OLIVIER DAVANNE
Risk Premium Invest

A Historical Perspective on US Treasuries Risk Premia

Abstract

The uncontrolled growth of US public debt is causing some anxiety among investors in US Treasuries. It is therefore useful to estimate the current risk premia embedded in the US yield curve and assess the extent to which investors are pricing in potential future financing difficulties for the US government.

In this paper, we provide both a theoretical and empirical explanation of the factors driving the US Treasuries yield curve and how it is possible to extract what market participants are currently pricing in.

It is widely acknowledged that expectations about future US monetary policy play a crucial role in this market. However, there is a notable underestimation — even within academic literature — of the symmetrical role played by expectations regarding future risk premia. Through our original modeling of the US Treasuries yield curve, we document the history of these expected risk premia. Our findings indicate that from 2000 to 2022, investors consistently underestimated the strength of demand for US Treasuries, which may explain the somewhat unusual behavior of this key market during that period.

Since 2022, however, a new paradigm has emerged. Demand for long-term US treasuries has declined due to the resurgence of inflation, while debt issuance has surged, driven by substantial deficits and the Federal Reserve's Quantitative Tightening policies. Consequently, risk premia have increased sharply.

The future remains highly uncertain as lower inflation could once again bolster demand for US Treasuries while public debt is expected to continue its rapid expansion. In this volatile environment, our model will help investors manage their positions by enabling real-time comparisons between their own expectations and the actual market pricing.

JEL Classification: G10, G12.

Keywords: Empirical finance, Term structure of interest rates, Risk premia.

Introduction

Understanding the US Treasuries yield curve is very important. This is obvious for traders and fund managers specialized in this large asset class, but the behavior of US yields is closely monitored by all market participants. Changes in the prices of US Treasuries have often strong direct and indirect impacts on the prices of other assets.

The direct impact results from the key role of US Treasuries as the risk-free reference, at least as far as dollar assets are concerned. All other assets are priced relative to US Treasuries.

The indirect impact results from the information that the US Treasuries are assumed to provide. Many investors and central bankers believe that the shape of the yield curve reveals information on the most likely future scenario for economic growth and inflation. Thus, when the US Treasuries yield curve moves, some investors may alter their fundamental macroeconomic scenario. For example, when the yield curve flattens, people often fear that this may be the sign of a forthcoming economic slowdown and are tempted to sell equities as a result. In this kind of situation, paradoxically, the indirect impact of lower long-term rates may be a weaker stock market.

Thus, it is important to understand the US yield curve. Yet, it is far from being a straightforward exercise! Over the last thirty years, US Treasuries have often had a strange behavior. Contrary to the analysis of many market participants, surprises have not started with the direct intervention of the Fed (Quantitative Easing) after the 2008-2009 financial crisis. As early as 2005, Alan Greenspan had some good reasons to qualify the low level of long-term rates of "conundrum".

The purpose of this paper is to explain what drives the US Treasuries yield curve from a theoretical perspective (Section 1/) and to show how empirically a model based on these premises help to explain the behavior of this key market over the last 30 years, and in particular why risk premia on US Treasuries have recently risen sharply (Section 2/). We'll conclude (Section 3/) by discussing briefly the uncertain future, as lower inflation could once again bolster demand for US Treasuries while public debt is expected to continue its rapid expansion.

I. Expectations regarding monetary policy and risk premia: the 8 key factors driving the US Treasuries yield curve.

The first well-known observation is that the yield curve reflects expectations regarding monetary policy in the future. In a world without risk premia, the expected return on a monetary fund should be equal to the return provided by a long-term bond hold until maturity. Thus, long-term rates are basically equal to the average expected short rates over the life of the bonds, plus a risk premia correction.

Any yield curve reflects an implicit path for monetary policy in the future. Unfortunately, this implicit path is very hard to extract due to the complex risk premia also embedded in the curve.

A first key question is how many variables or factors are needed to describe this implicit path for short-term rates? This question is related to the complexity of the monetary policy process. When short rates are not at their long-term equilibrium, how complex can be the expected returning path to this equilibrium?

In a simple two-factor world, expectations could be described by only two variables: the current short rate and the expected equilibrium rate. The process of convergence would always follow the same path. Obviously, this is not a realistic hypothesis. Sometimes investors expect a quick convergence and sometimes investors expect that short rates will stay for a long-time away from the equilibrium, or even diverge more before finally converging. Thus, to describe expectations correctly, at least three factors are needed.

For example, if we know the current short rate, the equilibrium short rate, and the short rate expected in one year, we are starting to have a pretty good view of the convergence process expected by investors. But is it enough? The answer is a clear no. There is more complexity than that in short rate expectations. Rates can stay at the one-year expected level for a while, especially when they are stuck around 0, or they can converge quickly at the one-year plus horizon. Indeed, if one looks at the available surveys of investors' expectations, one can see that knowing the expected equilibrium short rate and the short rate expected at the one-year horizon does not allow to estimate precisely the short rate expected in the medium term, let's say at the three years horizon.

To understand the current yield curve or forecast its shape in the future, we need (at least) four key variables regarding monetary policy:

- The current rate.
- The expected equilibrium short rate.
- The short rate expected in one year.
- The short rate expected in three years.

Let's now turn our attention to risk premia.

There is an abundant academic literature showing that risk premia vary over time. But there is often a lot of ambiguity about what we call "risk premia"!

The first fundamental risk premia to consider are **the current tactical or short-term risk premia**. How much excess returns investors require to hold bonds at a few weeks or few months horizon (i.e. the investors' tactical horizon)? These short-term risk premia are related to the current risks (and notably to the current correlation between the return on bonds and the return on equities: we'll come back to this issue later).

These tactical risk premia fluctuate widely around their expected equilibrium, as short rates do. And obviously, bond prices depend a lot on future risk premia expected by investors, as they depend on future expected short rates. If tactical risk premia are low, for example due to Quantitative Easing (QE), but investors expect them to climb back in the future, rational investors will expect bond yield to rise in the future, and obviously this pushes higher the long-term yields as soon as today. **There should be no doubt that bonds prices reflect future expected risk premia exactly as they reflect future expected short-term rates.**

As we have just emphasized with the short rates, it is very clear that the expected convergence path for risk premia also varies over time. Here again, we are not in a simple two-factor world where it would be enough to know the current tactical risk premia and their expected equilibrium to extract all the risk premia expected by investors at the future intermediate horizons. Sometimes, investors are very confident that risk premia will go back rapidly to the "normal" or equilibrium level. Sometimes, they believe that current distortions, like QE, will last for a while. In all markets, the changes of view on the speed of convergence towards equilibrium play a major role to explain the price dynamic.

Thus, to understand the yield curve, we also need an indication on the expected risk premia in the medium-term, let's say in 3 years. But again, is it enough? We have argued that for short rates, three factors were not sufficient to understand the yield curve and that expected path towards equilibrium could be rather complex. However, investors don't spend as much time studying the dynamic of tactical risk premia required by investors (maybe they should...) as they spend trying to second guess the decisions of the Fed in the coming months and years. Thus, we believe that the risk premia path embedded in the US Treasuries yield curve is much less complex than the short-rate path. Three factors seem enough: if we want to describe the expected path of 10-year Treasuries tactical risk premia, we probably need to know only the current short-term risk premium, its expected equilibrium in the long-term and its expected level in 3 years.

Thus, on top of the four key variables related to monetary policy expectations, we need at least three other key variables to understand the observed yield curves:

- The current short-term risk premium required on 10-year US Treasuries.
- The expected long-term equilibrium for this tactical risk premium.
- An indication on the speed of the expected convergence process: the expected tactical risk premium on these 10-year notes at the three-year horizon.

Obviously, all investors don't have the same tactical horizon. Some traders have a very short horizon, but most fund managers don't base their decisions on daily or weekly forecasts. **In all that follows, our short-term/ tactical risk premia will be the expected excess returns (annualized) at the three months horizon.**

We could stop here if there was a simple and robust relation between the tactical risk premia on bonds of various durations. For example, if the risk premia were strictly proportional to bonds' duration, knowing the current and future expected tactical risk premia on 10-year bonds would directly lead to the tactical risk premia on all other bonds (the tactical risk premium on a one-year discount bond would be one-tenth of the tactical risk premium on a 10-year discount bond). Thus, the US Treasuries yield curve would simply be the product of our seven key variables, four related to the expected monetary policy in the future and only three needed to describe the expected dynamic of the risk premia.

Unfortunately, there is some strong empirical evidence that risk premia on US Treasuries are not strictly proportional to duration. In general, the tactical risk premium on a one-year bond is significantly larger than one-tenth of the risk premium on a 10-year (zero-coupon) bond. But this hierarchy sometimes changes and there are situations where the risk premium on short-term bonds becomes abnormally low.

A key observation is that the short and the long end of the US yield curve are not subject to the same risks. The price of short-term treasuries is mainly influenced by monetary policy decisions: prices fall when the Fed raise rates (or is expected to raise rates). Long-term rates are also influenced by monetary policy decisions (or rather expectations regarding monetary policy) but depends also in a very significant way from changes in risk premia (current and expected). Without any expected change in monetary policy, the price of long-term bonds may fall if the risk premia required by investors increase.

Thus, the risks do not have exactly the same origin – monetary policy surprises versus changing risk premia - and it should not be surprising that risk premia along the yield curve are not the same per unit of volatility. A key observation is that, in general, markets for risky assets dislike very much the unexpected increases in the risk-free rates, i.e., in the official rates controlled by central banks. As William M. Martin, former chairman of the board of the Fed, famously said in the 1950s, the role of the Fed is "*to order the punch bowl to be removed just when the party is really warming up*"[1]. In the same speech to a group of investment bankers, he also said that "*those who have the task of making such policy don't expect you to applaud*". As a result, it is not surprising that investors require in normal time a specific risk premium at the short end of the yield curve to be exposed to unwelcome central banks' surprises.

The difficulty is that this specific "monetary policy risk premium" is unlikely to be stable over time. Indeed, the traditional view – a looser monetary policy is good for markets and a tighter one is bad - has been challenged over the last two decades by the introduction of the "Greenspan/Bernanke/Yellen/Powell puts": when stock markets fall sharply, the US central bank may react quickly to stop the rout. As a result, when this "put" seems active, holding short duration bonds can be especially effective in protecting the investors' portfolios. The correlation between short-duration bonds and equities becomes the opposite of the natural one implied by William M. Martin.

It is why in order to understand the observed yield curve, one also needs some information on this specific monetary policy risk premium. What is its current level? Are we still in the "normal" situation where investors fear the impact of a possible Fed tightening and require a specific risk premium on bonds of short duration? To take into account the fact that the "monetary policy risk premium" varies over time we have introduced another key variable: the current tactical risk premium on one-year US notes[2].

We believe that the role of these 8 key variables – four related to monetary policy (current and expected) and four related to risk pricing (current and expected) - is very strongly supported by the economic theory.

This is indeed the primary distinction between our approach and the rest of the literature on yield curve modelling. In the literature, there is a limited number of "latent variables" (ranging from three to five) that lack a clear economic interpretation, yet are presumed to simultaneously influence expectations for future short-term rates and future risk premia. However, this assumption is demonstrably incorrect: our use of eight variables is essential because they are not fully correlated. There is no mechanism to ensure that the expectation of one variable is determined by the other seven. The economy can exist in an infinite number of states, and no set of merely three to five variables can comprehensively determine expectations for short rates and risk premia across all scenarios. Consequently, relying on a limited number of uninterpreted latent variables invariably results in biased estimations of the 'true' eight economic factors that drive the yield curve.

Let's now turn our attention to the empirical evidence.

II. Revisiting the US Treasuries yield curve over three decades

Let's start by explaining how it is possible to extract these 8 key variables from the available information.

The first step is to establish the relationship between the observed rates on bonds of various durations and our key variables (i.e., finding what the technical jargon calls the "factor loadings"). As by design our key variables cover all what we need to understand bonds prices, it is not very difficult to establish these "factor loadings"[3].

In theory, once these factor loadings are known, one only needs to take 8 rates on the yield curve and by a simple matrix inversion, extract what are the underlying 8 key variables consistent with these 8 observable rates. Yet, in practice, the extraction process is more complicated than that.

The problem is what Duffee (2011) rightly called the "hidden factors" problem. A change of expected risk premia will produce a shift in the yield curve that will look exactly (or almost exactly) as the result of changing expectations regarding monetary policy. We don't easily observe 8 factors in the yield curve (and this is the reason why all published papers use between 3 and 5 factors), but that does not mean that factors spotted by economic theory don't exist. They are simply not apparent.

This is a very important point: there is no hope of understanding well the yield curve without the help of outside information. The same yield curve may result from very different sets of expectations regarding the future monetary policy and the expected dynamic of risk premia[4].

It is why, as in numerous academic papers, we also add the result of investors surveys to extract our 8 key variables. More precisely, we use the Consensus Economics monthly surveys and the quarterly Surveys of Professional Forecasters (managed by the Philadelphia Fed). These surveys inform on investors' expectations for both short-term and long-term rates at various horizons. Thus, they give some rich information on the returns and risk premia expected on bonds at various horizons.

Using a standard statistical procedure (a Kalman filter), it is possible to extract our 8 key variables from the joint information provided by the yield curve (Current Fed funds rates, 6-month rate, one-year rate, 2-year rate, 5-year rate and 10-year) and the answers to these surveys.

Thus, we may interpret the observed yield curves in terms of expected monetary policy and expected risk premia with a detail never produced before.

The results of other models developed within the Federal Reserve System are also available online[5]. However, these models, limited by a narrow set of uninterpreted factors, function as black boxes and are unable to provide reliable estimates of the expected dynamics of risk premia. Indeed, the only estimates available online are those of the cumulative 'term premia'—the excess return that buy-and-hold investors might expect if they hold the bonds until maturity[6]. Furthermore, the limitations inherent in these models often render these 'term premia' estimates somewhat unrealistic[7].

Let's discuss a bit the discovery we made regarding the dynamic of risk premia. The following graph shows our estimates for tactical risk premia on 10-year Treasuries. As explained previously, three horizons should be considered: the current tactical risk premium, the equilibrium risk premium and, to assess the convergence speed, the tactical risk premium apparently expected by markets' participants in the medium term (three years).

In this graph, the risk premium is annualized: a tactical risk premium of 4% means that investors on average expect an excess return of 1% over the coming three months, relative to a "safe" monetary instrument.

Let us begin by examining our estimates for the current tactical risk premia over the past thirty years (indicated by the generally lower line). Our model leverages all available information to derive this estimate, yet it is undeniable that surveys constitute the most crucial input for this specific variable. The surveys we utilize offer essential insights into the returns investors anticipate over short-term horizons ranging from three months to one year.

Figure 1. Tactical risk premia on 10-year US Treasuries (annualized)

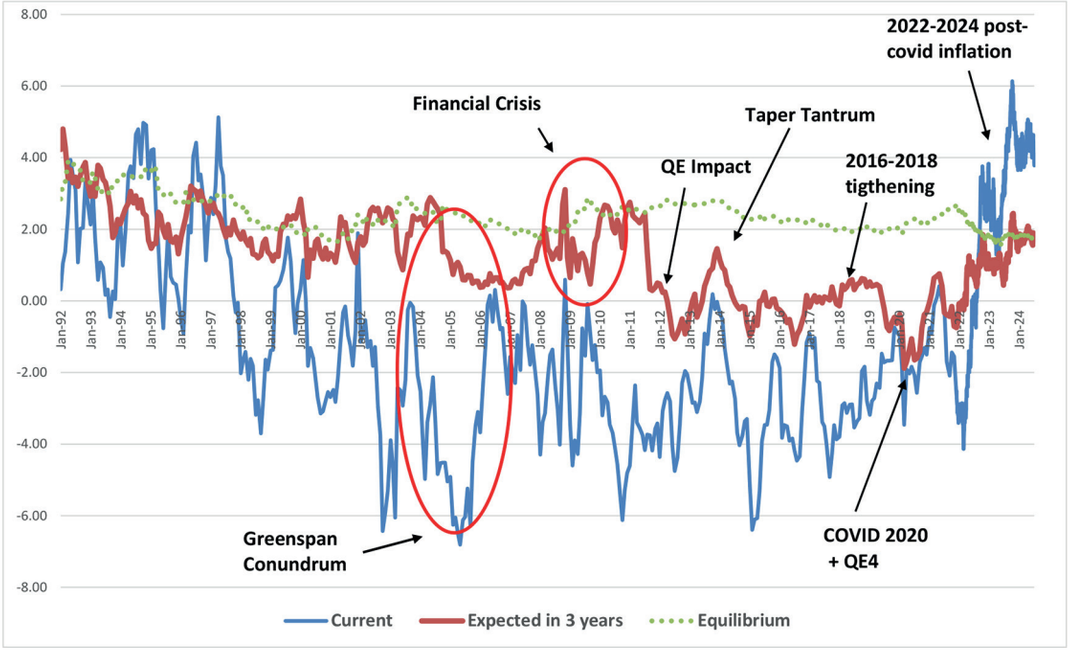
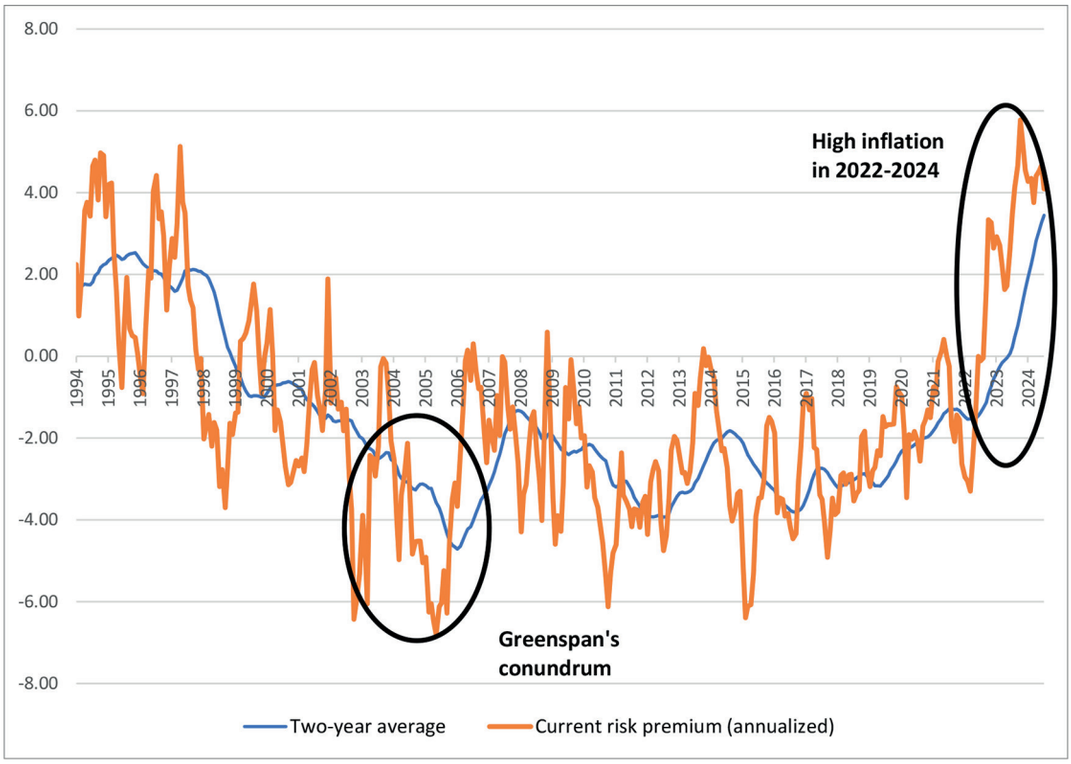


Figure 2. Current tactical risk premia on 10-year US Treasuries



The first observation is that this tactical risk premium is quite volatile, yet it exhibits noticeable structural breaks when we analyze its two-year moving average. Consequently, we observe volatility at both low and high frequencies.

While the tactical risk premium was generally positive during the 1990s, it shifted towards negative values in the subsequent decades. The two-year average remained negative for almost 25 years, from December 1998 through May 2023. However, it has recently surged sharply, reaching levels not seen since the early 1990s

The observation that the tactical risk premia on bonds stayed negative for so long may surprise many readers. There is a common view that long term bonds are riskier than T-bills since their prices are very volatile. Investors are often supposed to require some form of compensation to bear this short-term volatility risk. This was not the case between the late 1990s and 2022: according to surveys, investors were generally pessimistic about the likely returns of Treasuries at horizons of three months or one year.

But is should not be that surprising. This is a major result of the Capital Asset Pricing Model that risk premia on specific asset classes should not be related to volatility per se, but to the "betas", where correlations play a major role. A very volatile asset with a negative correlation to other risky assets should provide a large negative risk premium since investors can use it as a hedging instrument.

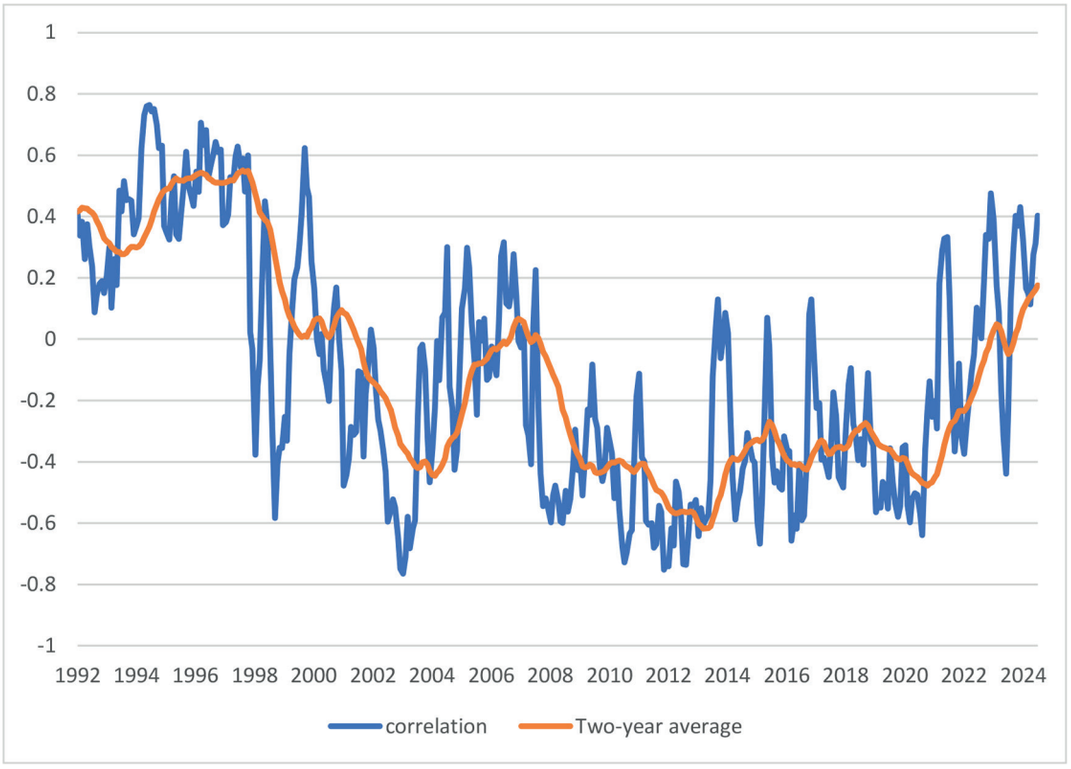
And, indeed, the structural breaks observed in risk premia (figure 2) seem clearly related to the changing correlation between bonds and equities in the US (figure 3).

In the 1990s, the correlation between the price of bonds and equities was positive. But later, during around 25 years, the correlation turned negative and holding long-term US Treasuries provided a form of protection to equities investors. This negative beta goes a long way to explain the observed negative risk premia during that time. But recently, the correlation has turned again positive, except for some special moment (for example, during the regional bank crisis in the spring of 2023 where US Treasuries benefited from investors' flight to safety).

What are the reasons for these changes of correlations? Many papers (see for example Cieslak and Pang (2021) or Campbell *et al.* (2020)) explain that this correlation depends very much on the nature of the shocks impacting the economy. Some shocks create a positive correlation (as seen recently, higher inflation generally lowers bonds and stocks prices), while others (higher productivity, financial crisis) have the opposite impact. The changing nature of risks since the mid-1990s (with more financial instability, a more credible Fed, but recently the 2022-2024 inflationary crisis) probably explains the structural or quasi-structural changes in correlations.

Correlations (or rather betas) are not the sole drivers of the tactical risk premia that balance supply and demand. On the demand side of the equation, investors are not all short-term investors mainly concerned by volatility and correlations and the strength of the demand for US Treasuries has other complementary explanations. There are many long-term investors, like pension funds, managing

Figure 3. Correlation between the price of the 10-year US Notes and the S&P500 (rolling period of three months)

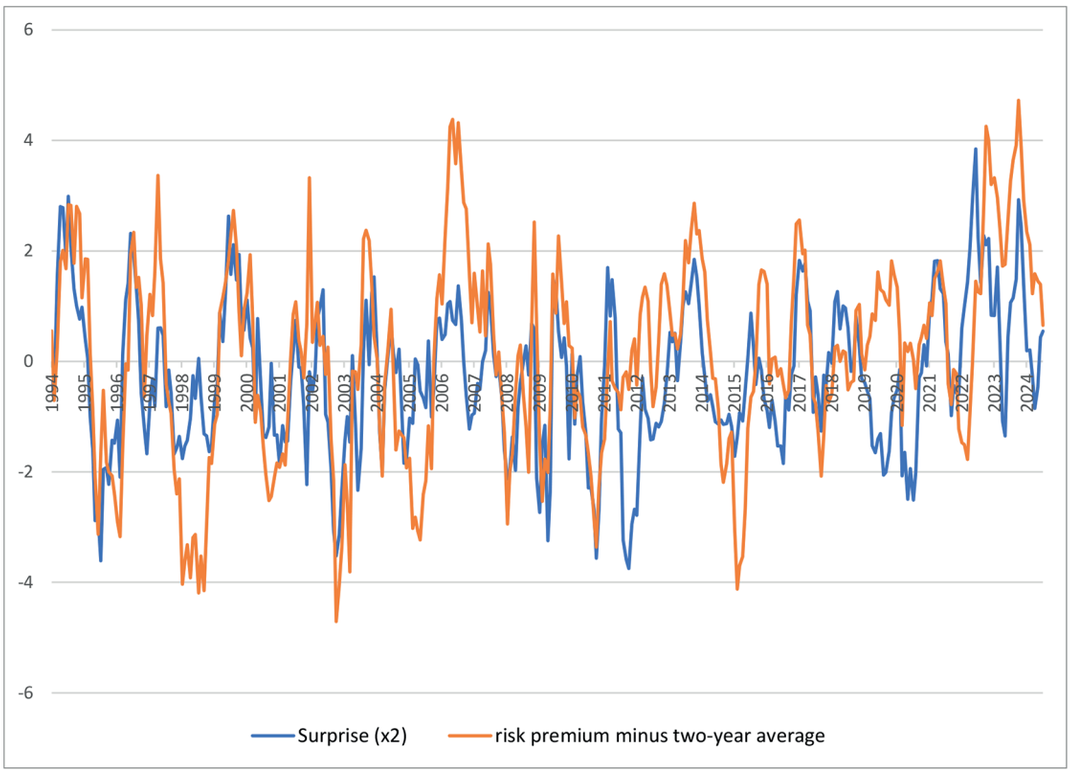


their "strategic" portfolios with a long-term horizon. For them, as long as there is little risk of inflation, long-term bonds may be less risky than monetary instruments. A highly rated long-term bond guarantees a fixed payment to the long-term buy and hold investors, while investing in monetary instruments may be extraordinary risky from a long-term perspective as short-term rates vary widely. And the last three decades have seen many structural changes leading to a higher demand for safe bonds coming from long-term investors (the increase in pension saving, the credibility of central banks in the fight against inflation, the more stringent regulations of institutional investors...). But recently, concerns about long-term inflationary prospects may have slightly weakened this strategic demand for long-term bonds. On the supply side, risk premia are also influenced by the volume of long-term bonds that investors need to absorb. This supply is determined by the size of the public debt and the average duration of the bonds held by investors, considering the impact of the Fed's bond holdings (Quantitative Easing). Lately, this supply has significantly increased, driven by a substantial public deficit and the Fed's Quantitative Tightening. Alongside the recent shift in correlations, this surge in bond supply has likely played a crucial role in the substantial recent rise in tactical risk premia.

Last but not least, to fully understand the high-frequency volatility of tactical risk premia, one must also consider the stringent constraints faced by traders and fund managers in managing their tactical positions. A crucial real-world investing mechanism, often overlooked in academic literature, is the presence of 'stop-loss' constraints. Most investors are compelled to close tactical positions that incur losses exceeding their risk budget. This requirement significantly impacts the dynamics of tactical risk premia: an asset that has experienced notable recent losses must likely offer higher risk premia to retain investor interest. Therefore, one can assume that some of the high-frequency volatility of the tactical risk premia can be explained by the recent behavior of the US Treasuries market.

This important mechanism is illustrated in Figure 4, which demonstrates a strong correlation between the short-term movements of the tactical risk premium (represented in this chart as the difference between the current risk premium and its two-year recent average) and the recent unexpected trends in the market. The variable 'Surprise' represents the difference between the observed 10-year rate and the forward rate that was priced into the yield curve six months earlier. For instance, if 'Surprise' equals 1, it indicates that the current 10-year yield is 100 basis points higher than what was priced six months ago.

Figure 4. Short-term volatility of the tactical risk premia and recent market surprises[8]



When 'Surprise' is positive, it implies that investors who maintained a long tactical position for six months have incurred losses.

This high volatility, at low and high frequency, of the current tactical risk premia contrasts sharply with the remarkable stability of the tactical risk premia investors consider as normal in the long term (dotted curve in figure 1). Investors seem to consider that the normal risk premium on a 10-year bond relative to a "safe" monetary instrument is around 2% per annum, and they don't seem to have changed much their view on that matter since the 1990s.

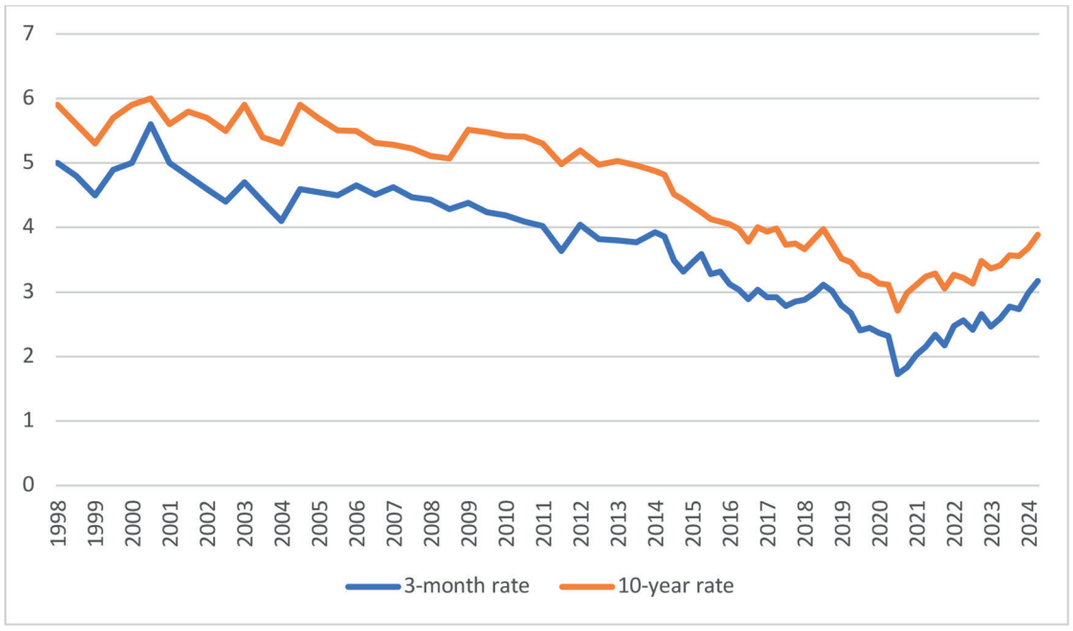
This is a key observation, and it is important to understand the piece of data that support this conclusion. There are clues pointing in that direction both in the yield curve and in investors surveys. In the yield curve, the slope of the forward rates at a very long horizon (more than 10 years) is directly related to the "normal" risk premia expected in the long term and it has always been compatible with an equilibrium risk premium around 2% for 10-year bonds (see Davanne (2021) for an analysis of the information in (and not in) long-term forward rates). As far as surveys are concerned, Figure 5 shows how the consensus for 10-year rates and 3-month T-bills at the 6-10 years horizon has changed since the late 90s (Consensus Economics survey). We can see that the expected spread at the long-term equilibrium is pretty stable around 1%. This spread or "term premium" of 1% is broadly in line with a tactical risk premium around 2% for 10-year notes[9].

Despite more than twenty years of negative tactical risk premia, period that ended in 2022, investors always considered that this situation could only be transitory and that sooner or later, some "normal" positive risk premia would again be required. This view may appear as a form of stubborn irrationality (see Davanne (2023)), but, after a very long wait, seems to have been vindicated by the rebound in risk premia observed since 2022.

However, the expected speed of convergence towards "normality" (i.e. a 2% risk premium) has varied a lot over time. And these changes of view about the convergence process have introduced a lot of volatility in the price of US Treasuries. This can be seen Figure 1 looking at the tactical risk premia expected at the three-year horizon. We can identify five different periods:

- **Until 2003, investors were confident that the return towards significantly positive risk premia would be quick.** Tactical risk premia priced at the three-year horizon were around 2%, pretty close to the expected long-term equilibrium.
- But the surprising strength of the demand for US Treasuries, and the low level of long-term rates, started to be noted in 2004-2005. Alan Greenspan observed

Figure 5. Expected long-term equilibrium for 10-year and 3-month rates (forecasts at the 6-10 years horizon)

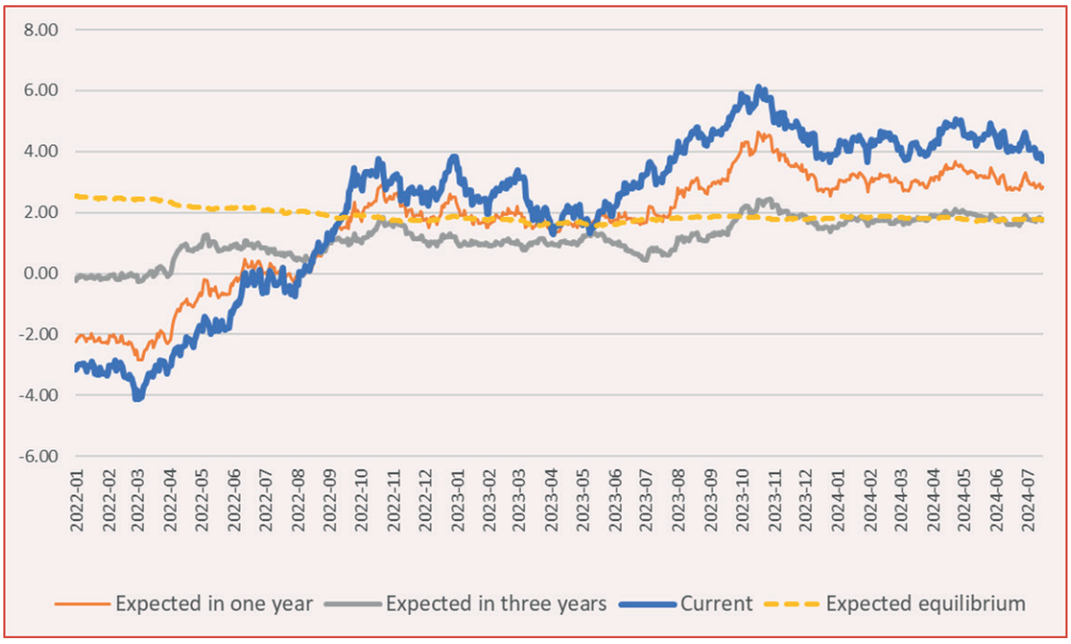


Source: Consensus Economics. The surveys are semestrial from 1998 to 2014 and quarterly since that date.

that "*For the moment, the broadly unanticipated behavior of world bond markets remains a conundrum. Bond price movements may be a short-term aberration, but it will be some time before we are able to better judge the forces underlying recent experience*"[10]. Investors implicitly conclude (wrongly?) that there was no new paradigm: they did not change their estimate for the equilibrium risk premia in the long-term. But they indeed took a cautious view of the convergence process: the expected tactical risk premium at the three-year horizon fell for a while at a relatively low level.

- In its first stage, the financial crisis put an end to this process of recognizing the strength of demand for US Treasuries. In an uncertain context, long term rates become again priced on the assumption that tactical risk premia on 10-year bonds would converge quickly towards 2%. As a result, the yield curve became quite steep: in 2009, 10-year rates were at 3.3% on average when the 3-month T-bills rates were at only 0.2%.
- **Everything changed in 2011-2012 with new powerful rounds of QE** ("QE2" in November 2010, "QE3" in September 2012 and "QE4" in March 2020). QE cut the supply of US Treasuries available for the private sector and pushed even more the current tactical risk premia into negative territory. But its main impact on long-term rates was psychological, playing through changing expectations: it provided a justification to challenge the traditional view that "normal" bonds risk premia are necessarily positive. Suddenly, thanks to central banks' interventions, the "this time is different" cautiously assumed by Alan Greenspan in 2005 became credible. As a result, expected risk premia at the 3-year horizon collapsed (and the long-term rates with them). Until the beginning of 2022, they were on average slightly negative. But, in some way, many markets' participants were still prisoner of the view that "lower for longer" does not mean "forever": as discussed, the yield curve still priced in the long term a recovery of risk premia on 10-year bonds towards 2%. And as QE was seen (wrongly) as the primary reason for low rates, each time there were indications that US monetary policy might normalize in the near future, the medium-term expected risk premia surged. It was the case in 2013 ("the Taper Tantrum" episode), in 2016-2018 (rising Fed Funds) and in the spring of 2021 (peak of the "reflation trade"). However, each of these increases in risk premia turned out to be temporary—until 2022, that is.
- **Everything shifted once more in 2022 with the post-COVID surge in inflation and the substantial increase in bond supply that investors needed to absorb.** Investors began to anticipate a rapid convergence of risk premia back to their presumed long-term equilibria. Unlike in the previous decade, this time their expectations were sustained, bolstered by the 'fundamentals'—namely, higher inflation, a significant increase in supply, and elevated tactical risk premia (see figure 6).

Figure 6. Tactical Risk Premia (10-year US Treasuries) expected at various horizons since early 2022



III. An uncertain future

The volatility observed in the past underscores the difficulty of forecasting future tactical risk premia. Two extreme scenarios are conceivable. On one hand, the demand for US Treasuries might once again benefit from the resurgence of negative betas. A more stable inflation outlook, along with numerous financial risks stemming from geopolitical tensions and the troubling expansion of the "shadow" banking sector, may strengthen the status of US Treasuries as a "safe haven. Drawing on the last thirty years of experience, this optimistic scenario, characterized by high demand for US Treasuries and the return of negative tactical risk premia, was our primary expectation until recently. However, the unchecked increase in the supply of US Treasuries might unfortunately sustain tactical risk premia at uncomfortably high levels or even drive them higher. In the worst-case scenario, concerns over US indebtedness could become a major influence on the dynamics of financial markets. Similar to inflation shocks, fears about excessive debt can result in a positive beta for bonds relative to equities (bad news regarding public finances tends to depress both bond and equity prices), and it's clear that positive betas adversely affect the demand for US Treasuries. We witnessed this kind of vicious cycle in the fall of 2023, when weak Treasury auctions precipitated a sharp rise in long-term interest rates and a corresponding downturn in the equity market.

It is important to remember that tactical risk premia are highly volatile, yet their impact on bond prices remains relatively minor as long as the changes are considered temporary and medium-term expectations stay well-anchored. However, these medium-term expectations are also likely to remain volatile and challenging to predict. In the optimistic scenario, where there is again high demand for US Treasuries and the public deficit is under control, investors might once again experience volatile expectations concerning the path from negative risk premia back to the 2% "equilibrium" risk premia.

In a less favorable scenario, where investors struggle to absorb new issuances and tactical risk premia remain high or even continue to escalate, the volatility of risk premia expectations could also be substantial. Currently, despite concerns over rising US public debt, expectations for future risk premia remain solidly anchored. The long-term equilibrium for the 10-year Treasury tactical risk premium is still projected at around 2%, despite significantly higher current premia, with convergence anticipated within a three-year horizon (see Figure 6). However, a potential de-anchoring of risk premia expectations could occur and would likely cause a significant increase in the volatility of long-term interest rates.

Regardless of the scenarios that may unfold over the next few years, it is important for investors to have a clear understanding of what is factored into the yield curve, in terms of short rates and risk premia expectations. The future holds considerable uncertainty, but the estimates

we provide[11] may aid in navigating the fluctuations of this pivotal market.

1. Address before the New York Group of the Investment Bankers Association of America, October 19, 1955.
2. We have also assumed that when the specific monetary risk premium is different from its normal level, investors expect a smooth return to normality over the long-term.
3. Yet, there is a key problem of interpolation: current bond prices depend on expected short rates at all horizons and expected risk premia at all horizons on bonds of all durations. One needs to assume an interpolation mechanism that establish a link between all these variables (an infinite number!) and our 8 key variables based on a few key specific horizons (current, one-year and three-year ahead, long-term equilibrium) and two specific maturities (one and 10-year bonds). We have done that in a way that respect the no-arbitrage constraint: the interpolation mechanism is such that it is not possible to make risk-free profits by playing some bonds against others (see Davanne (2021) for a first-generation version of the model where the specific "monetary policy risk premium" is assumed to be constant). The methodology we use is original, but our model belongs to the general class of essentially affine model discussed by Duffee (2002).
4. For those interested in this important issue and the role played by only three factors (the "level", the "slope" and the "convexity") in the academic literature, we can be a bit more specific about why most of our 8 factors are hidden. All these 8 factors have a rather smooth impact along the yield curve: thus, the factors loadings along the yield curve can be reasonably approximated by a polynomial of degree 2. Let's assume that the impact of a change of factor i on the rate of maturity T can be approximated by $a_i + b_i T + c_i T^2$. All factors have a specific signature on the yield curve as the parameters a_i, b_i, c_i are specific to the factor i. Yet, the cumulative impact of our 8 factors will systematically lead to a yield curve that will be of the form $R_T = \alpha + \beta T + \gamma T^2$, with α, β and γ changing over time. Thus, the yield curve will also always look like a polynomial of degree 2 and only 3 factors ("level", "slope" and "convexity") will be observable! Crump and Gospodinov (2019) arrived broadly to the same conclusion in a more formal discussion of the traditional factor analysis of the yield curve: "*At the heart of this "identification" problem lies the extreme cross-sectional dependence across maturities that produces a polynomial pattern in the eigenvectors of the covariance and correlation matrices of these processes*". This problem of identification is not specific to yield curve modelling as pointed out by Rebonato (2018): "*So, yes, the yield curve changes are well described by changes in levels, slope and curvature, but so are many other quantities that have nothing to do with yields. Indeed, in 30-plus years of working with principal components with a variety of data derived from sources as unrelated as neutron scattering and yield curves, I do not recall a single case in which I have not found a level/slope/curvature pattern for the first principal components, at least when all the variables have been positively correlated. Which simply suggests we are mainly observing a mathematical fact, rather than a sign from a higher being.*" Maybe this mathematical fact is that many smooth functions can be well approximated by a polynomial of degree 2.
5. The Federal Reserve System uses three models estimated on an ongoing basis by the staff of the Federal Reserve Board (the KW model), the New York Fed (the ACM model) and the San Fransisco Fed (the CR model) See KM and White (2005), Adrian, Crump and Moench (2013) and Christensen, Diebold, and Rudebusch (2011).
6. These "term premia" or "buy-and-hold premia" are the differences between the long-term rates and the average short rates expected in the future. For example, term premium on 10-year Treasury = Yield on 10-year Treasury – Average of expected Fed funds rates over next 10 years.
7. This is particularly true for estimates that rely solely on the yield curve without incorporating data from available surveys, such as the ACM and CR models. For instance, in February 2024, professional forecasters responding to the Philadelphia Fed's quarterly survey predicted that short-term rates in the US would average around 2.9% over the next 10 years. Meanwhile, the New York Fed's ACM model projected market participants' expectations significantly higher at 4.3%, resulting in a substantial negative term premium on 10-year Treasuries (rates were at 4.10% at that time). The discrepancy between the survey results and the ACM's estimate was too large to be deemed realistic.
8. The "Surprise" is multiplied by two in this graph to use the same scale as for risk premia.
9. The spread or "term premium" between 10-year rates and short rates is not the risk premium on a 10-year rate. The spread reflects the average excess return provided by the 10-year note until redemption. But its maturity declines progressively towards 0, thus this average excess return is close to half the risk premium required on a constant maturity 10-year note.
10. February 17, 2005, testimony before the Committee on Banking, Housing, and Urban Affairs of the U.S. Senate.
11. Our decomposition of the yield curve between expected short rates and expected risk premia is available on our website, www.riskpremium.com. It is updated every day at the end of the trading session at around 4:30 PM CT.

References

- Adrian, Tobias, Richard K. Crump, and Emanuel Moench, 2013, Pricing the Term Structure with Linear Regressions, *Journal of Financial Economics* 110, 110-138.
- Campbell, John Y., Carolin Pflueger, and Luis M. Viceira, 2020, Macroeconomic drivers of bond and equity risks, *Journal of Political Economy* 128, 3148–3185.
- Christensen, Jens H.E., Francis X. Diebold, and Glenn D. Rudebusch, 2011, The Affine Arbitrage-Free Class of Nelson-Siegel Term Structure Models, *Journal of Econometrics* 164(1), 4-20.
- Cieslak, Anna, and Hao Pang, 2021, Common shocks in stocks and bonds, *Journal of Financial Economics* 142, 880–904
- Crump, Richard K., and Nikolay Gospodinov, 2019, Deconstructing the Yield Curve, *Staff Report No. 884*, Federal Reserve Bank of New York.
- Davanne, Olivier, 2021, How markets price risks? Key insights from an analysis of the US Treasuries market, available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4451451
- Davanne, Olivier, 2023, Asset Pricing Inefficiencies: The Key Role Played by Fundamentalists' Mistakes on Risk Premia and a Faulty Learning Process, Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4451428
- Duffee, Gregory R., 2002, Term premia and interest rate forecasts in affine models, *Journal of Finance* 57, 405–443.
- Duffee, Gregory R., 2011, Information in (and not in) the Term Structure, *The Review of Financial Studies* 24, 2895-2934.
- Kim, Don H., and Jonathan H. Wright, 2005, An arbitrage-free three-factor term structure model and the recent behavior of long-term yields and distant-horizon forward rates, *Finance and Economics Discussion Series no 2005-33*, Board of Governors of the Federal Reserve System.
- Rebonato, Ricardo, 2018, Bond Pricing and Yield Curve Modelling, A Structural Approach, *Cambridge University Press*.