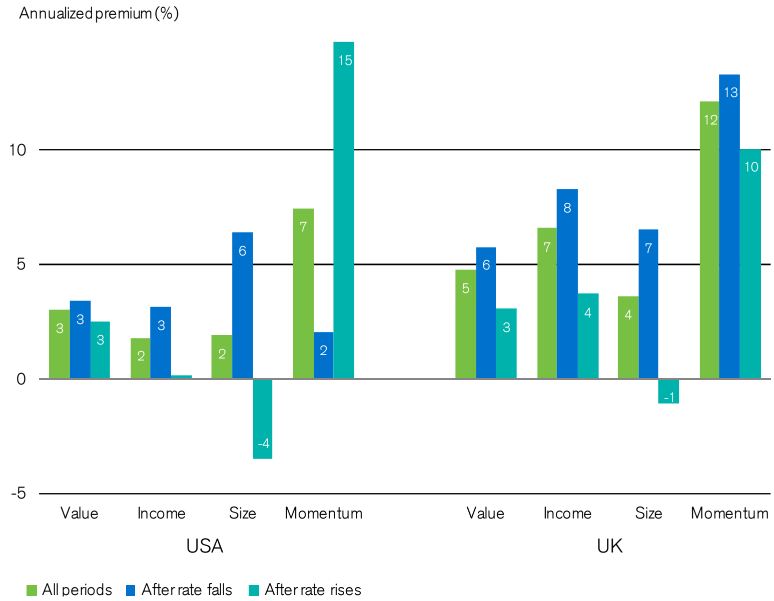
Impact of rate changes on industry returns, UK 1955–2015



Source: Elroy Dimson, Paul Marsh and Mike Staunton; Dimson-Marsh-Staunton (DMS) database; Bank of England, Federal Reserve. First bar truncated because of limited number of observations.

Figure 16

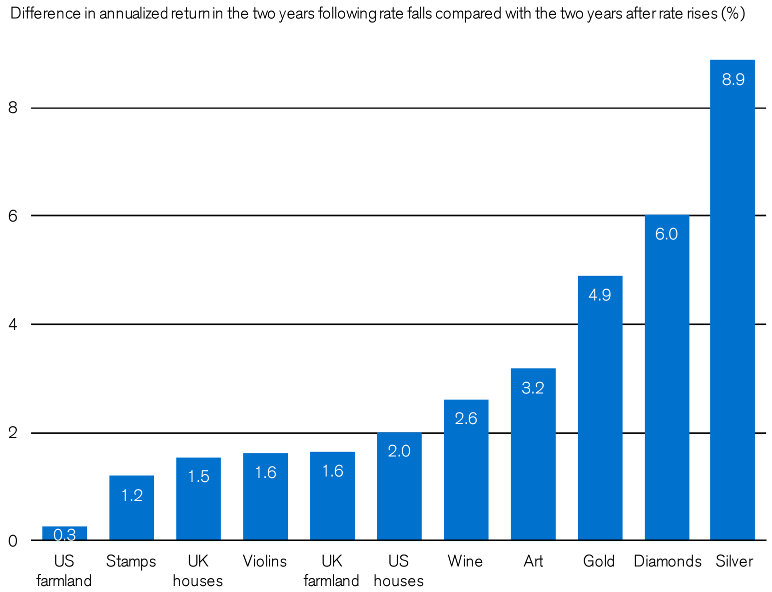
Impact of rate changes on factor returns



Source: Elroy Dimson, Paul Marsh and Mike Staunton; Dimson-Marsh-Staunton (DMS) database; Bank of England, Federal Reserve, Global Financial Data, Ken French's website.

Figure 17

Impact of rate changes on real asset returns



Source: Elroy Dimson, Paul Marsh and Mike Staunton; Dimson-Marsh-Staunton (DMS) database; Dimson and Spaenjers (2014). For full sources, see text and reference list.