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Stock-bond return correlation: Understanding the changing behaviour

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ABSTRACT

The stock and bond return correlation remains important given its central role in portfolio behaviour. Previous, primarily US, evidence indicates sign switching, which implies that bonds change between diversifying and hedging behaviour. This paper considers time-variation in the stock–bond correlation for the G7 markets, including the nature of its economic drivers. Using monthly data over a period spanning 1980 to 2023 evidence demonstrates that the correlation switches from positive to negative in the late 1990s for six of the seven markets (the switch for Japan occurs in the first half of the 1990s). A switch back to positive is observed towards the end of the sample for most markets but earlier for France and Italy. Evidence of time-variation within the correlation drivers is also noted. Nonetheless, results suggest that inflation and interest rates typically exhibit a positive effect on the correlation, consistent with previous work and theoretical underpinnings. That is, higher inflation and interest rates depress stock and bond prices due to higher discount rates and lower real cash flows, moving them in the same direction. Growth also largely imparts a positive effect on the correlation, but this contrasts with the prevailing view. This arises through portfolio considerations where higher growth leads to an increase in demand for all assets. Of importance for investors, the switch in correlation implies that a portfolio manager will need to alter asset weights to maintain a target value for returns or risk. A portfolio variance decomposition reveals that while the bond contribution remains broadly constant over the sample, that from stocks increases as the correlation contribution shifts from positive to negative. The results are of importance to investors and those engaged in modelling market behaviour.

1. Introduction

The stock–bond return correlation remains an important ingredient in our understanding of financial markets and for portfolio managers, and where it is recognised that the correlation is time-varying.[2] Moreover, that understanding can be enhanced through an examination of the drivers of correlation movement, and a consideration of key implications that arise from such movement. This

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[2] More specifically, this literature refers to the correlation between a country's major stock market index and long-term (typically 10-year) sovereign (Treasury) bonds. These assets forming the foundation stones of many portfolio holdings.

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paper examines the stock–bond correlation for the G7 markets in the light of more recent economic and geopolitical shocks (from the global financial crisis, and Covid-19 to the Russian invasion of Ukraine and subsequent high inflation).[3] Of importance, this paper argues that not only is the stock–bond correlation time-varying, but also the conditioning nature of key macroeconomic determinants for correlation movement. This arises due to the changing risk characteristics of both growth and inflation for stock and bond markets, and with implications for the relative weights of each asset within a portfolio.

Much of the impetus to the research examining stock–bond correlation dynamics comes from the observation that the correlation switched from being positive to negative in the early 2000s in the US market. Thus, bonds switched from acting as a diversifier within a stock–bond portfolio to a hedger. This early research includes Andersson et al. (2008), Aslanidis and Christiansen (2012) and Gulko (2002).[4] Key within this line of research is a desire to understand the drivers of such a switch in correlation. This is often ascribed to a flight-to-safety effect following the dotcom crash and the broader changing economic conditions that followed, including heightened economic risk (arising, for example, from the financial crisis and Covid-19) and a prolonged period of low interest rates. This greater risk led investors to seek safer assets and so moving into bonds and out of stocks, creating a negative correlation. This also aligns with the idea that bonds serve as a safe haven (or hedge) in such periods of risk. In contrast, when the economic environment is characterised by lower risk, investors are more likely to take a dominant position in stocks, with bonds acting as a diversifier, leading to a positive correlation. Correlation shifts thus arise from the evolving risk appetite of investors.

Recent work suggests that this correlation may have returned to a positive value following the high inflation period of 2022 (e.g., Lombardi and Sushko, 2023; Brixton et al., 2023). While this period has seen an increase in interest rates, it remains one of high economic risk (especially arising from the Russian invasion of Ukraine). Again, understanding the reason for the switch remains as equally important as acknowledging the switch. Moreover, this includes examining whether the factors that drive the early 2000s switch are the same as those that determine the early 2020s switch. The current literature suggests two broad sets of variables that can explain the time-varying nature of the correlations. This relates to inflation-based reasons and growth-based reasons. For example, higher inflation (and interest rates) is typically linked to lower stock and bond prices, creating a positive relation, however, there is some evidence that stocks may respond in the opposite direction. Higher output is likely to lead to a negative correlation with higher stock and lower bond prices, but equally, the opposite correlation can be supported. See, for example, the discussion in Li (2002), Duffee (2023), Portelli and Roncalli (2024), Jones and Pyun (2025) among others.

This paper seeks to contribute to the literature by considering three elements of this debate. First, the paper considers the stock and bond return correlation for the G7 markets. The majority of research focuses on the US market; however, it is important to consider whether the same change and the same factors are equally present in a wider selection of markets. Nonetheless, there are some exceptions to this and, for example, Ponrajah and Ning (2023) and Molenaar et al. (2024) do consider a range of international markets. Second, we examine the drivers of the change in correlation. As noted, several papers have previously considered this, but we seek to report on whether the nature of those factors changes between the early 2000s switch and the early 2020s one. More specifically, the literature identifies several key variables in explaining the time-varying correlation. This includes the real interest rate, inflation and output and hypothesises that the former two have a positive effect on the correlation and the latter a negative relation (in addition to the above noted papers, also see, Aslanidis and Christiansen, 2012; Viveira, 2012; McMillan, 2019). However, the opposite relations are possible, which leads to mixed results, and this paper seeks to examine this. Third, we consider the implications of the correlation switches for a stock and bond portfolio. Notably, considering how it affects both portfolio returns and variance, which are of key importance for investors.

We obtain monthly data for the G7 markets over the time period ranging from January 1980 to December 2023, although the exact sample starting point varies by country. This data consists of the stock and bond index from which return correlations are derived. Data is also collected to model the changing correlation, including inflation, output growth and Treasury yields. The results indicate several key points that are of interest to investors and those engaged in modelling financial markets. The stock–bond return correlation for all G7 markets does switch between being positive and negative. For five (Canada, France, Germany, UK and US) of the markets, the pattern of behaviour in the correlation is broadly similar. However, Italy and Japan exhibit differences with the former presenting a mostly positive correlation with only a short switch to negative, while the opposite is found for the latter. Further, the factors that determine the correlation dynamics, themselves, change over time both in terms of sign and significance, although the real interest rate is the most consistent predictor. Generally, however, interest rates, inflation and growth impart a positive effect on the correlation, although not without exceptions.

These results demonstrate that the switching correlation behaviour has implications for a stock–bond portfolio. This is in terms of both returns and risk with, for example, a lower return to a fixed weight portfolio when a negative correlation occurs. Indeed, the results highlight the need to alter weights to maintain a fixed return or risk (standard deviation) value. A portfolio variance decomposition also highlights the effect of the changing correlation in regard of diversification. These implications in turn provide the key contributions of the paper. Notably, extending our understanding of the ongoing debate surrounding the role of inflation and growth factors in the time-varying correlation and, especially, demonstrating that their relative importance varies over time.

[3] The choice of the G7 is motivated by these countries having the seven of the eight largest global sovereign bond markets (noting the exclusion of China, which is the second largest). Six of these countries are also in the top ten of global stock markets by size.

[4] Also see, for example, Baele et al. (2010), Campbell and Ammer (1993) and Connolly et al. (2005).

2. Background

There is an ongoing literature that seeks to understand the time-varying nature of the stock–bond correlation, linking it to movements in economic variables. Initial work considers the sign of the correlation, with Barksy (1989), Shiller and Beltratti (1992) and Campbell and Armer (1993) supporting a positive relation and Gulko (2002), Connolly et al. (2005) and Andersson et al. (2008) suggesting a negative one. Subsequent work argues that these results highlight the switching relation between the two assets, which is often linked to changing market and economic conditions, notably, flight-to-safety effects during crisis periods. For example, Ponrajah and Ning (2023) use a copula approach to identify regime switching between periods of flight-to/from-safety. Arising from this, several papers link this time-varying correlation to explicit macroeconomic and financial variables, including inflation, interest rates and output growth (e.g., Baele et al., 2010; Aslanidis and Christiansen, 2012, 2014; Viceira, 2012; Aslanidis et al., 2019).

These empirical observations led to the development of theoretical models designed to underpin and explain the nature of the identified relations. In an earlier model, Li (2002) argues that the source of the shock matters for the sign of the correlation, with interest rate shocks leading to a positive relation and inflation or dividend shocks resulting in a negative one. Subsequently, a series of papers consider the role of different macroeconomic shocks for the stock–bond correlation, including output and consumption growth shocks, as well as changes in real (as opposed to nominal) interest rates (see, for example, Burkhardt and Hasseltoft, 2012; Chernov et al., 2021; Jones and Pyun, 2025).

Duffee (2023) argues that macroeconomic shocks can produce either a positive or negative stock–bond correlation. Duffee highlights the persistence nature of macroeconomic shocks and the degree of economic uncertainty as being key determinants of the correlation. Moreover, as Brixton et al. (2023) note, the broad view appears to be whether inflation or growth considerations dominate.[5] Higher inflation will lead to higher expected interest rates, which depresses both stock and bond prices and so a positive relation arises. Whereas if higher expected interest rates arise from higher growth, then while bond prices will still fall, stock prices would be expected to rise, leading to a negative correlation. Furthermore, these effects will interact and vary according to wider economic conditions. For example, after the financial crisis, (very) low interest rates might be expected to raise both stock and bond prices, but the lower rates were also an indicator of poor expected future conditions and so stock prices continue to fall (e.g., Gregoriou et al., 2009).

Within this line of thought, several recent papers link the stock–bond correlation to a key macroeconomic correlation, sometimes referred to as the nominal-real correlation, between inflation and growth (see, for example, David and Veronesi, 2013; Song, 2017; Boon et al., 2020; Campbell et al., 2020). This research notes a change in the inflation-growth correlation from negative to positive at a time similar to the switch from positive to negative in the stock–bond correlation. This again, revolves around the nature of inflation and growth, where higher inflation prior to the 2000s, and especially before the financial crisis is associated with lower growth and lower stocks (in line with Fama, 1981), but after this period, higher inflation is associated with improving economic conditions, offsetting the fear of deflation, leading to higher growth and stocks. While acknowledging that inflation plays a role in the stock–bond correlation, Jones and Pyun (2025) argue that consumption growth persistence is a more important driver. Moreover, the nature of consumption growth on the stock–bond correlation arises through movements in real interest rates that result from intertemporal substitution.

Therefore, in assessing the factors that can affect the stock and bond return correlation, we can generate several hypotheses that can be tested. First, higher real interest rates should lead to a positive correlation as they would be associated with lower value of expected cash flows. That is, as the rate as which expected future cash flows are discounted rises, so the price of the assets falls, generating a positive correlation. However, it is noted that this relation may not hold under all conditions. For example, Gregoriou et al. (2009) note a change in the stock market response to falling interest rates during the financial crisis. This arises because the discount rate not only contains the interest rate but also a risk premium. The lower interest rates are a sign of worsening economic conditions during the financial crisis and thus, while bond prices rise in line with the lower rates, stock prices continue to fall. Second, inflation will also lead to a positive correlation as inflation will be related to future interest rate changes. Inflation reduces the value of real cash flows and leads to greater macroeconomic uncertainty and risk. However, where stocks act as a hedge against inflation, then a negative correlation can emerge. Evidence also exists of a positive relation between inflation and the dividend yield (e.g., Sharpe, 2001; Ritter and Warr, 2002; Bekaert and Engstrom, 2010), which implies higher future stocks and a negative correlation. Recent work from Duffee (2023) highlights that the nature of inflations role on the correlation is not clear, while earlier, Campbell et al. (2017) note a changing nature of the risk premium over time.

Third, output growth is also a factor in determining the correlation and is likely to generate a negative correlation between stock and bond returns. As noted above, this arises from the well-established flight-to-safety phenomenon, where investors move from stocks to bonds at a time of economic crisis, generating a negative correlation.[6] Equally, in a time of growth, investors will have expectations of higher future cash flows and so stock prices rise, whereas bond prices may be falling due to higher expected future interest rates. Again, generating a negative correlation. In contrast, within a growing economy, investors are likely to demand more of all assets, creating a positive correlation, consistent with diversification behaviour within portfolio theory. As a fourth hypothesis, the nature of the relation between inflation and output on the stock–bond correlation may also depend on the nature of the interaction between the two macroeconomic variables themselves and specifically, the changing risk characteristics of inflation. That is, with inflation being associated with lower growth in the first part of the sample (as higher inflation results in households and firms delaying consumption

[5] This view is also espoused in the paper of Portelli and Roncalli (2024) that provides an extensive overview of the research area.

[6] An opposite 'flight-to-risk' effect might be present during expansionary periods with investors moving from bonds to stocks.

and investment due to lower purchasing power), and higher growth in the second (as both inflation and growth were subdued such that higher inflation is an indication of improving economic conditions).

Thus, while there may be a general expectation that real interest rates and inflation lead to a positive correlation and output to a negative correlation, there are valid arguments to suggest the opposite. Moreover, that the sign and strength of any relation on the correlation will vary over time, and therefore, the fifth hypothesis states that we would expect the nature of the factors that condition the correlation to change over the sample period. This paper seeks to considers these issues below.

3. Data and time-varying correlations

3.1. Data

We obtain monthly stock and (sovereign 10-year) bond index return data for the G7. The sample starting period varies according to data availability, with the data obtained from LSEG DataStream. Fig. 1 presents the time series plots for the stock and bond price data, while Table 1 presents the summary statistics for the returns, and includes the sample start date, which varies from 1980 to 1991, with the end of the sample period being December 2023 for all series. While the plots (in Fig. 1) are shown for all available data, the summary statistics are for the common sample (as can be observed in Fig. 1, the stock price series is longer than that available for the bond price) to provide comparison. These summary statistics support our usual understanding of stock and bond return series. Stocks have a higher return than bonds, and this is accompanied by a higher standard deviation and a greater minimum to maximum range. All returns series, exhibit non-normality, notably with negative skewness (except US bond returns) and excess kurtosis.

The other data used in this paper consists of the consumer price index, industrial production and the 10-year Treasury bond yield, all taken from the same data source. From these, we construct inflation and the growth rate of output (as the log difference of the consumer price index and industrial production, respectively) and the real interest rate (as the difference between the 10-year Treasury yield and inflation). Summary statistics for this data is not presented but is available upon request.

3.2. Time-varying stock-bond correlation

To give some indication of time-variation in the stock and bond return correlations, Table 2 presents the Pearson correlation over the full sample of available data for each country and then separated into the first and second half of the sample for each country (and so, the exact sample dates differ across some of the countries). Taking the full sample correlations, we can see a mix of generally small positive and negative correlations across the G7 markets, with only Italy indicating some different behaviour, with a more moderate positive correlation. However, a clearer pattern can be seen when we separate the correlations between the first and second half of the respective samples. Across the first half of the sample for each market there is a positive correlation between stock and bond returns.

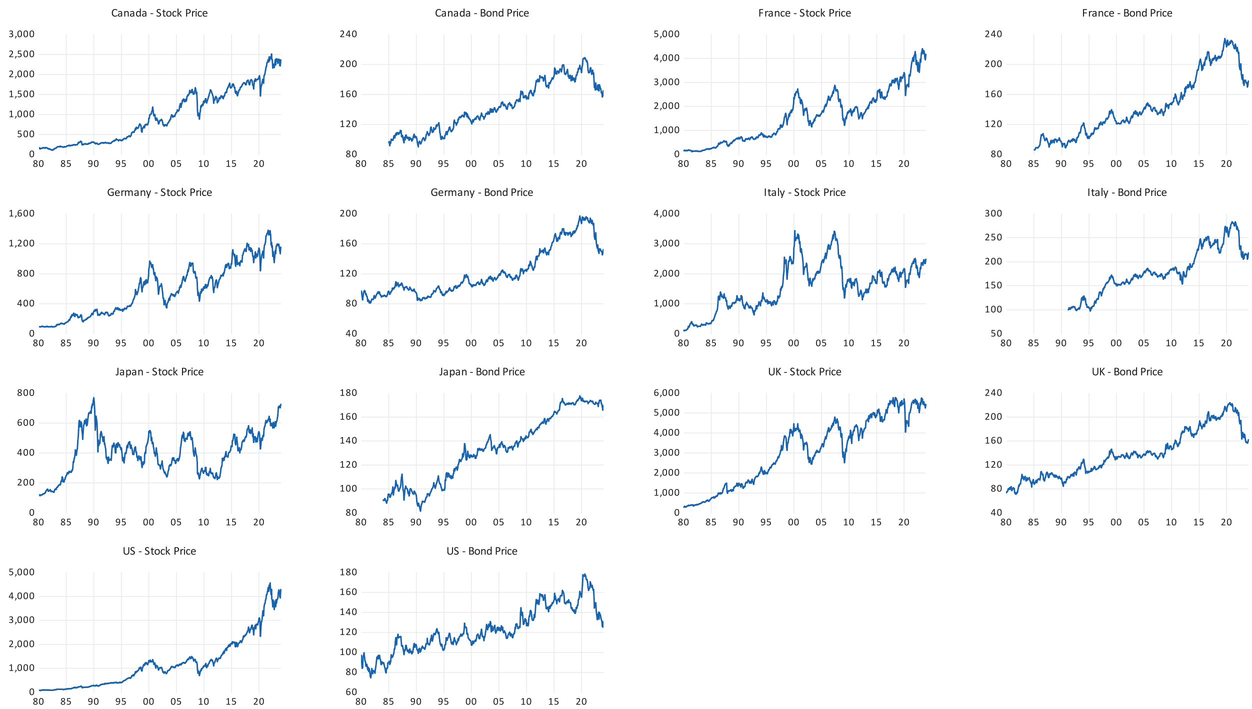

Fig. 1. Time Series Plots. Notes: Graphs depict the time-series plot of the stock and bond index for each series.

Table 1
Stock and Bond Return Summary Statistics.

Series	Sample Start	Mean	Std Dev	Min	Max	Skew	Kurt	JB
Stock Returns								
Canada	1985:01	0.534	4.350	−24.988	15.114	−1.309	9.322	0.00
France	1985:01	0.600	5.497	−24.186	16.567	−0.598	4.719	0.00
Germany	1980:01	0.472	5.377	−26.825	14.750	−0.878	5.344	0.00
Italy	1991:03	0.236	6.077	−24.770	21.034	−0.148	4.166	0.00
Japan	1984:01	0.268	5.511	−24.431	17.445	−0.441	4.577	0.00
UK	1980:01	0.561	4.575	−31.823	13.196	−1.245	8.944	0.00
US	1980:01	0.750	4.542	−23.660	14.021	−1.003	6.968	0.00
Bond Returns								
Canada	1985:01	0.116	2.042	−7.411	7.209	−0.095	3.794	0.00
France	1985:01	0.155	1.875	−6.893	6.294	−0.253	3.701	0.00
Germany	1980:01	0.086	1.848	−8.289	5.827	−0.525	4.555	0.00
Italy	1991:03	0.199	2.363	−8.429	9.060	−0.300	4.862	0.00
Japan	1984:01	0.131	1.520	−7.848	6.395	−0.542	8.076	0.00
UK	1980:01	0.150	2.417	−9.177	8.278	−0.453	4.866	0.00
US	1980:01	0.056	2.455	−8.757	12.334	0.295	4.774	0.00

Notes: The entries are the mean, standard deviation, minimum, maximum, skewness, kurtosis and Jarque-Bera p-values for the monthly stock and bond returns. The sample start date is also shown, with the end date being 2023:12.

Table 2
Stock-Bond Return Correlation (Pearson).

	Full Sample	First Half	Second Half
Canada	0.034	0.163	−0.117
France	0.105	0.221	−0.033
Germany	−0.011	0.179	−0.197
Italy	0.279	0.299	0.265
Japan	−0.043	0.022	−0.238
UK	0.156	0.315	−0.100
US	−0.008	0.217	−0.237

Notes: Entries are the Pearson correlation for the stock and bond return series. The correlations are reported for the full sample as well as for a sample split that apportions 50 % of the data in each sub-sample. The exact dates differ in accordance with that outlined in Table 1 but occur in the early to mid-2000s for all series.

For most of the markets, this correlation is relatively moderate in magnitude, although for Japan, it is near zero. In the second half of the respective samples, the stock–bond correlation is negative for all markets, except Italy. Again, the correlations are moderate in size, except for France, which has a near zero negative correlation. Thus, there is a clear pattern of a positive stock–bond return correlation switching to negative over the sample period. The only exception to that is for Italy, for which a similar sized positive correlation exists in both sample halves.

In addition to these statistics, Table 3 presents the mean stock and bond return, as well as the correlation, over different macroeconomic regimes, i.e., periods of increasing and decreasing output growth (change in industrial production) and inflation (the change in inflation rather than just inflation, which is mostly positive throughout). These results highlight some notable differences across regimes for both stock and bond returns and how they interact. During periods of positive economic growth, we see that stock returns are greater than bond returns for each of the markets, while the converse is generally true in periods of negative economic growth, although not uniquely with both the UK and US still exhibiting higher stock returns. There is no obvious pattern for the correlations across the two regimes. Here, both positive and negative correlations are present, although the correlation is generally higher in the positive growth regime (including being less negative for some markets). Comparing periods of rising and falling inflation, we observe higher stock returns with the former and higher bond returns with the latter. In terms of the correlations, again, we observe evidence of both positive and negative correlations in each regime, while being generally higher in the regime associated with increasing inflation.

The results from Tables 2 and 3, highlight the indicative presence of time-variation within the stock and bond return correlation. To consider this more robustly, we estimate the time-varying correlations utilising two common approaches. We use the DCC-GARCH model of Engle (2002) and a three-year rolling window correlation (rolling windows have previously been used by, for example, Rankin and Shah Idil, 2014). These two approaches are presented in Fig. 2 and reveal a notable degree of variation in each correlation series. Both approaches present a similar picture in terms of movement in the correlations, with the rolling correlations exhibiting greater variation around the same pattern. Correlation summary statistics are reported in Table 4.

As noted in the above cited literature for the US market, from both Fig. 2 and Table 4, we see a switch from a positive to a negative correlation during the sample period. This is equally observed for each of the G7 markets, although with some differences in behaviour. The plots for Canada, Germany, the UK and the US are broadly similar. Here, we see a positive correlation between stock and bond return series from the start of the sample until the early 2000s (except for temporary deviations) whereupon the correlation switches to negative. The correlation then remains negative until the last two years of the sample (again, except for transitory switches). The

Table 3
Returns and Correlations over Different Economic Regimes.

	Positive Industrial Production Growth			Negative Industrial Production Growth		
	Stock Return	Bond Return	Correlation	Stock Return	Bond Return	Correlation
Canada	0.646	0.141	−0.034	−0.001	−0.035	−0.192
France	0.877	0.145	0.084	−0.046	0.195	−0.031
Germany	0.566	0.154	−0.149	−0.003	0.129	−0.089
Italy	0.513	−0.133	0.282	−0.049	0.524	0.297
Japan	0.275	0.083	−0.034	0.198	0.198	−0.070
UK	0.555	0.114	0.171	0.526	0.236	0.137
US	0.821	−0.025	0.038	0.545	0.293	−0.085
	Positive Change in Inflation			Negative Change in Inflation		
Canada	0.958	−0.045	0.052	0.212	0.274	−0.033
France	0.859	0.020	0.039	0.223	0.300	0.028
Germany	0.791	−0.046	−0.034	0.170	0.172	0.003
Italy	0.330	−0.050	0.310	0.155	0.416	0.255
Japan	0.576	0.151	−0.056	−0.142	0.105	−0.056
UK	0.849	−0.130	0.259	−0.102	0.364	0.023
US	1.129	−0.284	0.083	0.415	0.341	−0.048

Notes: Entries are the mean values for stock and bond returns and the correlation between them over sub-periods defined according to positive and negative output (industrial production) growth and positive and negative changes in inflation.

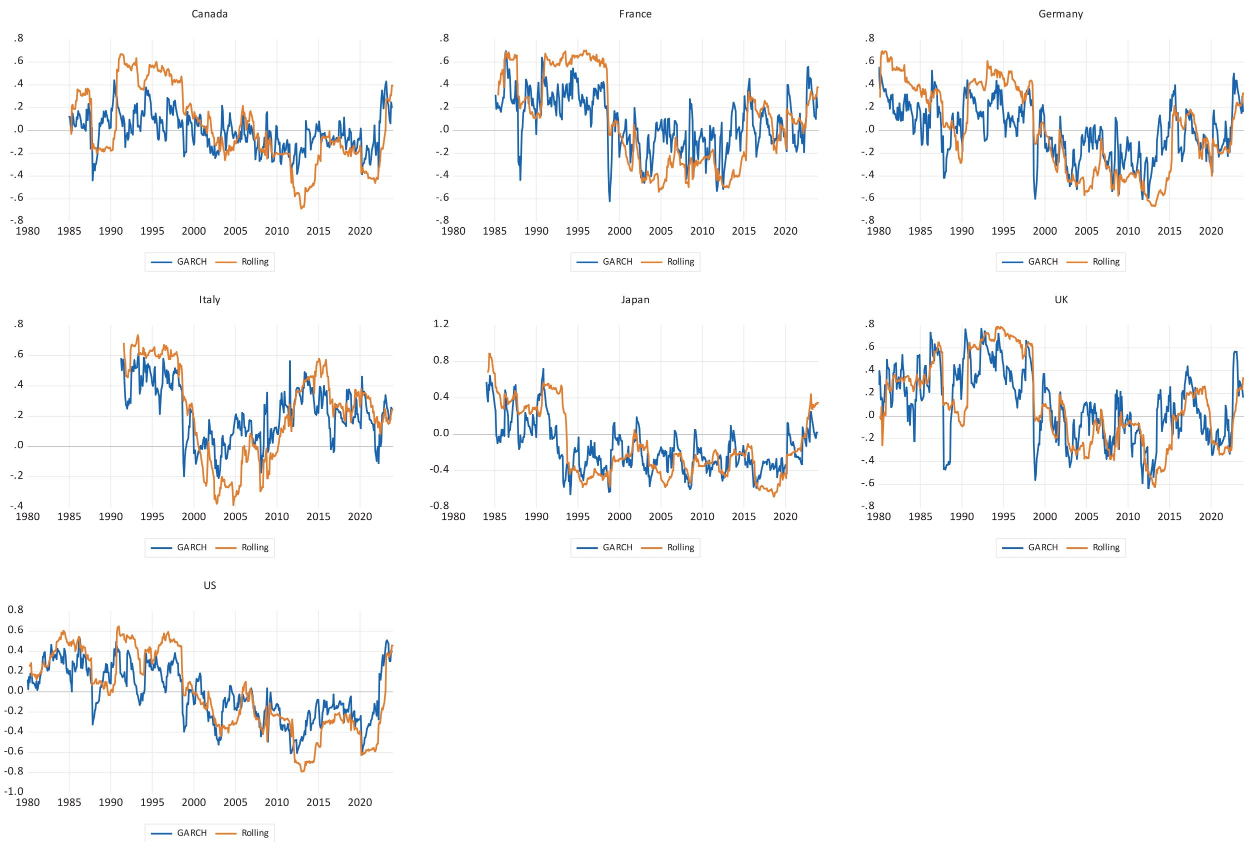

Fig. 2. Time-Varying Correlations. Note: Graphs depict the stock–bond return correlation for each country estimated using a DCC-GARCH model and a three-year rolling window.

pattern for France is similar, but with greater evidence of a move back to a positive correlation occurring earlier in the sample (mid-2010s). Differences, however, can be observed for Italy and Japan. Although both series exhibit a switch from positive to negative and back, the timeframes differ to those noted above. For Italy, the period of a negative correlation is much shorter and could be argued to be a more temporary phenomenon, largely occurring between 2000 and 2004 (again, with other short-term shifts). For Japan, the shift to a negative correlation is longer lasting. Here, the correlation switched to negative in mid-1992 and only presents weaker evidence of

Table 4
Stock-Bond Return Correlation Summary Statistics.

Series	Mean	Std Dev	Min	Max	Skew	Kurt	JB
	DCC-GARCH Estimated Correlations						
Canada	−0.014	0.160	−0.440	0.442	0.161	2.800	0.25
France	0.077	0.246	−0.622	0.697	−0.156	2.640	0.11
Germany	−0.002	0.242	−0.605	0.553	−0.148	2.331	0.00
Italy	0.221	0.185	−0.209	0.615	−0.012	2.219	0.00
Japan	−0.162	0.263	−0.662	0.718	0.896	3.565	0.00
UK	0.107	0.314	−0.635	0.768	−0.033	2.189	0.00
US	−0.019	0.269	−0.622	0.539	−0.044	2.079	0.00
	Rolling Window Estimated Correlations						
Canada	0.018	0.329	−0.688	0.671	0.329	2.196	0.00
France	0.081	0.390	−0.539	0.703	0.150	1.679	0.00
Germany	0.009	0.376	−0.666	0.699	−0.005	1.713	0.00
Italy	0.225	0.300	−0.386	0.735	−0.258	2.007	0.00
Japan	−0.142	0.367	−0.684	0.889	0.776	2.472	0.00
UK	0.107	0.360	−0.624	0.787	0.227	2.079	0.00
US	−0.014	0.387	−0.789	0.648	−0.024	1.848	0.00

Notes: The entries are the mean, standard deviation, minimum, maximum, skewness, kurtosis and Jarque-Bera p-values for the estimated time-varying stock and bond return correlations estimated over the sample period noted in Table 1. The rolling windows are based on a three-year period.

a return to a positive correlation in 2023. The correlation statistics in Table 4, again show that the correlation switches between negative and positive as evidenced by the minimum and maximum values. They also reveal that the variability (standard deviation) of the correlation series is greater with the rolling correlations. In a practical sense, this implies a switch in the behaviour of bonds from being an asset that helps diversify a stock position to one that hedges stocks.

4. Explaining Time-Varying correlations.

While observing time-variation within correlations is important, especially for investors engaged in portfolio construction and management. It is equally (or more) important in seeking to explain the time-variation. As discussed above, there are two broad approaches for such time-variation, linked to inflation and output growth respectively, while it is also noted that interest rates and the nature of the linkage between output growth and inflation are potential explanatory variables. Thus, we estimate a regression for the time-varying correlation against inflation and inflation volatility, growth and growth volatility (where the volatility series capture uncertainty), real interest rates and the correlation between inflation and growth. We consider the regression for each market and for both DCC-GARCH and rolling correlations. Inflation and output growth volatility are equivalently estimated with a GARCH and rolling standard deviation approach. The regression is given by equation (1), and the results are reported in Table 5.

$\rho_{sb,t} = \alpha_0 + \Sigma_i \beta_i x_{i,t-1} + \varepsilon_t (1)$

Where $\rho_{sb,t}$ refers to the correlation between stock and bond returns for time period t, $x_{i,t-1}$ are the noted explanatory variables and ε_t is a random error term. As noted, for each market inflation is given by the change (log difference) in the consumer price index, output growth is change in industrial production and the real interest rate is the difference between 10-year Treasury yields and inflation. The data is obtained from LSEG DataStream and again, there are some differences in the sample periods.[7]

From Table 5, we can see that inflation typically has a positive effect on the correlation where it is statistically significant. This includes for Germany (at the 10 % level), Japan, the UK and US for the DCC-GARCH correlation series and Canada, Germany, Japan, the UK and US for the rolling correlation series. The one exception is for the rolling correlation for Italy, where a negative and 10 % significant relation with inflation is noted. Inflation volatility also exhibits a positive relation where it is significant, with greater significance for the DCC-GARCH correlation series (France, Germany, Italy, Japan, the UK and US, including at the 10 % level) than for the rolling correlation (France and Italy). Output growth equally has a positive relation, including for Canada (DCC-GARCH) and France, Italy and the US (rolling). For output growth volatility there is evidence of both a positive relation (France, Italy and Japan across the two correlation measures) and a negative relation (Canada, the UK and US with the DCC-GARCH). Real interest rates have the greatest effect across the different markets. For the DCC-GARCH regression, there is a positive and significant relation across all markets except Canada and Germany, while for the rolling correlation regression, it is significant for all markets. In contrast, for the inflation-growth correlation, this is not significant for the DCC-GARCH correlation regressions and is only significant for two markets (France and the US, plus another two at the 10 % level, Canada and Germany) with a negative coefficient for the rolling correlation regression.

We can consider these results in the context of the discussion in Section 2. A simple description is also presented in Brixton et al. (2023). Here, there is an expectation that inflation is associated with a positive correlation as it should have the same impact on asset prices (higher inflation leads to lower expected cash flows), while output growth leads to a negative correlation (as an expanding

[7] Due to data availability, the regression for Canada begins in 1998, France and Italy in 1991, Germany in 1992, Japan in 1986, the UK in 1989, and US in 1980.

Table 5
Stock-Bond Return Correlation Regressions.

	DCC-GARCH Correlation Inflation	Infl. Vol.	Output	Output Vol.	Real I.R.	Corr N.-R.
Canada	−0.004	−0.661	0.009	−0.041	0.007	−0.031
	(−0.14)	(−0.02)	(2.42)	(−3.42)	(0.62)	(−0.24)
France	0.038	1.139	0.006	0.013	0.036	−0.023
	(0.49)	(2.48)	(1.62)	(2.02)	(4.02)	(−0.28)
Germany	0.081	0.589	0.004	0.008	0.014	−0.043
	(1.66)	(2.85)	(0.67)	(0.43)	(1.50)	(−0.35)
Italy	−0.019	0.537	0.001	0.005	0.046	−0.007
	(−0.47)	(5.33)	(−0.19)	(2.38)	(9.80)	(−0.12)
Japan	0.164	0.439	0.005	0.013	0.047	0.138
	(2.65)	(1.87)	(0.97)	(0.66)	(3.14)	(1.06)
UK	0.108	0.844	0.009	−0.052	0.060	0.007
	(2.30)	(3.83)	(1.27)	(−2.92)	(5.55)	(0.08)
US	0.157	0.209	0.009	−0.048	0.055	−0.064
	(3.86)	(1.85)	(1.12)	(−2.37)	(5.89)	(−1.03)
	Rolling Window Correlation					
Canada	0.091	−0.266	0.005	0.019	0.088	−0.072
	(4.50)	(−0.82)	(1.09)	(1.27)	(6.59)	(−1.95)
France	0.021	1.511	0.011	0.031	0.077	−0.131
	(0.59)	(1.91)	(1.69)	(3.09)	(4.74)	(−1.98)
Germany	0.085	0.460	−0.002	0.015	0.063	−0.091
	(3.09)	(1.64)	(−0.27)	(0.66)	(3.99)	(−1.68)
Italy	−0.035	1.402	0.008	0.005	0;084	−0.005
	(−1.89)	(4.28)	(2.52)	(1.34)	(7.50)	(−0.11)
Japan	0.185	−0.157	−0.003	0.093	0.111	−0.030
	(10.37)	(−1.15)	(−0.10)	(3.94)	(7.49)	(−0.80)
UK	0.082	−0.192	0.010	0.001	0.075	−0.023
	(3.79)	(−0.64)	(1.63)	(0.04)	(5.10)	(−0.44)
US	0.053	−0.184	0.009	0.010	0.095	−0.083
	(4.29)	(−1.27)	(1.76)	(0.60)	(11.81)	(−2.84)

Notes: Entries are the estimated coefficients (Newey-West t-statistics) for equation (1). Inflation is the change in CPI and output is the change in industrial production. The volatility measures are obtained either by a GARCH(1,1) model or a rolling window to match the correlation series. Real interest rates are the 10-year Treasury yield minus inflation. The nominal-real correlation is between inflation and output growth and obtained by a DCC-GARCH or rolling window approach accordingly. The sample periods vary with the availability of the macroeconomic data. They start in 1980 for Japan and the US, 1988 for the UK, 1990 for France, 1991 for Germany and Italy, and 1998 for Canada.

economy supports higher stock prices and a move towards risky assets, conversely falling output leads to a flight-to-safety effect and a move into bonds). However, as noted, the opposite relations are possible. The results here, are generally supportive of inflation leading to a positive correlation, as do real interest rates, with both variables having similar impacts on expected future asset values (i.e., higher inflation and interest rates are expected to depress both stock and bond prices). The effect of output is also largely positive, in

Table 6
Bai-Perron Breakpoint Tests.

	DCC-GARCH Correlation # of Breaks	Break Dates				
Canada	2				2007:06	2013:07
France	3		1998:09	2004:03		2013:07
Germany	3		1998: 09	2004:04		2013:07
Italy	4		1998:09	2004:06	2010:06	2019:01
Japan	4	1992:07	1998:08	2004:05		2016:02
UK	3		1998:08	2004:06		2013:07
US	4	1990:05	1998:09		2007:06	2014:09
	Rolling Window Correlation					
Canada	2			2005:05		2014:09
France	3		1998:09	2005:09		2015:05
Germany	4		1998:08	2003:07	2008:06	2015:05
Italy	4		1999:12	2005:10	2010:12	2016:04
Japan	3	1993:09		2003:08		2016:05
UK	3		1998:08		2008:12	2015:05
US	4	1990:10	1998:08		2008:10	2015:05

Notes: Entries are the number of breaks and dates reported using the Bai and Perron (1998, 2003a,b) breakpoint methodology. The breaks are determined using the Bai-Perron methodology on the regression in equation (1), see Table 5 for further notes.

contrast to the suggestion within the theoretical literature. This implies that both asset prices rise with growth and is more indictive of the view that investors increase demand for all assets with rising output, consistent with diversification and portfolio theory.

Time-Varying Explanatory Regression

One question that remains open is whether the factors that affect the time-varying correlation remain constant themselves. This is especially the case given notable changes in economic risk that occur over the sample period. As discussed by Boon et al. (2020) and Campbell et al. (2020), among others, this includes a change in the nature of the inflation and growth correlation, as well as periods of subdued inflation and low (and negative) real interest rates. To consider this question, equation (1) is reconsidered using the Bai and Perron (1998, 2003a,b) breakpoint testing procedure to examine whether there are breaks in the coefficient values.

The results of the breakpoint tests are presented in Table 6 and indicate that there are a number of breaks within the correlation regression for each market. The number and timing of the breaks are broadly consistent across the correlation regressions based on the DCC-GARCH and rolling correlation series. Across each of the seven markets, we see three broadly common breaks. This includes a break during 1998 or 1999, which is consistent with the dotcom bubble period. In addition, there is a break around the mid-2000s, which is just prior to the financial crisis that began in 2007. There is also a common break in the mid-2010s, which occurs around the time associated with a number of crisis periods, including US and European debt crises. There are also some breaks associated with individual countries, this arises in the early 1990s for those markets with sufficiently historical data (Japan and the US), while both Germany and Italy exhibit an additional break associated with the financial crisis and its aftermaths.

Table 7 presents the correlation regressions incorporating breaks.[8] Both Tables 6 and 7 seek to group the breaks (Table 6) and coefficients (Table 7) around their common dates, although this is not exact. The results in Table 7 show that the variables that affect the stock–bond return correlation change over time, both in terms of coefficient sign and statistical significance for each market. We can also see that in terms of significant variables across the different decades, these differ across markets within the same time period. For example, if we take the US, inflation and output volatility have a positive effect on correlation during the 1980s, only output volatility is significant for most of the 1990s, only inflation volatility for the early 2000s, and neither being significant in the post-financial crisis period. As another example, if we consider real interest rates, from the late 1990s/early 2000s, this is negative and significant for Japan and positive and significant for the remaining markets, while in the first half of the 2010s, it negative and significant for Germany, but positive and significant elsewhere. This implies the potential for diversification benefits when considering portfolios across international markets.

Across the full set of results, we can try to draw some general conclusions. Real interest rates is the variable that exhibits the most significance across the markets and time periods, as well as the most consistent estimates, although as noted, with some variation across markets. Notably, from the late 1990s/early 2000s, real interest rates are predominantly positive and significant. In the earlier part of the sample, however, this is not the case. For the macroeconomic variables of inflation and output, this tends towards a mixed picture over the different markets and time periods. As with real interest rates, there is greater evidence of significance from the late 1990s/early 2000s onwards. Moreover, this becomes increasingly predominantly positive for inflation and inflation volatility, although the same is not true for output and output volatility.[9] Likewise, the nominal-real correlation remains mixed in terms of significance and sign across the markets and time.

In sum, these results support the view that real interest rates and inflation will typically impart a positive effect on the stock and bond return correlation, although there are some country-specific differences. For output growth, a positive relation is also generally observed but there is greater evidence of a negative relation, suggesting a more mixed picture compared to inflation and interest rates.

5. Implications

In examining the implications of the above results, we consider several aspects from an investor perspective of the changing correlation behaviour. Fig. 3 presents the cumulative return to an investment that is equally weighted in stock and bonds, although the weights used is not specifically relevant to the nature of this exercise. Evident within Fig. 3 is the changing nature of the trend path for cumulative returns over the sample period and the switch in the stock and bond correlation from positive to negative observed in Fig. 2. This is most cleanly seen in the graphs for Canada, France, Germany, the UK and US. Here, there is an evident shallowing of the cumulative trend around the year 2000. This is consistent with the switch in correlation from positive to negative, such that bonds change from being a diversifier to a hedger and so detract from any positive stock return performance. The pattern for Italy and Japan appears different, given the different correlation behaviour. For Japan, we do see a steeper cumulate returns trend when the correlation is positive, however, this is just for the beginning of the sample, prior to the mid-1990s. For Italy, the correlation remains positive through the sample period, with the exception of a short period in the 2000s. This period is associated with a fall in cumulative returns, although it is noted (e.g., Table 1) that Italian stock return performance is weaker than for the other markets.

To provide an illustration of the effect of the switch in the correlation for portfolio performance, Fig. 4 provides a simple trend analysis for the US and the portfolio weights required to maintain this trend. The top figure again plots the cumulative 50/50 portfolio over the full sample period, while a trend term is estimated for this portfolio from the start of the sample until the end of 1999. This trend is then extrapolated (forecast) over the remainder of the sample. As can be seen, the path of the realised portfolio deviates notably below this extrapolated trend, highlighting the effect the change in the correlation has resulted in. The lower panel repeats the cumulative 50/50 portfolio and trend but also shows the alternative portfolio weights required to maintain the trend path. Evident

[8] These results are for the rolling correlations, with those for the DCC-GARCH available upon request.

[9] Although output growth tends to be more positive between the late 1990s/early 2000s and the mid 2010s, and more mixed thereafter.

Table 7
Breakpoint Stock-Bond Return Correlation Regressions.

	Canada	France	Germany	Italy	Japan	UK	US
Sample 1: Covering 1980s-Early 1990s							
					1986:01–1993:08		1980:04-1990:09
Inflation					0.020		−0.015
					(0.86)		(−1.37)
Infl. Vol.					−0.161		0.356
					(−0.90)		(2.56)
Output					−0.011		0.005
					(−3.90)		(0.78)
Output Vol.					−0.169		0.158
					(−2.50)		(2.23)
Real I.R.					−0.003		0.049
					(−0.11)		(3.53)
Corr N.-R.					−0.005		0.026
					(−0.16)		(0.60)
Sample 2: Covering Early 1990s-Late 1990s							
		1991:01–1998:08	1992:01–1998:07	1991:08–1999:11		1989:01–1998:07	1990:10–1998:07
Inflation		0.023	0.014	0.060		−0.155	0.044
		(0.91)	(0.66)	(2.86)		(−5.02)	(1.20)
Infl. Vol.		−0.320	0.007	−1.178		0.323	0.269
		(−1.10)	(0.04)	(−2.43)		(1.49)	(0.94)
Output		0.002	−0.007	0.010		−0.046	0.003
		(0.60)	(−2.12)	(4.52)		(−3.82)	(0.33)
Output Vol.		0.127	−0.063	−0.012		−0.140	0.246
		(0.10)	(−1.92)	(−0.50)		(−3.38)	(2.95)
Real I.R.		−0.002	0.010	0.034		−0.051	0.037
		(−0.22)	(0.35)	(4.79)		(−1.26)	(0.85)
Corr N.-R.		0.058	−0.002	−0.093		−0.152	−0.006
		(3.18)	(−0.04)	(−5.45)		(−2.92)	(−0.26)
Sample 3: Covering Late 1990s-Early/Mid 2000s							
	1998:01–2005:04	1998:09–2005:08	1998:09–2003:06	1999:12–2005:09	1993:09–2003:07		
Inflation	0.124	−0.083	−0.004	0.063	−0.112		
	(3.09)	(−2.47)	(−0.06)	(1.05)	(−6.25)		
Infl. Vol.	−0.354	−0.467	1.338	2.88	−0.051		
	(−0.85)	(−0.92)	(4.43)	(2.61)	(−0.42)		
Output	0.010	−0.005	0.003	0.007	0.005		
	(1.71)	(−0.40)	(0.05)	(0.78)	(1.05)		
Output Vol.	0.017	−0.560	−0.050	−0.013	0.331		
	(0.44)	(−0.49)	(−1.46)	(−0.42)	(3.94)		
Real I.R.	0.210	0.150	0.120	0.147	−0.063		
	(5.23)	(4.25)	(2.18)	(5.90)	(−3.46)		
Corr N.-R.	−0.106	0.014	−0.153	−0.003	0.010		
	(−2.76)	(0.50)	(−3.76)	(−0.10)	(0.40)		
Sample 4: Covering Early/Mid 2000s-Late 2000s							
	2005:05–2014:08	2005:09–2015:04	2003:07–2008:05	2005:6–2010:11		1998:08–2008:11	1998:08–2008:09
Inflation	0.292	−0.027	0.016	−0.118		0.133	0.094
	(12.74)	(−1.26)	(0.61)	(−2.46)		(1.60)	(4.92)
Infl. Vol.	0.701	0.724	−0.609	−0.483		0.237	0.521
	(2.42)	(2.03)	(−2.16)	(−0.79)		(0.40)	(6.18)

(*continued on next page*)

Table 7 (*continued*)

Output	0.003	0.012	0.033	0.002		0.022	0.006
	(1.26)	(3.81)	(3.59)	(1.05)		(3.30)	(1.20)
Output Vol.	0.089	0.402	−0.077	0.024		0.025	−0.023
	(2.36)	(0.26)	(−1.91)	(1.71)		(1.48)	(−0.29)
Real I.R.	0.271	0.067	0.101	−0.043		0.143	0.148
	(13.42)	(3.67)	(3.52)	(−1.43)		(2.30)	(13.06)
Corr N.-R.	0.081	−0.035	−0.073	−0.073		−0.044	−0.088
	(4.17)	(−1.36)	(−1.32)	(−1.88)		(−1.35)	(−4.15)
Sample 5: Covering Late 2000s-Mid 2010s							
			2009:06–2015:04	2010:11–2016:03	2003:08–2016:04	2008:12–2015:04	2008:10–2015:04
Inflation			0.043	−0.084	−0.047	0.111	0.176
			(1.59)	(−6.00)	(−0.85)	(3.23)	(3.67)
Infl. Vol.			0.918	0.113	−0.181	0.851	0.095
			(3.00)	(0.60)	(−1.19)	(1.41)	(1.07)
Output			0.009	−0.015	−0.001	−0.011	−0.022
			(6.10)	(−6.63)	(−0.02)	(−1.13)	(−3.06)
Output Vol.			0.023	−0.011	0.022	−0.042	−0.071
			(1.22)	(−0.52)	(1.33)	(−1.95)	(−1.45)
Real I.R.			0.032	−0.029	−0.073	0.149	0.161
			(1.77)	(−2.09)	(1.67)	(5.12)	(3.77)
Corr N.-R.			0.054	−0.007	−0.006	−0.076	−0.157
			(3.22)	(−0.35)	(−1.22)	(−1.62)	(−2.89)
Sample 6: Covering Mid 2010s-Early/Mid 2020s							
	2014:09–2023:12	2015:05–2023:12	2015:05–2023:12	2016:04–2023:12	2016:05–2023:12	2015:05–2023:12	2015:05–2023:12
Inflation	0.153	0.064	0.166	−0.032	0.656	0.173	0.187
	(7.27)	(5.02)	(7.94)	(−5.31)	(5.40)	(8.22)	(5.88)
Infl. Vol.	−0.295	0.705	−0.025	0.159	0.034	−1.055	0.026
	(−0.90)	(2.31)	(−0.15)	(2.86)	(0.17)	(−4.92)	(0.22)
Output	−0.011	−0.001	0.001	0.001	0.002	0.003	−0.011
	(−2.33)	(−0.14)	(0.42)	(0.09)	(0.71)	(0.73)	(−1.86)
Output Vol.	−0.017	0.177	−0.002	0.001	0.194	−0.001	−0.018
	(1.51)	(0.80)	(−0.30)	(1.26)	(7.34)	(−0.17)	(−1.57)
Real I.R.	0.193	0.126	0.194	−0.012	0.553	0.136	0.206
	(6.94)	(8.65)	(9.68)	(−1.54)	(4.33)	(7.20)	(8.09)
Corr N.-R.	−0.081	−0.021	0.028	0.020	−0.009	0.083	−0.122
	(−2.54)	(−0.88)	(0.79)	(1.18)	(−0.20)	(2.50)	(−2.26)

Notes: Entries are the estimated coefficients (Newey-West t-statistics) for equation (1) allowing for Bai-Perron breakpoints. The correlations are obtained using the rolling window approach. Inflation is the change in CPI and output is the change in industrial production. The volatility measures are obtained using a rolling window to match the correlation series. Real interest rates are the 10-year Treasury yield minus inflation. The nominal-real correlation is between inflation and output growth and obtained by a rolling window approach. The results are grouped by approximate sample dates in order to allow for comparison across the markets.

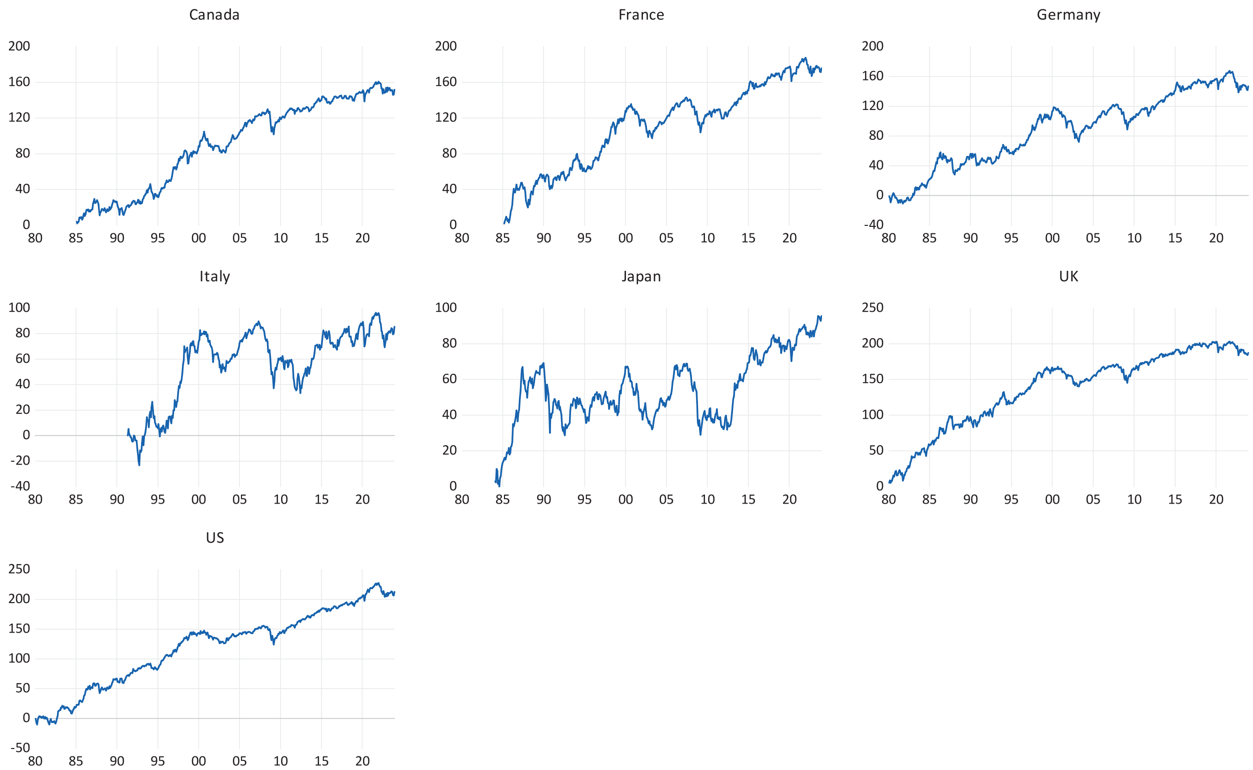

Fig. 3. Stock-Bond 50/50 Portfolio Performance. Notes: Graphs depict the cumulative return of a stock–bond 50/50 portfolio.

from this lower panel is that between 2000 and the end of 2008, the stock–bond portfolio requires a weight of 65 % in stocks to maintain the same performance as the pre-2000 50/50 portfolio. From 2009 onwards, an even higher (80 %) weight in stocks is needed to continue the same level of performance.[10]

The above example highlights the need to readjust portfolio weights in order to maintain performance. A second example is presented in Table 8 where we consider risk. The first two columns present the mean and standard deviation from the equal-weighted stock–bond portfolio over the full sample. Columns three and four present the mean and standard deviation of the same portfolio over the first half of the sample, strictly, this is until the end of 1999. The fifth column, denoted W1 is the weight needed in stocks to equalise the standard deviation to the same level as the full sample. Columns six to eight, do the same for the second half of the sample (strictly, from 2000 onwards), i.e., the mean and standard deviation over this period and W2 is the weight in stocks to again equalise the standard deviation with full sample. In corroboration with Figs. 3 and 4, this table highlights that the returns in the second half of the sample are lower than the first, where the negative correlation detracts from returns performance, but equally risk (standard deviation) is lower. For an investor looking to maintain a constant level of risk in their portfolio, this shows that the asset weights need to be adjusted as the correlation changes, with a lower weight in stocks in the first part of the sample and a higher weight in stock in the second part of the sample. Thus, both Figs. 3 and 4, and Table 8, emphasise that an investor needs to be vigilant with respect to the stock–bond returns correlation as it will alter the portfolio return and risk, such that asset weights will need to be readjusted according to target returns or risk.

In further consideration of portfolio risk, we can decompose the portfolio variance into its constituent parts related to stock return variance, bond return variance and the covariance.[11] This decomposition is given by based on the usual portfolio variance formula:

$$1.00 = \frac{0.5^2 \bullet \sigma^2_{stocks}}{\sigma^2_{p(\frac{50}{50})}} + \frac{0.5^2 \bullet \sigma^2_{bonds}}{\sigma^2_{p(\frac{50}{50})}} + \frac{2 \bullet 0.5 \bullet 0.5 \bullet \sigma_{stocks} \bullet \sigma_{bonds+corr_{stocks,bonds}}}{\sigma^2_{p(\frac{50}{50})}} (2)$$

Where the numerator in each term is the component of a portfolio variance and the denominator in each term is the overall portfolio variance. This transforms each component into their portfolio variance weight, which sum to 100 % (i.e., the total portfolio

[10] For robustness, this exercise is repeated with a stock–bond 60/40 portfolio, following the well-known pension 'rule'. An equivalent graph replicating Fig. 4 is available upon request. In short, the stock–bond 60/40 portfolio follows the same pattern as the 50/50 portfolio but with a higher cumulative return and a noticeably larger drawdown associated with the financial crisis. What is of interest is that post-2000, to maintain the cumulative return trend from the pre-2000 period, the weight in stocks rises to 75% between 2000 and 2008 and 90% thereafter. This heavy weighting towards stocks creates heightened risk and could lead to swings in stock and bond prices in the event of an economic crisis.

[11] A similar decomposition is undertaken by Molenaar et al. (2024) for the US only.

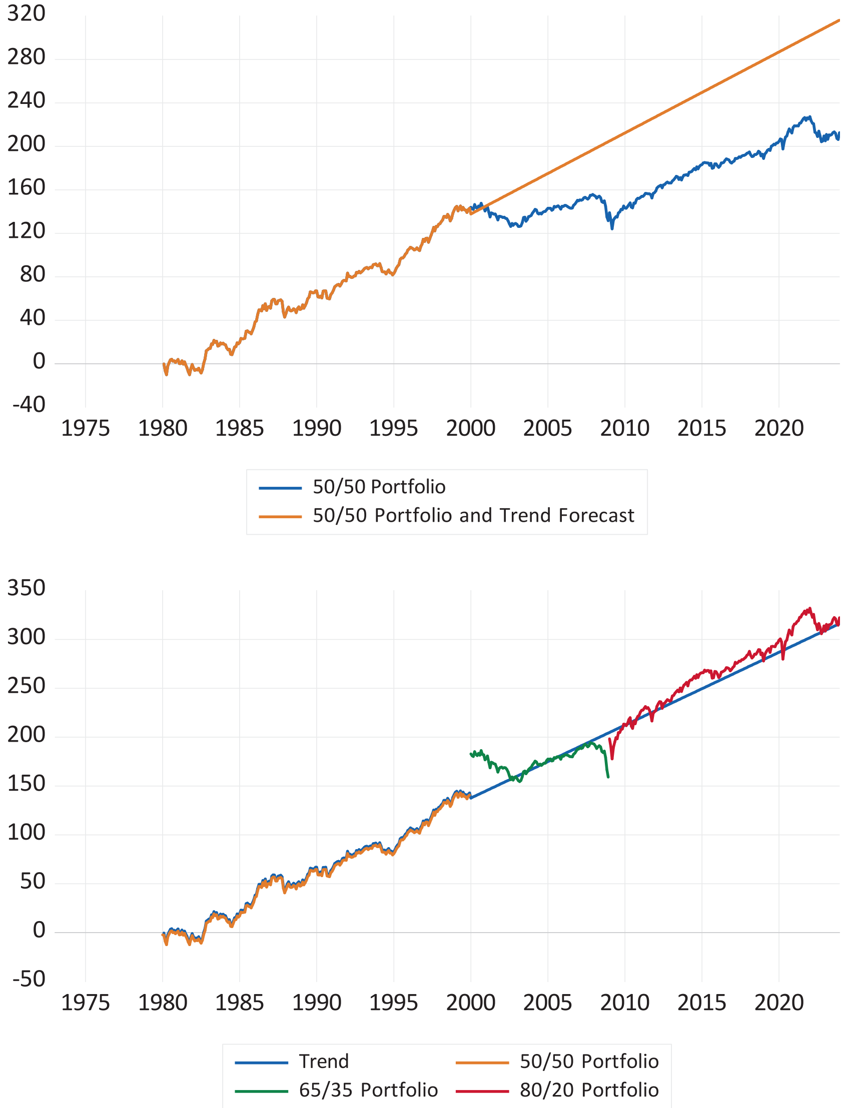

Fig. 4. US Stock-Bond Portfolio Performance – Pre-2000 Trend and Alternative Weights. Notes: The upper graph depict the cumulative return of a stock–bond 50/50 portfolio for the US, with a trend estimated from the start of 1980 to the end of 1999 and projected over the remaining sample. The lower graph depicts the same, but added is a stock–bond 65/35 and stock–bond 80/20 portfolio respectively.

Table 8
Equal-Weight Portfolio and Risk-Equalising Weights.

	Full Sample		Sample Until End 1999			Sample From Start 2000		
	Mean	SD	Mean	SD	W1	Mean	SD	W2
Canada	0.325	2.433	0.414	2.587	0.44	0.236	2.272	0.55
France	0.377	2.995	0.508	3.273	0.44	0.269	2.614	0.58
Germany	0.279	2.833	0.379	2.956	0.47	0.179	2.708	0.53
Italy	0.218	3.555	0.428	3.562	0.49	0.007	3.543	0.51
Japan	0.199	2.827	0.162	3.244	0.41	0.208	2.464	0.57
UK	0.356	2.749	0.595	3.155	0.25	0.117	2.254	0.64
US	0.403	2.573	0.515	2.720	0.41	0.292	2.417	0.54

Notes: Entries are the mean and standard deviation (SD) for an equal-weighted stock and bond portfolio over the full and sub-samples. W1 and W2 refers to the weights required in stocks to equalise the respective sub-sample SD to the full sample.

Table 9
Portfolio Variance Decomposition.

	Full Sample			Sample Until End 1999			Sample From Start 2000		
	Stocks	Bonds	Corr	Stocks	Bonds	Corr	Stocks	Bonds	Corr
Canada	0.84	0.20	−0.04	0.65	0.24	0.11	0.96	0.18	−0.14
France	0.89	0.12	−0.01	0.66	0.14	0.20	0.99	0.11	−0.11
Germany	0.96	0.10	−0.06	0.76	0.10	0.15	1.08	0.10	−0.19
Italy	0.79	0.10	0.11	0.62	0.11	0.28	0.82	0.10	0.07
Japan	0.98	0.07	−0.05	0.82	0.11	0.07	1.09	0.05	−0.14
UK	0.78	0.19	0.04	0.55	0.19	0.26	0.92	0.18	−0.11
US	0.88	0.24	−0.12	0.55	0.22	0.23	1.08	0.25	−0.34

Notes: Entries are the proportionate contributions to portfolio variance based on equation (2) from stock returns, bond returns and the stock–bond covariance across the respective samples.

variance). In computing these components, we use a five-year window for the variance measures. The results are presented in Table 9 and again, are separated across the sample between the (approximate) first and second halves (before and after 2000). Over the full sample, we can observe that stock return variance is the largest contributor to overall portfolio variance. Indeed, this holds for each of the two sub-samples, but the contribution is noticeably larger in the second sub-sample. The contribution to portfolio variance arising from bond returns is largely stable through the two sub-samples and thus, for the full sample. The more interesting result is perhaps for the covariance component. For the full sample, we see a mixed sign across the markets, being negative for five (Canada, France, Germany, Japan and the US) and positive for two (Italy and the UK). Nonetheless, regardless of sign, the magnitude is small, indicating a negligible effect. However, this masks a notable switch in behaviour across the sub-samples. In the first period, across all seven markets, there is a small to moderate positive effect, with Japan the smallest and the UK the largest. In contrast, in the second half all the sample, the contribution to portfolio variance arising from the stock–bond return covariance is negative for all markets, except Italy, for which the value is small. This again highlights the changing nature of portfolio behaviour arising from the shift in return correlation from positive to negative.

This section has sought to highlight some of the practical implications arising from the changing correlation between stock and bond returns. Notably, it illustrates that both portfolio returns and risk (variance/standard deviation) are affected by the switch in the correlation from positive to negative. With some indication of a switch back to a positive correlation, it will be of interest to further track this impact.

6. Summary and conclusion.

The stock–bond correlation is an important relation that remains of empirical interest given its potential to switch sign. The correlation has implications for our understanding of markets and portfolio management. Previous evidence, presented primarily for US data, demonstrates a change in the correlation between the stock and bond return from positive to negative around the year 2000. This is around the time of the dotcom crash and is often considered as an effect of flight-to-safety. Further, recent evidence suggests that this correlation may have reverted to positive around 2022, a period associated with higher inflation. A change in the sign of the correlation from positive to negative, implies that bonds switch from being a diversifying asset to a hedge. This paper considers the nature of the stock and bond return correlation for the G7 markets, considering not only the potential change in any correlation sign, but also seeking to examine the economic drivers of the time-varying correlation, including whether the nature of those drivers themselves, is also time-varying. The paper further considers some key implications of the change in correlation sign for investors.

Using monthly data for the G7 markets over a time period spanning 1980 to 2023 (with some variation in the start date across countries), this paper obtains stock and bond price index data as well as that for output, inflation and interest rates. We consider the nature of the time-varying stock and bond return correlations for each of the G7 markets using both a GARCH and rolling approach. The evidence demonstrates that the correlation does switch from positive to negative around the year 2000 for six of the seven markets, with the switch for Japan occurring much earlier (first half of the 1990s). A switch back from negative to positive is evident for all markets. This occurs towards the end of the sample period for the majority of markets (Canada, Germany, Japan, the UK and US), but earlier in the sample for both France and (especially) Italy.

We consider the drivers for this time-variation, but in contrast to the literature, we allow the nature of these drivers to also vary. This arises due to evidence suggesting that key macroeconomic correlations have changed over the course of the sample. For example, a negative correlation between inflation and output growth has switched to positive after the financial crisis as the implications of higher inflation changed from being an indicator of weaker to stronger future economic growth. Underlying theories, while indicating the likely impact of inflation, growth and interest rate variables on the correlation, do present a mixed view. The results of both a standard and breakpoint regression suggest that inflation and interest rates typically exhibit a positive effect on the correlation. This suggests that higher inflation and interest rates move stock and bond prices in the same direction, consistent with the view that higher values of these variables will likely depress prices due to higher discount rates and lower real cash flows. Growth also, largely, imparts a positive effect on the correlation, in contrast to the majority view that higher growth leads to a switch from bonds to stock, driving their prices in different directions. The positive effect here suggests, using a portfolio argument, that higher growth leads to an increase in demand for all assets. Nonetheless, a key element of the results here is that the sign and/or statistical significance of the macroeconomic predictors does change over the sample period, with greater significance generally observed in the post-financial crisis period.

Having examined the correlations and their drivers, it is important to consider the implications of the results for investors. Here, we undertake three exercises. From a starting position of a 50/50 stock–bond portfolio, we examine how both returns and risk are affected by the change in correlation. In the first exercise, graphs of the cumulative portfolio return show a downward step change in the trend path of the cumulative return after 2000 consistent with the switch in correlation from positive to negative. An illustrative example using the US shows that the weight in stocks needs to be increased in order to maintain the same level of performance. The second exercise considers the risk associated with the 50/50 portfolio and measures the standard deviation over the full sample and two sub-sample periods. Again, we examine the change in weights needed to maintain performance (i.e., to hold the standard deviation constant over the sample period). The results reveal a weight below 50 % in stocks is required in the first sub-sample, with above 50 % required in the second sub-sample. The third exercise, consider a portfolio variance decomposition and reveal that while the contribution from bonds remains broadly constant over the sample period, the contribution from stocks increases from the first half of the sample to the second half, while the correlation contribution shifts from having a positive to negative effect. The results here, and these implications are of importance for investors, as well as for those engaged in modelling market behaviour.

CRediT authorship contribution statement

David G. McMillan: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

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