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"Try and Hold" Credit Investing

We have developed a framework for risk/return analysis of long-horizon credit portfolios, recognizing that very few investors follow a pure "buy and hold" investment policy. The "sell discipline" that controls the liquidation of distressed securities has a profound influence on the loss distribution and should be explicitly considered in the analysis. In addition, we study how long-term probabilities of downgrade and default should be conditioned on the current spread environment.

Key conclusions of this article that should be considered by all long-horizon credit portfolio managers are as follows:

- **The "sell discipline" should be considered explicitly in evaluating the risk/return trade-off for a given asset class and when making asset allocation decisions.**
- **A policy to sell bonds upon a downgrade from investment-grade to high yield is particularly detrimental to portfolio performance. This provides strong motivation to structure the portfolio to avoid such events.**
- **When buying debt close to a sell threshold, the consideration of losses from forced sales creates a preference for shorter maturities. Longer-dated credits should be purchased at higher qualities, further from the sell trigger.**
- **The current level of credit spreads has predictive power over the near to medium term for projections of both risk and return. In particular, when spreads are higher than average, one should expect that:**
  - **Downgrade and default probabilities will be greater than long-term averages (and upgrade probabilities will be lower).**
  - **Spread differentials among rating categories will be higher as well, leading to higher cost of downgrades.**
  - **These effects tend to mean revert over a horizon of about two years. Beyond that, current spreads have little predictive power. This is consistent with the statistical properties of spreads themselves, which tend to mean revert over a similar time frame.**
  - **Spread carry returns should be higher as well, leading to above-average expected returns even after considering the increased risks outlined above. However, this must be evaluated against an accompanying increase in tail risk.**

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Introduction

Many long-term credit investors may refer to their mandates as taking a “buy and hold” approach. This implies that they buy bonds on a regular basis, and hold on to them without exception until they either mature or default. The long-term return on such a strategy can be measured and analyzed in terms of the bonds’ yields upon purchase (“book yield”) and the realized default experience.[1]

In real life, however, the majority of these investors do not actually follow this strategy. They may well buy bonds with the intention of holding them to maturity, but when credit deterioration strikes, they are often forced to sell the bonds at a loss well in advance of any possible default event. In so doing, they may prevent larger losses due to default, but they must record realized losses upon the sale of the bond. Investors in this situation do not necessarily view the risk/return trade-off of different asset classes using the same metrics as mark-to-market total return investors, who carefully measure month-over-month portfolio total returns and compare them with those of a benchmark. However, their performance considerations are also quite different from those described above for the pure buy and hold case. The primary loss event in this case is not default, but forced sales of degraded credits. We refer to this paradigm – in which investors buy bonds for the long term but may be forced to sell them upon some trigger event – as “try and hold” investing. In this article, we develop a framework for analyzing risk and return in such portfolios.

Our analysis of risk in long-horizon portfolios relies on long-term estimates of both the likelihood of adverse credit events and the severity of the accompanying losses. Probabilities of defaults and downgrades are estimated based on data collected and published by rating agencies. To estimate the realized losses upon a given downgrade event, we use the differential between the average spreads for bonds of different ratings. For investors forced to sell “fallen angel” bonds as they cross the boundary from investment grade to high yield, we add an additional performance penalty to reflect the selling pressure typical in such situations, based on our previous research.[2] We then examine the extent to which both types of estimates should be conditioned on the current spread environment. We find that higher spreads are indicative of higher probabilities of downgrades and defaults over a horizon of about two years. They are also accompanied by greater losses in case of forced sales, due to larger spread differentials between ratings categories. These effects are mitigated by the higher spreads themselves, which generate greater returns for bonds that are held to maturity, and by the tendency of spreads to mean revert towards their long-term averages over a time frame of about two years.

The result of our analysis is a model for the return distribution of a corporate bond over a long horizon (eg, 5 years) that depends on the current spread environment and the stated sell discipline for handling distressed securities. In this article, we present the basic elements of the model and supporting empirical research, and show examples of the model’s output for a single bond given different assumptions concerning credit ratings, spread levels, transition matrices, and sell disciplines. In a follow-up article, we plan to address the additional issues that arise when applying this approach to a diversified credit portfolio.

[1] For investors of this type who use book value accounting techniques, it can be difficult to evaluate manager performance due to the lack of appropriate benchmarks. A methodology for building customized book value benchmarks was presented in Dynkin *et. al.* (2006).
[2] Ben Dor, Arik and Xu, Jason, “Fallen Angels: Characteristics, Performance, and Implications for Investors”, Barclays Research, December 14, 2010.

The pure 'Buy and Hold' approach

To motivate our model, we begin with a simple analysis of the long-term risk/return trade-off among different credit asset classes, using a back-of-the-envelope type analysis corresponding to a pure buy and hold assumption. In this simplest possible view of credit investing, there are only two possible outcomes: either a bond survives to maturity or it defaults. In case of default, the recovery value is assumed to be fixed and known in advance. In Figure 1, we compare bonds of three different credit ratings based on long-term average spreads, default probabilities and recovery rates.

We assume a return horizon of five years and use historical 5-year cumulative default frequencies from Moody's[3] to approximate the probability of default. A representative average recovery rate of 40% is assumed, such that a loss of 60% is assumed to be incurred with the specified probability. The expected default loss over the 5-year horizon is then calculated as the product of the two. The analysis in Figure 1 shows, for example, that the average 309bp/year spread promised by Ba-rated securities over this time period includes compensation for 122bp/year of expected default losses, leaving 187bp/year of expected return; for Baa-rated debt, the spread of 162bp/year carries an expected default loss of 23bp/year, for an expected return of 140bp/year. By this analysis, the expected return differentials among the different rating categories are much smaller than those indicated by the average spread levels.

FIGURE 1

Pure "buy-and-hold" analysis of expected default loss over a 5-year horizon

Rating	Spread	5-Yr Default Probability	Recovery Rate	5-Yr Exp. Default Loss	Annual. Exp. Default Loss	Annual. Exp. Exc. Ret.
A	1.10%	0.87%	40%	0.52%	0.10%	0.99%
Baa	1.62%	1.88%	40%	1.13%	0.23%	1.40%
Ba	3.09%	10.19%	40%	6.11%	1.22%	1.87%

Note: Represents expected loss from default over a 5-year horizon for A, Baa and Ba-rated bonds. Default probabilities are based on Moody's long-term average 5-year rates from 1970-2012, and spreads are averages obtained from Barclays Corporate Bond Index data, adjusted to reflect the same time period. Source: Moody's, Barclays Research

The above analysis is overly simplified in many ways[4]. We have presented it to draw attention to two key issues that must be addressed to create a practical approach to asset allocation. First, this pure buy-and-hold viewpoint is not relevant for investors who are forced to sell distressed credits as a defensive measure to avoid default losses. We will demonstrate that when sell triggers are taken into account, the loss distribution has very different characteristics. Second, the above analysis uses historical measures to represent both the return side of the analysis (as a historical average spread) and the associated risk (using rating agency data). To address an investment decision as of a particular date, a manager can easily adjust the spreads to reflect the current market environment. However, it is much less clear how to project forward-looking estimates of default or downgrade frequencies. Is it reasonable to use an unchanged long-term estimate of risk regardless of the market environment, or should estimates of expected credit losses show some dependence on spread levels? In this article, we will develop an alternative model that focuses on the risk of forced sales due to downgrades as well as default losses. We present

[3] Ou, Sharon, David Chiu, Bo Wen and Albert Metz, "Annual Default Study: Corporate Default and Recovery Rates, 1920-2012", Moody's Investors Service, February 28, 2013.

[4] Even for a pure buy-and-hold investor, there are many relevant refinements that should be considered. For example, recovery rates are not fixed: they can vary widely between 0% and 100%, their averages vary by sector, seniority, and bond price, and they are correlated with default rates. These effects have been studied in the past and are beyond the scope of this study; our focus is on the effect of forced sales rather than the intricacies of defaults and recoveries. Our analysis shows that forced sales comprise the bulk of the loss distribution for many investors.

several empirical studies of the dependence of credit risk on spread levels and incorporate the results into the model's design. Finally, we use the model to illustrate the effect of the sell discipline on the risk/return trade-off for credits of different ratings and maturities under various spread environments.

The "Try and Hold" model

The "try and hold" approach to credit investing seeks a middle ground between pure mark-to-market investing, in which the risk/return trade-off is viewed in terms of expected excess returns versus the monthly volatility of excess returns, and the binary maturity-or-default analysis presented above. To achieve this, we maintain the notion of spread carry as the main source of return, but key off credit transition matrices rather than just default probabilities to flesh out the set of possible loss scenarios that should be considered. We assume there is a ratings threshold that governs the portfolio, and that a rating downgrade to below this level will require the bond to be sold. In such a case, the amount of the loss that will need to be written down is approximated using the difference between the book spread at which the bond was purchased and the average spread of bonds carrying the new, lower rating.[5]

Figure 2 illustrates how this approach can be used to evaluate the loss probability over a one-year horizon for a single Baa-rated bond. The top row of the figure presents the average spread level for a given rating; the spread levels indicated are long-term average spreads[6] for Barclays indices of bonds with the indicated letter-grade ratings. The second row indicates the implied average spread change that a bond would experience upon a ratings change from Baa to any other rating. For example, it would tighten by an average of 53bp upon a one-notch upgrade to A. This logic would similarly suggest that upon a downgrade to Ba, the spread would widen by 147bp, the difference between the average spreads of Baa and Ba bonds.

FIGURE 2

Example of the "Try and Hold" approach: loss distribution for a 5-year, Baa-rated bond over a 1-year horizon, with forced sale upon a downgrade to Ba or lower

	Aaa	Aa	A	Baa	Ba	B	Caa	Ca_C	Default
Average Spread	68	79	110	162	309	463	839	1863	
Spread Change from Baa	-94	-83	-53	0	147	300	677	1701	
Fallen Angel Penalty					78	78	78	78	
P/L Upon Liquidation	4.24%	3.75%	2.37%	0.00%	-10.13%	-17.03%	-33.96%	-60.00%	-60.00%
Transition Probability	0.04%	0.18%	4.36%	89.95%	4.30%	0.80%	0.17%	0.02%	0.18%
Expected Loss					-0.44%	-0.14%	-0.06%	-0.01%	-0.11%

Note: Credit transition probabilities are based on Moody's average 1-year transition rates from 1970-2012; spreads are averages obtained from Barclays Corporate Bond Index data, adjusted to reflect the same period. Spread duration of the bond upon downgrade is assumed to be 4.5 years. Forced selling is assumed to occur on a downgrade to Ba or below. Source: Moody's, Barclays Research

[5] A similar model of downgrade risk, combining downgrade probabilities with estimated losses upon downgrade, was explored in Dynkin *et. al.* (2010). However, the emphasis there was on sufficient diversification to control tracking error volatility in mark-to-market portfolios.

[6] The long-term average spreads used in this paper were calculated to give our best representation of "typical" spreads over the period covered by the transition matrix used (1970-2012). For the majority of the period, we use spreads reported for the appropriately rated components of the Barclays US Corporate Bond and US High Yield Indices. To extend those series back to 1970, we use several approximations and adjustments to arrive at the best available representation. An 8-month period from the peak of the global financial crisis (Sep 2008 – Apr 2009) was omitted from this average.

This simple difference between the average spreads of bonds with different ratings, while intuitive, does not fully represent the losses investors are likely to realize from forced sales of "fallen angel" bonds that are downgraded from IG to HY. Ben Dor and Xu (2010) show that the collective need to divest downgraded bonds in a short period of time can create pressures that temporarily drive fallen angel prices below equilibrium levels. They find forced selling to be associated with an additional penalty of 78bp, on average, incurred by investors selling shortly after the downgrade to high yield. These investors cannot benefit from any of the subsequent documented recovery of fallen angels. This additional spread widening, shown in the third row of Figure 2, is imposed whenever a bond starts the year as investment grade, gets downgraded to high yield, and must be sold immediately. In such cases, the spread widening locked in by selling upon the downgrade will include both the typical difference in spread between the starting and ending rating classes and the additional fallen angel penalty.[7]

The profit or loss upon liquidation, shown in the fourth row of the figure, is calculated by multiplying the spread change experienced by a bond (including the fallen angel penalty, where applicable) by an assumed average spread duration of 4.5, corresponding to a bond that started the year with a 5-year duration and is sold at an unknown time between the start of the year and the 1-year horizon[8].

The transition probabilities, which specify the likelihood of the bond having a given rating as of the 1-year horizon, are obtained from the appropriate line of a Moody's historical 1-year credit transition matrix[9]. The expected loss for a given event is obtained by multiplying the event probability by the loss that would be experienced. However, we only record the expected loss for events that would trigger a liquidation according to our sell discipline.

An analysis based on a 1-year horizon does not fully express the viewpoint of a long-horizon investor. To extend an analysis of this type to a longer horizon, say 5 years, one approach would be to simply replace the 1-year credit transition matrix used in Figure 2 with a 5-year cumulative transition matrix, also available from the rating agencies. However, we instead carry out the analysis in annual steps, using repeated application of a 1-year transition matrix, as shown in Figure 3.[10]

[7] The 78bp fallen angel penalty reported in Ben Dor and Xu (2010) was computed relative to a peer group that excluded fallen angel bonds. Technically, therefore, the average spreads used to represent HY ratings should exclude fallen angels as well, or the fallen angel penalty could be adjusted downward slightly. In any case, the 78bp figure represents a very rough estimate of a quantity that varies greatly over time and tends to be higher when downgrade rates are elevated. Small adjustments to this number should not substantially change the qualitative conclusions of this article. In practice, when conditioning to a particular spread environment as described in the final section of this article, recent fallen angel bonds should first be filtered from the bond universe.

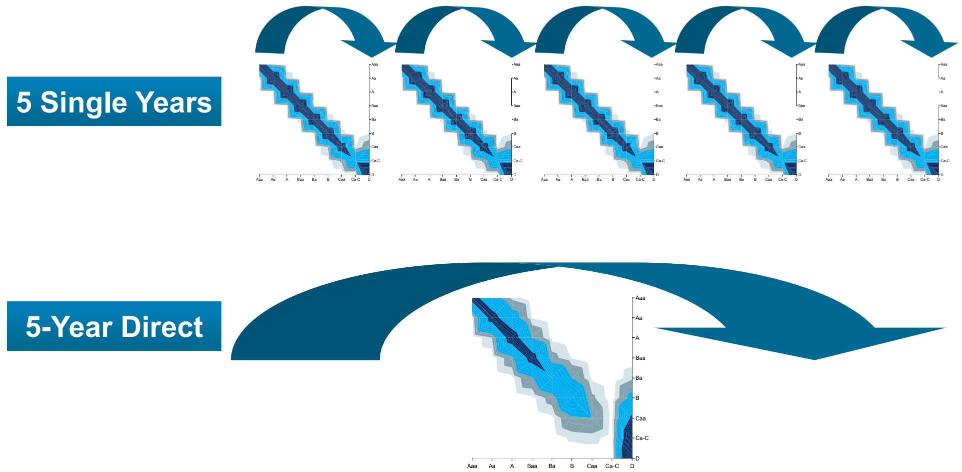
[8] The loss in case of default is estimated as 60%, which is the complement of the earlier assumption of a constant recovery rate of 40%. This loss is also used to cap the loss in case of a downgrade with a very wide spread differential, as shown for a transition from Baa to Ca in Figure 2.

[9] The matrix used was obtained from "Annual Default Study: Corporate Default and Recovery Rates, 1920-2012", Moody's Investors Service, February 28, 2013, Exhibit 26: Average One-Year Letter Rating Migration Rates, 1970-2012. We adjusted the matrix slightly to account for withdrawn ratings by pro-rating the probabilities on each line so that they sum to 100%.

[10] Note that multiplying the historical 1-year transition matrix by itself five times does not produce the historical 5-year cumulative transition matrix. Further research could investigate ways to adjust the 1-year matrix to make it as consistent as possible with the 5-year matrix.

FIGURE 3

Analyzing downgrade losses year by year



Note: The credit transition matrix is depicted in the form of a heat map. Darker areas along the diagonal indicate high probabilities of unchanged ratings or one-notch transitions. More distant transitions are shown to be less likely at a 1-year horizon and more likely at a 5-year horizon. Source: Moody’s, Barclays Research

We prefer this year-by-year approach over a one-step analysis using a 5-year matrix for several reasons. First, in the event that a bond gets downgraded after one year and then defaults after another two, the 5-year matrix will record this as a default; in the year-by-year approach, the bond will be sold and written down at a loss upon crossing the ratings threshold, but the default event will be avoided. Second, to properly record the performance effect of a sale upon downgrade, we need to know the spread duration as of the forced sale. A downgrade in year 1 will incur a much greater loss than a similar downgrade in year 4 due to the natural shortening of the bond’s duration over time. Finally, the year-by-year structure allows use of a different matrix for each year; in a later section, we will show how this can be used to condition on current spread levels.

We are now in position to repeat the try-and-hold analysis of a single Baa-rated 5-year bond, as shown in Figure 2, on a 5-year return horizon. In this case, we will have many more loss events to consider. A downgrade to Ba can occur in any year of the analysis; each such event will have a different probability and a different loss upon downgrade. This analysis is shown in Figure 4. The severity of the loss upon a downgrade to a given rating decreases over time due to the shortening spread duration. The probability of downgrades decreases over time as well, largely due to the effect of upgrades; bonds upgraded to A are much less likely to be subsequently downgraded to Ba or below.

FIGURE 4

“Try and hold” loss distribution for a 5-year, Baa-rated bond, over a 5-year horizon: probabilities and loss assumptions for downgrades, by final rating and event year

	Probability of Downgrade / Default			Loss Upon Downgrade / Default		
Year	Ba	B	Default	Ba	B	Default
1	4.30%	0.80%	0.18%	-10.13%	-17.03%	-60.00%
2	4.09%	0.76%	0.18%	-7.88%	-13.24%	-60.00%
3	3.92%	0.73%	0.17%	-5.63%	-9.46%	-60.00%
4	3.76%	0.70%	0.16%	-3.38%	-5.68%	-60.00%
5	3.63%	0.68%	0.16%	-1.13%	-1.89%	-60.00%

Note: Forced selling is assumed to occur upon any downgrade to Ba or below. Downgrades to Caa and Ca-C ratings are calculated as well, but omitted from this figure due to space limitations. Source: Barclays Research

This table of possible adverse outcomes, together with the desired outcome in which the bond is held to maturity and earns its promised spread, can be considered an approximate representation of the distribution of excess returns for the bond. We can use this to tabulate various measures of risk and return. Expected losses can be broken down into those due to forced sales and those due to default; total losses are subtracted from the total spread carry to arrive at the expected return. Various risk measures can be calculated from the distribution of 5-year cumulative returns: risk can be characterized by the standard deviation, or by various measures of tail risk.

One additional assumption that must be considered to complete this analysis is the reinvestment policy to be used for the proceeds of forced sales and defaults. The simplest case would be to assume that after any such loss event, the proceeds are held in cash until the return horizon. This, however, is not a realistic assumption. If a portfolio's mandate specifies that it should be invested into credits of a particular type, the proceeds from sales or defaults would typically be invested into similar credits. In addition, holding these sums in cash would result in the loss of spread carry, creating additional drag on portfolio performance. We therefore assume reinvestment into like credits with similar remaining maturity. For example, when we analyze a 5-year Baa-rated bond, we assume that if we are forced to sell it after 3 years due to a downgrade to B, we would invest the proceeds in a new Baa-rated bond with 2 years remaining to maturity.

This complicates the calculation of tail risk. Whereas the worst possible outcome shown in Figure 4 is a loss of 60% in case of default, the reinvestment assumption allows for even worse outcomes: two or more loss events could occur within the 5-year horizon. For example, if we recover 40% from a default and reinvest that in a second bond that takes a similar loss, we will be left with just 16 cents on the dollar of our initial investment. The probabilities of such events are quite low, but they should be taken into account. In what follows, we use a simulation approach to calculate the reported tail risk statistics.

The results of this analysis are shown in Figure 5 for bonds with four different initial credit ratings. Three different versions of the analysis are shown, each of which corresponds to a different sell discipline.

FIGURE 5

"Try-and-hold" analysis of risk and return over a 5-year horizon, for a single 5-year bond, by credit rating and sell discipline, using long-term averages for spreads and transition matrix

		Cumulative Probability of Loss (%)		Cumulative Expected Loss (bp)		Cumulative Expected Return (bp)		Risk Measures (bp)		
Rating	Long Term Spread (bp)	Forced Sales (Down-grades)	Defaults	Forced Sales (Down-grades)	Defaults	Carry	Total	Volatility (Return)	VAR [98%]	CVaR [98%]
Sell upon downgrade to Ba										
Aaa	68	0.4%	0.1%	-3	-3	340	335	146	341	53
Aa	79	1.4%	0.2%	-9	-13	394	373	297	395	-723
A	110	5.6%	0.3%	-42	-18	544	483	424	-510	-1,724
Baa	162	23.7%	0.8%	-165	-47	782	570	728	-1,083	-3,364
Sell upon downgrade to B										
Aaa	68	0.1%	0.1%	-1	-3	341	336	143	341	116
Aa	79	0.4%	0.2%	-4	-13	395	378	301	395	-482
A	110	1.8%	0.4%	-20	-22	546	505	426	278	-1,610
Baa	162	7.2%	1.1%	-72	-66	800	662	753	-1,083	-3,937
Hold to default										
Aaa	68	0.0%	0.1%	0	-4	341	337	148	341	159
Aa	79	0.0%	0.3%	0	-15	395	380	310	395	-379
A	110	0.0%	0.6%	0	-39	548	509	493	548	-1,427
Baa	162	0.0%	1.9%	0	-114	807	693	853	811	-5,117

Note: The figure presents the cumulative probability of selling upon downgrade or default (columns 3-4), expected losses from selling upon downgrade or default (columns 5-6), expected cumulative carry (column 7) and total expected return (column 8), all over a horizon of 5 years. The last columns present risk measures of stdev of cumulative returns, VaR 98% and Conditional VaR 98%. Computations assume transition rates according to Moody's long-term average rates from 1970-2012 and average spreads of Barclays Corporate Bond Indices over the same period (shown in column 2). We also assume a fallen angel penalty of 78bp when selling upon any direct downgrade from IG to HY. Losses from rating transitions are capped at 60%. Calculations assume proceeds from bonds sold upon a downgrade are re-invested in bonds of the original rating and maturity. Cumulative expected carry return includes an adjustment for lost carry due to expected forced sales and defaults. Source: Moody's, Barclays Research

The first set of outputs from our analysis concerns the cumulative probability of experiencing a loss event over the 5-year horizon (columns 3-4). We find that under the pure hold-to-default assumption, the probabilities of experiencing a default range from 0.1% for Aaa debt to 1.9% for Baa. If we assume that a stop-loss mechanism is in place, and bonds will be sold after a downgrade beyond some threshold, the probability of default is reduced, but the overall probability of a loss event is much greater. For Baa-rated debt, the probability that a forced sale will occur at some time over the 5-year horizon is 23.7% if forced to sell upon any downgrade to Ba or lower, and 7.2% under the less aggressive policy of selling upon a downgrade to B or lower.[11] As a result, when we calculate the expected losses under each policy, we find that the more aggressive the sell discipline, the greater the expected losses (columns 5-6). The small decrease in the probability of a large loss due to a default is more than offset by the much larger increase in the probability of losses due to forced sales, even though the loss experienced in each such event is much smaller. As a result, the cumulative expected excess return over the 5-year horizon decreases as the sell discipline becomes more aggressive. For example, A-rated debt has an expected cumulative return of 509bp under the hold-to-default assumption, but this decreases to 505bp under the sell-at-B policy and to 483bp under the most aggressive sell-at-Ba policy. This effect is present, though much smaller, for higher-rated debt, and is even more pronounced for lower-rated debt.

[11] Assuming the proceeds of forced sales will be reinvested complicates the analysis by making it possible to experience more than one loss event over the horizon. Technically, the "cumulative probability of forced sales" reported here is the expected frequency of occurrence of forced sales; the probability of experiencing one or more forced sales to the horizon is slightly smaller.

The largest expected losses from forced sales can be found in the fourth line of Figure 5. When investors who are required to sell upon any downgrade to high yield purchase Baa-rated bonds, the cumulative expected loss from forced selling over the horizon is 165bp. This is due to a combination of two effects. The proximity of the initial rating of Baa to the sell threshold at Ba means that just a single-letter downgrade will trigger a sale, leading to a very high cumulative loss probability of 23.7%. Second, the losses in case of such forced sales will be increased due to the fallen angel effect described above.

As described earlier, Ben Dor and Xu (2010) showed that it is suboptimal to sell immediately upon a downgrade to high yield. The fact that many investors follow such policies creates strong selling pressure for bonds downgraded to high yield, causing them to temporarily drop below their fundamental values. Selling immediately upon a downgrade locks in these losses. As the selling intensity dissipates, however, these price declines tend to reverse, and fallen angels outperform peer high yield bonds.

This behaviour provides motivation for investors to adopt more flexible investment mandates, allowing either continued holding of fallen angels or selling only upon further credit deterioration beyond Ba status. A policy to sell only at a B rating, for example, would allow investors to avoid, at least in part, the high penalty of selling at exactly the "wrong" time.[12] Figure 5 shows that for Baa bonds over a 5-year horizon, changing from a sell-at-Ba policy to a sell-at-B policy helps to decrease the expected loss due to forced sales from 165bp to 72bp, thus increasing the expected return from 570bp to 662bp.

Why do so many investors choose to sell upon any downgrade to high yield despite this performance penalty?[13] By their nature, bond investors tend to be conservative. A large loss event such as a default can be particularly unpleasant for a bond investor or portfolio manager. They would therefore prefer a higher probability of a less extreme loss event such as a forced sale. The risk reduction benefits of an aggressive sell discipline can be seen in the rightmost three columns of Figure 5. The volatility of returns is always decreased by more aggressive selling. We also show tail risk measures, VaR and CVaR, at the 98% confidence level. VaR and CVaR are defined relative to a particular confidence level. The 98% VaR, shown here, is the level of cumulative 5-year return that the bond will exceed with 98% probability. The 98% CVaR is the average return across the 2% of events with returns below this level. The numbers in the rightmost column show that these worst-case returns can be quite unpleasant. For Baa bonds in particular, the tail risk is most extreme in the hold-to-default case, and the use of a sell trigger can limit the losses in these worst-case events.[14]

To illustrate this risk/return trade-off, Figure 6 presents the entire distribution of cumulative loss over a 5-year horizon for Baa-rated bonds, by selling threshold. Investors who systematically sell upon a credit deterioration are less likely to experience large (default) losses; the higher the threshold, the lower the chance of encountering such losses. They are, however, more likely to incur smaller write-downs due to forced selling; the probability of such events increases with the rating threshold. This effect is most pronounced when holding bonds rated just above the sell cut-off (ie, for Baa-rated bonds).

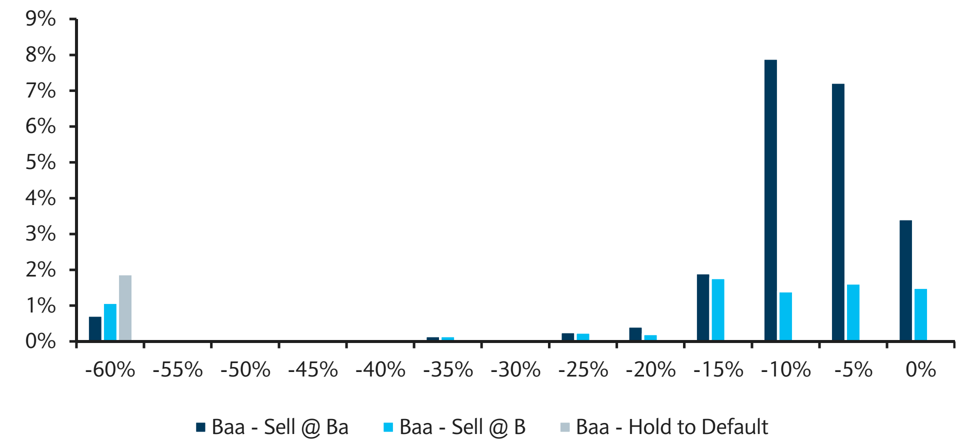
[12] Ben Dor and Xu (2010) showed that spreads of fallen angel bonds widen excessively in the first 0-3 months following a downgrade, but then revert to fair value after 12-24 months. No similar effect was found for a downgrade within HY, such as from Ba to B. To reflect these findings, we assume that if a bond is downgraded in one year to Ba, and then in the subsequent year to B, investors who sell the bond immediately upon the downgrade will suffer the full extent of the selling pressure, modelled as a spread widening of 78bp beyond fair value. However, an investor who sells the bond after the second downgrade from Ba to B is assumed to receive full fair value for a B-rated security.

[13] The above answer to this question focuses on risk. Another contributing factor linked to the strong selling pressure on fallen angels is that the rules governing many standard bond market benchmarks, including the Barclays Aggregate Index, drop bonds at month-end immediately following a fall in index rating to below investment-grade. Continuing to hold such bonds after they have exited the index can lead to an increase in tracking error volatility. To help ease this problem for investors who wish to relax their sell discipline, Barclays has introduced a series of downgrade-tolerant benchmarks that allow fallen angel bonds to remain in the portfolio. See Ng and Phelps (2010) for details.

[14] These effects are not as clear for A-rated bonds. This highlights one drawback of tail risk measures: they do not provide a single number, but a set of risk numbers, for different confidence levels. For A-rated bonds, with default probabilities under 1%, even the 98% and 99% CVaR numbers represent averages over default events and less severe losses.

FIGURE 6

Loss distribution for a 5-year, Baa-rated bond, over a 5-year horizon, by sell discipline

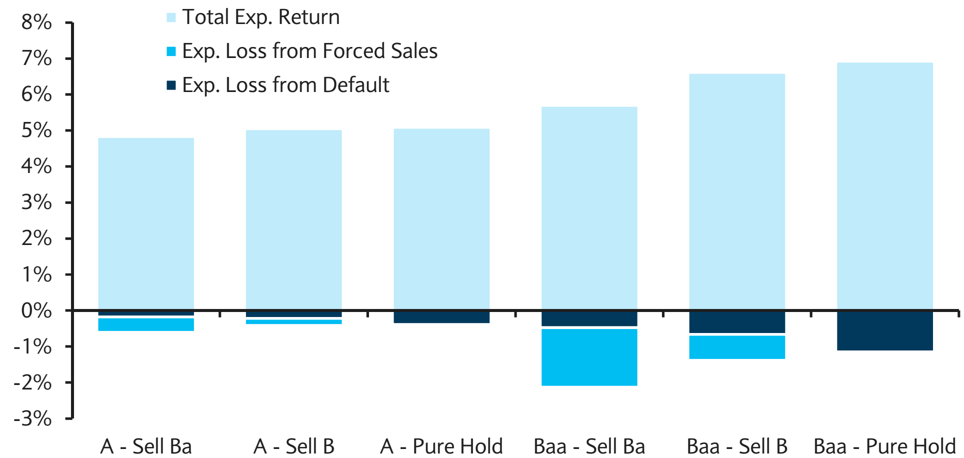


Note: Represents the projected loss distribution for Baa bonds assuming Moody's long-term average transition rates from 1970-2012 and average spreads obtained from Barclays Corporate Bond Index data, adjusted to reflect the same period. We assume a fallen angel penalty of 78bp whenever selling occurs immediately upon a downgrade to HY. Losses from rating transitions are capped at 60%. Calculations assume proceeds from bonds sold upon a downgrade are re-invested in bonds of the original rating. The figure reports results by sell discipline.
Source: Moody's, Barclays Research

Another comparison worth noting in Figure 5 is that across rating classes. The risk-return trade-off positions carry against potential losses from forced sales and downgrades. As a result, the increase in total expected excess return (column 8) obtained by moving down in credit is not as large as that promised by average spread levels (column 2); this effect is exacerbated by an aggressive sell discipline. For example, the average Baa spread is 162bp, which is 47% higher than the average A spread of 110bp. Due to the increased expected losses in lower-rated debt, the expected return advantage is lower: in the hold-to-default case, Baa debt is expected to earn 36% more than A-rated debt (693bp to 509bp); this advantage decreases to 31% under the sell-at-B policy and just 18% under sell-at-Ba. These results are depicted in Figure 7. The length of each bar in the figure represents the full carry return promised by the bond's spread; the part of each bar above the horizontal axis represents the net returns after subtracting expected losses due to forced sales and defaults. All returns are cumulative over a 5-year horizon. Long-horizon credit investors who sell upon a credit deterioration will, on average, incur larger losses from downgrades, but significantly lower default losses relative to pure buy-and-hold investors. Again, this effect is most pronounced when holding bonds rated just above the sell cut-off.

FIGURE 7

Expected cumulative excess returns for 5-year, A- and Baa-rated bonds over a 5-year horizon, by sell discipline



Note: Represents total expected return, expected losses from defaults and expected losses from downgrade for A and Baa bonds assuming Moody’s long-term average transition rates from 1970-2012 and average spreads obtained from Barclays Corporate Bond Index data, adjusted to reflect the same period. We assume a fallen angel penalty of 78bp when selling upon downgrade to Ba. Losses from rating transitions are capped at 60%. Calculations assume proceeds from bonds sold upon a downgrade are re-invested in bonds of the original rating. The figure reports results by sell discipline. Source: Moody’s, Barclays Research

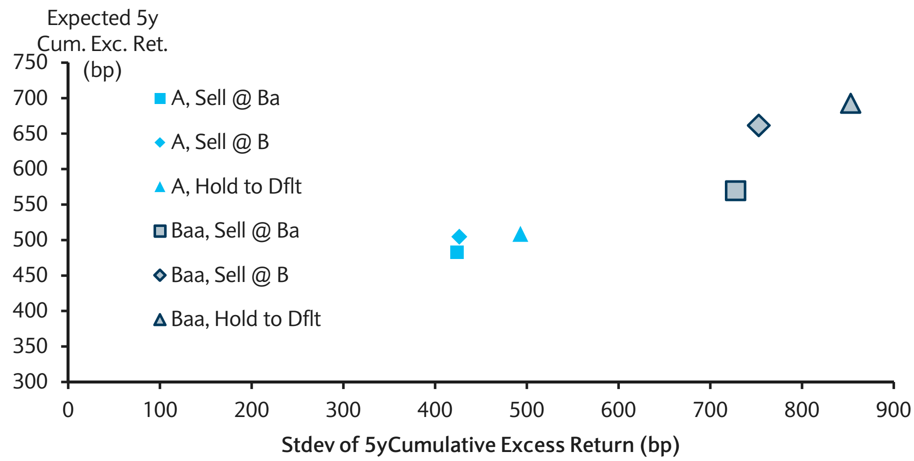
The net effect of the sell discipline on expected return is much more pronounced for Baa-rated debt than for A-rated debt. As a result, the expected return advantage of Baa debt is much more compelling for a pure hold-to-default investor than for one who is forced to sell upon any downgrade to Ba or lower.

In Figure 8, we use the data from Figure 5 to portray the effect of the sell discipline on the risk/return trade-off.[15] We find that, as expected, Baa-rated debt has both greater expected return and greater risk than A-rated debt, regardless of sell discipline. However, the effect of the sell discipline is clear. For bonds in both rating categories, the sell-at-B policy seems to give the best return per unit of risk. Going from there to a hold-to-default policy gives a large increase in risk for a small pick-up in expected return; adopting a sell-at-Ba policy gives a large decrease in expected return and just a small decline in risk. As noted above, this effect is much stronger for Baa-rated than A-rated bonds. Therefore, when comparing the two asset classes on a risk/return basis, the sell discipline will have a strong influence. Investors following a pure hold-to-default policy or a sell-at-B policy may find that although Baa debt carries more risk over the long term, it also promises a sufficient improvement in expected return to justify this additional risk. Under the sell-at-Baa policy, the smaller increase in expected return may make it harder to justify taking on the additional risk.

[15] We use the standard deviation of cumulative 5-year excess return as the measure of risk in Figure 8. The risk/return trade-off may indeed look different (and in this case might favor A-rated bonds even more) were we to choose a tail risk measure at a specific confidence level, such as 98% CVaR, as our primary risk metric. Each investor must decide upon the risk metric (and confidence level, if applicable) most relevant to his/her situation.

FIGURE 8

Risk/return trade-off for A-rated and Baa-rated debt on a 5-year horizon under different sell disciplines



Source: Barclays Research

Maturity effects

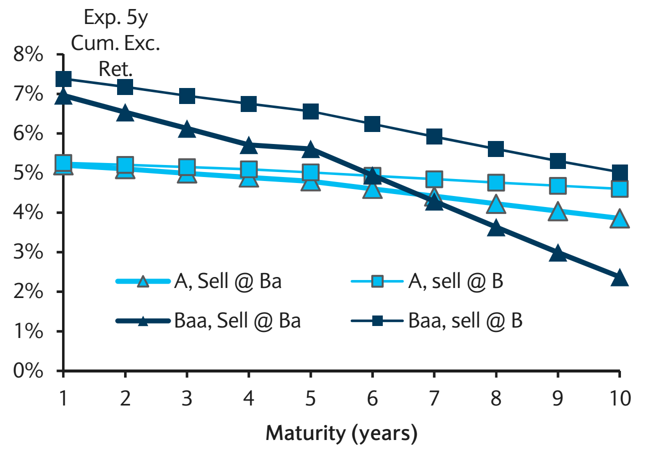
In Figure 4, we saw that the forced sale of a bond upon being downgraded to a given credit quality can have very different effects on performance depending on when it occurs. During the first year of the analysis, when the bond has a relatively long remaining spread duration, the loss upon default is expected to be much greater than in later years, as the spread duration continues to shorten. With this in mind, we can explore how our model represents the effect of investing in credits of different maturities. In Figure 9, we simply vary the maturity of the bond, leaving all other model parameters unchanged. We show the expected cumulative 5-year excess returns for A-rated and Baa-rated bonds, for sell disciplines in which we are forced to sell bonds upon a downgrade to either Ba or B. In all cases, we find that our model shows expected losses increasing with maturity, and thus expected returns decrease for longer bonds.

We must keep in mind that Figure 9 is extremely unrealistic. One of the assumptions that we have relied upon until now was a flat term structure of credit spreads; just a single average spread level is used to represent each quality, regardless of maturity. When we compare one credit quality to another, this simplification is largely immaterial. However, if we are specifically trying to compare bonds of different maturities, it is important to recognize that longer-dated bonds typically have higher spreads. Depending on the slope of the spread curve, this effect could largely offset the decreasing trends shown in this figure.

However, even with these limitations in mind, we can pull some valuable lessons from Figure 9. For A-rated bonds, which are far from either sell threshold, the decline in expected performance with increasing maturity (at unchanged spread) is rather mild; the difference between the results for the two sell disciplines is small as well. For Baa-rated bonds, both effects are much stronger: the decrease in performance for longer-maturity bonds is striking, and the choice of the sell discipline has much greater performance implications. In fact, for investors forced to sell any bond downgraded to HY, we see that the expected losses due to forced sales are sufficiently large to entirely offset the spread advantage of Baa bonds over A-rated ones at longer maturities, leaving the A-rated bonds with higher expected cumulative excess returns over the 5-year horizon. This suggests that such investors, to the extent that they buy Baa-rated credits, should prefer shorter maturities.

FIGURE 9

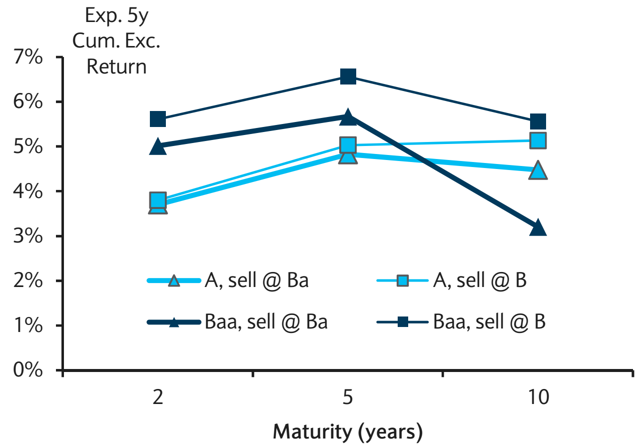
Effect of bond maturity on 5-year cumulative expected excess returns, under a flat term structure assumption



Source: Barclays Research

FIGURE 10

Effect of bond maturity on 5-year cumulative expected excess returns, including term structure of spreads



Source: Barclays Research

In Figure 10, we repeat this analysis, this time with an adjustment for a typical term structure of spreads. Based on a long-term analysis[16] of spreads of corporate bonds with different ratings in three maturity buckets (1-3 years, 3-7 years, and 7-10 years), we used average spreads of 81bp, 110bp and 119bp for A-rated bonds with nominal maturities of 2, 5 and 10 years, respectively. The corresponding spreads for Baa-rated bonds were 131bp, 162bp and 169bp. We used these numbers to represent the average spreads of the different asset classes; this introduces a return incentive for moving out on the curve, which offsets the increase in expected losses from forced sales shown in Figure 9. The net result of these competing forces is shown in Figure 10. The effect of extending from 2-year to 5-year maturities seems to be net positive in all four cases shown; the net effect of a further extension to 10 years is positive for A-rated bonds with a sell-at-B policy but negative for the other three cases shown. The inclusion of the term structure of spreads does not seem to negate the primary conclusion of Figure 9: long-horizon investors with a sell-at-Ba policy in place should avoid buying Baa credits with long maturities.

Moving beyond long-term averages

The framework presented thus far allows investors to evaluate the long-term performance implications of the sell discipline adopted for dealing with distressed credits, and to examine the risk/return trade-off among different credit asset classes under a specific policy. However, a number of the simplifying assumptions we have made are rather limiting and need to be adjusted.

First, all the numbers presented up to this point are based on long-term averages. The credit transition matrices that underlie this approach were 40-year averages obtained from Moody's, and the spreads were long-term averages adjusted to be consistent with the same period of time. This may help to set investment policy over a very long horizon. However, most portfolio investment decisions and analysis are more immediate in nature. Even a manager with a long return horizon such as 5 years will want to examine the projected risk and return of his portfolio over the 5 years starting today. Our best projection of expected excess returns cannot be based solely on long-term average spreads: it must account for the spreads currently available in the market.

[16] The long-term average spreads for the 5-year maturity are assumed to be equal to the long-term average spreads reported earlier in Figure 2 and Figure 5. To approximate the term structure of spreads, we used US Corporate Index data to produce time series of average spreads for each quality in three maturity buckets from May 1993 through November 2013. We computed the ratio of short-maturity to medium-maturity spreads, and a similar long-to-medium spread ratio each month. We then took the median values of this spread ratio over this relatively short time period and multiplied them by the longer-term average levels for the 5-year cell to obtain the representative spread levels shown above.

Second, we have essentially assumed that as time progresses, nothing changes but ratings. Not only do the average spreads of each rating category remain unchanged, but transition rates are kept constant at unconditional long-term averages. In practice, spreads, as well as transition rates, would be anything but constant, affecting carry, downgrade losses, etc.

Can we improve on this model? Can we use an intuitive observable, such as current spread levels, to better estimate transition rates and spreads in the upcoming and subsequent years? We begin by studying the predictive power of spreads.

The predictive power of spreads

In this section, we examine the historical relationships between the spreads of corporate bonds and the various contributors to corporate bond risk: default probabilities, ratings transition rates, and the cost of a downgrade, as represented by the spread differences between different ratings. We find clear connections among all of these quantities over the short term, which tend to dissipate with the passage of time. These results suggest that the information contained in spreads can be used to estimate conditional values for the various parameters of our model.

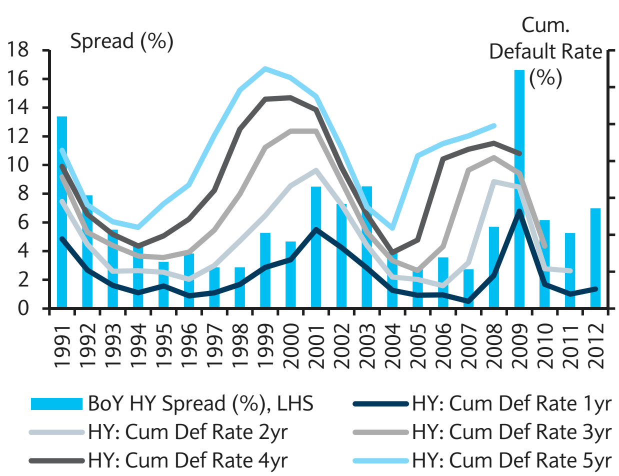
Spreads and default risk

We first study the relationship between corporate default rates and credit spreads. We utilize two main sources of data: historical spreads from Barclays Corporate and High Yield Bond Indices and Moody's reported cumulative issuer-weighted default rates by annual cohort over 1991-2012.[17] Figure 11 plots the beginning-of-year spreads of the Barclays High Yield Index versus Moody's high-yield cumulative default rates for the corresponding annual cohorts over 1-, 2-, 3-, 4-, and 5-year horizons. Figure 12 presents the same information for investment grade issuers.

For both rating groups, a clear positive relationship emerges for short and medium horizons (1-2 years). Purchasing bonds when spreads are high is clearly associated with higher-than-average default rates over a horizon of 1 or 2 years. The same waves of elevated defaults during crisis periods can be seen in the data for longer-horizon cumulative defaults, except

FIGURE 11

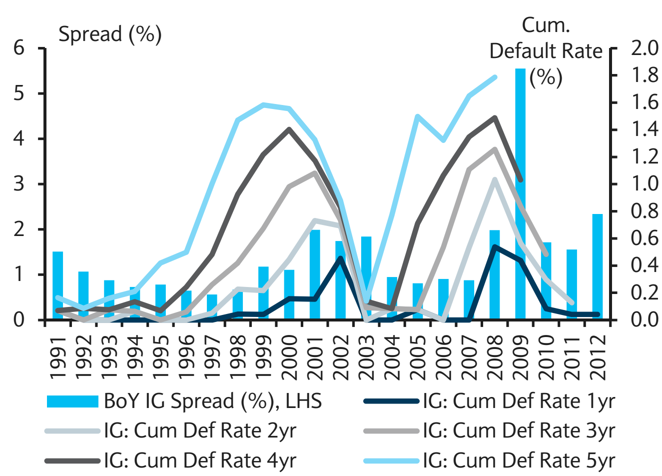
Moody's cumulative default rates vs. beginning-of-year spreads by annual cohort: High Yield



Source: Moody's, Barclays Research

FIGURE 12

Moody's cumulative default rates vs. beginning-of-year spreads by annual cohort: Investment Grade



Source: Moody's, Barclays Research

[17] Default rates for annual cohorts are obtained from "Annual Default Study: Corporate Default and Recovery Rates, 1920-2012", Moody's Investors Service, February 28, 2013, Exhibit 41, using summary data for investment grade and high yield debt. We have chosen to base our study on default rates rather than the annual number of defaults. The results of a study based on default counts might be misleading, since the number of issuers varies over time.

that they no longer line up well with spreads as of the start of the period. For example, the high cumulative 5-year realized defaults ultimately realized by the 1998 cohort make sense because they include results from the dot-com crisis of 2001-02. However, the low spreads as of the beginning of 1998 gave no indication of the future crisis.

The patterns observed in Figure 11 and Figure 12 translate into high positive correlations between beginning-of-period spreads and realized defaults over short horizons. For 1-year realized defaults, these correlations are 0.84 and 0.63 for high yield and investment grade, respectively, and in year 2, they are 0.12 and 0.18. By year 3, the relationship has dissolved, and correlations have gradually become negative.

These results suggest investors can improve on unconditional historical default frequencies for predicting default rates on 1- and 2-year horizons by utilizing information from current spread levels. Our results also illustrate just how difficult it is to make a 5-year prediction based on current spreads. An investor at the start of 1998 or 2006 saw very low spreads, which gave no clue as to the crises that later unfolded. Similarly, investors in high spreads at the start of 2003 and 2009 had no clear indication of future improvement.

Spreads and downgrade risk

Given the rarity of defaults from investment grade status, the risk of a downgrade to speculative grade rating is clearly more prominent for managing a high-grade credit portfolio. We demonstrated that spread levels are closely tied to default frequencies at horizons of one or two years: can investors utilize information incorporated in current spreads to estimate the conditional probabilities of downgrades as well? Do spreads also predict transition rates?

For this study we utilize data on bonds in Barclays Corporate and High Yield Indices for 1991-2013. We construct issuer-level data by aggregating all outstanding bonds for an issuer each month using market-value weighting. We then compose annual cohorts by rating and compute empirical frequencies of rating transitions over horizons of 1-5 years.

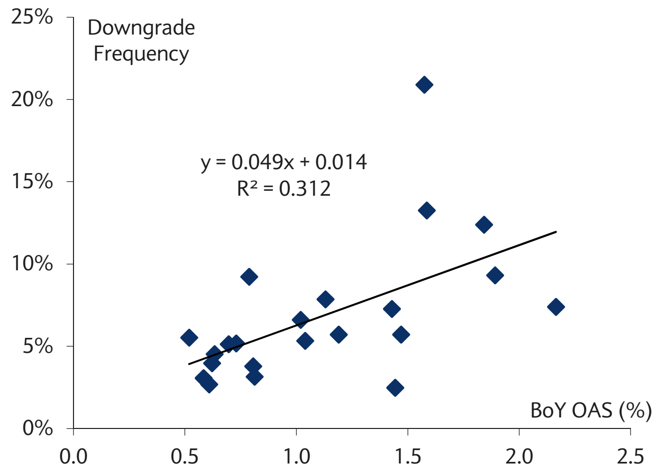
Figure 13 plots the realized 1-year downgrade frequency against the beginning-of-year spread level for A-rated issuers from different annual cohorts. Spreads are market value-weighted averages of outstanding bonds. Frequency includes all downgrades to a lower full-letter-grade rating in the corresponding year.[18] We find strong visual evidence of a trend towards higher downgrade frequencies when spreads are higher. Nevertheless, the observed outcomes can be quite far from the trend line. For example, near the center of Figure 13 there is a vertical strip of observations representing cohorts with similar beginning-of-year spreads of 140-160bp, but very different realized downgrade rates, ranging from 2.48% for the 2010 observation to 20.90% in 2003. Figure 14 shows the corresponding data for Baa-rated issuers. We find similar results: higher downgrade rates for higher spreads, but no strong convergence to a specific linear relationship.

We note that in Figure 13 and Figure 14, we have omitted the datapoint corresponding to the 2009 cohort, which is a clear outlier. Corporate spreads at the start of 2009 were unusually high: 488bp for A-rated bonds and 698bp for Baa. Realized downgrade rates were not nearly as high as might have been expected based on these spreads: 14.61% for A-rated issuers and 5.29% for Baa. These levels would be far to the right of all of the observations shown in these figures, but not particularly high up; they would thus strongly bias the

[18] One distortion inherent in this type of analysis is that a one-notch downgrade from A3 to Baa1 counts as a downgrade, while a two-notch downgrade from A1 to A3 does not. Nevertheless, as the ratings boundaries used for setting investment policy usually occur at full-letter-grade transitions, we believe this to be the relevant approach.

FIGURE 13

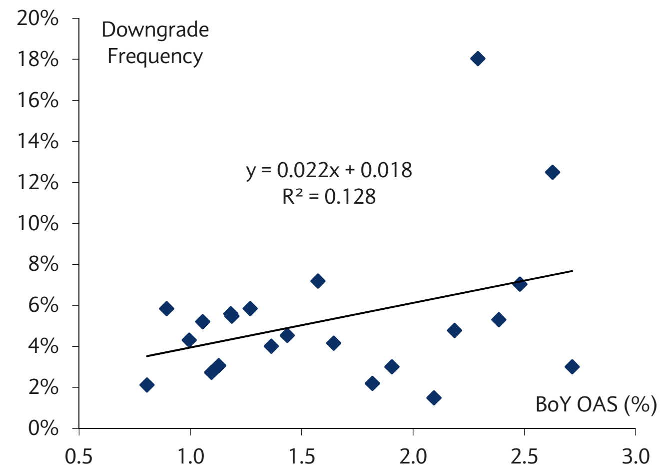
Dependence of 1-year downgrade frequency on beginning-of-year spreads for A-rated issuers



Note: Based on annual data from Barclays US Corporate Bond Index, 1991-2013, excluding 2009. Source: Barclays Research

FIGURE 14

Dependence of 1-year downgrade frequency on beginning-of-year spreads for Baa-rated issuers



Note: Based on annual data from Barclays US Corporate Bond Index, 1991-2013, excluding 2009. Source: Barclays Research

results.[19] Furthermore, a large part of the elevated spreads at the start of 2009 was due to the lack of liquidity in the market, rather than default concerns.[20] For both of these reasons, we have chosen to exclude the 2009 cohort from this analysis.

The results of linear regression analysis of the relationship between spreads and downgrades are shown as trend lines in Figure 13 and Figure 14. In each case, we can also calculate the correlation coefficients between beginning-of-year spreads and realized downgrade rates in the subsequent period. The resulting coefficients, again excluding 2009, are 56% for A-rated bonds and 36% for Baa-rated bonds.

What if we try to predict downgrades beyond the 1-year horizon? To address this question, we continue to track our issuer cohorts over longer periods. For each annual cohort, we track realized downgrade rates in year 1 as described above. We then calculate the realized Baa downgrade rate for year 2 using only issuers with a Baa rating as of the beginning of both years 1 and 2, and a non-missing rating at the end of year 3. We continue in this fashion to obtain realized downgrade rates for years 3, 4 and 5 after the initial formation of the cohort (and the observation of the beginning-of-period spread). We then calculate the correlation between the downgrade rates experienced by each annual cohort in year *n* with the spread as of the cohort formation date. The results obtained for A-rated and Baa-rated issuers are shown in Figure 15. For both qualities, we show strong positive correlations between beginning spreads and subsequent downgrade rates in both year 1 and year 2. However, as seen with defaults, there is a strong drop-off in this correlation in year 3, and by years 4 and 5 the correlation is slightly negative. It seems that two years is a long time in the context of the credit cycle; when we try to look beyond two years forward, there is little confidence that the state of the credit markets will resemble current conditions.

We can extend our cohort study to look at spreads as well. To what extent does the Baa spread today correlate with Baa spreads *n* years in the future? To make sure we are comparing the spreads of the same bonds at two different points of time, and not two

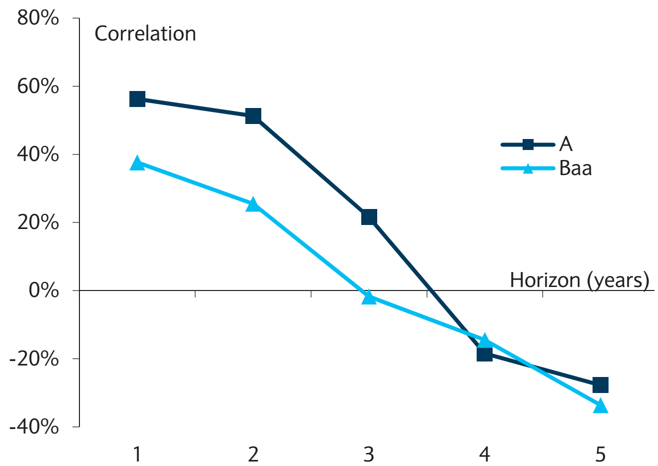
[19] The much higher downgrade rates for A-rated bonds over Baa-rated bonds in 2009 is due to a preponderance of A ratings among the many financial issuers that experienced downgrades in that year. Including 2009 would reduce the calculated slope of the dependence for both A and Baa bonds, but this effect would be much stronger for Baa because that downgrade rate was essentially on par with long-term averages despite record high spreads.

[20] This is corroborated by the large negative basis at that time between the spreads of cash bonds and CDS. The strong role of the liquidity component in the high spreads of 2008-9 was demonstrated in Dastidar and Phelps (2010).

different bond populations, we form a cohort of bonds outstanding at time *t*, and then revisit the same set of bonds *n* years later. From within this set of bonds, we find an average spread level corresponding to each whole-letter quality rating at both the beginning and end of the period. We carry out this analysis for cohorts starting in January of each calendar year from 1991 through 2013, for horizons of 1 through 5 years.[21] We then compute the correlations between beginning spread and horizon spread for each quality and horizon. The results are reported in Figure 16. We once again find that today's spreads are highly correlated with spreads 1 year or 2 years into the future, but that this correlation disappears and turns negative by the end of year 3.

FIGURE 15

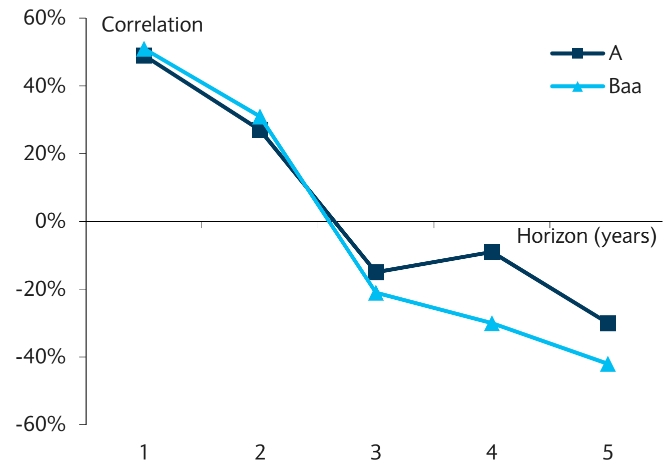
Correlation of downgrade frequencies with spreads, by credit quality and horizon



Note: Based on annual data from Barclays US Corporate Bond Index, 1991-2013, excluding 2009. Source: Barclays Research

FIGURE 16

Correlation of current spreads with future spreads, by credit quality and horizon



Note: Based on annual data from Barclays US Corporate Bond Index, 1991-2013, excluding 2009. Source: Barclays Research

These results are consistent with direct analysis of the time series of corporate spreads, which demonstrates a strong tendency towards mean reversion, with a time frame consistent with the above results.[22]

In this section, we have documented a positive relationship between spread levels and downgrade frequencies. Based on empirical studies using aggregated rates of downgrades to any lower rating, we have strong evidence suggesting that transition probabilities are different in different spread environments. However, to support an analysis of downgrade risk, such as the one we developed in the first section of this article, investors typically depend on complete transition matrices such as those published periodically by the rating agencies. How can one construct a complete transition matrix conditional on the current spread environment?

To answer this question, we sort the years in our sample by their respective overall 1-year probability of downgrade, and classify the top and bottom quartiles of years as "high" and "low" downgrade states. We classify the years 1993-94, 1996-97, 2010 and 2013 as the "low" state, while 1999, 2001-03 and 2008-09 comprise the "high" state. We can pool the realized one-year issuer transition data from our index database to form a separate historical transition matrix from each of these subsets of the overall time period. Figure 17

[21] We eliminate spread observations as of the beginning of January 2009 from this analysis. To do so, we drop both the cohort beginning on this date, as well as the observations from prior-year cohorts whose spread change horizon occurs on that date.

[22] For example, see Longstaff and Schwartz (1995). The authors demonstrate consistent mean reversion towards a long-term average by regressing monthly changes in log spreads against beginning-of-month log spreads. They report a half-life of convergence towards the mean ranging from 0.7 to 1.0 years for industrial bonds and from 1.5 to 4 years for utility bonds. Our own similar study of corporate spreads gives a half-life between 1 and 2 years.

presents the average 1-year empirical transition rates for the "high" and "low" states, as well as the average long-term transition matrix reported by Moody's for 1970-2012. We note that as we move further off the diagonal, the number of observations upon which the downgrade rates are calculated declines considerably, reducing the accuracy of our estimates. Furthermore, index issuers are largely concentrated in the A-Baa rating groups, so the numbers shown for these qualities should be the most accurate. As expected, based on the way these matrices were constructed, downgrade frequencies are significantly higher (lower) across the board in the "high" ("low") state than in the long-term average matrix. Conversely, the frequencies of unchanged ratings or upgrades tend to be below (above) average in the "high" ("low") state.

FIGURE 17

One-year transition matrices calculated empirically based on data from "low", "medium", and "high" downgrade states, compared with Moody's long-term transition matrix

Low Downgrade Probability	Aaa	Aa	A	Baa	Ba	B	Caa	Ca-C
Aaa	98.4%	0.8%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%
Aa	0.0%	92.6%	7.2%	0.2%	0.0%	0.0%	0.0%	0.0%
A	0.1%	1.4%	94.5%	3.7%	0.3%	0.1%	0.0%	0.0%
Baa	0.1%	0.1%	5.8%	91.4%	2.4%	0.1%	0.1%	0.0%
Medium Downgrade Probability	**Aaa**	**Aa**	**A**	**Baa**	**Ba**	**B**	**Caa**	**Ca-C**
Aaa	90.0%	10.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Aa	0.4%	88.3%	11.0%	0.2%	0.0%	0.0%	0.0%	0.0%
A	0.0%	3.3%	90.8%	5.5%	0.3%	0.1%	0.0%	0.0%
Baa	0.0%	0.2%	5.5%	89.6%	3.9%	0.6%	0.1%	0.0%
High Downgrade Probability	**Aaa**	**Aa**	**A**	**Baa**	**Ba**	**B**	**Caa**	**Ca-C**
Aaa	88.0%	12.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Aa	0.8%	72.2%	25.6%	1.1%	0.3%	0.0%	0.0%	0.0%
A	0.2%	2.0%	84.7%	11.7%	1.0%	0.2%	0.1%	0.0%
Baa	0.1%	0.0%	2.8%	87.1%	7.8%	1.5%	0.6%	0.0%
Moody's 1970-2012	**Aaa**	**Aa**	**A**	**Baa**	**Ba**	**B**	**Caa**	**Ca-C**
Aaa	90.8%	8.5%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%
Aa	1.0%	89.5%	8.9%	0.5%	0.1%	0.0%	0.0%	0.0%
A	0.1%	2.6%	90.7%	5.8%	0.6%	0.1%	0.0%	0.0%
Baa	0.0%	0.2%	4.4%	90.0%	4.3%	0.8%	0.2%	0.0%

Note: The top three categories are empirical transition matrices computed using index issuer data from selected years of our data sample. "Low" and "High" downgrade probability states are formed from the years with the smallest and highest total downgrade rates, respectively, across our sample years 1991-2013. "High" state years include: 1999, 2001-03 and 2008-09. "Low" state years are: 1993-94, 1996-97, 2010 and 2013. The bottom table shows Moody's long-term average transition rates over 1970-2012. Source: Moody's, Barclays Research

In Figure 18, we compare the overall A and Baa downgrade frequencies in the three downgrade states to their long-term averages from the Moody's matrix. We also calculate the average spreads in each of these sub-periods and compare these with the long-term average spreads from Figure 1. We then express each of these quantities, for each downgrade state and quality rating, as a ratio relative to the long-term average. We find that in the "high" downgrade state, downgrade frequencies are roughly double the long-term average, and in the "low" state, they are about half. Consistent with our findings in Figure 13 and Figure 14, spreads are also about double their average levels in the high-downgrade state. The low and medium downgrade states do not have significantly different beginning spreads.

FIGURE 18

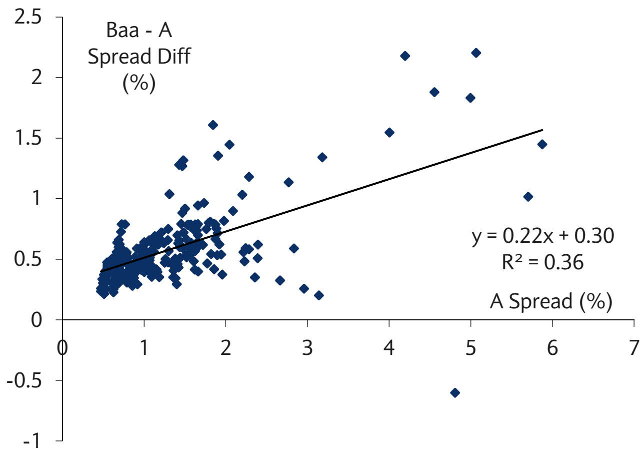
Ratios of downgrade frequencies and spreads in "high" and "low" downgrade states to corresponding long term averages

	Low-State		Medium-State		High-State		Moody's Long-Term	
	A	Baa	A	Baa	A	Baa	A	Baa
Downgrade Frequency	4.1%	2.6%	5.8%	4.6%	13.0%	9.9%	6.59%	5.47%
Average BOY OAS	1.10	1.74	1.20	1.66	2.42	3.26	1.10	1.62
Downgrade Freq / Long-Term Rate	0.62	0.48	0.89	0.84	1.98	1.82		
BoY OAS / Long-Term Avg	1.00	1.07	1.09	1.02	2.20	2.01		

Note: The figure reports overall empirical downgrade frequencies in the three different downgrade states for A-rated and Baa-rated bonds, and compares these with the long-term average frequencies from Moody's long-term transition matrix (1970-2012). Similarly, average spreads over these three states are compared with long-term average spreads. Downgrade frequencies include the sum of all transitions from the specified rating to lower whole-letter grade ratings based on the matrices shown in Figure 17. Ratios are used to express the downgrade frequencies and spreads in each state relative to the long-term averages. Source: Moody's, Barclays Research

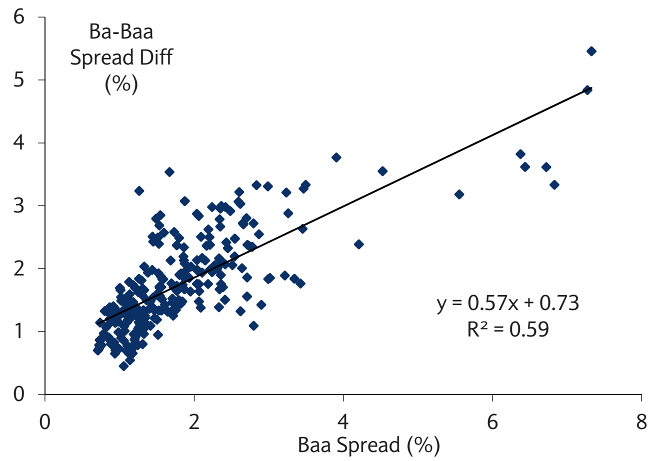
We have established that high-spread environments are associated with high probabilities of downgrades and, hence, forced sales. However, expected losses from forced sales are determined not only by the probabilities of such events but by the magnitude of the loss realized upon such events; in times of stress, these can be elevated as well. We have modelled the loss upon a downgrade as proportional to the spread differential between the average spreads in the different quality ratings. Typically, periods of heightened credit risk are characterized not only by higher spreads, but also by greater average spread differentials between different quality ratings. This is illustrated in the following pair of figures: Figure 19 plots the differential between the average spreads of Baa-rated and A-rated credits against the A spread; Figure 20 plots the Ba to Baa spread difference against the Baa spread. In both cases, wider spreads are associated with steeper spread differences. This means that a high-spread environment carries a two-pronged increase in the risk of forced sales: not only is the risk of a downgrade elevated, but the loss realized upon such a downgrade is likely to be larger as well.

FIGURE 19
Baa-A spread difference vs. spread level of A-rated bonds



Source: Barclays Research

FIGURE 20
Ba-Baa spread difference vs. spread level of Baa-rated bonds



Source: Barclays Research

The enhanced "Try-and-Hold" model

In the first section of this article, we presented a framework for evaluating portfolio losses for "try-and-hold" investors that explicitly considers the risk of downgrades and forced sales in addition to outright defaults. However, we limited ourselves to a through-the-cycle analysis, assuming a static environment based on long-term averages. Transition rates were set to unconditional long-term average levels, regardless of the spread environment, and kept constant throughout the investment horizon. Similarly, spreads were assumed to remain at their initial levels. In the previous section, we found empirical evidence that current spreads can help form expectations for transition rates and spread changes over the near term. In this section, we show how our "try-and-hold" framework can be modified to incorporate the results of our empirical analysis.

Model enhancements

Our empirical analysis has shown that current spread levels are highly correlated with future spread levels, and with transition rates, at horizons of 1-2 years. Higher spreads are associated with higher downgrade frequencies and higher future spreads. Therefore, we now require both current and long-term average spread levels as inputs to our model. The level of the former versus the latter determines the current market "state" and, consequently, the value of new transition rate adjustment parameters. We impose a simple structure on the transition matrix in which a single constant scales up the probability of all downgrade transitions, and a second – the probability of upgrades. Figure 21 shows the result of perturbing the 1-year transition matrix to reflect modified estimates of transition probabilities corresponding to a high-downgrade state of the environment. In Figure 18, we found that in such an environment, downgrades are roughly twice as frequent as average and upgrades are about half as frequent. Therefore, for this example, we set our downgrade scalar to 2 (and upgrade scalar to 0.5) – and adjust probabilities of unchanged ratings (along the diagonal) such that each row sums to 100%.

FIGURE 21

Perturbed transition matrix example: high spread environment

Long-Term Transition Matrix

	Aaa-Aa	A - Baa	Ba - B	Caa - D
Aaa - Aa	95.20%	4.80%	0.05%	0.02%
A - Baa	1.50%	95.40%	2.90%	0.24%
Ba - B	0.10%	3.60%	89.60%	6.80%
Caa - D	0.00%	0.10%	4.60%	95.40%

Downgrades Scaled by 2

Upgrades Scaled by 0.5

Perturbed Transition Matrix

	Aaa-Aa	A - Baa	Ba - B	Caa - D
Aaa - Aa	90.26%	9.60%	0.10%	0.04%
A - Baa	0.75%	92.97%	5.80%	0.48%
Ba - B	0.05%	1.80%	84.55%	13.60%
Caa - D	0.00%	0.05%	2.30%	97.65%

Source: Barclays Research

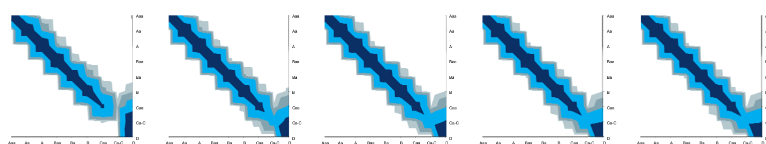
We have further found a strong relationship between spread levels and downgrade rates. To reflect this, we represent the state of the environment by the ratio of current spread levels to their long-term averages. We use this ratio as the downgrade multiplier, and its reciprocal to scale the rate of upgrades. However, as shown in Figure 15 and Figure 16, the correlation between today's spreads and future downgrade rates (or spreads) declines over time and has mostly dissipated by year 3. This motivates the incorporation of a mean reversion parameter, which controls the evolution of both spreads and transition rates.

FIGURE 22

Example: applying different transition matrices in different years

Year:	1	2	3	4	5
Downgrade Multiplier:	200%	141%	119%	109%	104%

Transition Matrix:



Source: Barclays Research

In Figure 22, we illustrate how the technique of chaining five year-by-year transition matrices introduced in Figure 3 can accommodate the results of our empirical studies. If high current spreads are double their long-term rates, indicating that we are in a high-downgrade-frequency environment, we perturb the transition matrix used for the first year of the analysis by a downgrade multiplier of 200% to reflect the higher probabilities of downgrades. This is illustrated by stronger upper off-diagonal elements in the matrix used for year 1. We then incorporate the mean reversion effect by reducing the downgrade multiplier in subsequent years of the analysis.[23] In the example shown, we have converged to something very close to the long-term average transition matrix by year 3 of the analysis.

Note that the mean reversion assumption affects our expectation of spreads as well as conditional downgrade frequencies. Spreads will also be assumed to converge to their long-term averages. The spreads assumed to be in place at different points in time will affect the

[23] The mean reversion assumption shown here reflects exponential convergence in log spreads, with a half-life of one year, consistent with the model of Longstaff and Schwartz (1995).

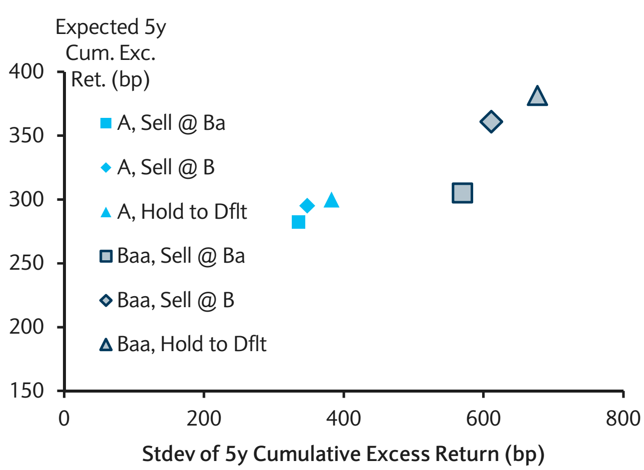
size of the loss experienced upon any forced sale event and the spread to be earned when reinvesting the proceeds of any loss.

We now show how our model can be used to condition the long-horizon risk/return analysis on a particular spread environment, incorporating the results of our empirical studies. We use the model to reproduce the risk/return trade-off between an A-rated and a Baa-rated bond under different sell disciplines, which was shown in Figure 8 using long-term averages. Now, however, we condition the model on the spread environment at a particular point in time. Figure 23 provides an example from a low-spread environment, using spreads as of the end of January 2007; Figure 24 gives a high-spread example, using spreads as of the end of November 2011. In each case, the model has been conditioned on spreads as follows. We start with the Moody's long-term transition matrix based on data from 1970-2012. We then input to the model two distinct sets of spreads: the long-term average spread per quality, as shown in Figure 2, and the current average spread per quality as of a particular point in time. We then use the ratio of current to long-term spreads to perturb the transition matrix used for the first year, as illustrated in Figure 21.[24] For subsequent years of the analysis, we assume that the spreads and downgrade multipliers for each quality converge towards their long-term averages as shown in Figure 22; the transition matrices are recalculated for each subsequent year based on the spreads assumed to pertain. (As a result, the transition matrix should also converge towards the long-term average.)

The first difference between the two figures is the scale of the two axes. The high-spread environment shown in Figure 24 is characterized by much higher levels of both risk (as measured by standard deviation of cumulative 5y excess return) and expected return than the low-spread environment of Figure 23. However, the relationship between the results for different asset classes and sell disciplines does not scale linearly; in the different spread environments, some conclusions remain consistent while others can be very different. When comparing performance using the three sell disciplines considered according to this risk metric, the sell-at-B discipline seems to offer the best risk/return trade-off for both A and Baa bonds, in both low-spread and high-spread environments. However, the size of this effect, as well as the relative performance of A and Baa assets, appear very different. In the

FIGURE 23

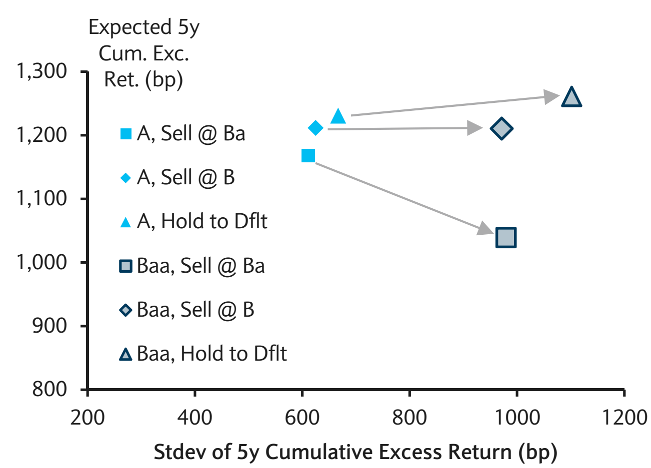
Modeled risk/return trade-off by quality and sell discipline, for a 5y bond on a 5y return horizon, conditioned on a low-spread environment (as of January 31, 2007)



Source: Barclays Research

FIGURE 24

Modeled risk/return trade-off by quality and sell discipline, for a 5y bond on a 5y return horizon, conditioned on a high-spread environment (as of November 30, 2011)



Source: Barclays Research

[24] The ratio of current spreads to long-term spreads varies by quality. In this analysis, unlike the simpler uniform rule depicted in Figure 21, we rescale each row of the transition matrix using a different downgrade multiplier, set equal to the appropriate spread ratio for each quality.

low-spread environment, extending from A to Baa credits brings both increased risk and increased expected return, regardless of the sell discipline; for investors forced to sell at Ba, the pickup in expected return is smaller, and possibly not worth the risk, but it is positive nonetheless. In the high-spread environment, the expected losses from forced sales have a stronger negative effect on Baa-rated assets. In this case, a Baa bond has just slightly larger expected return than an A-rated bond when using the sell-at-B or hold-to-default disciplines, but significantly worse expected returns under the sell-at-Ba discipline. For investors forced to liquidate any bond downgraded below IG, this analysis suggests strongly against purchasing Baa-rated bonds in a high-spread environment.

Comparing the two figures, though, we find a suggestion that the high-spread environment may offer an excellent opportunity to buy A-rated debt. The level of risk shown for A-rated debt in this case, about 600-700bp, is similar to that shown for Baa-rated debt in the low-spread environment, but it comes with significantly higher expected returns (about 1200bp over the 5-year horizon, as opposed to 300-400bp for Baa-rated bonds in the low-spread environment).

Conclusion

We have developed an approach to modelling risk and expected return in credit portfolios over a relatively long horizon that stakes out a middle ground between monthly mark-to-market risk measurement and pure hold-to-default analysis. This approach is relevant to mandates in which bonds are typically purchased to be held for an extended period of time, but sold early if the credit degrades beyond a certain point. We believe this description applies to a majority of credit portfolios, and that this modelling approach should therefore be widely relevant.

The main point we would like to emphasize is that the sell discipline enforced for liquidation of distressed credits can have a profound effect on the long-term performance characteristics of different credit asset classes. Consideration of these effects can be applied at different points in the portfolio decision process. Ideally, they should be considered when establishing the sell discipline for a portfolio. As we have concluded in earlier studies, “fallen angel” bonds downgraded from IG to HY are subject to selling pressure immediately after the downgrade event; a policy that requires immediate forced selling of such bonds is therefore suboptimal. However, even after such a policy is chosen, it is still important to model its effect. For example, the asset allocation decision among different IG asset classes can and should be influenced by the sell discipline that is imposed.

Our model recognizes the importance of forced sales in determining the loss distribution in credit portfolios. We use credit ratings as the primary representation of credit quality; it is therefore important to use a complete transition matrix to model loss events, rather than simply focusing on the risk of default. Furthermore, we have found strong empirical evidence that credit transitions, at least over the short term, are strongly linked to spread levels. We therefore need a mechanism by which to estimate the best available transition matrix conditioned on the current spread environment.

Our empirical results, based on data from the past 20-30 years, indicate that high spreads signal greater risk of credit losses in several ways. Not only do high spreads indicate greater frequencies of defaults and downgrades over the next 1-2 years, but high spreads also tend to be accompanied by high spread differentials between different quality ratings, increasing the severity of loss upon a forced sale as well as the likelihood of such events. These effects are especially harmful when purchasing Baa bonds under a sell discipline that would require selling them immediately upon a one-letter downgrade to Ba; they are exacerbated when investing in long maturity bonds. However, we have also found a strong tendency for spreads and downgrade rates to mean revert within about 2-3 years. This means that long-term risk does not increase by as much as spread, and that periods of high spreads may indeed be viewed as buying opportunities – but perhaps with a bias towards shorter maturities and/or higher qualities.

Bonds near the threshold for forced selling are most sensitive to increased risk. Our model includes a performance penalty based on empirical evidence of the selling pressure experienced by “fallen angel” bonds. Results of this model seem to suggest that a more relaxed selling discipline that allows bonds to be held in the portfolio until they are downgraded to B should tend to outperform the more widely used sell-at-Ba discipline. For investors who retain the sell-at-Ba discipline, our model suggests that depending on the level of spreads and the shape of the spread curve, it may be advisable to adopt a bias towards A-rated rather than Baa-rated credits, or to bias the Baa holdings to shorter maturities. Furthermore, these biases should be strengthened in elevated risk environments.

This article presents just the bare bones of the model and attempts to illustrate some of the fundamental effects that must be considered. However, the model constructed here is not a complete model of long-horizon risk for a credit portfolio because it is subject to some very limiting assumptions. First of all, we have limited ourselves to modelling the loss distribution of a single bond, not a portfolio. Second, the spread scenarios that we considered here concerned only expectations. In the first section of the article, we used long-term spreads and assumed them to be static; in the final section, we relaxed this assumption to allow conditioning on current spreads, with mean reversion to the long-term mean. This is reasonable concerning the expected path of spreads, but it does not begin to model all the possible evolutions of spreads over our return horizon, which may include some major spread widenings that would in turn imply a systematic increase in downgrade frequencies. We plan to demonstrate in a follow-up article a further extension of the “try-and-hold” model that measures risk at the portfolio level while addressing these additional issues.

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