BANK FOR INTERNATIONAL SETTLEMENTS

# How much should we read into shifts in long-dated yields?

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US Monetary Policy Forum

New York City, 3 March 2017

I am happy to be back at the US Monetary Policy Forum. As one of the early panel members following its inception in 2007, I was fortunate to be at the centre of many key debates. It is gratifying to see how the USMPF has cemented its place on the monetary economics calendar.

This session is on negative interest rates. The debate on how we should interpret very low, and even negative, long-dated yields was raging in the middle of last year, but this debate seems to have cooled down, overshadowed by recent events. Nevertheless, the experience of negative long-dated yields is still fresh in our minds, and I propose to focus on it today, as the episode last year presents a very instructive lesson on how much we should read into long-dated yields.

Storytelling is a powerful device in economics, as recently highlighted by Bob Shiller in his American Economic Association presidential address.[2] The power of narrative is especially strong when we try to make sense of fast-moving economic events, and look for a compass to guide us over unfamiliar territory. Nowhere is this more the case than in trying to understand shifts in long-dated yields.

Market prices serve an important role as a signal of underlying fundamentals. Even among prices, long-dated yields exert an especially powerful hold over economic commentary. I suspect this is because we see long-dated yields as providing a window on the future. We personify the "market" and endow it with foresight. So, when nominal yields fall to very low (even negative) levels, economic commentary turns to scenarios of protracted economic stagnation and accompanying deflation that make even negative long-dated yields attractive to new investors.

I will take a contrary stand today. Long-dated yields may be overrated as a forward indicator of economic conditions. Far from being a window on the future that reveals insights that no individual market participant has, low yields may, instead, reflect very ordinary motives of individual investors that have only a limited bearing on forecasts of the distant future.

As part of the argument, I will present some findings from BIS research on the European government bond market which suggests that the very low long-dated yields in the middle of last year may have had as much to do with yield-chasing behaviour arising from short-term risk management practices of long-term investors than any far-sighted portfolio choices based on predictions about the distant future.

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[1] I am grateful to Fernando Avalos, Claudio Borio, Dietrich Domanski, Andrew Filardo, Peter Hördahl, Krista Hughes, Robert McCauley, Elmar Mertens, Frank Packer, Eli Remolona, Vladyslav Sushko, Kostas Tsatsaronis, Goetz von Peter and Dora Xia for comments on earlier versions, and to José Maria Vidal Pastor for excellent research assistance. I thank the Deutsche Bundesbank for making available the data used in the studies reported here. The views expressed here are my own, and do not necessarily reflect those of the BIS.

[2] See Shiller (2017).

## The "market" is not a person

I mentioned that storytelling is a powerful device in economics. Let me start by telling you a story myself. My story is about a bell. It's not the famous bell at the New York Stock Exchange down the road from here, but a bell in the cathedral in Mexico City.

In 1947, a novice bell ringer died in an accident when he tried to move one of the cathedral's bells while standing underneath it. The bell was then "punished": its clapper was removed and the bell was sentenced to be tied down. It was renamed La Castigada (the "punished one"). The sentence was commuted in the Catholic Church's Jubilee of 2000, and the bell is now allowed to ring again, but it is still known as La Castigada. There is a YouTube video of the story.[3]

The idea of "punishing" a bell runs counter to modern sensibilities, but before we get too smug about it, we should ask ourselves whether we are committing a similar mistake. If you have ever caught yourself saying that *the market expects* this or that, you have committed the same mistake. This is an example of what philosophers call a "category mistake". Wikipedia defines a category mistake as "a semantic or ontological error by which a property is ascribed to a thing that could not possibly have that property".[4]

Of course, speaking of the "market's expectation" is fine as a shorthand for market prices. The difficulties arise when we take the shorthand literally. The temptation is to anthropomorphise the market, and endow it with foresight that is misplaced. The market is not a person. Market prices are outcomes of the interaction of many actors, and not the beliefs of any one actor. So it is a mistake to project consistency and foresight onto a place where it does not belong.

In spite of this, most discussions of central bank forward guidance treat the market as if it were an individual that you can sit down and reason with. Transparency over the path of future policy rates is seen as a device to manipulate long rates. And crucially, such manipulation is seen as something amenable to fine-tuning. But by thinking of things in this way, I believe we are in danger of committing a category mistake, just like those who punished the bell, where we anthropomorphise the market as an individual with beliefs.

Let me reinforce this point by offering a straw man, the expectations theory of the yield curve, which holds that long-dated yields are pinned down by the expected future path of short-term rates. The empirical validity of the expectations theory is questionable, to say the least, but it has exercised a powerful hold over economic commentary, especially among central bankers. Let me read you a passage from a *Brookings Papers* piece from 1983 by Bob Shiller, John Campbell and Kim Schoenholtz about the hold that the expectations theory of the yield curve has over central bankers:[5]

> The simple expectations theory, in combination with the hypothesis of rational expectations, has been rejected many times in careful econometric studies. But the theory seems to reappear perennially in policy discussions as if nothing had happened to it ...
>
> We are reminded of Tom and Jerry cartoons that precede feature films at movie theatres. The villain, Tom the cat, may be buried under a ton of boulders, blasted through a brick wall (leaving a cat-shaped hole), or flattened by a steamroller. Yet seconds later he is up again plotting his evil deeds.

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[3] www.youtube.com/watch?v=0A32Yt4vFOA (in Spanish).

[4] en.wikipedia.org/wiki/Category_mistake.

[5] Shiller et al (1983).

This is a sentiment that some of you may share even today. Certainly, the continued resilience of the expectations theory in everyday economic commentary is familiar to us today as it was to Shiller and his co-authors in the early 1980s.

Even if prices are the *average* of individual expectations, average expectations fail even the basic property of the law of iterated expectations. That is to say, the average expectation today of the average expectation tomorrow of some variable is not necessarily the average expectation today of that variable.[6] The normal rules for intertemporal consistency do not apply to average expectations as they do to an individual's expectations. This is why Keynes's beauty contest example – about how the savvy trader is able to go beyond the "average opinion of the average opinion" – is so potent.

Of course, it is not true that anything goes. The discipline set by consistency at a moment in time (no arbitrage) means that prices are consistent at a moment in time. But when things flip, everything flips completely consistently. This is another instance of the general maxim that the intertemporal dimension is inherently more difficult to pin down than the cross-section dimension.

Models of the term structure of interest rates address departures from the expectations theory of the yield curve by harnessing the discipline provided by representative individual asset pricing relationships.[7] Term structure models offer a decomposition of long-dated yields into that part attributable to the expected path of short-term rates and the rest as the term premium that arises, for instance, from future reinvestment risks. In this way, deviations from the expectations theory of the yield curve can be tracked over time.

Nonetheless, such decomposition of the long-dated yield is only the beginning, not the end, since the decomposition only postpones the important questions one stage further back. Saying that the term premium has changed is just another way of saying that the market has overreacted relative to the expectations theory of the yield curve. It still begs the question of why.

Over tranquil periods when long-dated yields do not change much, the questions are not so pressing, but turning points in the interest rate cycle pose more pointed questions for policymakers. For instance, when break-even inflation rates fall due to a decline in long-dated nominal yields, how should central banks respond? If the decline in break-even rates is met by more aggressive monetary easing that pushes nominal yields further down, could the break-even rate itself be a distorted signal? Worse, could there be a feedback loop between low yields and monetary policy responses? I will return to this question at the end.

In the bond market, the "overreaction" of long-dated yields relative to the expectations theory of the yield curve is the norm rather than the exception. However, the "overreaction" may be best seen as just the normal workings of the market when everyday risk-taking creates the circumstances wherein the accumulation of vulnerabilities eventually leads to reversals of risk-taking.

Identifying the exact mechanisms behind the "overreaction" will be challenging, but we can sometimes shed light on what is going on, without being able to predict when the break happens. The 1994 bond market crash involved the unwinding of hedging positions associated with holdings of mortgage-backed securities (MBS), which tended to amplify the sell-off in treasuries. This mechanism is probably less important now given market developments since, but new amplification mechanisms spring up to take the place of the old ones. A widely discussed amplification mechanism during the 2013 taper tantrum was the activity of risk parity funds that held leveraged positions in treasuries and which became forced sellers when volatility picked up.[8] Today, I would like to focus on yet another possible mechanism

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6 See Morris and Shin (2002).

7 See, for instance, Dai and Singleton (2002), Duffee (2002) and Cochrane and Piazzesi (2005). Cutting-edge term structure models used at central banks include Kim and Wright (2005), Adrian et al (2013), Hördahl et al (2015) and Hördahl et al (2006).

8 See *Wall Street Journal* (2013).

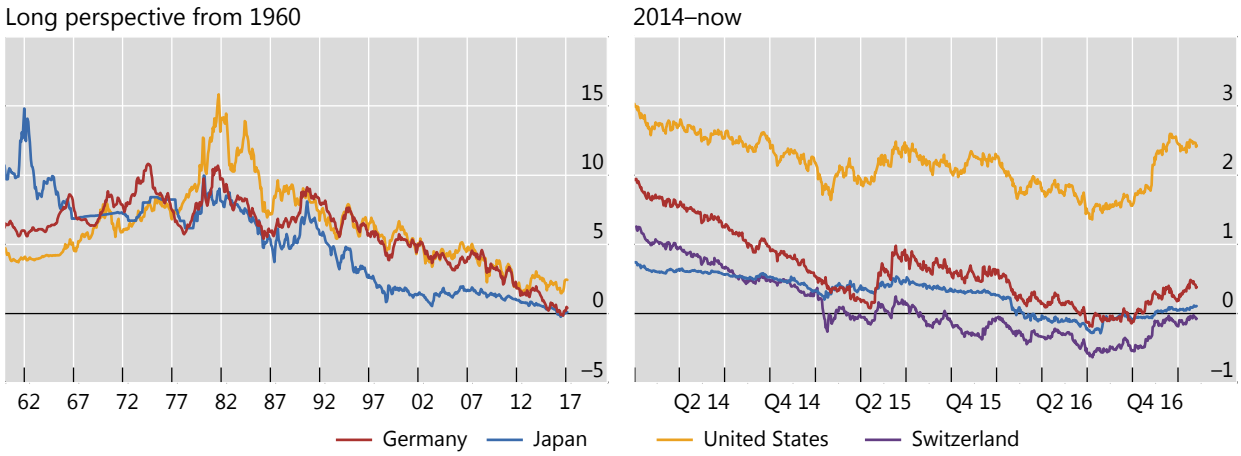
that may amplify the movement in long-dated yields, this time involving long-term investors such as pension funds and life insurance companies.

## Evidence from the German insurance sector

Long-term interest rates in Europe fell sharply in 2014 to historically low levels. Market commentary at the time gave prominence to yield-chasing in anticipation of the ECB's asset purchase programme. The 10-year nominal yields of German, Swiss and Japanese government bonds dipped into negative territory at different stages (Graph 1). The long sweep of the time series shows declining nominal 10-year yields, suggesting longer-term economic fundamentals are at play (Graph 1, left-hand panel). However, over shorter horizons relevant for monetary policy, internally generated market dynamics may be an important additional element in the determination of long-dated yields.

Ten-year government bond yields

In per cent — Graph 1




Sources: Bloomberg; Global Financial Database.

Let me take the opportunity today to introduce you to some recent work at the BIS which sheds light on how portfolio adjustments by long-term investors aimed at containing duration mismatches may have acted as an amplification mechanism in the fall in long-dated yields. I will draw on the paper "The hunt for duration: not waving but drowning?" that I co-authored with my BIS colleagues Dietrich Domanski and Vlad Sushko; the final version of the paper has been released on our website to coincide with my speech today.[9] I will also draw on some ongoing follow-up work using portfolio holding data on the German insurance sector provided by the Deutsche Bundesbank. The data encompass both market values and nominal values of bond holdings. Nominal values allow us to track shifts in portfolio holdings, not just marked to market changes.

The starting point is that life insurers and pension funds have bond-like liabilities associated with their long-term obligations to policyholders and beneficiaries. These obligations typically have a longer maturity profile than that of the fixed income assets held to meet those obligations.

[9] See Domanski, Shin and Sushko (2017).

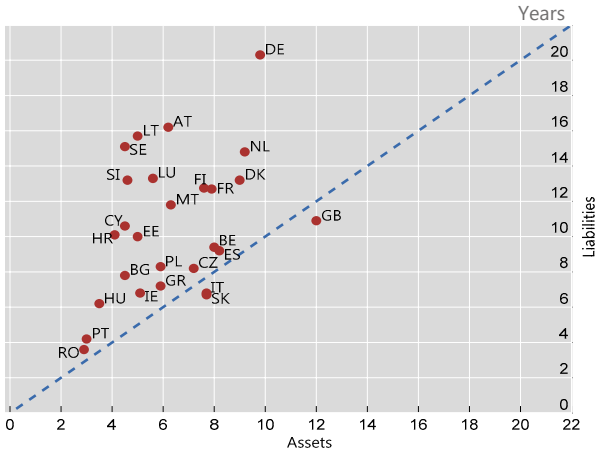
A key concept is *duration*, which is a measure of how front-loaded (or back-loaded) the cash flows are. If the cash flows are in the distant future, duration is high. If they are imminent, duration is low. Duration is closely related to maturity, but is itself a price, as it depends on interest rates. Duration also measures how sensitive the market values of assets and liabilities are to changes in discount rates.[10]

The left-hand panel of Graph 2 is a snapshot of the duration mismatch of European insurance companies, taken from the 2013 stress test conducted by the European Insurance and Occupational Pension Authority (EIOPA).[11] We see from this panel how insurance liabilities tend to have longer duration than their assets.

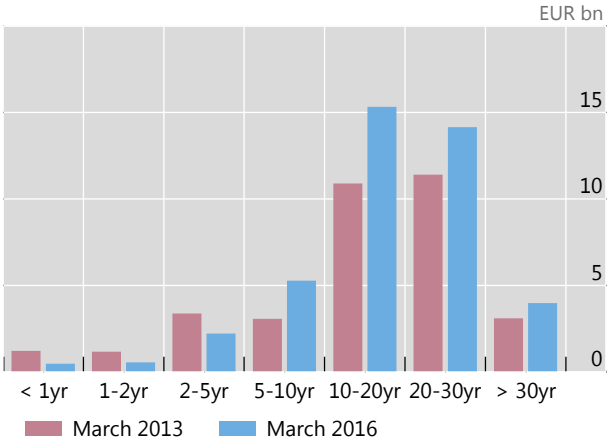
## Insurance firms' sovereign bond investments and balance sheet duration gap

Graph 2

Duration of assets and liabilities of European insurance companies




Nominal value of German insurance firms selected euro area government bond holdings[1]




[1] Book value of holdings of sovereign bonds of Austria, Belgium, Finland, France, Germany, Netherlands and Luxemburg by German insurance companies, by maturity bucket.

Sources: European Insurance and Occupational Pensions Authority (EIOPA); Research Data and Service Center of the Deutsche Bundesbank, Microdatabase Securities Holdings Statistics, December 2005 – March 2016; authors' calculations.

In the face of fluctuating value of liabilities, prudent management of interest rate risk influences the choice of asset portfolio towards one that matches the sensitivity of the assets and liabilities to further changes in long-term rates. Accounting rules and solvency regulation may reinforce the imperative to match duration, although the risk management imperative would be enough by itself to drive portfolio adjustments in this direction.

There is an additional element that is relevant for the dynamics of long-dated yields. Not only are the liabilities of pension funds and insurance companies of higher duration than their assets, there is, in the jargon, *negative convexity*. As long-term yields fall, the duration gap becomes larger. The duration of liabilities increases faster than that of the assets. If we imagine a pair of scales, the liabilities side of the scales becomes heavier and tips downwards. Closing the duration gap entails adding more longer-dated bonds to the asset side of the scales so that the asset duration catches up with the higher duration of liabilities. As rates fall, the demand for long-dated bonds increases.

[10] Formally, the duration is the weighted average of dates of cash flows where the weight is the proportion of the cash flows that are attributable to the payments at that date. See Shin (2010) for a discussion of general equilibrium effects of duration matching.

[11] See EIOPA (2014). The Bundesbank has also published an alternative estimate of the mean duration gap, taking smaller insurers into account and using a different methodology; see Deutsche Bundesbank (2016).

In their attempt to close the duration gap, the demand response of the long-term investor could become perverse. The demand response becomes *upward-sloping* in the price so that a higher price (lower yields) elicits further purchases. If a sufficiently large segment of the market is engaged in such portfolio rebalancing, the price mechanism may become distorted and generate a feedback loop whereby prices of longer-dated bonds are driven higher, serving to lower long-term interest rates further still and eliciting further purchases.

Domanski et al (2017) explore the extent to which the amplification mechanism sketched above was at play in the rapid decline in long-term rates in 2014 and early 2015. The starting point is observed portfolio adjustments. The right-hand panel of Graph 2 shows the maturity profile of the German insurance sector holdings of core euro area government bonds at two dates: end-March 2013 and end-March 2016. The holdings are the notional amounts, not the market values, so that the bars in the chart can be interpreted as shifts in holdings, not simply the marked to market changes. We see the substantial increase in longer-maturity government bonds, even as the holdings of shorter-maturity bonds decline in absolute terms. Indeed, Domanski et al (2017) find that the demand response of German insurers became upward-sloping for long maturities. Our ongoing analysis using micro data further suggests that German insurers seek higher duration primarily around auctions, buying up long-term government bonds in the same periods as when they are issued.

The key issue for market dynamics is whether the perverse demand response is strong enough to set off a feedback loop between bond holdings and yields. If a sufficiently large segment of the market has such upward-sloping demands in price (downward-sloping in yields) for long-dated bonds, the market price itself may be affected by the upward shift in the demand for long-dated bonds. The scenario would be circular. An initial shock results in declining long-term rates, and the fall in long-term rates induces even greater demand for long-dated bonds. Using security-level data, we find evidence that insurance sector demand is a significant factor in driving bond yields lower and bond excess returns higher.[12]

Life insurance firms are the main providers of long-term saving contracts for retirement to private households in the euro area. Euro area insurance companies held €7.3 trillion in assets in June 2016, while pension funds held about €2.4 trillion in assets. Interestingly, while insurance companies accounted for around 12% of the total holdings of government bonds at the beginning of 2014, they accounted for 40% of the net purchases of bonds in 2014 (Domanski et al (2017)).

The amplification effect of the dynamic hedging of duration mismatches is closely related to amplification channels in other contexts. A well known example mentioned earlier is the convexity risk due to the prepayment option in US mortgage contracts. Borrowers have a prepayment option, and these options are exercised when interest rates fall and borrowers refinance their mortgages. Investors in US mortgage-backed securities (MBS) who attempt to hedge the resulting changes in duration gaps may end up amplifying movements in long-term rates by buying long-dated treasuries when yields are falling (see Borio and McCauley (1995, 1996), Fernald et al (1994), Hanson (2014) and Malkhozov et al (2016)).

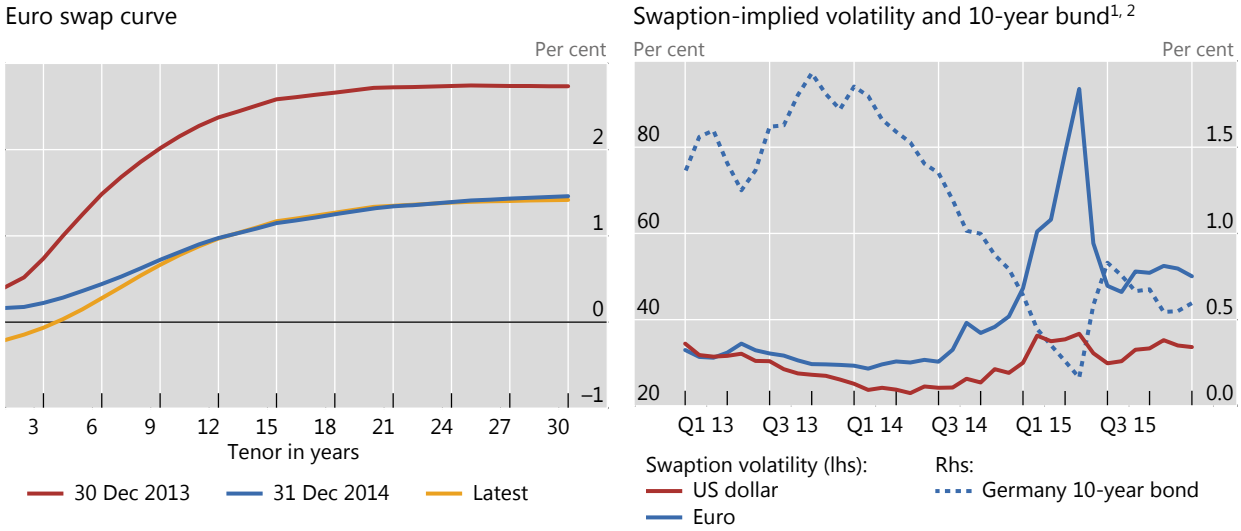
## Evidence from interest rate swaps

In addition to cash instruments, derivatives can also be used for duration matching. Entering an interest rate swap as the receiver of fixed rate payments allows investors to increase duration with no, or limited, upfront payment. In addition to entering a swap right away, investors can use options to enter an interest rate swap at a future date. These are options on swaps, and so are called "swaptions" for short.

[12] The results are strongest for German government bonds, but also extend to core euro area government bonds. The results are borne out in panel Granger causality tests; in regressions of bond excess returns controlling for macroeconomic drivers as well as Cochrane and Piazzesi (2005) term structure factors, controlling for demand from other major investor sectors which include banks, investment funds and households; and in panel vector autoregressions.

The data on the use of derivatives by insurance companies is incomplete at best, but we estimate that derivatives exposures account for between 2 and 4% of the total assets of large euro area insurance firms. Such derivatives include not only interest rate contracts but also credit default swaps (CDS). Nonetheless, insurance firms have told us that derivatives, such as interest rate swaps, have been useful as a way to take positions in the short run, and also that they convert those off-balance sheet positions into on-balance sheet exposures in the underlying cash assets gradually over time.

Euro swap curve and interest rate hedging costs — Graph 3




[1] Monthly average of daily observations. [2] US dollar and euro two-year into 10-year European swaption-implied Black Vol ATM.

Sources: Bloomberg; Domanski et al (2017).

Sundaresan and Sushko (2015) have examined the euro swaption market during 2014–15, and Graph 3 illustrates the key period. Over the course of 2014, the long end of the euro swap curve declined by over 150 basis points. The right-hand panel shows that while swap rates fell, the implied volatility on swaptions rose steeply. One plausible explanation is that insurers and pension funds, under pressure to extend their asset portfolio duration, were putting upward pressure on swaption prices. As 10-year swap rates compressed in early 2015, the relative cost of such options written on euro swap rates rose by a factor of three by 20 April 2015. Steeply rising euro rate hedging costs preceded the correction in yields, which started rebounding around the weekend of 18 April 2015, culminating in the so-called "bund tantrum".

These findings echo evidence from the MBS market in the United States from Perli and Sack (2003), who find that an increase in MBS prepayment risk, which would make convexity more negative or reduce duration, is associated with a rise in the swaption-implied volatility of long-term US dollar swap rates. They also show that the associated hedging activity tends to amplify movements in the 10-year swap rate. More recently, Klingler and Sundaresan (2016) find that duration hedging by defined benefit pension funds in the US has served to drive 30-year swap rates lower.

## Not waving but drowning

Our findings put the fall in the term premium in late 2014 and early 2015 in a different light from the usual interpretation that it was a sign of investor risk-seeking, and from forecasts of the distant future. Rather than exuberance on the part of investors who are happy to take on more risk, it may be better seen as an attempt to contain financial risks.

The expression "not waving but drowning" in the title of Domanski et al (2017) makes reference to the poem of the same title by the British poet Stevie Smith.[13] Her poem describes the flailing by a drowning man being mistaken by onlookers as waving. In the same vein, the deeply negative term premium may be better seen as the consequence of attempts to keep risks in check, not of exuberance that seeks greater risk. Ironically, such prudent risk management at the firm level may have had an aggregate effect of contributing to an undershooting of long-dated yields.

Negative long-dated yields present sharper conceptual challenges than simply low but positive long-dated yields. Negative yields make nominal losses certain, in the sense that the sum of coupon payments and final principal payment add up to a number which is smaller than the current price. Holding cash would be better, if higher returns are better than lower returns, providing of course that holding cash is costless. One possible explanation for negative yields is that investors are buying into a speculative bubble. The idea is that bond yields may fall even further, so that short-term speculative gain would outweigh the risk of an eventual loss at maturity. It is the "greater fool" theory of investing, where one buys the bond in the expectation of offloading it to a greater fool down the chain. We cannot rule out such an explanation, but it begs many questions about market dynamics.

A better explanation is suggested by our analysis. Long-dated bonds not only bring cash flows, but also offer duration. For an insurance company seeking to hedge duration risk, such a feature provides a useful means to hedge pricing risk. A risky bond is better than holding cash, as the price moves in exactly the right way as a hedge. The analogy would be with "negative beta" assets in the capital asset pricing model (CAPM). Risky assets that have returns negatively correlated with the market portfolio have lower expected returns than safe assets.

## Concluding remarks

Long-dated yields may be overrated as signals of what will happen in the distant future, especially during turning points in the rates cycle, when such guidance would be most valuable.

Does it matter? It matters if decisions depend on prices. One issue is calculations of fiscal sustainability. If government borrowing is indeed "free" as implied by zero rates, fiscal sustainability appears less challenging. However, the "snapback" of sharply rising long-dated yields would tilt the argument the other way.

The most important lessons are those for monetary policy. Market-implied inflation expectations, such as the break-even inflation rate or the forward inflation swap rate, tend to rise and fall with nominal yields. If monetary policy responds to lower market-implied inflation rates with further easing it could add to the feedback loop created by long-term investors chasing yield.

The interplay between market-implied inflation rates, monetary policy and amplification mechanisms in the fixed income market is a subject that merits further attention from economists. We may gain further clues about the underlying drivers of long-dated yields from what happens when long yields start rising again, as the amplification mechanism that pushed yields lower could equally work in reverse.

[13] S Smith, "Not waving but drowning", (1972), www.poetryfoundation.org/learning/poem/175778.

## References


Adrian, T, R Crump and E Moench (2013): "Pricing the term structure with linear regressions", *Journal of Financial Economics*, vol 110, pp 110–38.

Borio, C and R McCauley (1996): "The economics of recent bond yield volatility", *BIS Economic Papers*, no 45, www.bis.org/publ/econ45.htm.

——— (1995): "The anatomy of the bond market turbulence of 1994", *BIS Working Papers*, no 32, www.bis.org/publ/work32.htm.

Cochrane, J and M Piazzesi (2005): "Bond risk premia", *American Economic Review*, vol 95, pp 138–60.

Dai, Q and K Singleton (2002): "Expectations puzzles, time-varying risk premia, and affine models of the term structure", *Journal of Financial Economics*, vol 63, pp 415–41.

Deutsche Bundesbank (2016): "Funded pension providers continue to face challenges", *Deutsche Bundesbank Financial Stability Review*, 11 November.

Domanski, D, H S Shin and V Sushko (2017): "The hunt for duration: not waving but drowning?", forthcoming in *IMF Economic Review*, www.bis.org/publ/work519.htm.

Duffee, G (2002): "Term premia and interest rate forecasts in affine models", *Journal of Finance*, vol 57, pp 405–43.

European Insurance and Occupational Pensions Authority (2014): *EIOPA Insurance stress test 2014*, EIOPA-BOS-14/203, 28 November.

Fernald, J, F Keane and P Mosser (1994): "Mortgage security hedging and the yield curve", *Federal Reserve Bank of New York Quarterly Review*, summer–fall.

Hanson, S (2014): "Mortgage convexity", *Journal of Financial Economics*, vol 113, no 2, pp 270–99.

Hördahl, P, E Remolona and G Valente (2015): "Expectations and risk premia at 8:30AM: macroeconomic announcements and the yield curve", *BIS Working Papers*, no 527, www.bis.org/publ/work527.htm.

Hördahl, P, O Tristani and D Vestin (2006): "A joint econometric model of macroeconomic and term structure dynamics", *Journal of Econometrics*, vol 131, pp 405–44.

Kim, D H and J Wright (2005): "An arbitrage-free three-factor term structure model and the recent behavior of long-term yields and distant-horizon forward rates", Board of Governors of the Federal Reserve System *Finance and Economics Discussion Series*, no 2005-33.

Klingler, S and S Sundaresan (2016): "An explanation of negative swap spreads: Demand for duration from underfunded pension plans", mimeo.

Malkhozov, A, P Mueller, A Vedolin and G Venter (2016): "Mortgage risk and the yield curve", *Review of Financial Studies*, vol 29, no 5, pp 1220–53.

Morris, S and H S Shin (2002): "Social value of public information", *American Economic Review*, vol 92, no 5, pp 1521–34.

Perli, R and B Sack (2003): "Does mortgage hedging amplify movements in long-term interest rates?", *Journal of Fixed Income*, vol 13, no 3, pp 7–17.

Shiller, R (2017): "Narrative economics", *Cowles Foundation Discussion Paper,* no 2069, Yale University, presidential address delivered at the 129th annual meeting of the American Economic Association, 7 January, Chicago, cowles.yale.edu/sites/default/files/files/pub/d20/d2069.pdf.

Shiller, R, J Campbell and K Schoenholtz (1983): "Forward rates and future policy: interpreting the term structure of interest rates", *Brookings Papers on Economic Activity*, no 1, pp 174–5.

Shin, H S (2010): "Risk and liquidity", *Clarendon Lectures in Finance*, Oxford University Press.

Sundaresan, S and V Sushko (2015): "Recent dislocations in fixed income derivatives markets", *BIS Quarterly Review*, December, pp 8–9, www.bis.org/publ/qtrpdf/r_qt1512u.htm.

*Wall Street Journal* (2013):"Fashionable 'risk-parity' funds hit hard", 27 June.