JOIM
www.joim.com

Journal Of Investment Management, Vol. 19, No. 1, (2021), pp. 62–75

LENDING TO LOSE: WHO BUYS NEGATIVELY YIELDING BONDS AND WHAT IT MEANS FOR INVESTORS

Vineer Bhansali[a]

I discuss the demand and supply of negatively yielding bonds, which is a recent and relatively unprecedented phenomenon in financial markets. To understand why one would lend to lose, I classify buyers into three categories, i.e. "forced buyers", "speculators" and "non-financial government entities". I conclude that the demand for bonds that are guaranteed to lose money can locally be justified by a variety of rational reasons. However, while locally rational, this conclusion raises important questions about global financial stability. Do negative yields mean that the bond market is distorted due to demand and supply mismatch, and if so what are the consequences if there are unforeseen macroeconomic shocks?

One of the most interesting phenomena in finance is the apparent willingness of investors to part with something in exchange for nothing, or even for something whose expected value is worth less than what they are willing to pay for it. We know that financial insurance, e.g. the purchase of put options, is one example where investors are willing to pay a premium, which they typically expect to lose, in order to purchase safety or to transfer risk. In isolation, such a buy-and-hold long option strategy is a negative expected return investment. However, as is well documented in the literature, this assertion is only true when we look at the put option in isolation. When we combine the value of a put option with other parts of a risky portfolio, owning put options can be justified due to the ability of the put option to truncate the "left-tail", and add skew to the portfolio, i.e. it potentially provides the opportunity to tilt the distribution to one with more positive skew, less kurtosis and less risk of permanent loss of capital. Even without reference to the underlying portfolio, investors might prefer skewness due to behavioral reasons. For instance, the demand for "lotteries" and the demand for call options have been well documented in the literature (Barberis, 2005, 2012).

[a]Chief Investment Officer, LongTail Alpha, LLC, 500 Newport Center Drive, Suite 820, Newport Beach, CA 92660. Phone: (949)-706-7777. E-mail: vb@longtailalpha.com.

In recent years, another, more vanilla version of assets with guaranteed loss of value has emerged in the markets in the form of negatively yielding bonds. When held to maturity, these bonds are guaranteed to be worth less than the value paid today. In other words, these bonds, which now comprise almost 25% of the fixed income markets, violate the centuries of the financial edict that a unit of currency should be worth more in the future than it is today. The purpose of the present paper is to systematically evaluate the locally rational reasons for a broad category of investors who purchase negatively yielding bonds, and to finally provide a bird's-eye view of the inter-relationships between their actions and potential for global instability if the collective mind-set towards the level of yields changes. This helps shed light into why some market participants might be willing to lend to lose. While in hindsight many of the observations in this paper might seem all too obvious and perhaps even tautological, it seems apparent to me that investors do not have a clear idea of the magnitude or the composition of the participants in the market for negatively yielding bonds.

Even more importantly, the negative yielding bond market is a unique laboratory where the consequences of unprecedented monetary policy are being felt in real time, and where the participants' actions, while locally rational, are linked by common risk factors that have the potential of being consequential for market risk management. Analytically, one could argue, as stated recently by Alan Greenspan that "zero has no meaning, besides being a certain level" (Greenspan, 2019). However, there could be a difference between negative and positive when subjected to the perception of market participants, since below zero, a lender of money has to pay to lend. Or stated in terms of prices, *buying a bond at negative yields and holding it to maturity means a guaranteed loss of part of the money invested*. If we believe that people invest money to achieve a positive rate of return, then as discussed below, other factors necessarily have to account for why yields can persist to be negative for extended periods.

This paper is organized as follows: in Section 1 I provide an overview of the "what" and "why", i.e. the current state of the global bond markets, with special emphasis on long-term negative yielding bonds, and the possible reasons for this situation; in Section 2, I explore the "who" or the participants in the bond markets who are collectively helping clear this negative yield bond market; in Section 3, I discuss the consequences, or the "so what", and offer some conclusions for investors.

In writing this paper my focus has been on the investors who are "investing" in these bond markets. Thus most of the information and references are from recent news articles published in reputed newspapers. There is a small but growing literature on the academic perspective that justifies aggressive economic policy that is not covered or referenced in this paper. The reason is simply that the academic debate has so far been inconclusive, and there simply is not enough long-term historical data to justify one or the other viewpoint rigorously. But the impact on markets has been significant and could prove to be consequential for both future market and economic outcomes. So my task here is an easier yet important one—to explain the motivations of the participants in the bond markets, and what that motivation practically means for financial market participants and risk managers more broadly.

1 What's going on in the bond markets and why it is interesting

In recent years, the percentage of negatively yielding bonds has increased to approximately five trillion in dollar equivalent. This is a little over 25% of the total outstanding debt in the Barclays Global Aggregate Bond Index. Exhibit 1

Exhibit 1. Over 25% of the total global bond market is currently trading at negative nominal yields.

Source: Bloomberg, LongTail Alpha.

shows the growth in this ratio. As is apparent, the period beginning late 2018 saw a sharp rise in negative yielding bonds, as the whole yield curve out to 50 years in Germany recently went below zero, though more recently some of the longer maturity yields temporally turned positive.

The reason this state of affairs is amazing from a theoretical finance perspective is best explained with an example. In mid-September 2019 the German Government issued a 31-year maturity zero-coupon bond at a yield of −0.12%, or a price of Euro 103.61. Note that since this is a zero coupon bond, the maximum a buy-and-hold investor can receive is the par redemption in 2050. However, this investor is willing to pay 3.61% above the par value to receive par. In other words, the investor is paying a "premium" of 3.61% for a guaranteed return of principal. Assuming that the duration of the bond is roughly 31 years, this tells us that for each year of maturity, the investor on average is willing to part with approximately 12 basis points of premium.[1] Why an investor might be willing to do this will be discussed at length in the next section.

To explain why the bond markets are in this state of affair, I propose two main alternative hypotheses (there are a few other minor hypotheses related to these that are discussed below as well). The first hypothesis is that the reason the bond market is trading at such negative yields is due to the aggressive action of central banks, both in terms of reducing deposit rates significantly below zero, and also explicit purchase of long-term bonds ("quantitative easing"), and expectations management ("forward guidance") that rates are likely to stay low for a very long time. The deposit rate set by the ECB has been progressively taken down below zero, and as of September 2019 stands at −0.50%. In Exhibit 2, I show the recent history of the deposit rate and the yield on the 30-year German Bund. Note also that the ECB has been buying and holding close

Exhibit 2. ECB deposit rates and long-term German bund yields.

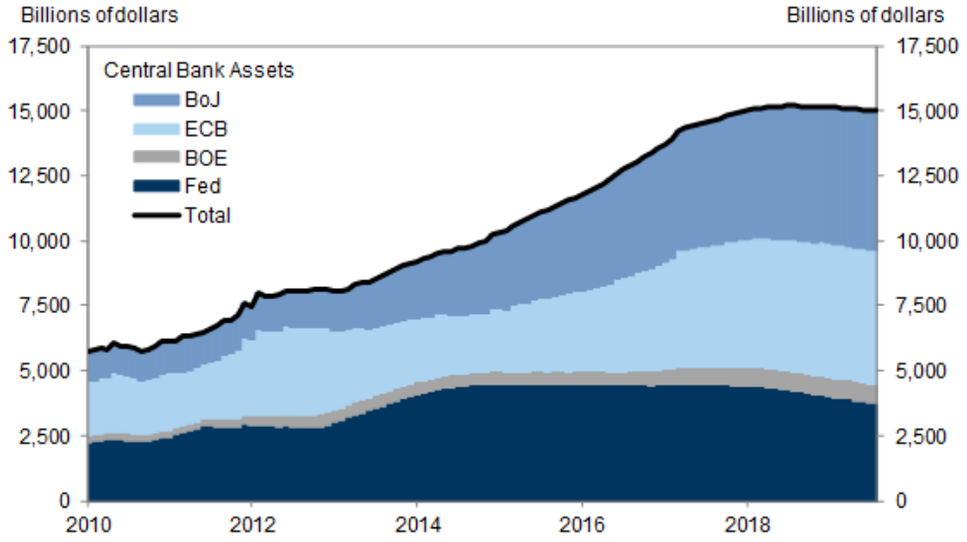
Source: Bloomberg, LongTail Alpha.

to 30% of the outstanding debt in Europe, and the scarcity of outstanding debt could be a proximate cause for the rapid rise in prices and fall in yields. While there has been talk of issuance by sovereigns like Germany to issue long-term bonds at negative yields, other than the anecdotal and relatively small issuance described in the previous paragraph, this issuance has been very small so far. In short, demand has exceeded supply.

The second, competing hypothesis is that the market in aggregate is perhaps correctly forecasting future economic conditions and thus creating incentives to buy assets that hold their principal value even though there is a high penalty (in terms of negative yields) in order to do so. While it is hard to fathom with any detail what this outcome might look like, the fact that investors are willing to pay to lend suggests that this priced outcome is a catastrophic outcome, i.e. deflation, default, a breakup of the Euro, or outright depression. Related to this hypothesis is the possibility that there has been a significant shift in time preferences, i.e. either due to demographics or due to Ricardian equivalence (i.e. people saving for future tax bills) investors are willing to receive less in the future than they are investing today.

In my view, the second hypothesis, though sound, is somewhat weak in light of the fact that not only sovereign bonds of countries like Germany are trading at negative yields, but also the bonds of peripheral countries such as Italy (below 0 out to five years) and Greece (in the shortest maturity) (Hunter, 2019). Furthermore, even some corporate bonds such as those of Siemens (rated A) were issued and purchased for prices that imply negative yields if held to maturity (Davies, 2019; Richter, 2019). So it is hard to argue that protection of capital for future obligations is the primary driver of negative yields, since corporates with weak credit ratings are not likely to be able to pay principal back in the catastrophic outcomes mentioned above.

Exhibit 3. Central Bank asset growth.



Source: Goldman Sachs, September 2019.

It is also interesting to note the risk–reward trade-off of a 30-year zero coupon bond to put this issue in context. Since the bond's duration is 30 years, it only takes a 1% change in yield for the bond to lose 30% of its value. The sensitivity and perhaps need for the interest rate sensitivity is further illustrated by the demand of what has recently been called the "tulip king" or the "Semper Augustus" of bonds: the almost 100-year maturity Austrian government bond, which very recently traded at a yield below 0.70%.[2] While few investors have had the opportunity to buy this bond, many have heard of it. Since its issuance three years ago, this bond doubled in price, and has a duration of a little over 50 years, which means that for a one basis point move in yields, it loses almost a whole year of yield income. This bond has an enormous amount of positive convexity (not unlike an option), which is desirable from the perspective of an investor who values this convexity. Clearly holding either bond is very risky from the perspective of potential price impact for any meaningful rise in yields. As a point of reference, between the first draft of this paper (in August 2019) and the acceptance of the paper in this journal (December 2019), this Austrian bond's price fell from a peak of 215 to a price of 161, i.e. a 25% fall in price in about five months, as yields rose sharply. This type of risk is more common to speculative investments such as equities and commodities, but rarely to government bond markets. So the natural question of who buys these bonds in the face of significant market risk is the topic addressed in the next section.

2 Who buys negatively yielding bonds

The simple and un-nuanced answer to the question of who buys negatively yielding bonds is: almost everyone! In broad terms, we can classify the buyers of negatively yielding bonds in three categories: (1) "Forced" buyers, who have to either buy due to risk management reasons (e.g. pension liability hedgers, convexity hedgers) or due to their legal agreements (e.g. indexed ETFs); (2) Discretionary buyers/speculators (e.g. currency hedged investors or speculators looking for price appreciation or carry traders); and (3) Non-financially Motivated Buyers, e.g. governments or their agencies (e.g. Central Banks).

2.1 Indexers and passive bond ETFs

Bond fund management has seen two significant developments in the last decade. The first is a move towards standardization of bond indices, and the second is the evolution of passive products such as Bond ETFs. Both these developments have been made possible due to the increase in transparency, reduction in transactions costs, and the increase in the size and quality of bond issuance and the data surrounding it. Due to the fall in yields, passive bond funds that can be acquired at a cheap cost result in more net yield for investors. Since bonds have been well established as diversifiers against equity markets over the history of the last three decades, bond funds have found demand from portfolio managers of multi-asset portfolios. In addition, due to the diversification characteristics of duration as a risk factor, investors have started to get comfortable with using bond derivatives and even leverage, as afforded by interest rate and bond futures contracts and swaps.

A good example of a passive bond ETF is provided by the Vanguard ETF BNDX. As required by law, the ETF publishes all its holdings daily for anyone to see. Digging into the holdings of this ETF, we find it holding many of the negatively yielding bonds globally, and also the Austrian 100-year bond mentioned above. The advertised yield of this ETF was slightly over 1% as of the end of the third quarter of 2019, but a significant portion (almost 50 basis points) of this yield arose from currency hedging (*Source*: Bloomberg, LongTail Alpha).

Indexers and passive bond ETFs are agents of their fund investors. They are required by their prospectus to purchase the bonds, or at least make an effort to replicate the bond holdings in their indices. In the case of the BNDX ETF, the index owns almost 11,000 securities, and to the degree that any new security is included in the index, the ETF will attempt to purchase it. The main risk for an index ETF is tracking error, or inability to replicate the return of the index, not absolute return. With an extremely low fee of only nine basis points a year on this ETF, the agent's objective is to replicate the index, not attempt to add active management value or return by not purchasing negatively yielding assets.

While it might seem obvious to some that the passive bond funds are non-discriminating buyers of bonds of all types, and hence have become the marginal price setters (including for bonds with negative yields), what is not so obvious is the sheer size and growth of these funds. BNDX has grown to be about $25 billion in assets from almost nothing during a decade ago, so even a small allocation to a bond in limited supply can have a substantial impact on price on the way up, and also on the way down, as ETF holders eventually redeem their fund holdings.

3 Pension funds looking to hedge liabilities

The second large category of investors who are buyers of long-term bonds are pension funds and insurance companies. Their need for bonds is both a function of the need to diversify asset (e.g. equity) risk and of the duration of their liabilities.

As interest rates fall, the present value of liabilities increases. To balance the asset–liability mix, these funds are thus required to acquire more duration. Since long-term fixed income securities have a price to yield relationship which exhibits positive convexity, the more the yield drops, the more the need from pensions to hedge the duration of liabilities with larger and larger positions in longer duration fixed income instruments.

On the diversification aspect, assuming that a typical pension has 0.60 equity beta, we can also ask the question of what owning bonds or duration does for their portfolio's overall risk. For a

50% decline in the equity markets (e.g. equal to the losses in equities during the financial crisis), this portfolio would be expected to lose approximately 30%. Assuming a duration of roughly 20 years on the fixed income portfolio, a 200-basis point fall in yields would make back 40% if the portfolio had 100% allocation to long-duration fixed income. While there are levered fixed income overlays in the market for hedging, at a 40% allocation to fixed income, only 16% of the losses would be made up by the bond allocation. But note that a 200-basis point decline in yields would squarely put almost the whole US yield curve as of this writing into negative territory (and European yields would have to fall to deeply negative territory from current negative levels).

One could argue that instead of hedging with a negatively yielding security, an investor could simply store the future obligations in cash (i.e. under the proverbial "mattress"), and pull the cash from under the mattress as needed to pay for the obligations. However, the reality of the matter is that this results in expenditure on large storage vaults for cash (or other proxy assets), risk of theft, and other frictions. Many countries have outlawed large denomination bills to discourage such hoarding of cash. So for all practical matters, investing in the bond markets is the only alternative available for the sheer size of such investments.

4 Systematic traders

Systematic traders such as risk parity strategies, volatility targeting strategies, and even trend followers are large buyers of negatively yielding assets due to the potential of substantial price appreciation of even bonds with negative yields, as long as the price appreciation is rapid enough.

A simple way to understand this is by decomposing the total return of a bond instrument over any finite horizon into the expected return from changes in the shape of the yield curve and from the passage of time. We can think of the yield and roll-down of a bond as the expected return from the passage of time, and we can think of the price appreciation as emanating from the change in yield times the duration. If the total return is the sum of these two components, it is easy to see why a negative yield for a bond, if accompanied by further price appreciation due to a rapid fall in yields, can still have positive expected total return (if held for a period less than the maturity of bond). A good example of this dynamic has recently been observed in the German Bund market. With the deposit rate at -0.50%, and the 10-year Bund yielding -0.70%, buying and holding the Bund to maturity is guaranteed to lose its principal. For any finite holding horizon, the -0.20% of negative carry is also a return detractor. However, from a systematic trader's perspective, the duration of 10 years on the bond means that a 0.20% decline in yields would make up for the negative carry, as long as the price appreciated rapidly. Thus the motivation to purchase these bonds for price appreciation can overwhelm the negative yield. The commonality between the ownership of negatively yielding bonds by systematic traders is that their decisions are based on prices and changes in prices, rather than yields to maturity.

5 Speculators

Speculators who buy negatively yielding bonds are likely betting that the price of the negatively yielding bonds will rise over a short-time horizon, so that they can be sold to another buyer (perhaps a forced buyer or a central bank buyer) who will be willing to buy it at a higher price than the price they have paid for it. Since most speculators do not intend to hold the bond to its maturity, we can think of this activity primarily driven by short-term demand and supply.

This begs the question of whether there is a theoretical limit on how low or negative rates can become, and whether we are indeed close to that limit. Since there is little historical evidence to support any claim on negative yield bounds, we have to speculate that the lower limit for yields is presumably a level at which an investor would simply choose to hold the money in cash (again "under the mattress"). Exhibit 7 shows that at −1% yields an investment would lose almost a quarter of its value if held to a maturity of 30 years. Alan Haghani and White (2019) have recently explored the question of what an investor should be "willing" to pay for an annuity today if yields were to drop and stay at −1% for 1,000 years, and how much would they allocate to such an annuity. Their conclusion is that with a large enough risk-aversion coefficient in the utility function, an investor would be willing to allocate no more than 0.01% of their wealth on such an investment. But even with such a small allocation to negatively yielding bonds, the gigantic size of the global bond market creates enough speculative demand for these bonds to impact prices and yields.

6 Arbitrageurs/carry traders

One extremely interesting participant in the negatively yielding bond markets is the cross-border investor who buys the negatively yielding bond and turns it into a positively yielding bond via a currency hedge. As an example, consider a US investor looking to buy a German 10-year Bund at a native (Euro) yield of −0.50%. As of the end of the third quarter of 2019, the short-term interest rate in the money markets in the US was about 2%, whereas the same in Europe was approximately −0.65%. The short-term interest rate differential was 2.65%. For a US buyer of German Bunds the total "yield" on the currency hedged transaction was thus 2.15%. Of course if we dig deeper we see that this is not yield to maturity, since the forward currency hedges have to be rolled at the current rate spreads for the term of the bond to realize the carry. Whether the carry trader is able to harvest the spread for that length of time or not thus depends critically on the rate differential persisting for the holding horizon of the bond. For further details see Bhansali (2019).

Interestingly, this "arbitrage" has become somewhat institutionalized. In a recent announcement (Appell, 2019), the $1.5 trillion GPIF of Japan announced that it would re-classify currency hedged foreign bonds as domestic Japanese bonds. Due to the very different sovereign credit risk of international bonds compared to Japanese domestic bonds, this classification could be risky if the credit profile of the foreign bonds changes over time.

7 Central banks

In the aftermath of the financial crisis, the balance sheet of the four largest central banks of the world has mushroomed to almost 15 trillion dollars. As part of their debt buybacks, the ECB has been a large buyer of negatively yielding bonds. For instance, the 31-year zero coupon bond issued in September of 2019 was issued in a total size of Euro 3.5 BN, but Euro 1.176 BN was "retained for market intervention". In other words, not only are central banks buying these bonds in the open market, but also they are purchasing them in the primary issuance at negative yields! Since it is hard to ascribe a profit motive to a central bank, I will classify them as non-financial buyers whose purchases are designed to achieve other economic and geopolitical objectives than financial profits. In the case of the ECB, one such objective is to maintain the integrity of the Euro currency and the monetary union of the Eurozone countries that have little if any fiscal integration.

It can again be argued that the action of Central Banks and their impact on bonds is obvious, since

they have made it part of their policy to engineer low rates to stimulate demand and inflation via the traditional channels. However, there is general agreement that quantitative easing, especially in Europe and Japan, has not resulted in the desired economic outcomes or rise in inflation. As recently discussed by a number of ex-central bankers, the next logical step in the experimentation might be "going direct", or what has been called "helicopter money", or transfers directly to the public (Fischer, 2019). If this is the case, then the important question to ask is what happens to the substantial holding of debt on central bank balance sheets.

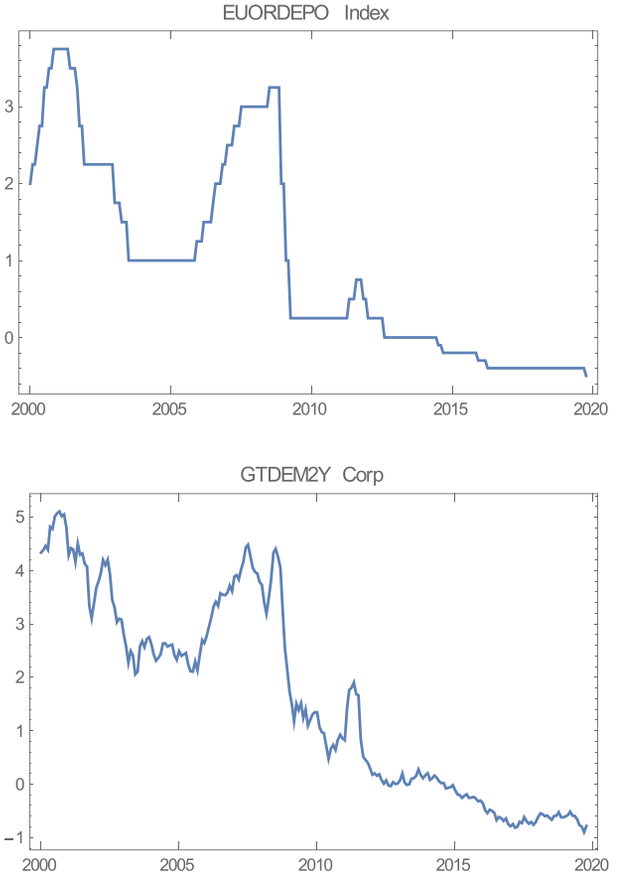
8 Other factors

It is also possible that the current negative yield environment is not just due to the action of the participants mentioned above, but due to other possibilities, such as negative time preference. This hypothesis would argue that investors are more worried about the return of their capital, not the return on their capital, and in order to ensure this outcome, are willing to part with some of their principal. An increasing cohort of retirees looking to save for retirement could result in exactly this type of environment. I find this argument less compelling, due to the existence of short-term negatively yielding corporate bonds, which provide no such protection of capital in the long run. Similar macroeconomic arguments in support of negative yields that have been made in the literature are Ricardian equivalence (i.e. investors are saving today for paying taxes in the future that are all but inevitable), or the possibility of secular stagnation, i.e. the lack of investment opportunities. While many of these arguments are indeed reasonable to explore, it is hard for me, especially in the context of negatively yielding corporate bonds, to see how in aggregate investors could rationally be using the bond markets to insure against these macroeconomic outcomes. Further research is needed to fully explore these possibilities. Another source of demand for negatively yielding German Bunds arises from banks who can use them as collateral for "repo" transactions.

9 The term premium

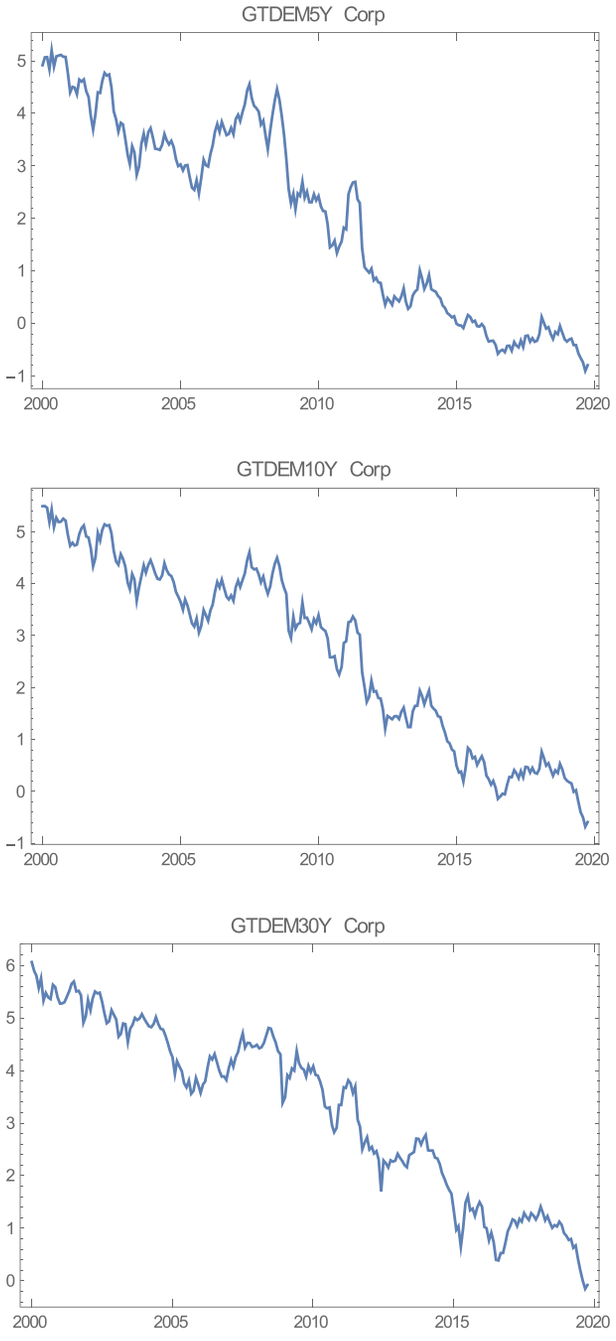
While negative yielding bonds are clearly anomalous from a long-term historical perspective, is this a real problem? The answer depends on what we think the impact of negative yields is on various metrics that markets use to calibrate risk return tradeoffs. We can attempt to answer this question by building a simple term structure model and extract the risk premium embedded in the term structure.

Exhibit 4. German yields from the shortest maturity deposit rate to 30-year yields from 2000 to 2019.



Source: Bloomberg, LongTail Alpha.

Exhibit 4. (*Continued*)



To do so, we use a very simple and elegant two-factor affine model specified by two yield curve factors. This model has a natural mapping to inflation, growth and monetary policy variables, and can be solved in closed form (see Bhansali, 2007).

The model is specified by two latent stochastic factors x and y, and a deterministic factor z. The evolution is specified by the coupled equations:

$$dx = \mu dt + \sigma_x dw_x$$

$$dy = -\alpha y dt + \sigma_y dw_y$$

$$dz = k(x + y - z)dt$$

Intuitively the long-term factor x represents the fundamental structure of the economy, and the spread factor y represents mean-reverting transitory fluctuations that are pulled back towards the long-term mean of y. The central bank, e.g. the ECB in our example, controls the short-term rate z near its equilibrium value of $x + y$, in a locally deterministic manner. Since the processes are normal, negative realizations for both the factors and the short rate are allowed to become negative.

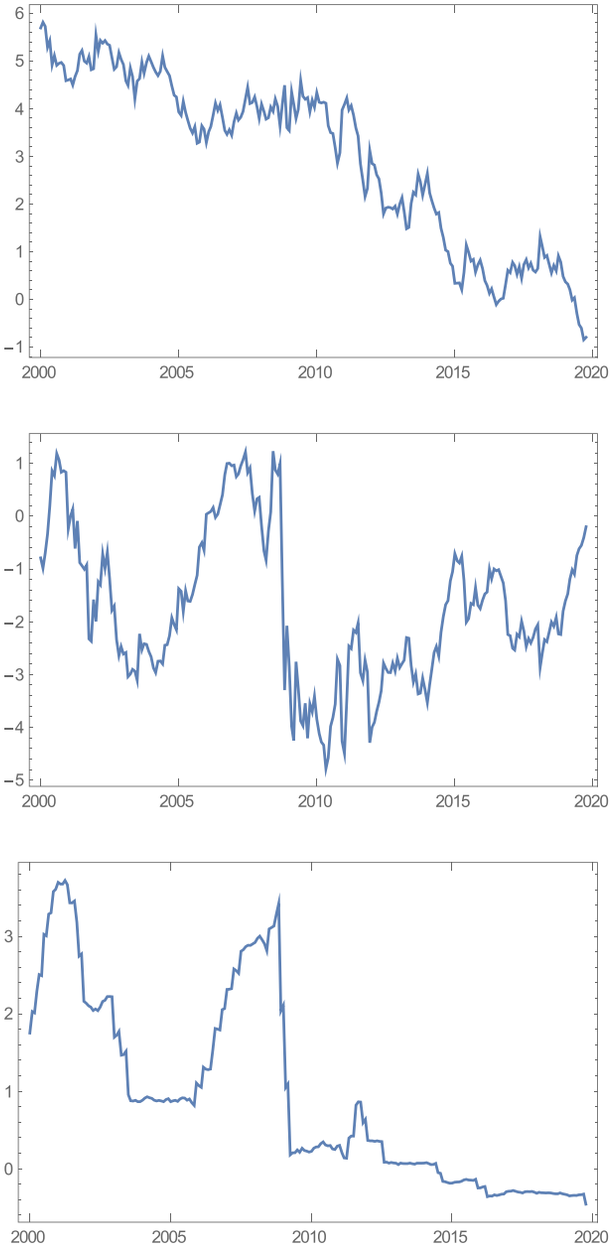
Our interest is in estimating the term premium given by μ as well as the value for the fundamental factors x and y. Furthermore, we would like to extract from the state of the yield curve at any time t the market's best estimate of the level of short rates for any maturity T. This simple model allows to solve for these quantities readily.

To calibrate the model, we fix the parameters $\sigma_x = 0.0091, \alpha = 0.5, \sigma_y = 0.0155, k = 2$ and use the zero-coupon yield levels for the German yield curve going back to the year 2000.[3] The Bloomberg tickers for the yields are as follows: EURDEPO Index for the deposit rate, GTDEM2Y Corp for the 2-year yield, GTDEM5Y Corp for the 5-year yield, GTDEM10Y Corp for the 10-year yield, and GTDEM30Y Corp for the 30-year yield. These time-series are displayed in Exhibit 3.

In Exhibit 5, I display the fits for the four variables obtained by fitting the closed-form solution to the model to the yield data:

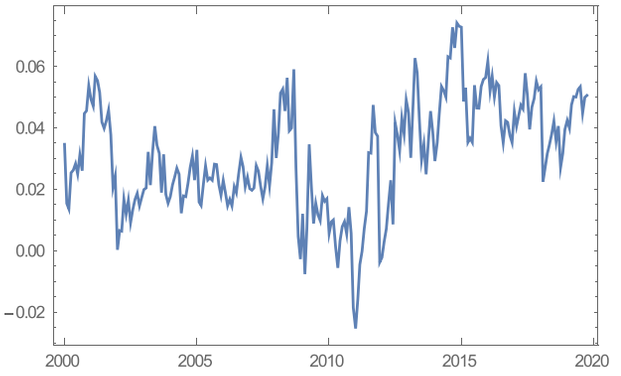
Furthermore, Exhibit 6 illustrates the implication of the model for all instantaneous forward short rates for maturities from 1 year out to 30 years.

Exhibit 5. Fits for x, y, z, μ from 2000 to 2019 for the German sovereign bond market yield curve.



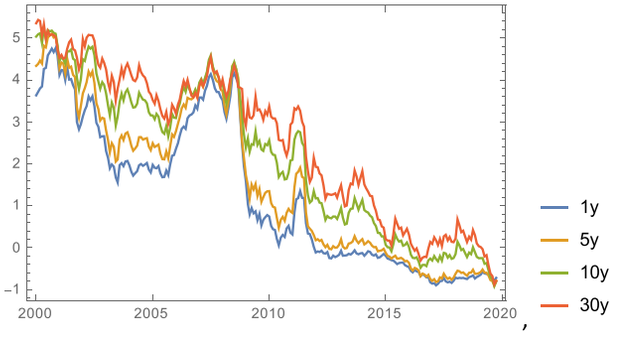
Source: Bloomberg, LongTail Alpha.

Exhibit 5. (*Continued*)



From Exhibits 5 and 6 it seems apparent that the impact of declining level of short rates, "forward guidance" and bond purchases by the ECB has been to drive expectations of forward rates at all maturities below zero. However, the term premium in this admittedly naïve model of the term structure, as illustrated by the last chart in Exhibit 5, has actually increased. In other words, it is possible that even as short rates have been driven below zero, the required compensation for extending duration risk has gone up. This begs a fundamental question for bond investors: when long-term yields are negative, and holding long-term bonds to maturity will result in guaranteed loss of investment, does it even make sense to call the term premium a "risk-premium"?

Exhibit 6. Implied instantaneous forward rates for different maturities from 2000 to 2019 for the German sovereign bond market yield curve.



Source: Bloomberg, LongTail Alpha.

Exhibit 7. Future value of $1 for varying maturity and yield levels.

	Years					
	$1	1	10	30	50	100
	5.00%	$1.05	$1.63	$4.32	$11.47	$131.50
	2.00%	$1.02	$1.22	$1.81	$2.69	$7.24
Yield	0.50%	$1.01	$1.05	$1.16	$1.28	$1.65
	0.00%	$1.00	$1.00	$1.00	$1.00	$1.00
	−0.50%	$1.00	$0.95	$0.86	$0.78	$0.61
	−1.00%	$0.99	$0.90	$0.74	$0.61	$0.37
	−3.00%	$0.97	$0.74	$0.40	$0.22	$0.05

Source: Author.

To understand this further, note that just by applying the simple formula $FV = (1+y)^n PV$ relating future value (FV) to present value (PV), we can deduce that for a negative yield of 1% and inflation of 2%, the real value of one dollar falls to only 40 cents in 30 years, and to five cents in 100 years! In other words, investing at negative yields the investor does not earn any "real" premium, but actually pays for safety of principal (see Exhibit 7).

This is an interesting and consequential conclusion, since the risk-less term structure is the building block for the discount factor for all assets, and as such is likely to impact the pricing of other, long-duration assets such as equities and real-investments.

10 Potential Risks and Consequences

The biggest potential impact of negative forward rates out to very long maturities is that long-term investments become a negative expected return proposition (see Exhibit 7). Since the pricing of every asset depends on discounting at the risk-free rate plus a spread, unless the spread component can be maintained large enough to compensate for the negative expected return, investors would be naturally discouraged from holding these assets. One consequence of low yields has been for investors to search for yield in other asset classes, which has compressed spreads, and thus reduced the prospective expected returns further across all asset classes.

Furthermore, since the discount factor is common to all assets, any upward shock to rates would impact all assets simultaneously. In other words, the natural diversification benefits of having multiple assets in a portfolio can be overwhelmed due to a simultaneous decline in the price of all assets. In particular, it is easy to imagine a world where central bank stimulus results in a rise in inflationary expectations, which in turn results in both stock and bond prices declining simultaneously. Given the already low level of yields, even if bonds were to act as diversifiers, there is simply not enough room for yields to fall (unless they are very negative) to result in meaningful price appreciation to hedge the risky asset portion of the portfolio.

The second consideration emerges from the action of investors searching for yield in a low-yield environment. As discussed in Bhansali and Harris (2018), the need for yield and income generation has resulted in the development of an ecosystem of "short-volatility" strategies than can

be collectively dubbed "shadow insurance" and short-volatility speculation (see Ciolli, 2017). The commonality between these strategies is that they are all contingent on selling volatility via implicit or explicit options, and as exhibited by the sharp unwind of the XIV short-volatility ETN in February 2018, run the risk of overwhelming liquid derivative markets if the delta hedging activity is correlated and simultaneous. A destabilizing shock that results in many participants in the short-volatility ecosystem exiting or attempting to hedge using liquid equity index futures could result in a self-perpetuating cascade of selling not unlike the February 2018 episode that wiped out the value of the XIV inverse volatility ETN or the type of market meltdown observed in March 2020.

Third, negative interest rates in a world where banks cannot pass the losses on their deposits to depositors are detrimental to the balance sheets and profitability of banks. Much has been written on this topic, and I will limit my discussion here to say that until "helicopter money" or "going direct" is exercised as a viable option by policymakers, reducing bank profitability will only create the potential of less risk taking and possible liquidity gaps in the financial system (Fischer *et al*., 2019).

Finally, a very perverse result of negative interest rates in Europe and Japan, when combined with the positive interest rates in the United States is that the short-term interest rate differential turned very wide. This made it attractive for US buyers to prefer even negative yielding bonds in Europe on a currency hedged basis. This cross-border strategy is essentially a yield curve and cross-currency investment in which a negatively yielding bond is held primarily because of the benefit from the currency hedging which has to be rolled on a short-term basis. One consequence of a disorderly unwind of this strategy would be the impact on currency markets or funding markets.

It is no secret that the low level of yields proved to be a boon for corporations looking to buy back their own stock. As of the end of the third quarter of 2019, total buybacks in the S&P500 were running at a record pace, and had surpassed the last high of approximately $700 billion per year posted in 2007, prior to the financial crisis. If the low rate fueled buybacks were to stop suddenly, would enough organic buyers of equities emerge to take up the slack and stabilize the markets?

In addition, some of the negative yield policies are now also facing socio-political pushback. An increasing chorus of participants suggests that low rates have increased inequality via increase in asset prices which are predominantly owned by the wealthier fraction of the population.

11 Conclusions

Only time will tell whether the great economic experiment of this generation, i.e. negative yields in the bond markets, was a success in generating purported economic outcomes. As usual, financial markets are ahead of academia in adjusting to consequences of such unprecedented policy. It is the sheer size of this anomaly that has the potential to create substantial distortions across markets and strategies. A disorderly unwind of many of these policies, whether due to political or market reasons, can be substantial. We indeed do live in "strange times", when if comes to bond markets and this paper has attempted to provide an overview of the causes, participants, rationales and consequences of negative yields in the bond markets. The lesson for market participants is straightforward: those who are looking to global bond markets for long-term positive returns, or even diversification, are likely to be disappointed. Market participants who are looking to the bond

markets for insurance against catastrophic deflation, default or geopolitical troubles are likely to be able to justify owning bonds with negative yields in the short run. Even so, they should really evaluate whether other methods of insuring, including, for instance, simply divesting away from risky assets, or purchasing options, might warrant further consideration. From the perspective of risk premium harvesters, the conclusion is even more straightforward: perhaps for the first time in recent memory a long-term investor earns risk premium not by buying bonds, but by doing its exact opposite.

Notes

[1] Source for all data in this paper unless otherwise specified is from Bloomberg.

[2] "Few people ever actually saw a Semper Augustus flower. The man who held a near monopoly on the small supply-refused to sell his bulbs, which drove up the price. In 1638, one was advertised for 13,000 florins, the price of a nice house. That was the year the market for tulips in the Netherlands crashed." Source: *https://www.atlasobscura.com/articles/the-most-beautiful-tulip-in-history-cost-as-much-as-a-house*

[3] The estimates for the volatility parameters represent long-term estimates of factor volatilities. The mean reversion parameter of $\alpha = 0.5, k = 2$, correspond to a half-life of roughly a year and a half for the factor y and roughly three months for the central bank's policy actions. The motivation is less to estimate these parameters accurately, and more to show the implications of such a macro equilibrium model for premia.

References

Appell, D. (2019). "Classification Change by Japan's GPIF Paves the Way for Further Boost in Foreign Bond Allocations," *Pensions & Investments*, https://www.pionline.com/markets/classification-change-japans - gpif - paves - way - further - boost - foreign - bond-allocations

Barberis, N. and Ming, H. (2005). "Stocks as Lotteries: The Implications of Probability Weighting for Security Prices," Working Paper, Yale International Center for Finance.

Barberis, N. (2012). "A Model of Casino Gambling," *Management Science* **58**, 35–51.

Bhansali, V. (2007). "Putting Economics (Back) into Quantitative Models," *The Journal of Portfolio Management* **33**(3) (Spring), 63–76.

Bhansali, V. and Larry, H. (2018). "Everybody's Doing It: Short Volatility Strategies and Shadow Financial Insurance," *Financial Analysts Journal* **74**(2) (Winter), 72–84.

Bhansali, V. (2019). "Trading Sardines: The Case of Currency Hedged Negative Yielding Bonds" *Forbes.com*.

Ciolli, J. (2017). "A Former Manager at Target Became a Millionaire Using One of Wall Street's Favorite Trades," *Business Insider*, Aug. 28, 2017, at http://www.businessinsider.com/former-target-manager-becomes-millionaire-using-short-volatility-trade-2017-8.

Davies, P. J. (2019). "Oxymoron Alert: Some 'High Yield' Bonds Go Negative," *The Wall Street Journal*.

Fischer, S. *et al.* (2019). "Dealing with the Next Downturn: From Unconventional Monetary Policy to Unprecedented Policy Coordination," *Blackrock Investment Institute*.

Greenspan, A. (2019). "Greenspan Says 'There Is no Barrier' to Negative Yields in the US", Bloomberg.

Alan Haghani, V. and White, J. (2019). "Negative Interest Rates and the Perpetuity Paradox", Elm Partners, https://elmfunds.com/perpetuity-paradox/.

Hunter, M. (2019). "Even Greece Is Getting Paid to Borrow Money in Debt Markets" *Bloomberg*.

Regnier, P. Ed. (2019). "The Bonds That Eat Your Money," *Bloomberg Businessweek*.

Richter, W. (2019). "Negative Yielding Junk Bonds Have Arrived in Europe", https://wolfstreet.com/2019/07/09/negative-yielding-junk-bonds-have-arrived-in-europe

Keywords: Negative yielding bonds; index funds; pension funds, risk management; hedging; central banks