Issuing 50 to 100-Year Bonds

Niso Abuaf

In 2010-2011, investment-grade borrowers such as the California Institute of Technology (Caltech), Norfolk Southern Corporation, Rabobank Netherlands, United Mexican States (UMS), the Massachusetts Institute of Technology (MIT), and the University of Southern California issued 100-year bonds with no call provisions; and the Tennessee Valley Authority (TVA) issued a 50-year bond with no call provisions. AAA-rated TVA's 50-year bond, and BBB-rated UMS's 100-year bond had coupons of 4.625%, and 6.125%, respectively. Also in the same period, Goldman Sachs twice issued 50-year bonds with attractively-priced five-year call provisions, as the retail market traditionally under prices bond call options. Similar to Goldman Sachs, Telephone and Data Systems Inc, and its subsidiary United States Cellular Corp issued retail-targeted 49 NC-5s (non-calls) with attractively priced call provisions. The confluence of record-low 30-year Treasury yields and relatively tight corporate spreads are among the factors driving the issuance of bonds with 50 to 100-year maturities. The market for 50- and 100-year bonds (ultra-long, or super-long bonds) was invigorated in 1992 and 1993 by the: first-of-its-kind deal-of-the-year TVA 50 NC-20 (50-year non-call 20), Texaco 50 NC-20, Boeing 50 NC-L (non-call life), Walt Disney 100 NC-30, and Coca Cola 100 NC-L bonds. Typically, asset-liability managers such as insurance companies buy ultra-long bonds to match the duration of their assets and liabilities. The duration and, thus, the quarterly mark-to-market sensitivity of such bonds are only marginally higher than 30-year bonds. Asset managers may also buy ultra-long bonds to mitigate the negative convexity of their mortgage portfolios. Therefore, even small amounts of additional yield may tend to compensate investors for the incremental risks that they undertake.

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I. Introduction

The issuance of ultra-long bonds has recently picked up, following declines in nominal and real long-term interest rates. This behavior follows a pattern observed in 1992, 1993, 1997, and 2006 where ultra-long bond issuance peaked following declines in interest rates (see Figures 1 and 2).

The market for super-long bonds has existed for a long time, though its modern resurgence should be traced back to the deal-of-the-year TVA 50 NC-20 (non-call) issued in 1992. Historically, railroads have been the major issuers of ultra-long bonds. The bonds issued by the West Shore Railroad and the Elmira & Williamsport Railroad are prime examples. Initially sold in 1885, the West Shore bonds carried terms of 476 years. And, the $500 face value bonds issued by the Elmira & Williamsport Railroad in 1862 had 999 year terms.

From 1921 to 1928, the Canadian Pacific Railroad serially issued Perpetual Consolidated Debentures at 4% coupon and in three different currencies, including the Canadian dollar, the US dollar, and the British pound. Interestingly, Canadian Pacific Railroad's website still lists three different transfer agents for each of the three different currency denominations.

Currently, for example, as in the Goldman Sachs (GS) issuances described in the abstract, 50-year bonds with five-year call provisions are largely marketed to retail investors, have $25 face values, trade on the New York Stock Exchange (unlike most corporate bonds), are frequently traded by preferred-stock trading desks, and are frequently and mistakenly referred to as *"preferred"* even though they are treated as and are indeed senior debt in the capital structure. Moreover, traders quote the spread of these bonds relative to the 30-year US Treasury (30Y UST). Intuitively, we can posit that if the market does not expect these bonds to be called, they would trade as a spread to the 30Y UST, and at a spread to the 5Y UST if the market expects the bonds to be called.

Figure 1. Select 50 to 100-Year Bond Issuance in the US, Apr 1992 – Nov 2011

Effective Date	Principal Amount ($ Mln)	Issuer	Rating	Coupon	Structure	New Issue Spread (bp)	Comments
04/09/92	1,000	Tennessee Valley Authority	Aaa/AAA	8.250 %	50 NC-20	+58	
03/04/93	200	Texaco Inc	A1/A+	7.500	50 NC-20	+89	
04/06/93	175	Boeing Co	A1/AA	7.875	50 NC-L	+100	
05/19/93	250	Consolidated Rail Corp	A2/A	7.875	50 NC-L	+87	
06/10/93	200	Ford Motor Co	A2/A	7.750	50 NC-L	+98	
07/09/93	300	Pacific Bell(Pacific Telesis)	Aa3/AA-	7.375	50 NC-20	+77	
07/21/93	300	Walt Disney Co	Aa3/AA-	7.550	100 NC-30	+95	
07/21/93	750	Tennessee Valley Authority	Aaa/AAA	7.250	50 NC-10	+83	
07/22/93	150	Coca-Cola Co	Aa3/AA	7.375	100 NC-L	+80	
10/12/93	125	Boeing Co	A1/AA	6.875	50 NC-L	+84	Re-open
11/09/93	250	US WEST Communications Inc	Aa3/AA-	7.125	50 NC-20	+85	
12/08/93	500	Tennessee Valley Authority	Aaa/AAA	6.875	50 NC-10	+80	
06/14/94	850	Tennessee Valley Authority	Aaa/AAA	7.850	50 NC-5	+87	
07/18/95	500	Tennessee Valley Authority	Aaa/AAA	6.235	50 NC-15	+14	Par Put 6
10/25/95	150	IBM	A1/A	7.000	50 NC-L	+75	
11/20/95	200	Columbia/HCA Healthcare Corp	A3/BBB+	7.500	100 NC-L	+116	
11/29/95	600	News America Holdings Inc	Baa3/BBB	7.750	50 NC-L	+155	
11/29/95	150	News America Holdings Inc	Baa3/BBB	7.900	100 NC-L	+165	
12/05/95	125	Johnson Controls Inc	A2/A-	6.950	50 NC-L	+85	
12/05/95	100	Wisconsin Electric Power Co	Aa3/AA	6.875	100 NC-L	+92	
12/06/95	126	BellSouth Telecommunications	Aaa/AAA	7.000	100 NC-L	+70	
01/23/96	100	Peoples Republic of China	A3/BBB	9.000	100 NC-L	+299	
04/02/96	125	Yale University	Aaa/AAA	7.375	100 NC-30	+70	
08/06/96	300	Dresser Industries Inc	A1/A	7.600	100 NC-L	+86	
10/02/96	200	Union Carbide Corp	Baa2/BBB	7.750	100 NC-L	+97	
10/11/96	100	News America Holdings Inc	Baa3/BBB	8.250	100 NC-L	+146	
10/30/96	500	Ford Motor Co	A1/A+	7.400	50 NC-L	+77	
10/31/96	75	MIT	Aaa/AAA	7.250	100 NC-L	+60	
10/31/96	150	Union Pacific Resources Group	A3/A	7.500	100 NC-L	+84	
10/31/96	150	Apache Corp	Baa1/BBB	7.625	100 NC-L	+95	
11/07/96	148	Times Mirror Co	A1/A+	7.250	100 NC-L	+74	
11/07/96	100	Anadarko Petroleum Corp	A3/BBB+	7.250	100 NC-L	+79	
12/03/96	200	Citizens Utilities Co	Aa3/AA+	7.050	50 NC-L	+68	
12/03/96	850	IBM	A1/A	7.125	100 NC-L	+80	
12/12/96	150	Crown Cork & Seal Co	Baa1/BBB+	7.500	100 NC-L	+100	
01/08/97	100	Tosco Corp	Baa2/BBB-	7.900	50 NC-L	+103	
01/09/97	100	Reliance Industries Ltd	Baa3/BB+	10.250	100 NC-L	+354	
01/16/97	500	US WEST Communications Inc	Baa1/BBB+	7.950	100 NC-L	+120	
01/17/97	200	Endesa	Baa1/A-	8.125	100 NC-L	+127	
02/04/97	150	Mead Corp	A3/A-	7.550	50 NC-L	+80	
02/06/97	500	Chrysler Corp	A3/A-	8.125	100 NC-L	+82	
02/20/97	500	JC Penney Co	A2/A	7.625	100 NC-L	+95	
02/26/97	300	Caterpillar Inc	A2/A	7.375	100 NC-50	+75	
04/03/97	100	Amgen Inc	A2/A	8.125	100 NC-L	+105	
05/08/97	500	Ford Motor Co	A1/A+	7.700	100 NC-L	+85	
05/14/97	350	Norfolk Southern Corp	Baa1/BBB+	7.900	100 NC-L	+97	
06/19/97	100	Bangko Sentral Pilipinas	Ba2/BB	8.600	100 NC-L	+198	
06/24/97	100	Boston University	A3/BBB+	7.625	100 NC-30	+95	
07/07/97	250	Federal Express Corp	Baa2/BBB	7.600	100 NC-L	+103	
07/15/97	500	Chrysler Corp	A3/AA-	7.400	100 NC-90	+82	
07/22/97	500	BellSouth Corp	Aa1/AAA	7.120	100 NC-L	+60	
07/24/97	200	Burlington Northern Santa Fe	Baa2/BBB	7.250	100 NC-L	+85	
07/28/97	175	SunAmerica Inc	Baa1/A	5.600	100 NC-L	+103	
07/31/97	150	Harcourt General Inc	Baa1/BBB+	7.300	100 NC-L	+101	
08/01/97	100	Noble Affiliates Inc	Baa2/BBB	7.250	100 NC-L	+100	
08/07/97	300	Bristol-Myers Squibb Co	Aaa/AAA	6.875	100 NC-L	+44	
08/08/97	150	Apache Corp	Baa1/BBB+	7.375	50 NC-L	+88	
09/30/97	100	Embotelladora Andina SA	Baa1/BBB+	7.875	100 NC-L	+145	
10/06/97	250	Safra Republic Holdings	NR/AA-	7.125	1000 NC-L	+93	
10/07/97	300	Motorola Inc	Aa3/AA	5.220	100 NC-L	+65	
10/08/97	100	Ultramar Diamond Shamrock Corp	Baa3/BBB	7.450	100 NC-L	+110	
12/04/97	194	Alabama Power	NR/A+	7.125	50 NC-5	+110	$25

(*Continued*)

Figure 1. Select 50 to 100-Year Bond Issuance in the US, Apr 1992 – Nov 2011 (*Continued*)

Effective Date	Principal Amount ($ Mln)	Issuer	Rating	Coupon	Structure	New Issue Spread (bp)	Comments
12/10/97	250	Archer-Daniels-Midland Co	Aa3/AA-	6.950	100 NC-L	+84	
01/21/98	200	Rockwell International Corp	A1/AA-	5.200	100 NC-L	+105	
02/26/98	165	Cummins Engine Co Inc	Baa1/BBB+	5.650	100 NC-L	+155	
03/04/98	150	KN Energy Inc	Baa2/BBB-	7.450	100 NC-L	+145	
04/01/98	200	AMBAC Inc	Aa2/AA	7.080	100 NC-5	+115	$25
04/17/98	190	Alabama Power	A2/A	7.000	50 NC-5	+115	$25
05/13/98	250	Coca-Cola Enterprises Inc	A3/A+	7.000	100 NC-L	+105	
06/22/01	325	Viacom Inc	A3/A	7.250	50 NC-5	+168	$25
09/28/01	600	General Motors Corp	A3/A	7.375	50 NC-5	+195	$25
10/10/01	200	AMBAC Inc	Aa2/AA	7.000	50 NC-5	+164	$25
02/07/02	800	General Motors Corp	A2/A	7.250	50 NC-5	+184	$25
03/19/03	175	AMBAC Financial Group Inc	Aa2/AA	5.875	100 NC-5	+99	
03/07/05	300	Norfolk Southern Corp	Baa1/BBB+	6.000	100 NC-L	+137	
03/29/06	1,000	Tennessee Valley Authority	Aaa/AAA	5.375	50 NC-L	+59	
09/14/06	1,000	Comcast Corp	Baa2/BBB+	7.000	49 NC-5	+208	$25
12/06/06	750	Viacom Inc	Baa3/BBB	6.850	49 NC-5	+225	$25
02/06/07	1,150	AT&T Inc	A2/A	6.375	49 NC-5	+151	$25
03/20/07	700	CBS Corp	Baa3/BBB	6.750	49 NC-5	+204	$25
05/03/07	550	Comcast Corp	Baa2/BBB+	6.625	49 NC-5	+179	$25
08/23/10	250	Norfolk Southern Corp	Baa1/BBB+	6.000	95 NC-L	+229	Re-open
09/14/10	350	Rabobank Netherlands	Aaa/AAA	5.800	100 NC-L	+201	
09/16/10	1,000	Tennessee Valley Authority	Aaa/AAA	4.625	50 NC-L	+77	
10/05/10	1,000	United Mexican States	Baa1/BBB	5.750	100 NC-L	+235	
11/02/10	1,325	Goldman Sachs Group, Inc.	A1/A	6.125	50 NC-5	+220	$25
11/16/10	200	Telephone & Data Systems Inc	Baa2/BBB-	6.875	49 NC-5	+253	$25
03/21/11	300	Telephone & Data Systems Inc	Baa2/BBB-	7.000	49 NC-5	+255	$25
05/09/11	300	United States Cellular Corp	Baa2/BBB-	6.950	49 NC-5	+264	$25
05/11/11	750	Massachusetts Inst. Of Tech.	Aaa/AAA	5.600	100 NC-L	+130	
05/18/11	400	Norfolk Southern Corp.	Baa1/BBB+	6.000	100 NC-L	+175	
08/10/11	1,000	United Mexican States	Baa1/BBB	5.750	99 NC-L	+242	Re-open
08/17/11	300	University of Southern California	Aa1/AA	5.250	100 NC-L	+174	
10/26/11	575	Goldman Sachs Group, Inc.	A1/A	6.500	50 NC-5	+332	$25
11/14/11	100	Norfolk Southern Corp.	Baa1/BBB+	6.000	100 NC-L	+230	Re-open
11/29/11	350	California Institute of Technology	Aa1/NR	4.700	100 NC-L	+180	

Source: Bloomberg, Thomson Financial

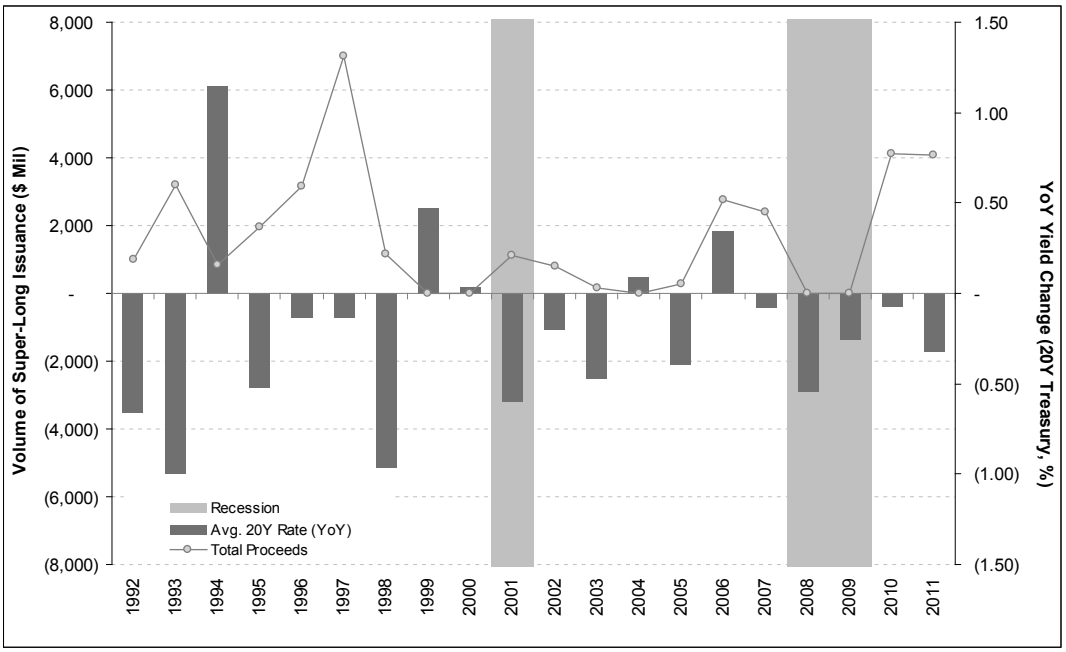
More sophisticated users, however, may prefer to analyze the above-type bonds by tracking their OASs (Option Adjusted Spreads). These pricing issues will be discussed in greater detail in Section IV.

As Figure 1 shows, from 1992 to 1993, issuers started accessing the ultra-long bond market. The 1992 TVA's deal-of-the-year 50 NC-20, was followed up by a flurry of activity including Texaco's 50 NC-20, Boeing's 50 NC-L (non-call life), Walt Disney's 100 NC-30, and Coca Cola's 100 NC-L. See Lindenberg, Abuaf, Mehrish, Sajadian, Vilensky, and Shaffran (1993).

As Figure 1 and the above observations suggest, bonds with ultra-long maturities exceeding 30 years may carry attached optionalities, and are typically issued with 50 and 100 year maturities. They also have different credit qualities, albeit at investment-grade levels. As such, understanding the spread-pricing of such bonds to the 30Y UST is a non-trivial exercise. See, for example, Kalotay and Williams (1993) for a critique of the hype surrounding the risk-reward characteristics of super-long bonds.

In this paper, we briefly explore why issuers issue, and investors buy super-long bonds in the current macroeconomic environment; and analyze the pricing of super-long bonds. In particular, Section II highlights the correlation of super-long bond activity and macroeconomic variables, while Sections III and IV respectively analyze an issuer's and an investor's perspectives of issuing and buying super-long bonds. Section V is the main technical part of the paper analyzing the pricing of super-long bonds, and the optionalities associated with them, remembering that once a 50 or 100-year bond has an attached short-term optionality, it may cease to trade like a super-long bond. Section VI concludes the paper.

Figure 2. Change in Long-Term Rates versus 50 to 100-Year Issuance ($ Millions), Apr 1992 – Nov 2011



Source: Federal Reserve, Thomson Financial

II. Super-Long Bonds and the Macroeconomic Environment

A. The Issuance of Super-Long Bonds is Correlated with Macroeconomic Conditions in General and with Interest Rates in Particular

As Figure 2 illustrates, the issuance of super-long bonds is highly correlated with macroeconomic conditions, and the change in long-term interest rates.

- 50 to 100-year bond activity reached local or global maxima (depending on whether we track number of transactions or volume of deals) in 1993, 1997, and 2006, following, or coincident with significant decreases in interest rates.
- Super-long bond activity seems to increase after recessions, in line with its correlation with decreases in long-term interest rates.
- Super-long bond issuance started climbing in 2010 as a result of even further declines in nominal long-term interest rates, and the components of these rates embodied in real interest rates and inflationary expectations. Though super-long bond activity has picked up in 2010 and 2011, it is nowhere near the levels observed in earlier peaks. The primary reason behind this observation may be the paucity of private sector borrowings in 2010. Since the start of 2009, associated with the decline in economic activity and the rise of "fear," private sector borrowings have markedly decreased and largely offset by the increase in US government debt issuance.

B. The Issuance of Super-Long Bonds is Correlated with the Expected Path of Interest Rate Movements over the Long-term

Though forecasting interest rates is a risky game and is beyond the scope of this paper, we would like to make a few observations:

- The nominal interest rate consists of three building blocks:
  - The real rate of interest (may be measured by observing yields on Treasury Inflation Protected Securities (TIPS) or by subtracting the inflation rate from nominal yields).
  - Inflationary expectations.
  - Credit spreads.
- All of the above three building blocks are either at, or significantly below their historical means or medians.
  - The 30-year TIPS-measured real interest rate is less than 1%, or more than two standard deviations to the left of the mean or median.

- The current US Core consumer price index (CPI) inflation is close to a historically low level, though increasing.
- Current Baa spreads are very close to their historical mean or median.

- Theoretically, long-term real rates approximate the long-term growth rate of gross domestic product (GDP). This observation is consistent with M. Allais's, E.S. Phelps's, P. Samuelson, and R. Solow's writings which state that consumption per person is maximized when the interest rate is equal to the growth rate of GDP (see Phelps, 1966).
- Most economists would agree that in the long term, inflation follows the path of monetary aggregates (Base Money, M1, or M2).
  - Though US base money has markedly increased since the onset of the crisis, M1 and M2 have not followed suit.
  - Nonetheless, if the Fed cannot drain the excess liquidity that it has created once the economy improves, US inflation is likely to pick up in the medium to long term. Moreover as Niall Ferguson ably argues, economic imbalances such as the ones the US is currently facing are frequently resolved through higher levels of inflation designed by the policy authorities.
- Credit spreads are highly correlated with GDP growth in that better GDP performance depresses credit spreads, and conversely as default rates are highly correlated with economic performance.
- In summary, all of the above points suggest that interest rates are far more likely to go up than down over the medium to long term.

III. An Issuer's Perspective of Super-Long Bonds

A. The Benefits and Costs of Issuing Super-Long Bonds

We note that in September 2010, the AAA-rated Tennessee Valley Authority (TVA) issued a 50 NC-L at 77 basis points (bps) over the 30Y UST, versus a comparable spread (to the 30Y UST) for their 30-year at 62 bps; or 15 bps for a 20-year maturity extension (i.e. 0.75 bps per year of extension).

We also note that in October 2010, the BBB-rated United Mexican States (UMS) issued a 100 NC-L at 235 bps over the 30Y UST, versus a comparable spread of their 30-year at 143 bps; or 92 bps for a 70-year maturity extension (i.e. 1.31 bps per year). Analyzing the daily spread of these UMS bonds in the 7 Oct 2010 – 17 Nov 2011 period, we find that the average spread of the 100-Year UMS to the 30-Year UMS is 62 bps, with a standard deviation of 8 bps (it seems that 92 extra bps for the 100-Year UMS versus the 30-Year UMS is an outlier, which is understandable for new issue spreads). So, the plus one standard deviation estimate of the 100-Year versus the 30-Year UMS is 70 bps, or one bps per year of extension.

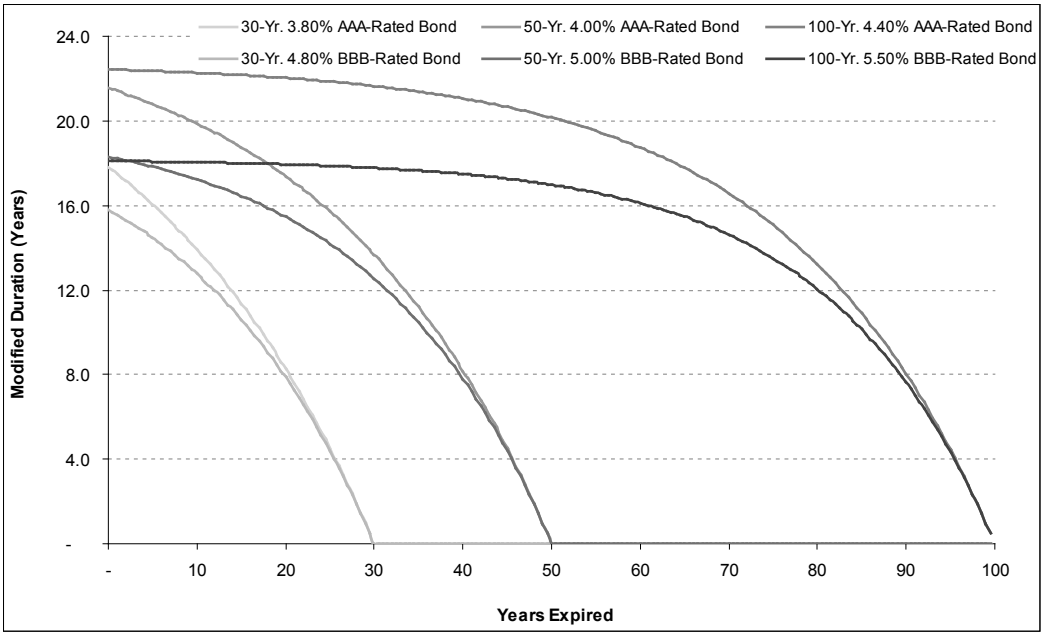
We note that analyzing the cost of issuing super-long bonds as the price per year of a maturity extension may not be theoretically appealing, but issuers ask this question all of the time. More detailed analyses with breakevens etc., follow in Section IV.

We now ask ourselves as to why an issuer should issue a super-long bond such as a 50 NC-L, or a 100 NC-L bond and bear an indicative extra cost of 15-92 basis points (0.75-1.00 bps per year).

We list below the reasons as to why a borrower would issue a super-long bond:

- To match assets and liabilities. Borrowers who have long-term assets such as brand names, oil reserves, railroad networks, and research and development expenses to be amortized over long horizons may be inclined to issue super-long bonds as an economic hedge. Indeed, two of the 100-year bond issuers in 1993 were very-well recognized brand-household names such as Coca Cola and Disney. In addition to the railroad bonds cited in the introduction, railroads such as Topeka and Santa Fe, and Chicago and Eastern Illinois issued 100-year bonds in the 19th century to finance land leases that lasted 100 years or more. Moreover, financial institutions may view ultra-long bonds as "cheap equity." Indeed, in October 1997, Safra Republic Holdings issued 1,000 NC-L bonds, at a new issue spread of 93 bps.
- To reduce rollover risk. If an issuer's borrowing horizon is greater than 30 years, then the risk/return tradeoff of issuing super-long bonds may look attractive.
  - For example, let's assume that BBB-rated industrials can issue 10-Year, 20-Year, and 30-Year paper at respectively 4.07%, 4.84%, and 5.03%. If the 20-Year rate increases to 6.26% and beyond in 10 years, a current 30-Year funding would be more cost efficient. This is approximately a 143 bps increase from today's 20-Year level. Depending on one's view of the behavior of interest rates, we can calculate the probability of such a move. If we assume that the natural logarithm of interest rates follow a random walk model with drift, the drift term and the volatility of interest rates determine this probability. We calculate a volatility of 10.7% per year based on the standard error of the autoregression of the logarithm

Figure 3. Modified Duration vs. Time; 100-, 50-, and 30-Year Noncallable Bonds



Notes: Calculations assume that coupon equals yield to maturity.

of the long-term Merrill Lynch utility yield index. So, for a volatility of 10.7% per year:

- A zero bps per year drift term implies a 22% probability of breaching the breakeven rate (this assumes that the best forecast of future yield curves is the current yield curve).
- A 15 bps per year drift term implies a 51% probability of breaching the breakeven rate (roughly, this assumes that future yield curves will revert to their historical means).
- And, a drift term of 50 bps per annum implies an 88% probability of breaching the breakeven rate (this assumes that modest inflation takes over in the future).
- We apply a similar type analysis to UMS's 30 (at 4.86%) versus 100-year (at 5.56%) funding. We find the following breakevens:
  - To benchmark our analysis, and to approximate a breakeven rate, we first use the coupon curves and find that the 70-year rate 30 years out needs to breach 5.86%. We first use this approximation because constructing a zero coupon curve when data are limited requires several assumptions that may be less than ideal.
  - To reach a more precise estimate, we use an imputed zero coupon UMS curve, and find that the 70-year coupon rate 30 years out needs to breach 6.40% for the current 100Y UMS to be the cheaper alternative. We can argue that this is an approximately 155 bps point move of the yield curve 30 years out.
  - Therefore, if the decision to move from a ten-year financing horizon to a 30-year horizon is rational, then the decision to move from a 30-year to a 50-year horizon may also be rational. Stated differently, both examples suggest about a 140-160 bps parallel shift of the yield curve at the forward funding point.
- To vote a borrower's views. If a borrower believes that long-Treasury yields, corporate-bond spreads and inflation rates have bottomed out, then issuing super-long bonds is a reasonable strategy (see the economic analysis in Section I).
- Moreover, if a borrower expects that the short-end of the curve will not rise significantly in the near future, he can overlay the long-dated bond with an interest rate swap.

Based on current break-even analysis, an issuer may justify issuing a 100-year NC-L bond versus a 50-year NC-L bond because of the above benefits and even though the durations of these two bonds are very close (see Figure 3). Specifically, for the BBB scenario the durations are virtually identical (actually the 50Y starts off being a little higher). On the other hand, for the AAA scenario, the durations of the 50Y and 100Y start off being approximately one year apart.

Moreover, the duration of a bond is one of the primary

determinants of the price of a bond, but not the only one. Unlike Treasury pricing, corporate bond pricing also is critically dependent on credit spreads. When maturities extend as long as a century, investors have to be compensated relatively more for credit because of the enormous range of uncertainty associated with such issuers – this is true for even the best known names and credit histories. Therefore, investors will demand correspondingly extra compensation for bearing such uncertainties.

B. Issuing Super-Long Bonds Versus Issuing Equity

Super-long bonds have significant equity-like features in that principal repayment is extremely distant. And, super-long bonds can be analyzed from various perspectives:

- The accounting treatment of ultra-long bonds is no different than any other long-term debt, as verified by analyzing the 10-Ks of super-long bond issuers such as Norfolk Southern.
- From a capital structure perspective, issuers will be raising equity-like capital at relatively low cost.
- From a credit-rating agency, or credit-analyst perspective, super-long bonds may have positive implications especially if they are used to replace excessive short-term debt on an issuer's balance sheet. Because such a replacement reduces rollover-interest-rate risk, credit analysts may view it favorably.
- From a tax perspective, some observers have been worried that the Internal Revenue Service (IRS) may not allow the interest-tax-deductability of super-long bonds by arguing that they are equity like. On the other hand, the duration of a super-long bond is less than the duration of a 30-year zero-coupon bond (see Figure 3). That is, based on duration, if the IRS allows interest-tax-deductability on 30-year zeros, it may do the same with super-long bonds.

C. Super-Long Bonds in a Historical Perspective

The historical predecessors of super-long bonds predate the railroad and financial bonds cited in Section I and Section II. As reported in Berk and DeMarzo (2007), "companies sometimes issue bonds that they call perpetuities, but in fact are not really perpetuities:

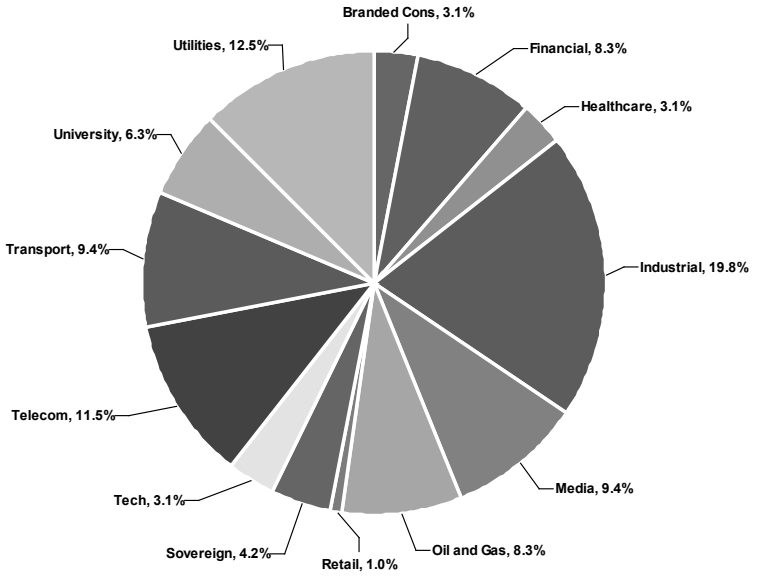
- For example, according to Dow Jones International News (February 26, 2004), in 2004 Korea First Bank sold $300 million of debt in 'the form of a so-called *perpetual bond* that has no fixed maturity date.' Although the bond has no fixed maturity date, Korea First Bank has the right to pay it back after 10 years, in 2014. Korea First Bank also has the right to extend the maturity of the bond for another 30 years after 2014. Thus, although the bond does not have a fixed maturity date, it will eventually mature in either 10 or 40 years. The bond is not really a perpetuity because it does not pay interest forever.
- Perpetual bonds were some of the first bonds ever issued. The oldest perpetuities that are still making interest payments were issued by the *Hoogheemraadschap Lekdijk Bovendams*, a seventeenth-century Dutch water board responsible for upkeep of the local dikes. The oldest bond dates from 1624. Two finance professors at Yale University, William Goetzmann and Geert Rouwenhorst, personally verified that these bonds continue to pay interest. On behalf of Yale, they purchased one of these bonds on July 1, 2003, and collected 26 years of back interest. On its issue date in 1648, this bond originally paid interest in Carolus guilders. Over the next 355 years, the currency of payment changed to Flemish pounds, Dutch guilders, and most recently euros. Currently, the bond pays interest of €11.34 annually.
- Although the Dutch bonds are the oldest perpetuities still in existence, the first perpetuities date from much earlier times. For example*, cencus* agreements and *rentes,* which were forms of perpetuities and annuities, were issued in the twelfth century in Italy, France, and Spain. They were initially designed to circumvent the usury laws of the Catholic Church: Because they did not require the repayment of principal, in the eyes of the church they were not considered loans."
- Also, consols (short for consolidated stocks) that are frequently mentioned in economics textbooks, and according to some, were issued by the British to finance the India Campaign, are perpetual bonds that were first issued by the British in 1751.

D. Types of Issuers that Issue Ultra-Long Bonds

We outline below the characteristics of super-long bond issuers in the 1992-2011 period (see Figures 1 and 4):

- Until 1996, issuers were all rated A or better, with many being rated AAA.
- The flood of issuance started in 1992, when high-rated energy and industrial issuers such as TVA, Atlantic Richfield, Boeing, and Mobil accessed the market.
- The modern market for 50- and 100-year bonds was established 1992-1993. In April 1992 TVA opened the market by issuing the deal-of-the-year 50 NC-20, in March 1993 Texaco mimicked TVA by issuing a 50

Figure 4. 50 to 100-Year Issuance by Industry, Apr 1992 – Nov 2011



NC-20 and later on that same year Walt Disney came to market with a 100 NC-30.

- Between 1996 and 1997, the ultra-long bond market experienced an upward spike. During this period, issuers from different industries, including elite universities such as Yale, MIT, and Caltech were able to access the market with varying call structures.
- Ultra-long bond issuance experienced a lull during the 2001 recession and never fully recovered to the level of issuance seen during 1990s. The typical ultra-long bond issuance during the period of 2001-2011 was a $25-par retail-targeted bond with a short five-year call, and with maturities ranging from 50 to 100 years (we treat the 49-year maturities as if they were 50 years).
- As illustrated in Figure 4, ultra-long bond issuance since 1992 is distributed as follows:
  - 24% by telecom, media, and technology companies.
  - 20% by industrial companies.
  - 13% by utility companies.
  - 9% by transports.
  - 8% by financials.
  - 8% by oil and gas companies.
  - 7% by branded consumer, healthcare, and retail industries.
  - 6% by universities.
  - 4% by sovereigns.
- Almost all of the above industries have long-term assets and liabilities, or long-lived brand names to protect.

IV. An Investor's Perspective of Super-Long Bonds

Insurance companies and pension funds with very-long liability profiles are the major buyers of super-long bonds. For example, according to Bloomberg, 80% of the reported (41% of total) TVA 4.625 50 NC-L bonds are held by life insurance companies while the remaining 20% are held by asset managers. As circumstantial evidence, we would like to point out that the Japanese and UK yield curves have a downward sloping part in the 30+ year range. This picture suggests that an aging country such as Japan has a "high" demand for super-long dated bonds, thereby resulting in a downward sloping yield curve.

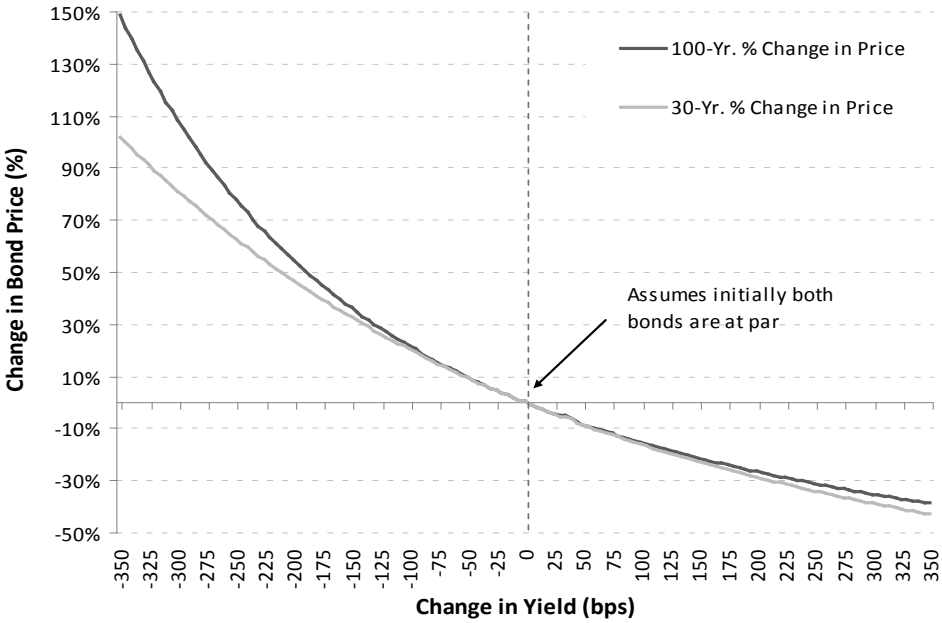
A. The Aging of Super-Long Bonds

Compared with a 30-year noncall life bond, super-long bonds age slower in the beginning of their lives. For example, a 50- or 100-year bond's duration remains relatively constant versus that of a 30-year bond in the early stages of its life (see Figure 3). In the first decade of their lives the durations of 30Y, 50Y, and 100Y bond drop as follows:

Duration Drop in Years

	30Y	50Y	100Y
AAA	3.9	1.6	0.16
BBB	3.1	1.1	0.06

Figure 5. Convexity of a 30Y vs. 100Y Bond of Equal Initial Duration



The above observations imply that issuers and investors who wish to maintain a constant duration throughout time will benefit from super-long debt. The duration stability of 50- and 100-year bonds frees asset or liability managers from the need for frequent portfolio rebalancing.

B. The Convexity of Super-Long Bonds

Some commentators have suggested that super-long bonds offer investors a form of "relatively cheap positive convexity" to offset the negative convexity of mortgage backed securities (MBS). Though a thorough analysis of this insight is beyond the scope of this paper, we can intuitively illustrate a few points:

- Let us remember that:
  - As interest rates go up, the price of an MBS goes down more than a bullet bond as mortgagors extend the maturity of their payments.
  - As interest rates go down, the price of an MBS goes up by less than a bullet as mortgagors shorten the maturity of their payments.
  - The above two points imply that compared to a bullet of identical initial duration, an MBS's duration increases as interest rates go up and decreases as interest rates go down.
  - This mathematical relationship, intuitively demonstrated above, is called negative convexity.
- Indeed, the duration and convexity of 5.50% 100Y bond, as calculated by Bloomberg and us, are 18.102Y and 6.427Y, respectively. When we construct a hypothetical 30Y bond with a coupon of 3.668%, this bond has an identical duration to the above 100Y (i.e. 18.102Y), but a lower convexity of 4.471Y. We illustrate this relationship in Figure 5, where we illustrate the price change versus changes in interest rates of a 30Y and a 100Y bond with identical initial durations.
- As Figure 5 illustrates, the duration of a super-long bond decreases (increases) as interest rates go up (down). And this relationship, known as positive convexity, ameliorates the interest rate sensitivity of a negative convexity portfolio such as one consisting of mortgages or related assets. A full mathematical treatment of this question is beyond the scope of this paper.

V. The Pricing of and Optionalities Associated with Ultra-Long Bonds

50- to 100-year bonds are priced as a spread to the 30Y UST. We would expect this spread to increase as follows:

- As maturity increases.
- As credit-rating deteriorates.
- As optionalities are introduced.

Figure 1 suggests that the above observations seem true. Excluding optionalies, maturity and credit spread are the two major variables driving super-long bond spreads. So, a simple statistic would be to calculate the basis point per year cost of maturity extension.

Concentrating on the 2010-2011 period, as the more

distant periods might have less relevance to today's market conditions, we observe that:

- The AAA-rated TVA 50 NC-L's new issue spread is 77 bps, versus the AAA-rated MIT's 100 NC-L new issue spread of 130 bps, confirming the rule of thumb that a year of extension costs approximately 1 bp per year. Though we realize that this is not a correct theoretical way to analyze the question, it is nonetheless the way the market thinks about it.
- At the other end of the investment-grade credit rating spectrum, as reported earlier, the plus one standard deviation spread difference between the 30-Year UMS and the 100-Year UMS is 70 bps, again confirming the rule of thumb that 1 bp per year is the cost of extending to ultra-long maturities.
  - It is important to note that on November 23, 2011 the yield difference between the 10-Year USTs versus the 30-Year USTs was 95 bps, or 4.75 bps per year of extension. The difference here, however, is that the duration of a 30Y UST is 19.99 years versus a duration of 9.09 years for a 10Y UST, or 10.9 years. The duration difference between a 50 NC-L versus a 100 NC-L does not approach such a magnitude, not even reaching two years (see Figure 3).
- With the exception of Rabobank which is in the risky financial sector, spreads do indeed go up with deteriorations in credit ratings.

A. Call Provisions in Ultra-Long Bond Financing

The decision to include a call provision in a debt issue should be based on the following factors:

- The need for additional refinancing flexibility within the current portfolio.
- A theoretical valuation of the call provision.
- Future breakeven financing rates.
- The borrower's tax paying status.

On November 22, 2011, for example, according to Bloomberg's calculations, the above GS 6.5% NC-5s traded at an OAS of 356 bps, versus an OAS of 425 bps for the GS 30-year bond, and an OAS of 406 bps for the GS NC-5s, assuming no optionality. These observations support the viewpoint that the retail market does not properly price the optionality embedded in the above GS NC-5 bond. (Please note that Bloomberg gives us a choice to calculate OAS as a constant spread to the UST zero-coupon curve, or to the zero-coupon swap curve. In this paper we report OAS as a spread to the zero coupon treasury. Please also note that the calculation of OAS is a complex procedure that is beyond the scope of this paper. Here we are merely reporting market practices that practitioners rely upon). These pricing issues will be discussed in greater detail in the following sections.

- We also need to remember that the typical underwriting spread of a retail issue is about 3.15% versus 0.75% for an institutional issue. So, the analyst needs to carefully consider the underwriting-spread differential for tapping the retail market versus the benefit of acquiring the relatively cheap optionality embedded in a NC-5 bond.

A comprehensive analysis of bond valuation and call option pricing is beyond the scope of this paper. For this purpose, see Kalotay (1993, 1998) and Pedersen (2006); see Kalotay (2006) for a perspective on retail bonds with different optionalities.

B. Case Study: Goldman Revisits the 50 NC-5 Market

According to Bloomberg News, on October 19, 2011:

- *"Goldman Sachs Group Inc, which yesterday reported its second quarterly loss in 12 years, sold $500 million of 50-year unsecured bonds in a transaction aimed at individual investors.*
- *Goldman Sachs sold the debt in increments of $25 at a yield of 6.5% after doubling the size of the offering.*
- *The New York-based firm has the option to redeem the bond after five years.*
- *The transaction was the second Goldman Sachs has targeted at individual investors, allowing the firm to diversify its sources of capital while locking in attractive borrowing costs, said James Leonard, a credit analyst at Morningstar Inc., in Chicago.*
- *'It's a great deal for Goldman,' Leonard said in a telephone interview. 'They are sitting in a win-win situation, because if interest rates stay low they can call them, but if rates go up they've got 50 years of funding.'*
- *Leonard said he wouldn't recommend individual investors buy the notes because of the difficulty of valuing Goldman Sachs's option to redeem them after 2016."*

According to our calculations, on the date of issuance, the Goldman 50 NC-5 bonds traded at about 342 bps to the 30-year UST versus a spread of about 345 bps to the 30-year UST for a Goldman 30-year bond. A few days after issuance, on October 21, 2011, these spreads were 335 bps for the 50 NC-5 versus 332 bps for the Goldman 30-year bond. This observation further strengthens our earlier suggestion that the retail market under-prices call provisions. Indeed, the only price that Goldman seems to have paid for the call

option is the larger underwriting spread for a retail vs. institutional issue (3.15% vs. 0.75%).

The pricing and spread analysis of the GS 6.5% NC-5 is not as simple as it seems. Primarily because there are three moving parts: the 30Y UST, the 30Y GS bond, and the 50 NC-5 GS bond. Even if we assume that the 30-Year UST trades continuously, the two GS bonds do not, and frequently we do not know the exact point during the day at which the bonds have traded. Nonetheless, by framing the spread question as a range estimate vs. a point estimate, and by making certain reasonable assumptions, we can make reasonable inferences about the relative pricing of the two GS bonds.

October 21, 2011: Pricing on the Date of Announcement of the GS 50 NC-5 Bonds

According to Ramirez traders, the 50 NC-5s priced at the end of the day, at par, i.e., at $25. Given that the coupon is 6.50%, the spread to the 30Y UST would be 6.50% minus the 30Y UST yield. At the end of the day, 30Y UST yield was 3.175%, suggesting a spread of 332.5bps. During the day, the 30Y UST traded in the 3.14%-3.23% range, suggesting a range spread of 327-336 bps, with the end-day spread of 332.5 bps being very close to the mid-point.

Bloomberg reports two 30Y GS trades, each exceeding $5 million and with 313bps, and 328bps spreads. As such we assume that the 30Y GS bonds traded in the 313-328 bps range.

November 14, 2011: Pricing After the Dust Settles

Bloomberg reports two 30Y GS trades: one of $1 million with a spread of 345 bps, and the other of $1.8 million with a spread of 356 bps. So, we assume that the 30Y GS bonds traded in the 345-356 bps range.

Bloomberg reports a yield of 6.62% for the 50 NC-5s. Given that the 30Y UST traded in the 3.19%-3.07% range, we assume that the spread range is 343-355 bps**.**

In summary, the old adage that the retail market under-prices call provisions is supported by the above observations. Indeed, the November 14, 2011 data suggest that the call provision may be priced at zero, notwithstanding measurement error.

VI. Conclusion

As the US economy heals, and private sector borrowing activity revitalizes, the issuance of 50 to 100-year bonds is likely to increase as borrowers move to monetize:

- Super-low real interest rates,
- Super-low Inflationary expectations, and
- Moderately-low credit spreads.

Breakeven analysis suggests that if the yield curve moves by about 140-160 bps in the forward funding point, issuing super-long bonds might be cheaper than issuing 30-year bonds. A mean-reversion type of interest-rate modeling suggests that the probability of breaching such a breakeven shift in the yield curve might be very high. Moreover, the cost of a maturity extension beyond 30 years seems to be around one basis point per year. Such a rule of thumb may not satisfy a theoretical fixed-income purist. Nonetheless, issuers do look at such rules of thumbs.

Moreover, if bond options remain underpriced versus theoretical models, particularly in the retail market, issuers are likely to include optionalities in their offerings and either monetize these optionalities or derive the economic benefits themselves. ■

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