Portfolio and Index Strategies During Stressful Credit Markets

January 23, 2004

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- As a result of the stressful credit markets of 2001 and 2002 many valuable lessons were learned and new portfolio management strategies were adopted that will remain standard portfolio management practice for the future.
- Investors and plan sponsors now closely examine their benchmarks for large single issuer concentrations. While issuer-capped portfolios have long had a role to play, issuer-capped benchmarks are new and here to stay. Care must be taken when constructing issuer-capped benchmarks as the cap level and the redistribution rule have significant impacts on the risk and return performance of the benchmark. Lehman Brothers has developed tools to allow construction of a variety of custom issuer-capped indices.
- Periods of stressful credit markets draw attention to the issue of replicability of the Corporate Index. Does the index possess a performance advantage because it can immediately remove fallen angels whereas a manager needs time to sell? We measured the magnitude of the performance bias and found that the bias is typically small, but not negligible. However, the bias is volatile and can, at times, be positive or negative. If plan sponsors are willing to give managers time to work out of downgraded issues, they should give managers at least six months.
- Since many investment-grade investors are required to eventually sell fallen angels, when was the best time to sell? We examined the optimal holding period and performance of fallen angel issues across many dimensions. We found that the performance results vary greatly across fallen angel issues. There were no clear decision rules as to which type of fallen angels to hold or sell, or the best time to sell.
- During stressful credit markets the most prevalent problem for credit managers is what to do about the many distressed investment-grade issues in their portfolio. We examine the historical performance of distressed investment-grade bonds after their distress month. Overall, we find that distressed bonds as a group have tended to produced positive excess returns both versus Treasuries and versus quality and duration-matched credit peer groups. However, while this outperformance can be substantial, it can take time.

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INTRODUCTION

2001 and 2002 witnessed a sharp increase in idiosyncratic credit risk—the so-called "credit torpedoes" that played havoc with investor portfolios. Unlike previous episodes of credit market turmoil, usually involving smaller and lower-quality names, this time, the center of the credit storm included some large and highly-rated issuers whose bonds were widely held. Not unexpectedly, the tremendous spread volatility was accompanied by serious trading liquidity problems.

For portfolio managers benchmarked against a credit index, the stressful credit markets forced a reconsideration of their approaches to risk management and portfolio construction. In addition, plan sponsors increased their involvement in the risk management of their plans' assets. Overall, investors adopted a more disciplined approach to diversifying security-specific risk. Investors also re-examined the design of their benchmark, the relevance of their investment policies, and the capabilities of their analytical tools. Specifically, the credit market turmoil generated renewed investor interest in the following topics:

- *Portfolio Diversification;*
- *Synthetic Credit Products;*
- *Quantitative Risk Management Tools;*
- *Credit Benchmark Design; and*
- *Investment Strategy for Distressed Issues.*

The first three topics are discussed at length in other Lehman publications but will be briefly outlined below. The focus of this report is on the last two topics: credit benchmark design and investment strategy.

Portfolio Diversification—"Sufficient Diversification"[1]

In response to the heightened credit event risk, investors sought better credit name diversification. Diversifying credit risk presents its own challenges. While it is clear that event risk is higher in lower qualities, the optimal levels of diversification are less obvious. The costs of excessive diversification must also be considered. Increased transaction costs, as well as the increased cost and dilution of credit research, put constraints on the degree of diversification. We address these issues in our study of sufficient diversification in credit portfolios concentrating on the risk of downgrade in investment-grade portfolios. We develop a simple model of downgrade risk based on the observed historical underperformance of downgraded bonds and transition probabilities published by rating agencies. To minimize tracking error due to downgrade risk, the model recommends uneven diversification in various credit ratings.

When we first published the study using data through the end of 2000, the optimal position size in Baa-rated bonds was nine times lower than in Aaa/Aa-rated bonds and four times lower than in A-rated bonds. In 2003, the study was extended to include the 2001 experience. Not surprisingly, the recommended diversification levels have become even more skewed, with the ratio of optimal (i.e., to minimize the effect of downgrades) position sizes at 10:3:1. While investors may not precisely follow these rather dramatic

[1] *Sufficient Diversification in Credit Portfolios*, Lehman Brothers, June 2002.

ratios, the clear conclusion is to diversify more in the lower credit qualities. To arrive at more realistic position size ratios, we took into account the volatility of spreads not caused by rating transitions ("natural" volatility). Indeed, this type of volatility is significant in the high-quality segment of the market. As a result, the inclusion of the natural volatility mitigates to some extent the differences in the optimal diversification levels. The recommended position size ratio including both natural volatility and downgrade volatility was found to be 4:3:1 in the 2001 study. The extension to 2002 made this ratio more skewed as well, at 5:3:1. These levels are accepted by most portfolio managers as realistic.

Synthetic Credit Products—Diversified Credit Baskets

Investors' demand for credit diversification generated a new type of credit instrument: a basket of liquid corporate bonds traded as *one security*. Lehman Brothers (and other broker/dealers) launched "targeted return index securities," or TRAINS®, in both the U.S. dollar and euro markets. The US$-TRAINS® contain about twenty-five corporate bonds having a minimum outstanding amount of $1 billion. The weights of the individual securities in the TRAINS® basket are designed to minimize the tracking error against the Lehman Credit Index. TRAINS® are issued in several maturities, offering the possibility of combining several TRAINS® according to their index weights and reliably tracking the overall index with just a few transactions. In general, choosing the relative weights of various maturity TRAINS® is an efficient way to achieve the desired term structure exposure, while closely matching the sector and quality distribution of a credit benchmark.[2]

Quantitative Tools—Enhancements to the Multi-factor Risk Models

In response to heightened event risk in the credit markets, investors have sought better quantitative credit analysis tools to measure portfolio risk. In 2002, many credit portfolios experienced deviations from the benchmark that exceeded five times the standard deviation predicted by the Lehman multi-factor risk model. These deviations were driven almost entirely by events affecting individual issuers and affected portfolios concentrated in these issuers. The risk model's estimate of portfolio risk, based on the long-term historical volatility of residuals in the credit market, was an inadequate predictor of issuer-specific risk in the changed marketplace.

In response to these events, the risk model was enhanced to include a user option to give recent observations more weight in the estimation of idiosyncratic risk than more distant observations. The weighting scheme is exponential time decay. The speed of time decay was set to "one year half life" so that with each year of age, an observation's weight in the estimation was reduced by half. The time decay option lets the risk model adjust to idiosyncratic shocks much faster. As a result, tracking errors predicted by the model for undiversified portfolios increased significantly. In the months following the change, the realized performance of most credit portfolios fell in line with predicted tracking errors.

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[2] TRAINS® come in many flavors. Currently, there are five U.S. cash TRAINS®: 5-year, 10-year, and "long" maturities of the Lehman Credit Index; Baa TRAINS®; and a high-yield TRAINS® representing the B and higher component of the Lehman High Yield Index. There is also a Euro-TRAINS®, a 5-year bullet bond backed by a portfolio of fifty single name credit default swaps and an underlying Aaa-rated fixed coupon bond. The 50-name basket was assembled to approximate the spread performance of the Euro Corporate Index. Innovation in the credit markets is likely to continue. Expect to see more issuance of TRAINS® and perhaps variations on the theme in the form of exchange-traded funds (ETFs) or baskets representing broader sets of securities (e.g., the Lehman very-liquid credit investment grade and high-yield indices —"VLIs").

Users of the risk model should consider carefully whether to use time decay. It is not necessarily always the best and "most conservative" option. Indeed, if a user had used time decay prior to the 1998 crisis, he would have severely underestimated his tracking error, as the experience of the 1990 recession would have been significantly underweighted. In general, one should not use time decay after a period of calm. When, at some point, the current high idiosyncratic volatility comes to an end, managers looking for conservative estimates of risk should switch back to the equal weighting scheme.

The introduction of time decay was part of the general overhaul of the Lehman multi-factor risk models in 2002.[3] New models were developed for all asset classes in the Lehman Aggregate Index. Some of them, such as ABS and CMBS, did not have risk models before. The models for the government, credit, and MBS markets were redesigned to use different methods of return splitting and of measuring interest rate and volatility risk. Key rate durations are now used to describe the term structure risk; vegas represent sensitivity to volatility risk; and the specifications for systematic and non-systematic spread risk have changed, as well. A new model for high-yield credit includes a module that measures default risk using a Merton-type model incorporating correlated movements in issuer asset values and tail dependence in the loss distribution.

Benchmark Design—Issuer-Capped and Downgrade-Tolerant Indices

Excessive exposure to individual issuers is not just a problem for portfolio managers. Plan sponsors now scrutinize their *benchmarks* for high issuer concentrations. Sponsors ask: "Does it make sense for our organization to have a 2% exposure to name XYZ?" The high level of absolute issuer name risk has led to the demand for issuer-capped benchmarks. In the simplest case, a market-value cap (e.g., 2%) can be imposed, and every issuer capitalization is checked against this ceiling. The market value in excess of the cap is "shaved off" and distributed to all other issuers in the index in proportion to their market values. In some cases, the caps are chosen to be different for various credit ratings, reflecting the differences in issuer-specific risk between higher and lower credit qualities.

As we will discuss, constructing an issuer-capped index requires two decisions. First, how low should the cap be? And second, how is the "excess" market value weight to be redistributed to other issuers in the index? Section I examines the risk and return behavior of various issuer-capped indices using various cap levels and redistribution rules.

Another benchmark issue facing both managers and sponsors is whether the Corporate Index is replicable in a market environment where a large number of issues are downgraded below investment-grade (i.e., so-called "fallen angels"). While the Corporate Index simply removes fallen angels at the end of the downgrade month, a portfolio manager must find a willing buyer. This is particularly problematic for large fallen angels. Since the high-yield market is much smaller than the investment-grade credit market, when a large investment-grade issuer is downgraded, investors must locate and entice high-yield investors to buy a relatively large holding in a new credit. The Corporate Index prices fallen angel issues at the end of their downgrade month at levels where bonds could be sold at the margin. This price, however, will not reflect where all

[3] "The New Lehman Brothers Credit Risk Model, May 14, 2002, *Quantitative Credit Research Quarterly,* 2002-Q2, Lehman Brothers.

outstanding bonds of the issuer could be sold. In fact, prices for fallen angels typically continue to fall after the downgrade month as the high-yield market adjusts to the supply-demand imbalance of the incoming fallen angel debt.[4]

While some portfolio managers are required to sell fallen angels immediately at whatever price they can find, other investment-grade portfolio managers have discretion to hold the bonds (perhaps with increased monitoring requirements). As a practical matter, managers may have little choice but to hold on to fallen angels for at least several months until willing buyers can be located and the price stabilizes. Some suspect that their inability to sell downgraded bonds immediately gives the Corporate Index an inherent performance advantage, a "survivorship bias," since the index can "sell" bonds immediately without suffering the painful and sometimes costly task of finding buyers. Some investors concerned about survivorship bias are considering a custom index that is "downgrade-tolerant." Such an index allows fallen angel issues to remain in the index for a fixed period of time after downgrade. Section II examines whether a downgrade-tolerant index might be a more replicable performance benchmark for investment managers. Of course, a key decision is how long a fallen angel issue should remain in the index.

Investment Strategy—Performance of Fallen Angels and Distressed Investment-Grade Debt

Beyond the issue of index replicability, what has been the investment performance of fallen angels? Since many investment-grade managers can use their discretion to work out of fallen angels over time, these managers have asked whether there is "best" time to sell. As Section II shows, downgraded bonds then to recover after a "seasoning" period subsequent to downgrade. The goal of Section III is to identify the "optimal" seasoning period. This information gives investors guidance on how long to hold onto fallen angels to maximize risk-adjusted returns.

While portfolio managers must occasionally deal with investment-grade bonds downgraded to high-yield, the more common problem is what to do with investment-grade bonds that have become distressed.[5] Is the investor better off holding, selling, or buying more? Section IV examines the historical performance of distressed investment-grade bonds over the two-year period following a bond's distress month. We find that distressed bonds, as a group, have produced positive excess returns over the two-year horizon. Moreover, they outperformed quality- and duration-matched peer groups.

The past several years of stressful credit markets have taught us valuable lessons in credit portfolio management. While the onset and depth of the turmoil caught most investors unawares, some positive developments emerged as investors struggled to cope. This paper examines many of these developments: the improvement of quantitative risk management tools, customized benchmark design, and better-informed investment strategies. Hopefully, these developments will make investors better prepared for the next period of stressful credit markets.

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[4] Some high-yield managers have adopted customized high-yield indices that only include "seasoned" fallen angel debt for some of the following reasons: High-yield managers' lack of familiarity with new fallen angels inhibits discovery of an equilibrium price; some new fallen angels are so large that they dominate the high yield indices; and new fallen angels often have volatile prices which add to the volatility of the index.

[5] Our definition of a distressed bond is a bond with an option-adjusted spread greater than or equal to 400bp and a price below 80% of par.

I. Issuer-Capped Credit Benchmarks

The Lehman Indices are rules-based; issues are added to and removed from an index according to a published set of rules. In addition, in standard Lehman Indices, individual securities contribute to index averages in proportion to their market value weight. Given the advancements in Lehman's index technology, investors can now request a wide array of made-to-order indices that follow a *customized* set of rules. In reaction to the recent credit market dynamics, many investors have examined adding two customized rules: imposing an issuer cap and having a more flexible quality requirement that allows downgraded bonds to remain in the index for a period of time. The purpose of this section is to examine the implications of an issuer cap on the return performance of the Corporate Index.

Two important Lehman U.S. Corporate Index rules are the liquidity constraint and the quality requirement. The liquidity constraint states that a bond must have a minimum current par amount outstanding to be index eligible. For the Lehman U.S. Corporate Index, the liquidity constraint is currently $200 million.[6] There is no maximum issue size limit. In addition, there is no *issuer*-level minimum or maximum. In other words, the Lehman Corporate index is an uncapped index. The liquidity constraint ensures that the index only contains issues that are large enough for investors to obtain. Obviously, it is not realistic for all investors to buy a given index issue. However, an index issue is typically large enough to be actively traded and, more importantly, allow Lehman to obtain a market price for index calculations.

The absence of a minimum issuer-level constraint helps ensure that the Corporate Index is a well-diversified index of issuers. As of January 31, 2003, the U.S. Corporate Index contained 668 issuers with over 500 of them having a weight less than 0.2% in the index.[7] This high level of diversification facilitates security selection (i.e., it is easy to overweight and underweight many different names), which is a potentially rewarding portfolio management activity.[8] Figure 1 presents a histogram of the issuer weights in the Corporate Index for the past three years with the same liquidity constraint (minimum of $150 million per issue).

The absence of a minimum or maximum issuer-level constraint is also important because it allows the index to adapt automatically to changes in the corporate marketplace. In other words, the composition of the Corporate Index reflects what is reasonably available in the marketplace and the performance of the index accurately captures the overall performance of the credit market.

The last few years served as a painful reminder of the presence of idiosyncratic risk in the credit markets as some of the largest issuers were among the biggest relative underperformers. Figure 2 shows the cumulative excess returns (un-annualized) of the

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[6] The Index liquidity constraint was increased from $150 million on 1 October 2003. The liquidity constraint is revised infrequently. The constraint was raised from $100 million to $150 million on 1 July 1999. For more information about the liquidity constraint, see: "Amount Outstanding Constraint for the US Corporate Index*," Global Relative Value,* Lehman Brothers, November, 2000.

[7] As of 1 October 2003, with the new higher liquidity constraint, the Lehman U.S. Corporate index contained 604 issuers with 4 of them having a market value weight of more than 2% in the index.

[8] For the importance of security selection as an outperformance strategy see *Value of Security Selection versus Asset Allocation in Credit Markets: Part II – An "Imperfect Foresight" Study,* Lehman Brothers, June 2000.

top decile (by market value)[9] of the Corporate Index, the remaining 90% of the Corporate Index and the Corporate Index itself. Figure 2 shows that the top decile was a severe relative underperformer during much of 2002.

[9] The top decile is identified as follows. The issuers are listed in market value order. We include in the top decile as many of issuers from the top of the list as we can without exceeding 10% of the market value of the index. For example, if the top 5 issuers have a combined market value of 9.5% of the index market value, but the top 6 have a combined market value of 10.4%, then the top decile will consist of the top 5 issuers. All remaining issuers will belong to the bottom 90%. Over this period, the top decile contained an average of 4 issuers.

Figure 1. **Histogram of Issuer Market Value Weights in the Corporate Index**
As of 31 January 2001, 2002, and 2003

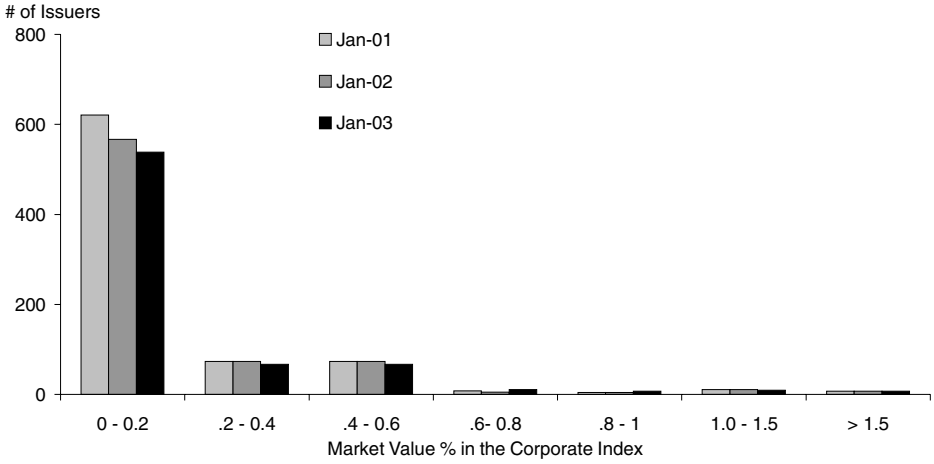
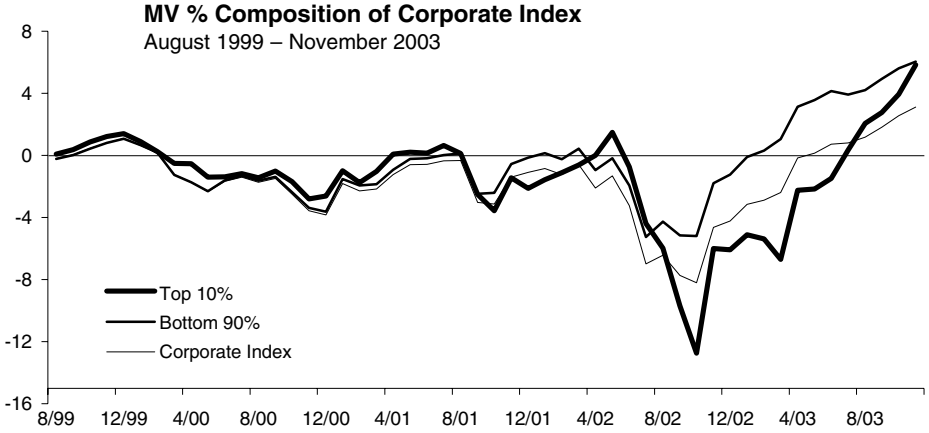


Figure 2. **Cumulative Excess Returns: Top 10% and Bottom 90% by MV % Composition of Corporate Index**
August 1999 – November 2003



Given the sharp underperformance of a few large issuers, some investors (e.g., plan sponsors and insurance companies) have raised questions about "uncapped indices," i.e., indices without a per-issuer maximum, as benchmarks. These investors are asking whether it is appropriate from a risk management perspective for a plan's assets to have uncapped exposure to particular issuers due to the plan's exposure to the benchmark. As a result, some investors are considering adopting customized "issuer-capped" indices as benchmarks to limit any issuer's potential total return impact on the index. While investors have often capped holdings in their portfolios, the novel and strong interest in adopting capped benchmarks was a direct response to the stressful credit markets of 2001 and 2002.

The goal of this section is to examine the risk and return behavior of issuer-capped indices. Do issuer-capped indices accomplish their objective of having lower volatility and better information ratios? To answer these questions, we examine the performance of various issuer-capped indices over the past several years, including the stressful markets of 2001 and 2002.

Issuer Concentration in the Lehman U.S. Corporate Index

What is the degree of issuer concentration in the U.S. Corporate Index? Figure 3 shows that there are only a handful of issuers in the index that have relatively large market value weights. As of the end of November 2003, the four largest issuers (presently F, GE, GM, and C) each had a market value weight that exceeded two percent of the index's market value. The largest issuer was Ford with a weight of 3.46%. Ford's weight exceeded 4% in early 2001 and then declined as the issuer increased its reliance on the asset-backed market for financing in response to the difficult credit markets. As of the end of January 2003, HSBC was the fifth largest issuer with a weight of 1.96%.[10]

[10] Our issuer concentration charts begin in August 1999, when the Lehman index database adopted tickers to identify issuers. For large issuers, the market value percentage weights likely jumped upward in July 1999 when the liquidity constraint increased from $100 million to $150 million. Of course, large issuers may also lose issues from the index due to the increased liquidity constraint. However, the larger issuers typically have issue sizes that easily exceed the constraint. Interestingly, while most discussions regarding raising the liquidity constraint typically revolve around the impact of a large number of smaller issues excluded from the index, less attention is paid to the potential impact on issuer concentration. As of October 1, 2003, with the new higher liquidity constraint, the four largest issuers and their market value weights were Ford, 3.4%, GE, 3.2%, GM, 2.9% and Citigroup, 2.6% compared to 3.1%, 2.9%, 2.8% and 2.6%, respectively, as of September 1, 2003 under the lower liquidity constraint.

Figure 3. **Percentage of Corporate Index MV**
Represented by the 1st through 5th Largest Issuers
August 1999 – November 2003

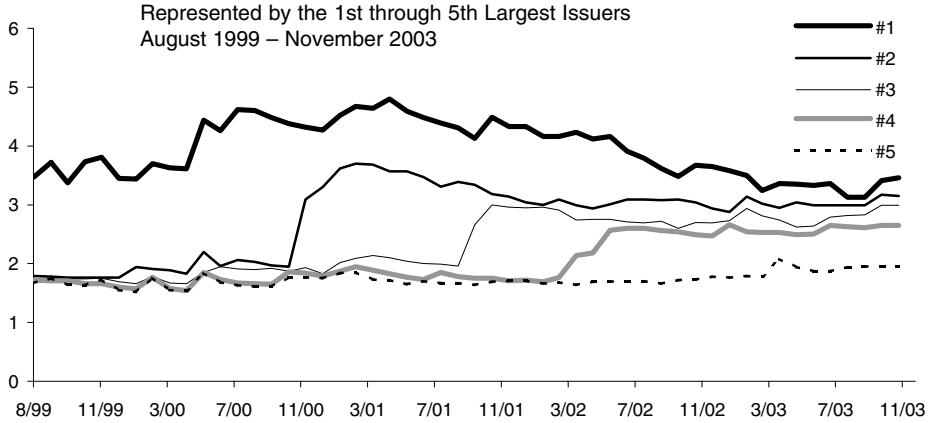


Figure 4 presents the market value weights for the sixth through tenth largest issuers. As of the end of November 2003, the sixth through tenth largest issuers, BAC, VZ, MWD, DCX, and GS, all had market value weights of approximately 1.5%.

Figure 5 shows that as of November 2003, the market value weight of the top ten issuers as a group was approximately 21%, near the high of its range over the past three and a half years. As of the end of November 2003, the top ten issuers as a group have a total market value weight of 21.6%. Figure 5 also shows that the weight of the ten largest issuers increased sharply at the end of 2000, due primarily to the acquisition of Associates by Citicorp.

Constructing Issuer-Capped Indices

An issuer-capped benchmark imposes a maximum on the market value weight that an issuer can have in the index. For example, an issuer-capped benchmark might impose

Figure 4. **Percentage of Corporate Index MV**
Represented by the 6th through 10th Largest Issuers
August 1999 – November 2003

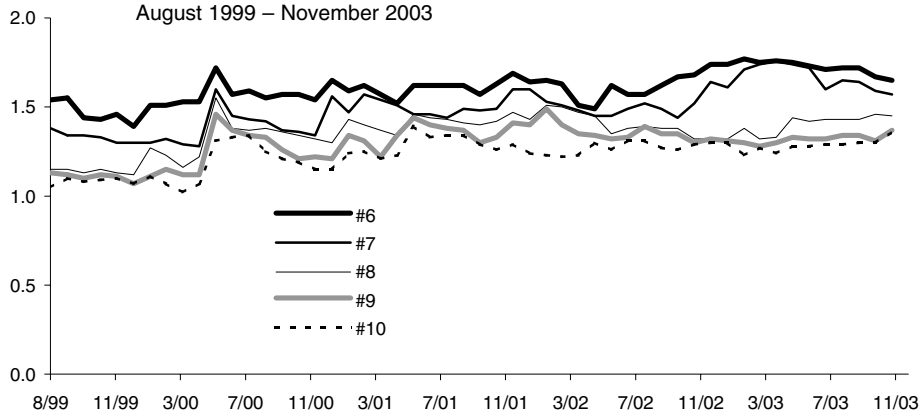
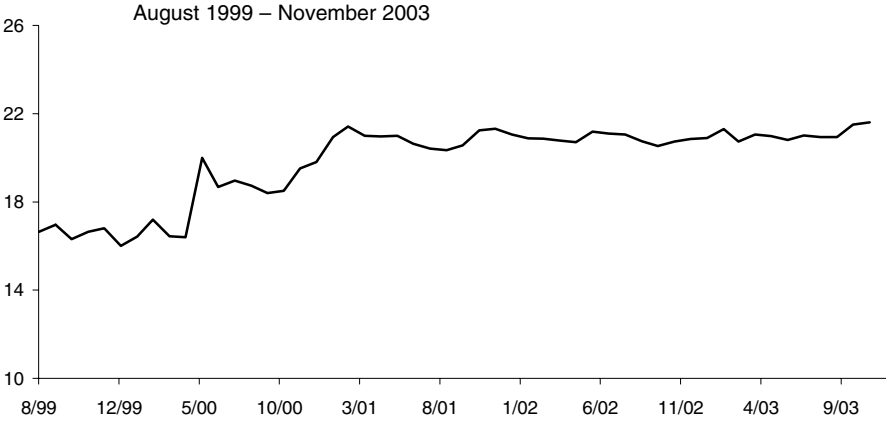


Figure 5. **% MV Weighting of Top Ten Issuers as a Group in the Corporate Index**
August 1999 – November 2003



a requirement that an issuer's weight not exceed 1% of the index. The motivation for such a cap is to limit the index's exposure to the idiosyncratic risk of the issuer. Given the large negative excess returns experienced by large issuers in recent years, an issuer-capped benchmark presumably would have higher excess returns and lower excess return volatility than an uncapped index. The goal of this section is to describe what the behavior of issuer-capped indices would have been in recent years.

Constructing an issuer-capped index requires two decisions. First, how low should the cap be? The answer depends on setting a cap level that is low enough to limit the effect of idiosyncratic risk on the index, but not so low that many issues will be capped. Keep in mind that limiting the size of a large issuer in the index is equivalent to boosting the size of all the other issuers so that the large issuer becomes a smaller percentage of the whole. If too many large issuers are capped, the weights of very small issuers increase disproportionately to their availability in the marketplace, making the index less investable. To be practical, this section analyzes issuer cap levels that are greater than or equal to 1%.

An issuer cap works as follows. Suppose the cap level is set at 3% and the market value of a single issuer exceeds 3% by 0.5%. The issuer's market value is reduced 0.5% by "shaving off" a sufficient *pro rata* share from each of the issuer's issues in the index so that the reductions add up to 0.5% of the Corporate Index. In other words, if the issuer had two issues outstanding, one with a market value weight of 2% and the other 1.5%, then the weight of the first issue would be reduced by approximately 0.29% to 1.71% and the second by 0.21% to 1.29%. How is the 0.5% "excess" market value reassigned to the other issues in the Corporate Index? To answer this question, we need to make a second decision on what *redistribution rule* to use.

We analyze two redistribution rules: "index-wide" redistribution and "quality-sector neutral" redistribution. "Index-wide" redistribution takes any "excess" market value and distributes it across all issues of non-capped issuers in the index in proportion to their weights in the index. In the example above, the large issuer under consideration originally constituted 3.5% of the index. Suppose that all the other issuers, who together constitute 96.5% of the index, do not need to be capped, and the 0.5% we shaved off the large issuer must therefore be divided among all of them. If one of the other issuers constitutes 2% of the index, then it will receive 0.0104% = 0.5% × 2% ÷ 96.5% of the weight of the index as a result of the redistribution of the large issuer's weight.

The "quality-sector neutral" redistribution rule works as follows. The entire index is divided into sector-quality buckets. When a large issuer is capped, we look at each of the issuer's bonds to determine which bucket it belongs in. The weight shaved off that bond is redistributed among bonds in the same bucket issued by other issuers. In the previous example, one of the large issuer's bonds, which we will call issue A, was reduced by 28.6 bp. Suppose that no other issuers need to be capped, and that the sum of the weights of all bonds in the same bucket as issue A but issued by other issuers is 15%. Suppose issue B is in the same bucket as issue A but issued by a different issuer, and issue B constitutes 0.5% of the index. Then the amount of index weight added to issue B as a result of the redistribution is 0.95 bp = 28.6 bp × 0.5% ÷ 15%. This redistribution rule has the effect of preserving the market value weights of each quality-sector combination in the Corporate Index. As we show below, both the choice of the cap level and the

redistribution rule have important implications for the relative performance of an issuer-capped index versus the uncapped index.[11]

Either redistribution rule may require several iterations until all issuers satisfy the cap level. In the first iteration, all issuers exceeding the cap are identified and their excess market value is then redistributed, depending on the redistribution rule, across all remaining issues. As a result of the redistribution, issuers that were below the cap before may be above the cap now, requiring another round of redistributions. The capping procedure is applied repetitively until all issuers satisfy the issuer cap.

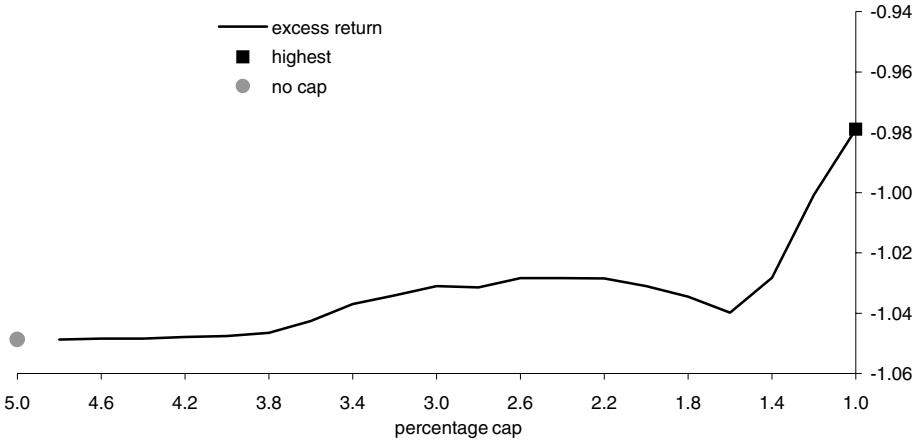
Risk and Return Performance of Issuer-Capped Indices

We first examine the effect of the cap level assuming we follow the "index-wide" redistribution rule. Figure 6 shows the effect of various issuer cap levels, beginning at 1%, on the annualized excess return performance of the Corporate Index for the period from August 1999 through December 2002. This period covers a period of intense idiosyncratic risk in the credit markets, especially for large issuers. If issuer caps were to affect the excess return performance of the Corporate Index dramatically, their effect would likely appear during this period.

Figure 6 shows that the effect on the average excess return is negligible for issuer cap levels down to approximately 1.5%, less than 3 bp per year. However, once the issuer cap is reduced below 1.5%, the average excess return increases more rapidly. For an issuer cap of 1.0%, the average annual excess return is approximately 7 bp higher (-0.98% versus –1.05%). Nevertheless, this result is surprising and very disappointing. Given the very negative excess returns of large issuers, it is remarkable that a 1% issuer cap improves annualized excess returns by only 7 bp per year.

[11] While an issuer-capped index can use a variety of redistribution rules (e.g., keep *sub*-sector weights unchanged) it is important to remember that the redistribution rule must be such that there are a sufficient number of uncapped issues remaining in each peer group so that the "excess" weight can be fully redistributed.

Figure 6. **Average Excess Return of Corp. Index as Function of Cap**
August 1999 – December 2002, Annualized
Index-Wide Redistribution of Excess Weight



Another motivation for imposing issuer caps is to reduce the excess return volatility of the benchmark. By removing the potential effect of idiosyncratic events affecting large issuers, an issuer-capped index should be expected to have less excess return volatility. Figure 7 shows the excess return volatility of the Corporate Index for various issuer cap levels using index-wide redistribution.

With index-wide redistribution, an issuer cap level of 1% reduces excess return volatility by only 4 bp, compared with the uncapped Corporate Index. Again, this result is both surprising and disappointing. Issuer-capped indices, even at very reasonable cap levels, do not seem to provide much improvement in risk and return performance compared with uncapped indices.

Why do we observe only a very modest improvement in the risk and return characteristics of the issuer-capped index versus the uncapped Corporate Index? As discussed at the outset, issuer-capped benchmarks require a decision on how to redistribute the "excess" market value weight. The results in Figures 7 and 8 are based on the redistri-

Figure 7. **Excess Return Volatility of Corp. Index as Function of Cap**
August 1999 – December 2002, Annualized
Index-wide Redistribution of Excess Weight

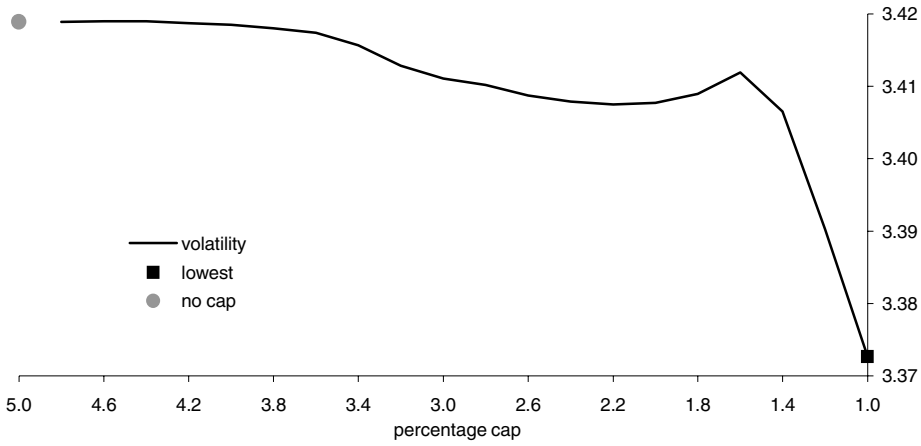
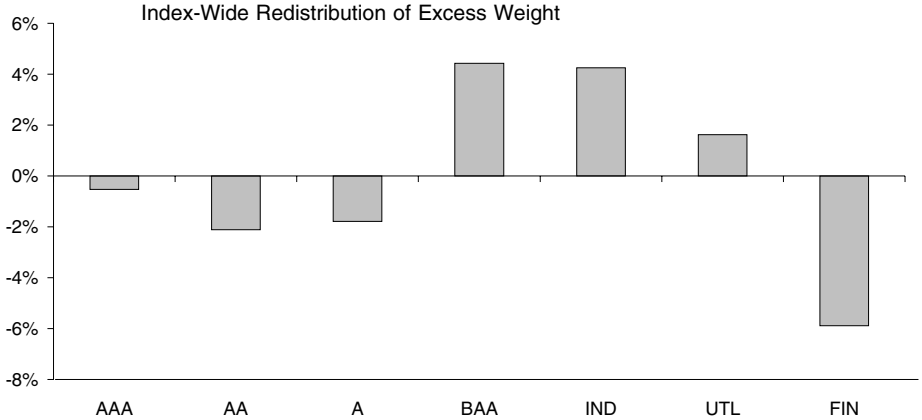


Figure 8. **Average Sector and Quality Exposures of 1%-capped Index vs. Corp Index,** August 1999 – December 2002
Index-Wide Redistribution of Excess Weight



bution rule that spreads the excess equally across all uncapped issues in the index. However, as we will show, such a rule can produce an index which has very different, and probably unintentional, sector and quality exposures than the uncapped index. For example, if the large issuers in the uncapped index are A-rated financials, then a 1% issuer-cap using the index-wide redistribution rule may unintentionally produce a capped index having a higher weighting to Baa-rated industrials than the uncapped Corporate Index. In fact, this is exactly what happens. For the period from August 1999 through December 2002, we calculated the average sector and quality exposures of the 1% issuer-capped index (with index-wide redistribution) and the Corporate Index. Figure 8 shows that the 1% issuer-capped index had a higher weighting in Baa-rated and industrial issues than the Corporate Index and a significant underweight to financials.

During the historical period under consideration, Baa-rated and industrial issues generally had lower excess returns and higher excess return volatility while financials outperformed other sectors.[12] Consequently, a 1% issuer-cap (with index-wide redistribution) index may not show much improvement versus the Corporate Index, as the increased exposure to Baa-rated and industrial issues offsets much of the reduction in idiosyncratic risk due to the issuer cap. The lesson learned is that the redistribution rule can undo much of the benefit of an issuer cap. Investors who seek issuer caps most likely do not wish their issuer-capped indices to have different quality and sector weightings from the Corporate Index. Investors want to reduce the effect of large issuers but not necessarily change their market value exposures to the various quality and sector buckets in the credit marketplace.

As stated earlier, the quality-sector neutral redistribution rule avoids introducing any unintended quality-sector biases as a result of the issuer-capping process. Figure 9 shows that using a quality-sector redistribution rule significantly improves the average excess return of the issuer-capped index relative to the uncapped index. Specifically, the average excess return of the 1% issuer-capped index (quality-sector neutral) is approximately 24 bp better than the uncapped Corporate Index.

The benefits of issuer-capped indices using the quality-sector neutral redistribution rule are also apparent in terms of excess return volatility (see Figure 10). At a 1% cap, the excess return volatility of the issuer-capped index is approximately 3.24%, compared with 3.42% for the Corporate Index.

We also examined the performance of another sector-quality neutral variant in which we impose lower caps on lower-quality issuers than on higher-quality issuers. Adjusting the issuer cap level according to the quality of the issuer is in keeping with the principle

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[12] Average annualized excess returns and annualized excess return volatility for various sectors for the period August 1999 through December 2002 were:

Quality/Sector	Average Excess Return	Excess Return Volatility
industrial	-1.35%	3.97%
utility	-4.31%	6.88%
financial	0.38%	2.61%
Aaa-rated	0.09%	1.67%
Aa-rated	0.80%	1.97%
A-rated	-0.62%	3.14%
Baa-rated	-2.55%	4.94%
Corporate Index	-1.05%	3.42%

Figure 9. **Average Excess Return as Function of Cap**
August 1999 – December 2002, Annualized
Quality-Sector Neutral Redistribution

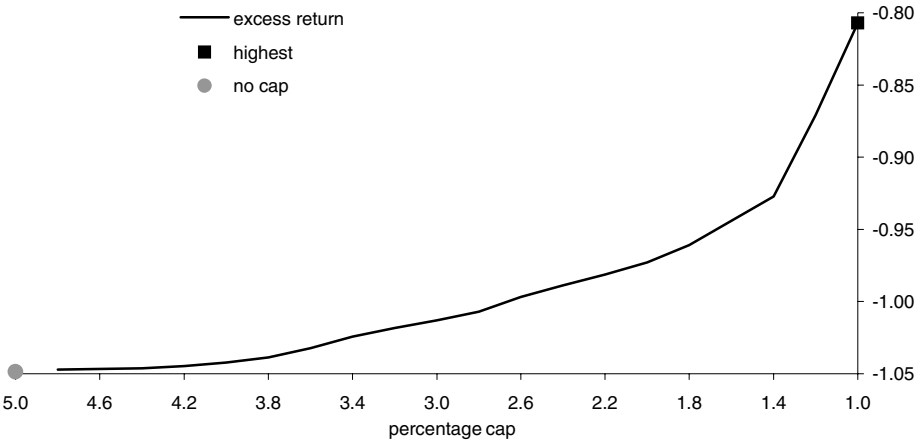
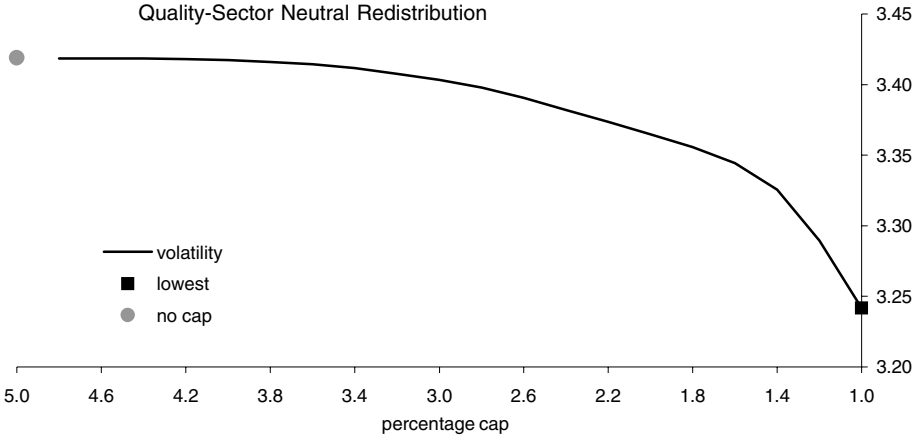


Figure 10. **Excess Return Volatility as Function of Cap**
August 1999 – December 2002, Annualized
Quality-Sector Neutral Redistribution



that lower-quality issuers are subject to greater idiosyncratic risk than higher-quality issuers and therefore require greater diversification.[13] Specifically, we examined a sector-quality neutral capping of the Corporate Index that imposes a 2.5% cap on Aaa/Aa issuers, a 1% cap on single-A issuers, and a 0.5% cap on Baa issuers.[14] From August 1999-December 2002, this index had an average annualized excess return 16 bp better than that of the unconstrained index and an annualized volatility of excess returns 22 bp lower than that of the unconstrained index.

[13] For an analysis on how the idiosyncratic risk varies with quality, see *Sufficient Diversification in Credit Portfolios,* Lehman Brothers, June 2002.

14 Another difference between this index and the 1% sector-quality neutral index is related to the handling of issuers that have issues in more than one sector-quality bucket. The 1% index considers all the issuer's bonds, regardless of which buckets they are in, when deciding whether the issuer exceeds the cap or not. In contrast, this index effectively treats the issuer's bonds in two different buckets as belonging to two separate issuers, and applies the appropriate caps separately to the issuer's bonds in one bucket and its bonds in the other bucket.

Figure 11 provides a summary of the results.

To further examine the potential benefits of issuer capping and different methods of redistribution, we examined what would happen to the Corporate Index and its issuer-capped variants in the event of default by a major issuer. To simulate such an event, we examined these indices during the period from August 1999 until Enron's bankruptcy in November 2001 and "imagined" what the returns of these indices would have been during this time if the amounts outstanding of all of Enron's bonds had been ten times larger than they were. This would have given Enron up to a 3.76% market value weight in the Corporate Index in some months, making Enron one of the largest issuers but still not the largest. The results, shown in Figure 12, indicate that imposing a 1% cap on the Corporate Index would have boosted annualized average excess return significantly at the expense of a slight increase in excess return volatility and that sector-quality neutral redistribution would have been somewhat better than index-wide redistribution in this regard.

"Sloshing"

While issuer-capped indices do reduce the market value weight of the largest issuers, the "flip-side" of such indices is that the market value weight of the smaller issuers is increased, often dramatically so. This shift of market value weight from the large issuers to the small ones, which we call "sloshing," can sharply increase the index weight of small issuers, which may make the index difficult for the portfolio manager to replicate. Recall that an advantage of "uncapped" indices is that the index reflects what is available in the marketplace. However, a capped index increases the market value weight of small

Figure 11. **Annualized Average Excess Return and Volatility**
As a Function of Issuer Cap Level and Redistribution Rule
August 1999 – December 2002

			Difference from Corporate Index	
	Avg. Excess Return	Excess Return Vol.	Avg. Excess Return	Excess Return Vol.
Corporate Index	-1.05%	3.42%	—	—
1% Issuer-Cap (index-wide)	-0.98%	3.37%	7 bp	-5 bp
1% Issuer-Cap (sector-quality neutral)	-0.81%	3.24%	24 bp	-18 bp
2.5%/1%/0.5% Issuer-Caps (sector-quality neutral) (cap varies with quality)	-0.89%	3.20%	16 bp	-22 bp

Figure 12. **Performance of Corporate Index with and without 1% Caps**
With Enron Amounts Outstanding Multiplied by 10
August 1999 – November 2001

		1% cap	
	Corporate Index	(index-wide)	(sector-quality neutral)
Average Excess Return (annualized)	-1.39%	-1.12%	-0.99%
Excess Return volatility (annualized)	2.63%	2.71%	2.65%

issuers in the index above the market value weight of the issuer in the marketplace. Consequently, a pertinent question arises: Is there enough supply in the marketplace to enable an investor to replicate the issuer-capped index?

To give a sense of the amount of "sloshing" that an issuer-capped benchmark can produce, we first calculate, as of May 1, 2003, how much market value is moved among issuers in a 1% capped Corporate index that uses a quality-sector neutral redistribution rule. (As of May 1, 2003, a 1% market value issuer cap corresponds to a market value of $18,359,336,300.) For each quality-sector bucket, we find all issuers whose market value in the bucket increased as a result of the capping and add up the dollar amounts of all the increases. This gives us a dollar amount of sloshing per bucket. (Equivalently, we could find all the issuers that decreased in market value and add up the dollar amounts of their decreases.) To express sloshing as a percentage, we take the dollar amount of sloshing and divide by the market value of the bucket. These results are presented in Figure 13. Note that some buckets experience a large amount of sloshing. For example, the Aa+-FIN sector has over 32% of its market value reallocated across different issuers within the bucket. On the other hand, none of the utilities buckets experiences any sloshing.

The Aa+-FIN bucket experiences a great deal of sloshing because it contains some large issuers that greatly exceed the 1% cap. To further illustrate the degree of sloshing in the Aa+-FIN bucket, Figure 14 presents the "scale factors" by which issuers in the bucket are adjusted as a result of the 1% cap with quality-sector neutral redistribution. The scale factor is amount by which the issuer's initial market value (across all of its issues in the bucket) is multiplied to arrive at its market value in the capped index. For example, the market value of Northern Trust in the Aa+-FIN bucket in the uncapped index is $166 million. As a result of the 1% cap, a large amount of market value from other, larger, issuers must be redistributed to Northern Trust. In fact, the market value weight of Northern Trust in the capped index is approximately 5 times its weight in the uncapped index ($834 million versus $166 million). Some investors may have difficulty locating bonds for a relatively small issuer whose market value weight in the benchmark has been artificially raised due to issuer-capping. Figure 14 highlights one of the potential risks of issuer-capped indices – the index may become uninvestble.

Note that many issuers in the Aa+-FIN bucket have the same scale factor of 5.03. These are relatively small issuers with few, if any, issues in other buckets (e.g., A-FIN bucket). The market value weight for all these issuers is scaled up by the same factor to preserve their relative weights. However, some other issuers have different scale factors. Those issuers with scale factors less than 1.0 were subject to the 1% cap due to their initial market value

Figure 13. **Sloshing (as a % of Bucket Market Value)**
1% Issuer-Capped Index with Quality-Sector Neutral Redistribution
May 1, 2003

	IND	UTL	FIN
Aa+	7.0%	0%	32.4%
A	5.4%	0%	22.0%
Baa	4.1%	0%	0%

weight in the index. For example, Wells Fargo has a scale factor of 0.80 as its uncapped market value of $22,814,509,000 fell to $18,359,336,300 in the 1% capped index.

Other issuers have scale factors of 1.00-5.03. These issuers had initial market value weights less than 1%. However, as a result of redistribution, their weights reached 1% and they became ineligible to receive any further redistribution. Hence, their scale factors were less than the maximum of 5.03. Finally, note that the market values of some issuers in the bucket are reduced by the capping process to an amount well below the cap limit ($18,359,336,300). For example, look at Bank One, whose uncapped market value was $11,767,761 yet its 1% capped market value is lower at $10,967,533. Why was it necessary to reduce its market value to a level below the 1% limit? (Moreover, in the case of Bank One, which was below the 1% limit to begin with, why was it necessary to lower its market value at all?) The answer is that the cap operates at the index level, not the bucket level. Bank One has index issues in other buckets that cause its overall weight in the uncapped index to exceed 1%. Consequently, its weight in every bucket, including the Aa+-FIN bucket, must be reduced. Its overall weight in the capped index is 1%, or $18,359,336,300, but only a portion of that amount is in the Aa+-FIN bucket.

Figure 14. **Sloshing – Scale Factors**
1% Issuer-Capped Index with Quality-Sector Neutral Redistribution, May 2003
amounts in thousands

Issuer	Uncapped Market Value	1%-Capped Market Value	Scale Factor
AMBAC INC	$196,744	$989,061	5.03
AMERICAN GENERAL FIN CORP	2,092,880	2,494,155	1.19
AMERICAN EXPRESS CO	262,879	1,321,529	5.03
BANK OF AMERICA CORP	32,138,680	18,359,337	0.57
BARCLAYS BANK PLC	495,595	2,491,429	5.03
BBV INTL FIN (CAYMAN)	392,256	1,971,925	5.03
BANK OF NEW YORK	1,051,487	5,285,975	5.03
PARIBAS NY	1,549,277	7,788,437	5.03
CAL ENERGY CO INC	376,041	1,486,020	3.95
CITIGROUP INC	48,567,674	18,359,336	0.38
CIBC CAPITAL FUNDING LP	381,604	1,918,380	5.03
CREDIT SUISSE USA INC	15,546,949	18,359,336	1.18
FIFTH THIRD BANCORP	520,515	2,616,701	5.03
GENERAL ELECTRIC CAPITAL	48,738,154	16,018,374	0.33
GOLDMAN SACHS GROUP	20,802,031	18,359,335	0.88
HOUSEHOLD FINANCE	1,745,528	889,884	0.51
AETNA INC/LION CONN	1,728,152	8,687,670	5.03
MBIA INC	357,659	1,798,005	5.03
MERRILL LYNCH & CO	15,357,059	18,359,335	1.20
M&I MARSHALL & ILSLEY BANK	313,630	1,576,662	5.03
MERCANTILE SAFE DEPOSIT & TRUST	224,234	1,127,257	5.03
MORGAN STANLEY DEAN WITTER	26,422,956	18,359,335	0.69
NATIONAL CITY CORP.	1,034,855	4,158,743	4.02
NORTHERN TRUST	165,953	834,269	5.03
BANK ONE	11,767,761	10,967,533	0.93
PITNEY BOWES INC	581,959	2,925,589	5.03
NATWEST PLC	3,044,474	15,305,005	5.03
BSCH ISSUANCE LTD	214,401	835,657	3.90
SUNTRUST BANK - ATLANTA	2,936,688	11,608,971	3.95
STATE STREET CORP	174,681	878,147	5.03
SVENSKA HANDELSBANKEN	442,156	2,222,779	5.03
TOYOTA MOTOR CREDIT	1,554,789	7,816,149	5.03
UNION BANK SWITZERLAND - NY	4,598,877	18,359,336	3.99
US BANK	8,706,905	14,296,938	1.64
WACHOVIA CORP	10,521,786	10,635,846	1.01
WELLS FARGO	22,814,509	18,359,336	0.80

In summary, the Lehman Corporate Index is composed of issues that meet certain rules. The two most important of these rules are the liquidity constraint and the quality requirement. However, credit events over the last few years have caused investors to reevaluate the Corporate Index rules. To address these market stresses, we have advanced our index technology *via* POINT[15] to an extent that allows investors to design a wide array of made-to-order indices that follow a customized set of rules. In particular, investors have sought to impose a cap on the maximum weight that any one issuer may have in the Corporate Index. In this section, we have examined the risk and return behavior of indices with issuer caps.

We saw that imposing a 1% cap on the market value weight that an issuer may have in the Corporate Index would have improved the Index's average excess return and excess return volatility over the past few years. It would also have improved average excess returns, at the expense of a slight increase in excess return volatility, in the event of a default by a major issuer (Enron). The magnitude of these improvements, however, depends on the rules used for redistributing index weight from large issuers to small ones. The "index-wide" redistribution rule tends to lessen the benefits of capping by introducing unfavorable sector-quality exposures relative to the uncapped index. The "sector-quality neutral" redistribution rule, which preserves the sector and quality weights of the index, achieves much better results.

The next section discusses the second key index rule: the quality requirement. What would be the risk and performance effect on the Corporate Index if the quality requirement were relaxed to allow downgraded bonds to remain in the index for a period of time subsequent to downgrade?

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[15] POINT is Lehman Brothers portfolio analytics platform that not only allows managers to design customized indices and but also to perform risk analysis and performance attribution of their portfolio versus their customized indices

II. Downgrade-Tolerant Credit Benchmarks

Compounding the poor performance of large issuers in the index has been the recent downgrading of some of them below investment grade. The quality requirement of the index states that an issue must be rated investment-grade to be index eligible. If at some point during the month an index issue is subsequently rated below investment-grade, it is removed from the index at the end of that month. The quality requirement ensures that the index maintains a certain minimum quality level over time. Consistency of an index's quality is very important for plan sponsors who make strategic asset allocation decisions and select indices as their benchmarks.

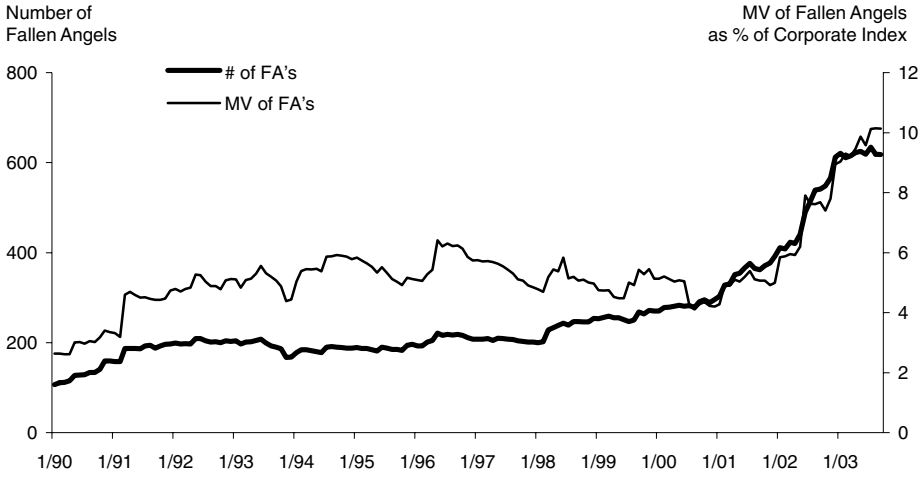
When a large issuer leaves the index due to downgrade, a portfolio manager must sell the issuer's bonds at the end of the month to be neutral to the index with respect to the issuer. 'Tis easier said than done, especially for large issuers. In practice, some managers feel they have no practical alternative but to hold a downgraded issue for several months after the downgrade as they try to find buyers in the smaller high-yield market.[16]

Bonds downgraded below investment-grade are often referred to as "fallen angels." For purposes of this study, we define a "fallen angel" as a bond in the Corporate Index downgraded below investment-grade and removed from the index. We consider the fallen angel to be "outstanding" until it matures, is called, goes into default, or is bought back by the issuer.

Figure 15 shows the number and total market value as a percentage of the Corporate Index market value of all fallen angel issues that dropped out of the Corporate Index after August 1988 and were still outstanding as of the end of the month in question. As of the end of September 2003, there were 618 such issues outstanding, and their combined market value was 10.1% of the market value of the Corporate Index on that date.

[16] As of September 2003, the market value of the investment-grade Corporate Index was $1,782 billion compared to $517 billion for the High-Yield Index.

Figure 15. **Total Number of FA Issues Outstanding**



When a fallen angel leaves the Corporate Index at the end of its downgrade month, the index prices the bonds of the downgraded issuer at levels that reflect where they can be sold at the margin. However, this price is unlikely to reflect where all outstanding amount of the bonds of the downgraded issuer can be sold. In fact, the prices for fallen angel issues often continue to fall after the downgrade month as the high-yield market needs an incentive to absorb the full supply of the fallen angel's debt.[17]

While some portfolio managers are required to sell fallen angels immediately at whatever price they can find, other investment-grade portfolio managers have discretion to hold the bonds, perhaps with increased monitoring requirements. (In the last section of this paper, we analyzed optimal risk-adjusted holding periods for fallen angels.) As a practical matter, however, managers have little choice but to hold on to fallen angels for at least several months until willing buyers can be located and the price stabilizes. Some investment-grade investors suspect that their inability to sell downgraded bonds immediately gives the Corporate Index an inherent performance advantage, a "survivorship bias," since the index can "sell" bonds immediately without suffering the painful task of finding buyers. A downgrade-tolerant index that allows fallen angel issues to remain in the index for a fixed period of time after downgrade might be a more replicable performance benchmark. In this section, we analyze the performance characteristics of such a downgrade-tolerant Corporate index.

Constructing a Downgrade-Tolerant Corporate Index

To measure the performance of a downgrade-tolerant Corporate Index, we first construct a fallen angel index consisting only of fallen angels (market value-weighted). A key parameter of the fallen angel index is the "tolerance period," the time a fallen angel is permitted to remain in the index. For example, a fallen angel index with a one-month tolerance period contains only issues that left the Corporate Index due to downgrade at the prior month-end. Consequently, the monthly returns series for such an index is the average monthly return for a portfolio of fallen angels during the first month after their downgrade month.

We then examine tolerance periods of two months, three months, and so on out to 24 months. For example, a fallen angel index with a six-month tolerance period contains issues that were dropped from the Corporate Index due to downgrade in any of the six months prior to the current month. In other words, the June 2002 monthly return for the six-month tolerant fallen angels index is the average June 2002 return for issues that were downgraded during December 2001-May 2002. Another way of looking at the fallen angel index is that an issue downgraded during January 2002 will be included in the six-month tolerant fallen angel index beginning in February 2002-July 2002.

Finally, we define a fallen angel index with an "unconstrained" tolerance period. This unconstrained index allows fallen angels to remain in the index until they are no longer outstanding. The monthly returns series for such an index is the average return for a portfolio of all outstanding fallen angels.

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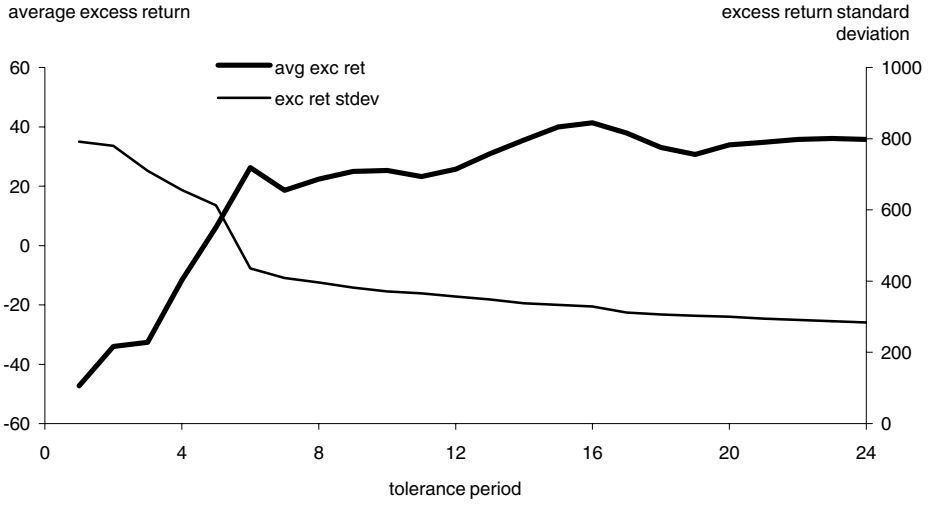
[17] Some high-yield managers have adopted customized high-yield indices that exclude "fallen angels" for some period of time following downgrade. These managers worry that immediately adding fallen angels to the high-yield index would cause the index to perform poorly. The worry is that fallen angels will continue to decline in price following downgrade due to both a lack of familiarity with new fallen angels and because some fallen angels are very large relative to the high yield market. Some managers also seek to exclude new fallen angels because they feel such bonds have volatile prices for a period of time after downgrade. Immediately adding such bonds to a high-yield index would increase the volatility of the index.

Figure 16 presents the average monthly excess returns for the fallen angel indices of various tolerance periods. The figure shows that an index of fallen angels that were downgraded in the prior month (i.e., the fallen angel index with a one-month tolerance period) had an average monthly excess return of –47 bp for January 1990-September 2003. However, the volatility of this excess return (792 bp) was more than sixteen times the mean excess return, indicating that monthly returns vary considerably from the mean. An index of issues that were downgraded in the prior three months had a better average monthly excess return of -33 bp (and a standard deviation of 710 bp) over the same period. The unconstrained fallen angel index had an average monthly excess return of 27 bp, with a considerable amount of volatility (218 bp).

Figure 16 shows that the average monthly excess return generally increases as the tolerance period lengthens. Allowing downgraded bonds to remain in the index longer improves the performance of the fallen angels index. This result also suggests that seasoned fallen angels tend to perform better than unseasoned fallen angels. In the next section, we explore in detail the risk and return performance of fallen angels. In particular, we focus on a question that most portfolio managers have faced: "Given that a bond I hold has been downgraded to junk, should I sell it immediately, or is it better to wait?" In Section III, we explicitly examine how long investors should hold onto bonds, after they are downgraded below investment-grade, to maximize risk-adjusted returns.[18] In the meantime, we will use the various fallen angel indices described in Figure 16 as a first step toward determining what the characteristics of the Corporate Index would have been had fallen angels been allowed to remain in the index for a given tolerance period.

[18] In Section IV. we examine the risk and performance of distressed *investment-grade* bonds.

Figure 16. **Performance of Various Fallen Angel Indices**
Excess Return (bp) **per Month as a Function of the Tolerance Period**
January 1990 – September 2003



Not unexpectedly, fallen angel issues performed very differently from investment-grade corporates over the period. Figure 17 presents the mean monthly excess return and standard deviation for both the unconstrained fallen angel index and the Corporate Index. For January 1990-September 2003, the unconstrained fallen angel index had an average monthly excess return of 27.4 bp, compared with 2.8 bp for the Corporate Index. The standard deviations of the monthly excess returns were 218.0 bp and 63.1 bp, respectively, for the unconstrained fallen angel index and the Corporate Index.

Figure 17 also subdivides the period, using July 1998 as the break point, and presents the same statistics for the sub-periods. The performance of both the fallen angels and Corporate indices were much worse in the latter sub-period. However, the fallen angel index outperformed the Corporate index in both sub-periods.

Measuring the "Survivorship Bias" in the Lehman Corporate Index

The purpose of introducing the fallen angel indices is to estimate what the performance of the Corporate Index *would have been* if downgraded bonds had been allowed to remain in the Corporate Index for the specified tolerance period. What is the value of this exercise? Currently, the Corporate Index removes bonds at the end of their downgrade month. However, portfolio managers may be able to remove such bonds from their portfolio only after some delay (say, three months). If fallen angel issues continue to underperform over the next three months, then the manager will underperform the index even if his goal at the outset was to replicate the index. The difference between the index return and the manager's return is the "survivorship bias" due to the fact that the Corporate Index can jettison fallen angels immediately whereas the manager cannot.

To measure the survivorship bias, we construct a market value weighted combination of the fallen angels index for a given tolerance period and the Corporate Index and define this combination as the downgrade-tolerant Corporate Index for the given tolerance period. We then define the survivorship bias as the difference in excess returns between the Corporate Index and the downgrade-tolerant Corporate Index. If the performance of the Corporate Index is greater, then the fact that the Corporate Index

Figure 17. **Excess Returns: Means and Standard Deviations,** (bp)
Unconstrained Fallen Angel Index and Corporate Index
January 1990 – September 2003

Period	Unconstrained Fallen Angel Index	Corporate Index
January 1990 – September 2003		
Mean	27.4	2.8
Standard Deviation	218.0	63.1
January 1990 – July 1998		
Mean	36.4	4.7
Standard Deviation	143.6	30.1
August 1998 – September 2003		
Mean	12.5	-0.4
Standard Deviation	304.9	95.7

immediately discards fallen angel issues produces a survivorship bias in favor of the Corporate Index.

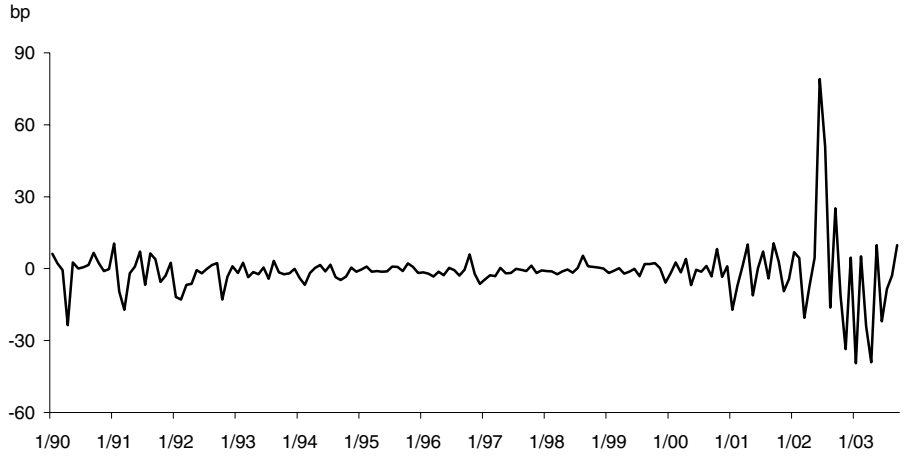
First, we show in Figure 18 the performance of the downgrade-tolerant Corporate Index assuming an unconstrained tolerance period. This downgrade-tolerant index *outperforms* the Corporate Index by 1.2bp per month – indicating that there is actually no survivorship bias against the unconstrained downgrade-tolerant index.

Figure 19 presents the monthly excess return difference between the Corporate Index and the unconstrained downgrade-tolerant index from January 1990-September 2003. As illustrated, since the latter half of 1999, the bias has been quite volatile, exhibiting a peak in June of 2002 with the downgrade of WorldCom. Figures 18 and 19 show that while the survivorship bias is negative for the period as a whole, there are periods where the survivorship bias is positive.

Figure 18. **Average Monthly Excess Returns and Survivorship Bias** (bp/month)
Corporate Index and Unconstrained Downgrade-Tolerant Index
January 1990 – September 2003

Period	Unconstrained Downgrade-Tolerant Index	Corporate Index	Survivorship Bias
January 1990 – September 2003			
Mean	4.0	2.8	-1.2
January 1990 – July 1998			
Mean	6.2	4.7	-1.5
August 1998 – September 2003			
Mean	0.4	-0.4	-0.8

Figure 19. **Monthly Excess Return Difference** (bp)
Corporate Index Minus Unconstrained Downgrade-Tolerant Index
January 1990 – September 2003



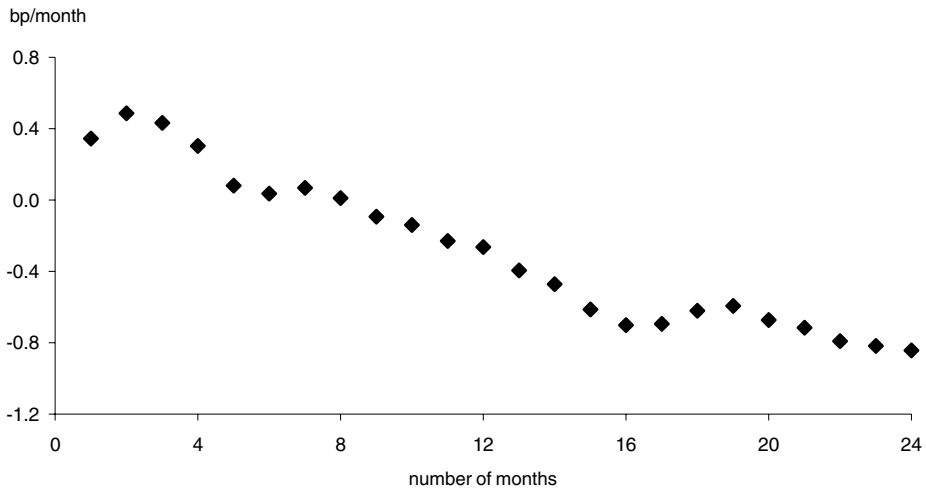
Figures 18 and 19 display data only for the unconstrained downgrade-tolerant index. Figure 20 shows the magnitude of the survivorship bias for the other downgrade-tolerant indices as a function of the tolerance period.

Figure 20 illustrates that the survivorship bias is a small but not negligible issue. If portfolio managers were unable to sell downgraded bonds for a month after they left the Corporate index, then they underperformed their benchmark by 0.3 bp per month over the past fourteen years or so. Figure 20 also shows that the survivorship bias is generally a decreasing function of the tolerance period.[19] If fallen angels are permitted to remain in the Corporate Index for a longer period of time, then the general partial recovery of fallen angels helps to reverse the survivorship bias. If downgraded bonds are allowed to remain in the Corporate Index for six months, then the survivorship bias is effectively zero, and if they are allowed to stay in the index longer, the bias becomes negative. The important lesson from these results is that if a plan sponsor wants to use the Corporate Index as a benchmark and plans to give the manager less than six months to eliminate a position in fallen angels, the sponsor should consider using a downgrade-tolerant index as a benchmark in order to eliminate the survivorship bias against the manager.

In summary, the quality requirement of the Lehman Corporate Index puts managers at a disadvantage because they cannot sell their positions in fallen angel issues as soon as those bonds leave the index. This section measured the effect of relaxing the index's quality requirement by first constructing fallen angels indices of various tolerance periods. Our results indicate that as the tolerance period for the fallen angels index is extended, the average monthly return performance improves up to the sixth month,

[19] Figure 20 is not necessarily the "mirror image" of Figure 16 and does not necessarily rise when Figure 16 falls or vice-versa. As we lengthen the tolerance period, the market value of the fallen angels index increases (i.e., there are more fallen angel issues in the index) which increases its relative weight in the downgrade-tolerant corporate index. Thus, the fluctuations in Figure 20 are caused not only by the fluctuation in the performance of the set of fallen angels as we increase the tolerance period but also by the change in their weight in full downgrade-tolerant index.

Figure 20. **Survivorship Bias As a Function of The Tolerance Period**
January 1990 – September 2003



with less dramatic improvement afterward. Furthermore, by combining the fallen angel indices (with various tolerance periods) with the Corporate Index, we are able to create the corresponding downgrade-tolerant corporate indices. We then measure the survivorship bias that may be inherent in the Corporate Index versus downgrade-tolerant corporate indices. The results indicate that the survivorship bias is particularly acute when the tolerance period is three months or less. After this point, the bias diminishes and eventually turns negative, demonstrating the recovery of fallen angels over this lengthening tolerance period. Our evidence suggests that plan sponsors should consider a time horizon of at least six months to allow managers to unwind their positions of fallen angel debt.

Given that fallen angels tend to perform better as they season, the next section examines how long an investor should wait to sell a fallen angel issue in order to maximize risk-adjusted returns.

III. Empirical Notes on the Performance of Fallen Angels after Downgrade

Generally, an investor benchmarked against an Aggregate or Corporate Index is not allowed to hold non-investment grade bonds. While the investor is often given time to work out of a downgraded position, the investor must determine the best time to sell. As discussed in the previous section, downgraded bonds appear to have a tendency to recover after a "seasoning" period subsequent to their downgrade month. This section analyzes the performance of "fallen angels" subsequent to their downgrade month and tries to identify the optimal seasoning period. In other words, given that a bond has been downgraded, how long should the investor wait to sell?

For this analysis, the term "**downgrade**" refers to the downgrading of an investment-grade bond below investment grade, and the term "**downgrade month**" refers to the month in which this downgrade occurs. The terms "**since downgrade**" and "**post-downgrade**" refer to the period after the end of the downgrade month, not the period after the day of the downgrade. (We do not examine intra-month performance between the downgrade day and the end of the downgrade month.) Finally, we define the term **"seasoning"** as the length of time, in months, since a bond's downgrade month. So, a fallen angel issue that is "four months seasoned" is a bond whose downgrade month ended four months ago.

During the course of this analysis, we examine the following empirical questions asked most frequently by investors:

Q1. What is the average change (*i.e.,* drop) in the dollar price of a fallen angel in its downgrade month? Also, if we divide the fallen angels into groups based on their pre-downgrade ratings (*e.g.,* Baa3, Baa2, Baa1 and >Baa1), what is the average price drop in each group? For example, what is the average price drop for fallen angels that were rated Baa2 before downgrade?

Q2. Again grouping by pre-downgrade rating, what is the price of the fallen angel, expressed as a percent of the pre-downgrade month-end price, as a function of seasoning (e.g., 1-month, 3-months, 6-months and 12-months since downgrade)?

Q3. What is the average monthly excess return for a fallen angel given its seasoning? Do seasoned bonds perform better than unseasoned bonds? Is there a difference in the post-downgrade return performance of fallen angels according to the size of the issuer? In other words, is there a "large" versus "small" issuer difference? We group the universe of fallen angels according to whether or not a bond belonged to the top 100 issuers[20] by market value in the Lehman Corporate index as of the beginning of its downgrade month.

Q4. Does the post-downgrade performance of a fallen angel depend on its initial rating after downgrade? We group fallen angels according to their rating at the end of the downgrade month. For each group, we calculate the average monthly excess return and standard deviation of monthly excess returns over the twelve month period following the downgrade month.

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[20] I.e., top 100 tickers by market value. Ties for the 100th position on the list, if any, were resolved alphabetically by ticker.

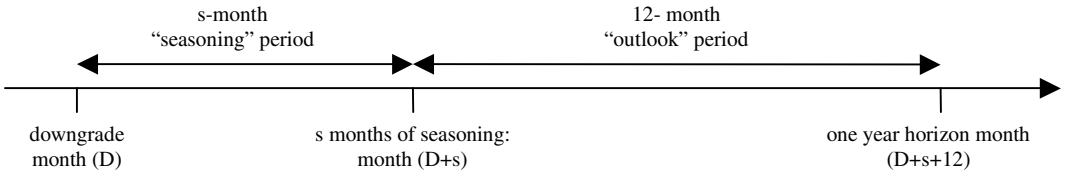
Q5. Similarly, how does the post-downgrade performance of the fallen angel depend on the dollar price of the bond at the end of the downgrade month? Is there a "knife-edge" price at the end of the downgrade month below which a fallen angel is not expected to recover? We group fallen angels according to their dollar price at the end of the downgrade month. For each group, we examine the average and standard deviation of monthly excess returns over the twelve month period following the downgrade month.

Q6. Finally, once a bond has been downgraded, what has been the best length of time to hold onto the bond? Based on the historical record, should the investor sell immediately at the end of the downgrade month or hold onto the fallen angel for a period of time to maximize his expected return?

To answer this question, we track each fallen angel issue as it seasons month by month from the end of its downgrade month. We then calculate its realized excess return for the one-year "outlook" period which begins at the end of each seasoning period and terminates one year later. For example, if a bond was downgraded in January 2001, we calculate its annual excess return from the end of January 2001 until the end of January 2002. This is the bond's one-year outlook excess return given that the bond has zero months of seasoning. Then we allow the bond to season one month and calculate the annual excess return from the end of February 2001 until the end of February 2002. This is the bond's one-year outlook return given that the bond has one month of seasoning. We move on in this fashion, advancing the start of the outlook return calculation period by one month but keeping the length of the period fixed at one year. A diagram of this setup is presented below.

Similar calculations are made for all fallen angels. Then, for every seasoning period, we calculate the average and standard deviation of one-year outlook excess returns across all fallen angels. From these values, we calculate information ratios.

The motivation for this approach is as follows: The one-year outlook return is what the portfolio manager truly wants to know. After the downgrade, when much of the performance damage has already occurred, the portfolio manager must decide whether to sell or hold the fallen angel issue. This decision can only be made by comparing the *future* risk-adjusted excess return expected from the fallen angel, given its amount of seasoning, with the future risk-adjusted excess return expected from other assets.



Method

For each month starting with January 1990, we identified all bonds that became fallen angels during that month. Also, for each month, we computed the total market value of every issuer in the Lehman Corporate index as of the beginning of the month and identified the 100 largest issuers. Fallen angels created during the month were "tagged" to indicate whether or not they belonged to one of the 100 largest issuers. For every fallen angel, we gathered price, total return, and excess return data for up to 24 months after the downgrade month.

Total returns and excess returns from consecutive months were used to compute cumulative excess returns.[21] These cumulative excess returns as well as monthly excess returns were sorted among various "buckets" depending on which question we were trying to answer. For example, when answering question Q4 above, each monthly excess return observation was placed in one of the following four post-downgrade ratings buckets: Ba1, Ba2, Ba3, or below Ba.

There were, however, several types of special cases that needed to be handled differently.

Defaulted and matured bonds. If a bond defaulted during a month in which the bond's price or returns were needed, its month-end full price was set to the lesser of $20 and the full price recorded in the database and its returns were adjusted accordingly. If the bond matured during that month, its month-end full price was set to $100 + (coupon/2) and its excess return was adjusted accordingly.[22]

When computing 12-month outlook period returns for question Q6, if a bond defaulted or matured during an outlook period, we assumed that at the end of the default or maturity month the market value of the bond was invested at LIBOR for the remainder of the outlook period. (We assumed a LIBOR rate of 4% for the entire historical period.)

Repeat fallen angels. There were a few fallen angels that were upgraded back to investment grade some time after their downgrade and then later became fallen angels again during our historical period. For these bonds, we ignored all downgrades after the first one.

Missing Data. A number of price and return observations needed for our calculations were not found in the Lehman index database. These data were estimated as follows.

Estimating Full Price Data: For each bond for which data were missing we first determined the bond's "horizon date," i.e., the last date for which we needed the bond's price and return data. The horizon was typically the earlier of 24 months after the end of the bond's downgrade month and August 29, 2003, but was earlier if the bond

[21] As we indicated earlier, cumulative excess returns over a multi-month period cannot be computed by geometrically linking the monthly excess returns. Rather, the cumulative total return of the asset in question and that of duration-matched Treasuries must be computed separately, and the difference between the two cumulative total returns can be considered the cumulative excess return ("Annualizing Excess Returns," *Global Relative Value,* November 5, 2001).

[22] We did not include in our analysis any outlook period returns for bonds that matured or defaulted before the outlook period began.

matured or was downgraded before those dates.[23] We determined the bond's "horizon price," i.e., its clean price on the horizon date, from another data source, if possible. If the horizon price was unavailable from other sources, we estimated the price using the spreads of bonds from the same issuer on the horizon date.

The clean price of the bond at every month-end between the last date for which the bond's price was found in our database and the horizon date was interpolated linearly from the last clean price in the database and the horizon price. The accrued interest was calculated from the bond's indicative data.

Estimating Excess Return Data: The excess return of the bond over the course of a given month was computed as the bond's total return minus the total return of duration-matched Treasuries.

The total return of the bond was computed by estimating the full price of the bond, using the above method, at the beginning and the end of the month and determining whether or not the bond paid a coupon during the month. The total return was then estimated as

100 × (ending full price + coupon (if any) – beginning full price) / beginning full price.

The total return on duration-matched Treasuries was estimated as follows. We found the latest duration observation for the bond in the database.[24] For every month in which we needed to estimate the bond's total return, we examined a set of Treasuries of varying maturities that were outstanding as of the beginning of the month and selected the one whose option-adjusted duration was closest to the bond's latest duration observation. The total return of this Treasury over the course of the month was used as the estimate of total return on duration-matched treasuries.

Results

The results of our analysis are organized by the empirical questions listed at the beginning of this section.

Q1. What is the average change (i.e., drop) in the dollar price of a fallen angel in its downgrade month? Also, if we divide the fallen angel issues into groups based on their pre-downgrade ratings, what is the average price drop in each group? Figure 21 shows that the average (equal weighting) dollar price drop for a fallen angel over its downgrade month was approximately 5.7% of par.

[23] Data in this study include returns through August 2003 for issues that became fallen angels by month-end July 2003.
[24] If the latest duration observation was prior to the current month, we subtracted from the duration value the number of months that elapsed since the latest duration observation.

Figure 21. **Average Drop in Full Price over the Downgrade Month**
Grouped by Pre-Downgrade Rating
(January 1990 – August 2003)

	>Baa	Baa1	Baa2	Baa3	All Ratings
Average % drop in price	-0.86%	-8.99%	-7.60%	-5.09%	-5.68%
# of bonds	49	70	236	756	1,111

Surprisingly, bonds with the highest pre-downgrade ratings had the smallest average drop in price, despite the fact that their ratings all fell at least four notches. One reason why their ratings drops were so steep may have been that the ratings agencies were catching up with changes that had already happened in the market place (as evidenced by the need for a steep drop in the rating), and there was no further market movement as a result of the downgrade. However, these bonds were a small portion of the overall downgrade dataset (i.e., 49 out of 1,111).

Q2. For each pre-downgrade investment grade rating bucket, what is the average full price of the fallen angel, expressed as a percentage of the pre-downgrade full price, 1 month, 3 months, 6 months, and 12 months after the downgrade month? Figure 22 shows that prices of fallen angels generally improve, on average, with seasoning. Oddly, fallen angels rated Baa1 before downgrade showed little price improvement. However, these bonds were a small portion of the overall downgrade dataset (i.e., 70 out of 1,111).All other pre-downgrade rating categories tended to show some price improvement as a function of seasoning. Does this indicate that it is beneficial to wait and allow a fallen angel to season before selling? We come back to this question in Q6 below.

Q3. What is the average monthly excess return for a fallen angel issue given its seasoning? Do seasoned bonds perform better than unseasoned bonds? Is there a difference in the post-downgrade return performance of fallen angels according to the size of the issuer? Figure 23 presents the average monthly excess return sorted by both the seasoning period and issuer size. The value given for a particular month in the seasoning period is the average of all monthly excess returns observed for any fallen angel during that month in its particular seasoning period. For example, the average of all excess return observations for small issuers over the fourth month since downgrade appears at the "4" mark on the horizontal axis and is about 30 bp.

Figure 22. **Average, Minimum and Maximum Full Price after Four Seasoning Periods, as % of Pre-Downgrade Full Price**
Grouped by Pre-Downgrade Rating
(January 1990–July 2003)

1 mo seasoning	**>Baa**	**Baa1**	**Baa2**	**Baa3**
Average	99.7	86.2	87.4	94.1
Min	80.1	13.3	23.8	1.4
Max	112.7	115.7	166.7	150.8
3 mos seasoning	**>Baa**	**Baa1**	**Baa2**	**Baa3**
Average	97.7	93.9	93.3	95.8
Min	23.7	67.2	20.7	12.0
Max	109.9	133.3	160.1	160.6
6 mos seasoning	**>Baa**	**Baa1**	**Baa2**	**Baa3**
Average	101.8	92.9	104.4	98.2
Min	86.5	30.8	35.7	21.3
Max	169.3	111.8	165.0	201.2
12 mos seasoning	**>Baa**	**Baa1**	**Baa2**	**Baa3**
Average	107.1	91.4	101.9	100.1
Min	42.0	29.8	15.4	6.2
Max	145.0	126.4	168.3	200.9

The results in Figure 23 show that monthly excess returns tend to become positive by the fourth month of seasoning. In addition, small and large issuers tend to perform similarly, except during the early months of seasoning. This may reflect the difficulty of large fallen angels finding their equilibrium price as they are absorbed by high-yield investors.

Q4 & Q5.

Does the post-downgrade performance of a fallen angel depend on its initial rating after downgrade or its price after downgrade? If so, then investors may seek to construct a decision rule for determining whether to hold onto fallen angel issues. For example, the data may show that if the issue's post-downgrade price is not too low then it has a good chance of recovering.

For seasoning periods of 1 month, 3 months, 6 months, and 12 months, we partition excess return observations by post-downgrade rating bucket (Ba1, Ba2, Ba3, and <Ba) and post-downgrade price bucket (in twenty-point increments) and compute the average excess return and standard deviation of excess returns in each bucket (where applicable). Results are shown in Figure 24.[25]

The goal here was to see whether a "knife-edge" value could be found for seasoning period, post-downgrade rating, or post-downgrade price that would serve as the boundary between fallen angels that could be expected to do well and those that would not. For example, we might have found that bonds whose post-downgrade prices are at least $60 usually recover and provide good returns, whereas those whose post-downgrade prices are below $60 do not. However, across all qualities and seasoning periods, there is no "knife-edge" price value. In fact, some of the lower price buckets tend to do relatively well compared with the higher price buckets. Figure 25 presents twelve month excess returns for all bonds with 12 months of seasoning sorted by their full price at the end of their downgrade month. There is no strong indication that higher priced downgraded bonds perform better subsequently to their downgrade compared to lower priced bonds.

[25] Figure 24 does not report results for buckets with five or fewer observations.

Figure 23. **Average Monthly Excess Returns by Seasoning Period**

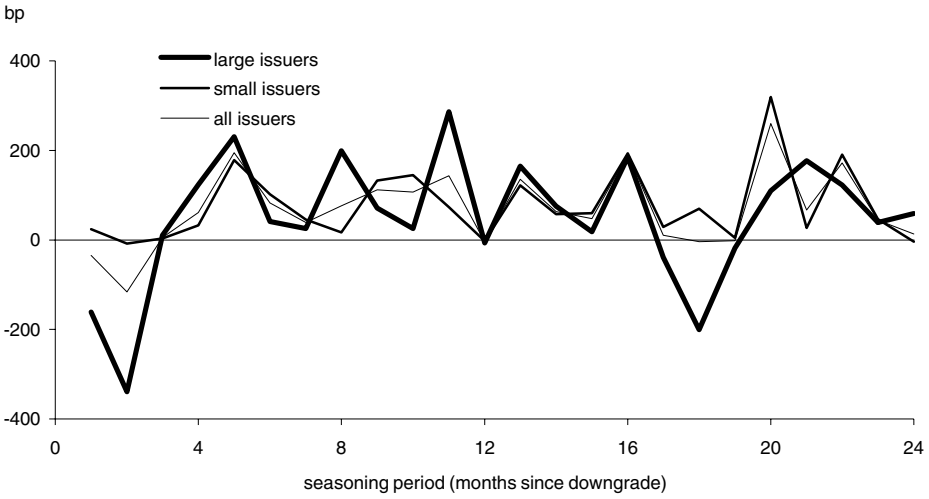


Figure 24. **Average and Standard Deviation of Twelve-Month Excess Returns** (in bp)
Sorted by Post-Downgrade Rating, Seasoning and Post-Downgrade Price
(January 1990 – July 2003)

Ba1	**100+**	**80-100**	**60-80**	**40-60**	**20-40**	**0-20**	**all prices**
1 mo Avg	-0.1	-1.1	15.0	39.0	-4.7	—	4.2
1 mo StdDev	11.3	15.6	58.8	49.5	80.9	—	33.1
1 mo #obs	*113*	*258*	*93*	*26*	*6*	*0*	*496*
3 mos Avg	-1.7	1.5	15.2	37.3	0.0	—	4.9
3 mos StdDev	18.5	22.9	64.2	64.3	82.2	—	37. 4
3 mos #obs	*113*	*254*	*78*	*25*	*6*	*0*	*476*
6 mos Avg	0.6	3.7	7.9	19.4	-16.0	—	4.3
6 mos StdDev	16.3	22.3	49.8	44.4	38.9	—	29.6
6 mos #obs	*108*	*229*	*73*	*25*	*6*	*0*	*441*
12 mos Avg	-1.2	2.0	10.0	42.9	—	—	5.2
12 mos StdDev	20.7	20.8	21.5	34.7	—	—	24.4
12 mos #obs	*104*	*200*	*63*	*22*	*4*	*0*	*393*

Ba2	**100+**	**80-100**	**60-80**	**40-60**	**20-40**	**0-20**	**all prices**
1 mo Avg	4.2	-4.1	16.5	-25.7	—	—	-0.4
1 mo StdDev	8.7	32.2	31.8	40.7	—	—	34.0
1 mo #obs	*26*	*119*	*68*	*29*	*3*	*0*	*245*
3 mos Avg	5.1	4.2	15.7	6.1	—	—	7.5
3 mos StdDev	6.3	26.3	45.2	21. 7	—	—	31.0
3 mos #obs	*25*	*99*	*48*	*9*	*0*	*0*	*181*
6 mos Avg	6.4	0.4	14.8	4.6	—	—	4.8
6 mos StdDev	5.3	21.5	30.6	15.7	—	—	22.8
6 mos #obs	*25*	*92*	*37*	*9*	*0*	*0*	*163*
12 mos Avg	6.2	5.9	40.7	19.0	—	—	14. 4
12 mos StdDev	5.0	22.6	83.7	20.4	—	—	45.4
12 mos #obs	*25*	*68*	*29*	*5*	*0*	*0*	*127*

Ba3	**100+**	**80-100**	**60-80**	**40-60**	**20-40**	**0-20**	**all prices**
1 mo Avg	8.3	7.3	24.3	—	—	-9.9	14.8
1 mo StdDev	6.0	17.0	29.0	—	—	24.8	29.1
1 mo #obs	8	28	33	1	1	6	77
3 mos Avg	7.9	5.0	28.5	—	—	5.4	15.1
3 mos StdDev	5.7	15.8	63.2	—	—	28.2	40.8
3 mos #obs	*8*	*25*	*19*	*1*	*1*	*6*	*60*
6 mos Avg	8. 3	3.0	5.7	—	—	44.1	9.0
6 mos StdDev	6.3	16.0	60.9	—	—	39.0	37.1
6 mos #obs	*8*	*24*	*15*	*1*	*1*	*6*	*55*
12 mos Avg	2.9	-1.4	4.2	—	—	—	-0.2
12 mos StdDev	2.6	17. 7	44.7	—	—	—	29.5
12 mos #obs	*7*	*21*	*14*	*1*	*1*	*0*	*44*

<Ba	**100+**	**80-100**	**60-80**	**40-60**	**20-40**	**0-20**	**all prices**
1 mo Avg	0.2	11.7	-2.6	34.4	—	-26.2	11.1
1 mo StdDev	5.5	9.8	66.1	27.9	—	26.8	33.5
1 mo #obs	*8*	*23*	*7*	*24*	*2*	*10*	*74*
3 mos Avg	1.0	10.9	2.2	2.8	—	-13.7	3.7
3 mos StdDev	6.7	13.5	49.0	29.3	—	10.7	22.6
3 mos #obs	*8*	*23*	*6*	*10*	*2*	*7*	*56*
6 mos Avg	2.67	12.0	—	44.5	—	—	16.4
6 mos StdDev	7.7	12.4	—	31.8	—	—	25.8
6 mos *#obs*	*7*	*23*	*4*	*10*	*2*	*1*	*47*
12 mos Avg	4.1	3.3	—	77.9	—	—	20.2
12 mos StdDev	7. 2	8.8	—	47.2	—	—	45.4
12 mos #obs	*5*	*20*	*4*	*10*	*2*	*1*	*42*

all qualities	**100+**	**80-100**	**60-80**	**40-60**	**20-40**	**0-20**	**all prices**
1 mo Avg	1.1	-0.7	16.4	13.5	1.7	-20.1	4.4
1 mo StdDev	10.6	21.7	47.1	50.1	72.4	26.5	33.3
1 mo #obs	*155*	*428*	*201*	*80*	*12*	*16*	*892*
3 mos Avg	0.1	3.0	16.5	23.2	12. 6	-4.9	6.2
3 mos StdDev	16.4	23.1	57.8	52.7	74.4	22.1	35.4
3 mos #obs	*154*	*401*	*151*	*45*	*9*	*13*	*773*
6 mos Avg	2.1	3.3	9.4	21.7	-3.1	31. 7	5.6
6 mos StdDev	14.5	21.3	45.6	38.9	40.8	48.5	28.76
6 mos #obs	*148*	*368*	*129*	*45*	*9*	*7*	*706*
12 mos Avg	0.5	2.7	16.3	46.0	45.1	—	7.8
12 mos StdDev	18. 2	20.5	51.0	44. 8	36.7	—	32.3
12 mos #obs	*141*	*309*	*110*	*38*	*7*	*1*	*606*

Q6. Once a bond has been downgraded, what has been the best length of time to hold onto the bond? Figure 26 presents the average and standard deviation of the one-year *outlook* excess returns as a function of the seasoning period across all fallen angels. Recall that the one-year outlook excess return is defined as the excess return over the year that begins after the end of the seasoning period. For example, the average one-year return for a fallen angel with no seasoning was 2.4%. However, the standard deviation of these returns was very high at almost 40%.[26] In general, outlook excess returns rise with seasoning while the standard deviation of excess returns remains relatively constant, indicating that the information ratio for fallen angels increases with seasoning. Figure 27 presents the 12-month outlook information ratios for fallen angel issues of various seasoning periods.

[26] The spike in the 8-month outlook average excess return and standard deviation of excess return is due to one bond (NGC Corp, 62912PAC), which had an extremely large twelve-month excess return starting eight months after its downgrade.

Figure 25. **12-Month Exc Ret vs. Full Price at End of Downgrade Month**
Bonds have Twelve Months of Seasoning, January 1990-July 2003

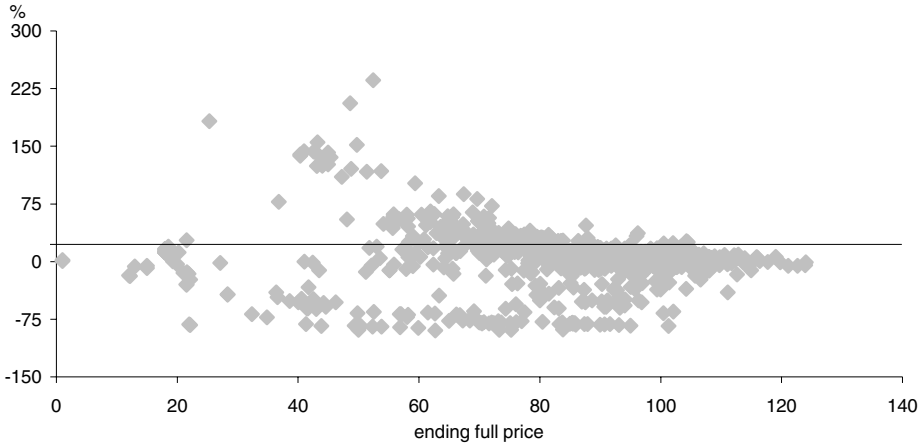


Figure 26. **12-Month Outlook Excess Returns, Average and Standard Deviation as a Function of The Seasoning Period**
January 1990 – July 2003

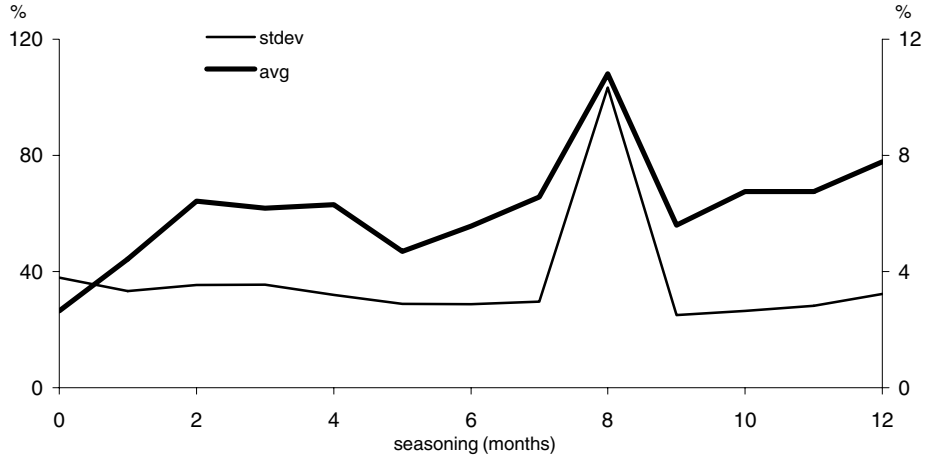
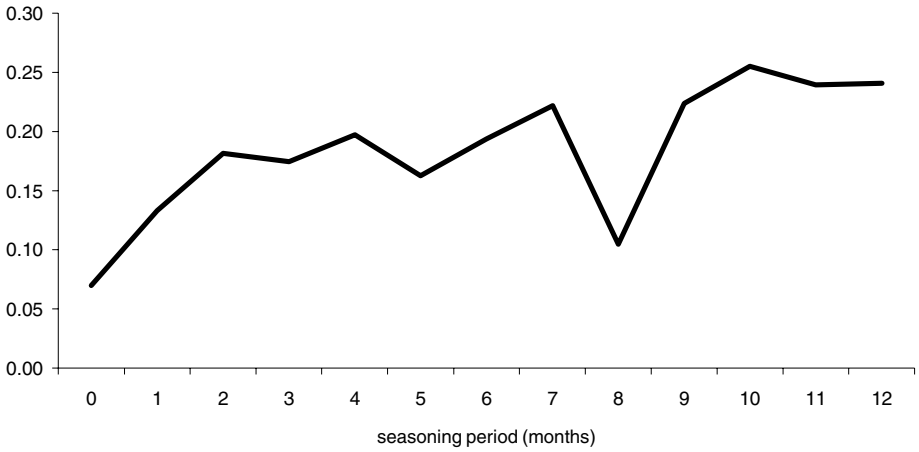


Figure 27. **12-Month Outlook Information Ratios for Fallen Angels As a Function of the Seasoning Period**
January 1990 – July 2003



Should the investor sell or hold? In principle, the investor should compare the mean and standard deviation of these outlook returns, or perhaps information ratios of the outlook returns, with those of other assets' outlook returns. If fallen angel issues compare favorably, then the investor should hold. If an investor finds unseasoned fallen angel issues relatively attractive compared with other asset classes, the results in Figure 27 tend to support a strategy of holding onto fallen angel issues, as their information ratio improves with time.

To address this issue, we compare the 12-month information ratios with those of other asset classes that the portfolio manager may be considering. Figure 28 presents 12-month cumulative information ratios for the Baa-rated Corporate Index, the overall Corporate Index, the Agency Index, and the MBS Index, as well as information ratios for fallen angels with various amounts of seasoning.

Overall, we see that fallen angel issues, even those with little seasoning, have information ratios that are comparable to several other asset classes that a portfolio manager may consider for his portfolio.

Investment-grade investors sometimes find themselves unexpectedly holding fallen angel issues. If they are not required to sell such a bond immediately, they may ask what the prospects are for these bonds once the portfolio has already suffered the initial drop in price.

The data presented in this paper generally show that while fallen angels do, on average, experience positive excess returns after their initial downgrade, there is great variability in these returns from one bond to the next. Nevertheless, their information ratios compare well with those of other possible asset class contenders for a manager's portfolio. In addition, the information ratios tend to improve with seasoning which would argue for the continued holding of fallen angel issues.

There does not seem to be a post-downgrade price or seasoning period that signals good future performance.

Figure 28. **Comparing 12-Month Information Ratios for Fallen Angels (of various seasoning periods) and other Asset Classes**
January 1990 – July 2003

Baa-Corporate Index-0.02	
Corporate Index	0.07
Agency Index	0.61
MBS Index	0.07
FA(0)	0.07
FA(1)	0.13
FA(2)	0.18
FA(3)	0.17
FA(4)	0.20
FA(5)	0.16
FA(6)	0.19
FA(7)	0.22
FA(8)	0.10
FA(9)	0.22
FA(10)	0.26
FA(11)	0.24
FA(12)	0.24

IV. Return Performance of Investment-Grade Bonds after Distress

Given the rash of distressed bonds in the Lehman Investment-Grade Credit Index in 2000-2002, many investors have pondered the question of whether it makes sense to sell distressed bonds out of their portfolios. Some investors feel it is better to sell as soon as the issue becomes distressed because it is unlikely that the issue will recover. Others feel that a distressed bond offers a very attractive yield and as long as the issue does not default, there is good potential for strong total and excess returns over time. The purpose of this study is to answer the following question: "Based on history, if an investment-grade issue becomes distressed, is one better off holding or selling?"

The events of 2000-2002 produced a large number of distressed investment-grade issues, which may indicate that the credit markets were facing structural problems never before seen. However, other years also produced a significant number of distressed issues in a similarly bleak corporate environment. In fact, some may argue that the spate of distressed issues in recent years was merely the result of a vicious crisis-of-confidence cycle, with issues declining in price simply because they had declined in price. If this is the case, perhaps a dispassionate historical perspective may be helpful to portfolio managers as they decide whether to hold distressed investment-grade issues.

This study shows that distressed investment grade bonds have performed well, as a group, versus Treasuries and other corporate issues subsequent to their distress month. However, this outperformance takes time: over a year.

Identifying Distressed Investment-Grade Bonds

To answer our question, we first identify those bonds in the Credit Index that become distressed and then we measure their subsequent return performance. Defining a bond as "distressed" is highly subjective. As a starting point for this analysis, we define a distressed investment-grade bond as a security that:

a) Is rated Baa3 or higher;
b) Has a fixed coupon of at least 2%;
c) Has an option-adjusted spread to U.S. Treasuries greater than or equal to 400 bp; and
d) Has an index dollar price of less than 80% of par.

Of the 3,951 issues in the Lehman Credit Index as of the end of August 2003, three satisfied the distress criteria above. (All three had become distressed by October 31, 2002.)

At each month-end since the beginning of 1990 through August month-end 2003, we sorted through the Lehman Credit Index to generate a list of CUSIPs that satisfied the "distress" definition on that date but had not done so in the previous twelve months. We refer to the month at the end of which an issue satisfies the distress criteria for the first time in at least twelve months as the issue's "distress month." For example, if an issue was distressed at the end of June 2000 but had not been distressed at the end of the months June 1999 through May 2000, then June 2000 was its distress month. We then tracked each distressed bond over a "performance period" of up to twenty-four months subsequent to its distress month. We chose twenty-four months as the length of the performance period to give the issue a chance to resolve its credit situation one way or the other. For example, bonds whose distress month was June 2000 were tracked from July 2000 through June 2002. We found 580 issues that became distressed from January 1, 1990-August 31, 2003.

For distressed issues that defaulted before the end of the performance period we recorded the default date (usually the Chapter 11 filing date) and, to be conservative, assumed a recovery value of zero at the end of the month in which the issue defaulted.[27] In these cases, the performance period was truncated at the end of the default month.

For distressed issues that matured or were called during the performance period, we recorded the relevant date and price and assumed that the redemption occurs at the end of the month. In these cases, the performance period was truncated at the end of the month in which the issue matured or was called. For distressed issues that left the indices because they were exchanged for other issues, we assumed that the issue was exchanged as announced and the performance of the new issue was measured until the end of the performance period. The new bond's performance after the exchange was combined with the old bond's performance before the exchange to make a single distressed bond performance history. Finally, there were many bonds whose performance periods were not truncated due to maturity, call, or default, but for which twenty-four months of data were not available because they became distressed after September 2001 and our return data set ends with September 2003. For such bonds, the performance period ends with September 2003. Overall, this study accounts for all investment-grade bonds in the Credit Index that became distressed as defined above.

If a distressed issue recovered and later became distressed again, we did not regard the two distress incidents as separate incidents, each producing a twenty-four month observation, unless there were twelve consecutive "non-distress" months in between. This avoids the problem of issues bouncing in and out of distress status and generating multiple observations. In our historical period, seventeen issues (from ten separate issuers, e.g., KM) became distressed, subsequently became "non-distressed" for at least twelve consecutive months, and then became distressed again (and therefore appear twice in our list of 580 distressed issues).

Figure 29 presents some summary data on the 580 issues in the Credit Index that met the distressed criteria from January 1990-August 2003. Figure 29 shows the number of issues and the par and market value amounts outstanding at the end of the distress month (both absolute and as a percentage of the Lehman Credit Index). Figure 29 aggregates the monthly results by "vintage year," with an issue's vintage year defined as the calendar year in which it became distressed. (The set of bonds that became distressed in that year will be called that year's "vintage".) Figure 30 shows that in 2002, 271 investment-grade bond issues, accounting for 5.6% of the outstanding market value and 8.5% of the par value of the Credit Index, became distressed.

What eventually happens to these distressed issues? By and large, they recover. As shown in Figure 30, 431 of the 580 distressed issues, or 74%, traded at "non-distressed" levels (i.e., OAS less than 400 bp) within twenty-four months of their distress month. This number will likely rise as the 2002 and 2003 vintages season. For issues distressed prior

[27] This is a very conservative assumption that understates the return performance of distressed issues. Later in this section, we examine how the results change if we assume a default price of 20% of par rather than our previously assumed, and possibly severe, default price of zero. For example, it was widely reported on 14 April 2003 that WorldCom debt holders will receive about 36 cents on the dollar under the proposed reorganization plan. (CNN/Money web site: 14 April 2003).

to 2001, approximately 75% either matured or traded at "non-distressed" spread levels within twenty-four months of their distress month. Of the remaining 25%, 8% defaulted and 17% continued to trade at distressed levels. For issues distressed in 2001 or later, approximately 75% trade at "non-distressed" levels so far, 1% have been called, 18% have defaulted, and 5% continue to trade at distressed levels. (The percentages do not add up to 100% due to rounding.)

Figure 29. **All Distressed Issues Summary Information**
1990 – 2003, Sorted by Vintage Year, $ millions

		Amount (par) Outstanding		Amount (Market Value) Outstanding	
Vintage Year	# Distressed Issues	Distressed Issues	as % of Credit Index	Distressed Issues	as % of Credit Index
1990	50	$9,731	1.70%	$7,326	1.36%
1991	14	1,953	0.34%	1,506	0.24%
1992	1	75	0.01%	60	0.01%
1994	1	248	0.04%	192	0.03%
1995	5	900	0.13%	690	0.09%
1996	1	100	0.01%	83	0.01%
1998	29	6,992	0.65%	5,253	0.45%
1999	10	2,375	0.20%	1,840	0.16%
2000	139	36,746	2.62%	27,162	1.91%
2001	54	17,939	1.01%	13,329	0.72%
2002	271	158,227	8.53%	113,998	5.60%
2003*	5	992	0.05%	995	0.05%
Total	**580**				

* Updated through 30 September 2003 using bonds that became distressed by 31 August 2003.
Missing vintage years had no issues that satisfied the distress criteria.

Figure 30. **Status of Distressed Issues (up to) Twenty-four Months after Distress Month,** 1990 – 2003*

	Issues with distress month prior to 2001	Issues with distress month in 2001 or later
Defaulted:	21	60
Matured:	5	0
Called:	0	4
Trading at distressed levels:	42	17
No longer trading at distressed levels:	182	249
Total	250 issues	330 issues

* Updated through 30 September 2003 using bonds that became distressed by 31 August 2003.

Total Return and Excess Return Performance of Distressed Investment-Grade Bonds

What have been the total return and excess return performances of distressed issues subsequent to their distress month? These numbers are the most relevant to portfolio managers. Once an issue becomes distressed, does it make sense to hold it, sell it, or possibly buy more? While some of the distressed issues subsequently lost their investment-grade rating, at the end of a bond's distress month it was investment grade and eligible to remain in most investor portfolios. Many portfolio managers are allowed to continue holding (although with stiffer monitoring requirements) an investment-grade issue that becomes distressed.

We measure the performance of each distressed issue for twenty-four months, if possible, subsequent to, but not including, its distress month. For bonds that default we assume a price of zero at the end of their default month. This assumption will be relaxed later in this section.

We calculate both cumulative total returns and cumulative excess returns. Return numbers are not annualized. We calculate excess returns by measuring the difference between the twenty-four month cumulative total return on the distressed issue and the twenty-four month cumulative total return on duration-matched Treasuries.[28] This cumulative excess return calculation allows the manager to ask what his relative performance would have been if he had sold the distressed issue at the end of the distress month and invested in Treasuries with similar duration.[29]

Cumulative total returns, of course, are calculated by compounding monthly total returns. Complete time series of monthly returns that went though the normal index pricing quality controls are available for distressed bonds that remained in one or another Lehman Brothers index during their entire performance period. Most distressed issues remained in the Lehman Credit Index or migrated to the High Yield Index during their performance period.

However, some distressed issues left the Credit Index at some point in their performance period and were no longer members of any Lehman Brothers index. For example, a distressed issue might no longer satisfy the index liquidity constraint (i.e., amount outstanding), which has increased over time. More commonly, a distressed issue might have left the Lehman Family of Indices because it came within a year of its maturity date. Unfortunately, for distressed issues that drop out of the Lehman Family of Indices, the price and return time series comes to an abrupt end.

Excluding such bonds might introduce a bias into our results. Therefore, these bonds are included, and we use their known monthly return data for the months in which they remained in some index. We now discuss our method for calculating returns for these issues once they have left the Family of Indices.

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[28] Cumulative excess returns over a multi-month period cannot be computed simply by geometrically linking the monthly excess returns ("Annualizing Excess Returns," *Global Relative Value,* November 5, 2001).

[29] In an earlier publication we discussed the limited relevance for distressed issues of duration as a measure of price sensitivity to changes in the Treasury curve ("Risk and Return for Low-Price Investment-Grade Bonds," *Global Family of Indices*, May 2002). In this exercise we wish to evaluate a strategy of selling distressed bonds for comparable duration Treasuries. Presumably, the portfolio manager would replace a distressed credit issue with a comparable duration Treasury to maintain his overall portfolio duration.

The first step is to determine the horizon price for the bond, i.e., the price of the bond at the end of its performance period. The horizon price is set to 100 for matured bonds, to 0 for defaulted bonds, and to the call price for called bonds. For a bond that did not mature or default and was not called, we first look for other issues from the same issuer which have a similar maturity and rating but which satisfied the liquidity constraint and remained in the indices. We then used the bid spread of the index issue at the end of the non-index issue's performance period to price the non-index issue. In all but a handful of cases, distressed issues that left the indices for liquidity reasons were priced in this way using index bonds of the same issuer.[30]

We then estimated the price of the non-index bond at every month-end between the time it left the Family of Indices and the end of the performance period by interpolating linearly between the horizon price determined by our research and its price the last time it was in an index. These price data, combined with accrued interest and coupon payment information, allowed us to estimate total returns on the bond in the months when it was not in any index. We calculate excess return on the bond in a non-index month by measuring the difference between the total return on the bond and the total return on a Treasury with a duration equal to the last reported duration of the distressed issue when it was in the indices.[31]

Figures 31a and 31b show, respectively, the cumulative total and excess returns of distressed bonds during their respective performance periods (up to twenty-four months after the distress month). The distressed issues are sorted by distress month, with the issues with the earliest distress month appearing at the left end of the horizontal axis and those with the latest distress month appearing at the right end. The vertical line

[30] In a handful of cases, we had to price the distressed bond that had left the indices using a comparable, but not identical, issuer. Complete details are available from the authors.
[31] There may have been some distressed issues that left the Family of Indices and then returned before the end of their performance period. In any case, we used this pricing methodology for all months after a distressed bond left the indices, whether or not it returned.

Figure 31a. **Cumulative Total Return Performance of Distressed Bonds During Performance Period (up to 24 Months after Distress Month)**
January 1990 – August 2003; observations sorted by distress month (Returns data through September 2003 for bonds distressed by August 2003. Prices for defaulted bonds set to zero at end of default month.)

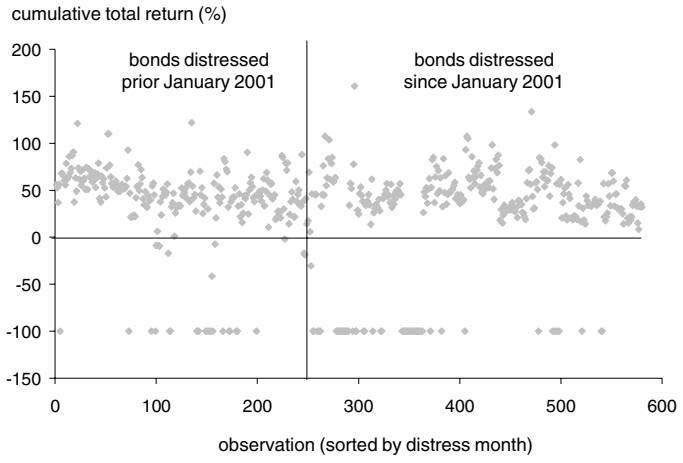
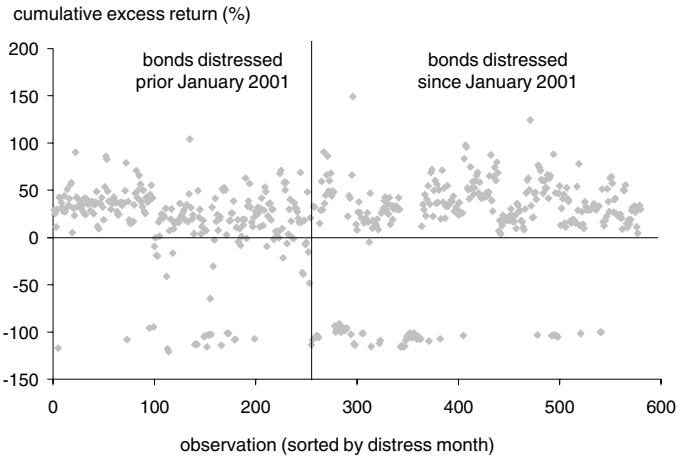


Figure 31b. **Cumulative Excess Return Performance of Distressed Bonds During Performance Period (up to 24 Months after Distress Month)**
January 1990 – August 2003; observations sorted by distress month (Returns data through September 2003 for bonds distressed by August 2003. Prices for defaulted bonds set to zero at end of default month.)



demarks issues that become distressed before and since January 2001. Figures 31a and 31b show that total and excess returns for distressed bonds have generally been positive.

We also calculate average cumulative total and excess returns by vintage year and for the entire study period. For every vintage year, we compute the cumulative total or excess returns of all bonds in the year's vintage over the bonds' respective performance periods. The unweighted average of these returns is the total or excess return for that vintage year. Total and excess returns for longer periods are calculated similarly. Figure 32 presents cumulative total and excess returns by vintage year. It shows that for bonds distressed prior to 2001, twenty-four month total and excess returns have been very positive (averaging 33.79% and 13.93%, respectively). However, for bonds distressed in 2001 and thereafter, total and excess returns have been worse (averaging 20.41% and 11.32%, respectively).

The 2001 vintage stands out as the only poor performer, with an excess return of -17.13%. The 2001 vintage has had almost two years to start showing some recovery, but there seems little indication that this vintage year will fully recover. Keep in mind that this vintage is dominated by Enron issues. If we were to exclude Enron issues from the 2001 vintage, the twenty-four month cumulative total and excess returns as of the end of September 2003 would be 22.44% and 8.09% respectively.

Figure 32. **Performance of Distressed Bonds Cumulative Total and Excess Returns vs. Duration-Matched Treasuries, Twenty-Four Months (if available) after Distress Month**
Results by Vintage Year: 1990 – 2003
Default recovery is assumed equal to zero

Vintage Year	# observations	Twenty-Four Month Cumulative Total Return	Twenty-Four Month Cumulative Excess Return vs. duration-matched UST
1990	50	60.36%	31.58%
1991	14	65.71%	44.61%
1992	1	54.17%	24.43%
1994	1	56.22%	36.36%
1995	5	55.11%	38.63%
1996	1	92.99%	78.93%
1998	29	25.48%	21.19%
1999	10	33.36%	11.98%
2000	139	24.34%	4.82%
2001	54	-7.04%†	-17.13%†
2002	271	25.80%†	16.80%†
2003*	5	24.60%†	21.94%†
Vintage Years prior 2001	250	35.49%	15.76%
Vintage Years since 2001	330	20.41%†	11.32%†
All Vintage Years	580	26.91%	13.24%

* Updated through September 30, 2003 using bonds that became distressed by August 31, 2003.
† Issues of the 2001, 2002, and 2003 vintages generally do not have a full twenty-four months of returns since their distress month.
Default recovery is assumed equal to zero.

Vintage year 2002 is another story and seems to be recovering nicely, as the earlier vintages generally did (2001 notwithstanding). This vintage year was dominated by WorldCom, which became distressed in April 2002. Many more issues became distressed subsequently in 2002. By the end of September 2003, however, the vintage had cumulative total and excess returns of 25.80% and 16.80%, respectively. If we were to exclude WorldCom issues from the 2002 vintage, the twenty-four month cumulative total and excess returns as of the end of September 2003 would be 34.75% and 25.49%, respectively.

In light of the generally strong performance of distressed issues after their distress month, we might wonder whether this strong performance begins immediately after the distress month, or perhaps these bonds continue to deteriorate for some time after the distress month only to recover later. To answer this question we examine the performance of all distressed issues in the twelve-month performance period subsequent to their distress month, to see if it is as good as the twenty-four month performance. (As before, we truncate a bond's performance period due to maturity, default, or call or if the bond became distressed after September 2002.) Figure 33 presents the performance of distressed bonds for the twelve-month performance period sorted by observation, with the issues with the earliest distress month appearing to the left and those with the latest distress month appearing to the right. We have used a vertical line to mark off bonds distressed prior to 2001. We note that the distressed bonds of the 2002 and 2003 vintage years have had a relatively short time to resolve their creditworthiness, even a twelve-month subsequent performance horizon may be too short to compare with other distressed issues. Figure 34 summarizes the twelve month total and excess returns by vintage year. For ease of comparison, Figure 34 also repeats (in the grey box) the twenty-four month total and excess returns reported in Figure 32.

As seen in Figures 34, for bonds distressed prior to 2001 their average twelve-month cumulative excess return (3.34%) was significantly worse than their twenty-four month cumulative excess return (15.76%), indicating that distressed bonds tend to improve strongly in their second year following distress.

Figure 33. **Cumulative Excess Return Performance of Distressed Bonds Twelve Months (if available) after Distress Month**
January 1990 – September 2003; observations sorted by distress month
(Returns data through September 2003 for bonds distressed by August 2003. Prices for defaulted bonds set to zero at end of default month.)

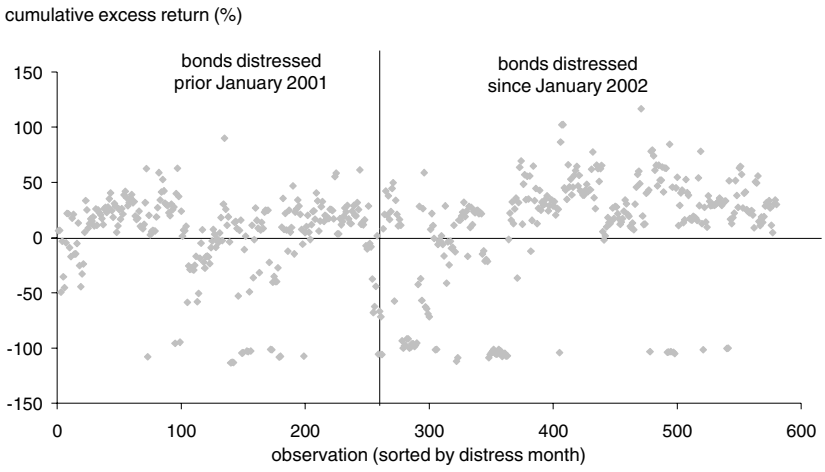


Figure 34. **Performance of Distressed Bonds**
Cumulative Total Returns and Cumulative Excess Returns vs. Duration-Matched Treasuries
Twenty-Four and Twelve Month Performance Periods
Results by Vintage Year: 1990 – 2003
Default recovery is assumed equal to zero

Vintage Year	# issues	Twenty-Four Cumulative Month Total Return	Twenty-Four Month Cumulative Excess Return vs. duration matched UST	Twelve-Month Cumulative Total Return	Twelve-Month Cumulative Excess Return vs. duration matched UST
1990	50	60.36%	31.58%	21.80%	6.67%
1991	14	65.71%	44.61%	41.28%	29.74%
1992	1	54.17%	24.43%	32.17%	17.37%
1994	1	56.22%	36.36%	40.97%	23.78%
1995	5	55.11%	38.63%	19.22%	14.21%
1996	1	92.99%	78.93%	64.78%	62.39%
1998	29	25.48%	21.19%	10.80%	13.90%
1999	10	33.36%	11.98%	-15.65%	-20.06%
2000	139	24.34%	4.82%	9.14%	-2.45%
2001	54	-7.04%†	-17.13%†	-25.82%†	-32.53%†
2002	271	25.80%†	16.80%†	23.16%†	15.79%†
2003*	5	24.60%†	21.94%†	24.60%†	21.94%†
Vintage years prior 2001	250	35.49%	15.76%	13.52%	3.34%
Vintage years since 2001	330	20.41%†	11.32%†	15.17%†	7.98%†
All vintage years	580	26.91%†	13.24%†	14.46%†	5.98%†

* Updated through 30 September 2003 using bonds that became distressed by 31 August 2003.
† Issues of the 2002 and 2003 vintages generally do not have a full twelve months of returns since their distress month. Issues of the 2001, 2002 and 2003 vintages generally do not have twenty-four months of returns since their distress month.

Although the twenty-four month cumulative excess returns for the 2001 vintage are better than its twelve-month cumulative excess returns (-17.13% versus -32.53%, respectively), the vintage remains a very poor performer relative to the other vintages. It seems likely that the twenty-four month cumulative excess return for the vintage will finish very negative—the only vintage year to do so. This vintage may have characteristics (e.g., fraud and greater leverage) that will ultimately cause its returns behavior to deviate permanently from that of the other vintages.

One might argue that the strong cumulative excess returns of distressed merely reflect the outperformance of credit product in general versus Treasuries. It is possible that credit spreads were particularly wide during years in which there were a number of distressed bonds and that the subsequent twenty-four months of strong excess returns may simply reflect the general recovery of credit spreads. If this is so, distressed investment-grade bonds may not have anything special to offer investors. To test this notion, we adjust the performance of a distressed bond for the performance of the credit sector by calculating the bond's excess return to corporates, defined as the bond's cumulative excess return versus its composite credit index. We define a bond's composite credit index as the set of issues in the Lehman Credit Index (which includes any distressed issues which remain in the index) belonging to the same quality-sector bucket as the distressed bond. Long and short issues in the index are weighted so as to match the duration of the distressed bond.

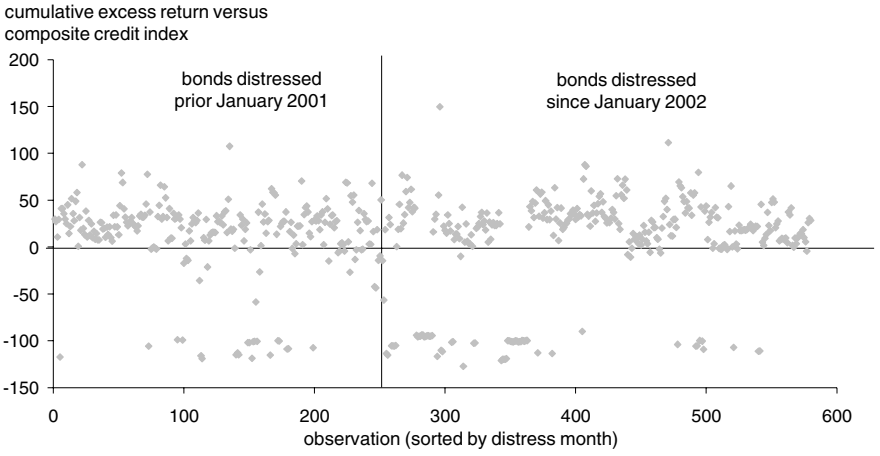
Figures 35 and 36 present the cumulative excess returns of distressed bonds versus their respective composite credit indices as defined earlier. Overall, the results show that distressed bonds tend to outperform their corporate bond peer groups. For vintage years prior to 2001, distressed investment grade bonds outperformed their sector-/quality-/duration-matched credit composite indices by 12.36 percentage points in the twenty-four months after distress. The strongly positive excess return to corporates indicates that as a group distressed bonds do, in fact, offer higher returns than credits in general.

For vintage years 2001 and on, twenty-four month (if available) cumulative excess performance versus the composite credit index was 4.02%. As with excess returns to Treasuries, the performance of the 2001 vintage, this time versus its composite corporate index, has remained poor. The twenty-four month cumulative performance of the 2001 vintage is -20.76%, further suggesting the distinctly inferior quality of this vintage.

Figures 35 and 36 show that distressed bonds outperform their credit benchmarks. Overall, distressed issues on average outperformed a quality- and duration-matched credit portfolio by 7.61%, cumulatively over 24 months, compared with 13.24% of cumulative excess return versus Treasuries. This indicates that the outperformance of distressed bonds versus Treasuries is probably not due to the general tightening of corporate spreads after a period of distress. As we have seen before, there is a strong difference in performance between the prior-2001 vintages and the since-2001 vintages. Issues distressed prior to 2001 outperformed a duration-matched credit portfolio by 12.36%, on average, over the twenty-four months since the distress month. This compares with the 15.76% cumulative twenty-four month excess returns versus Treasuries for these distressed issues. Issues distressed since 2001 outperformed the Credit Index by an average of 4.02%, compared with outperforming Treasuries by 11.32%.

Is there any particular pattern to the cumulative excess returns (to Treasuries) of distressed issues? For example, perhaps the shorter-maturity debt of a distress issuer underperforms longer-maturity debt because the longer-maturity debt may have reacted more negatively

Figure 35. **Performance of Distressed Bonds Cumulative Excess Returns vs. Quality-, Duration-, and Sector-Matched Credit Index, Twenty-Four Month Performance Horizon**
January 1990 – September 2003; observations sorted by distress month
(Returns data through September 2003 for bonds distressed by August 2003.
Prices for defaulted bonds set to zero at end of default month.)



during the distress month. We examine whether issues with shorter duration (as measured at the end of the distress month) have better excess return performance than longer-duration issues. Figures 37a (for the 1990-2000 vintages) and 37b (for the 2001-2003 vintages) show the relationship between a bond's duration and its cumulative twenty-four month (if available) excess return. We see little relationship between the two.

Figure 36. **Performance of Distressed Bonds**
Cumulative Excess Returns vs. Quality- and Duration-Matched Composite Credit Index
Twenty-Four Months (if available) after Distress Month
Results by Vintage Year, Default recovery is assumed equal to zero

Vintage Year	# issues	Twenty-Four Month Excess Return vs. quality-, duration-, and sector-matched credit index
1990	50	22.16%
1991	14	34.65%
1992	1	22.64%
1994	1	33.15%
1995	5	35.71%
1996	1	77.59%
1998	29	10.86%
1999	10	17.23%
2000	139	5.02%
2001	54	-20.76%†
2002	271	8.71%†
2003*	5	17.28%†
Vintage Years prior 2001	250	12.36%
Vintage Years since 2001 and later	330	4.02%†
All Vintage Years	580	7.61%

* Updated through 30 September 2003 using bonds that became distressed by 31 August 2003.
† Issues of the 2001, 2002, and 2003 vintages do not generally have twenty-four months of returns since their distress month.

Figure 37a. **Performance of Distressed Bonds**
Cumulative Twenty-Four Month (if available) Excess Returns vs. Duration
1990 – 2000 (Prices for defaulted bonds set to zero at end of default month.)

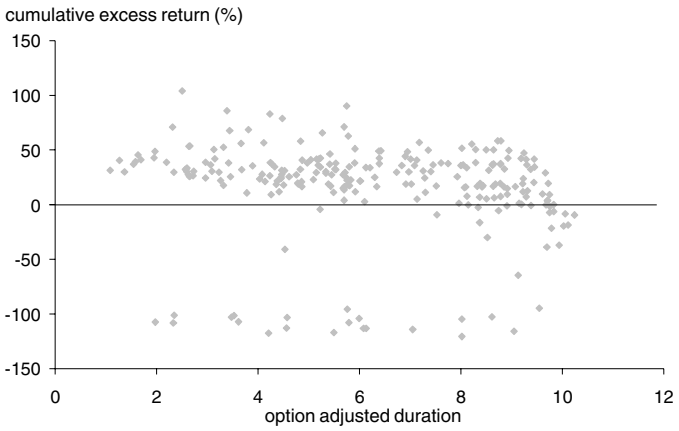
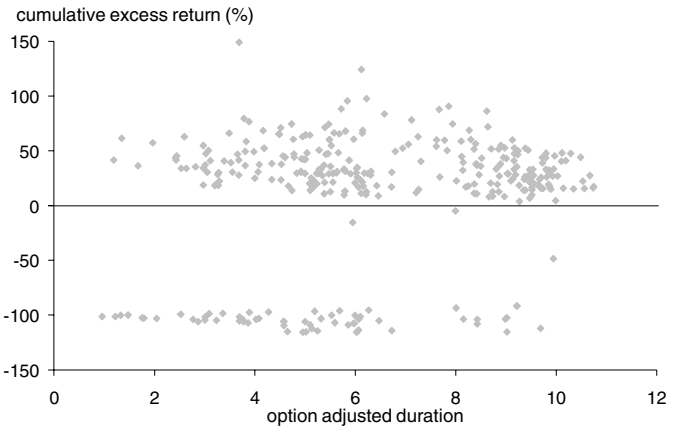


Figure 37b. **Performance of Distressed Bonds**
Cumulative Excess Returns vs. Duration
2001 – 2003 Vintage Years (Prices for defaulted bonds set to zero at end of default month.)



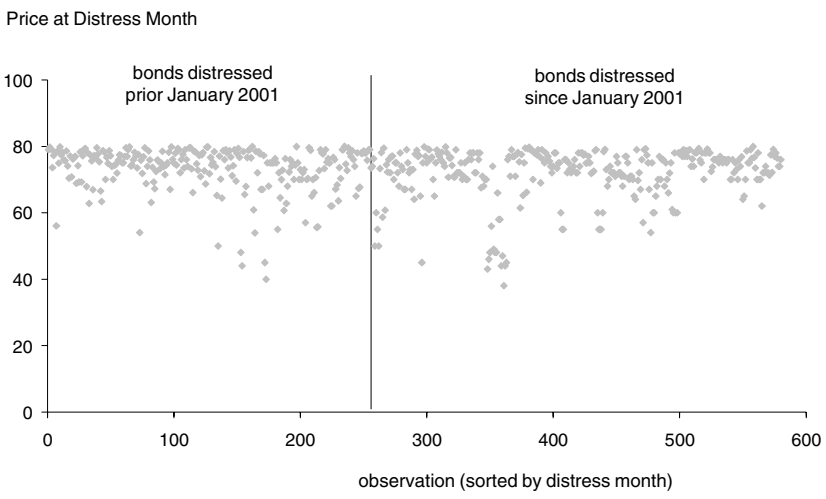
There does not seem to be a strong relationship between a distressed bond's duration and its cumulative twenty-four month excess return for either period. Upon reflection, this result is not surprising. When an issuer enters a "distressed" state, all its bonds, irrespective of maturity and coupon, usually start trading at approximately the same (low) dollar price. One reason for this flat price curve is that investors seem to believe that in bankruptcy all creditors with similar claims will be treated similarly. Since the seniority of a 3-year debenture is usually no different from that of a 30-year debenture, the holders of both can expect to receive the same recovery value (represented by the bond's dollar price). As the expected recovery value fluctuates, all issues of a given issuer will tend to have the same return irrespective of duration.

There seems to be a perception in today's corporate market that recently (i.e., since 2001) distressed issues have a much lower price at the end of their distress month than distressed issues in earlier years. Figure 38 does not support this perception and plots the series of prices (at the end of the distress month), sorted by distress month, with the issues with the earliest distress month appearing at the left and those with the latest distress month appearing at the right. While there has been some recent deterioration in the price of distressed issues at the end of their distress month, it has not been large. In fact, the average distress price for the prior-2001 issues was 73.26, versus 72.04 for the since-2001 issues.

Finally, we examine the idea of a "knife-edge" price for distressed bonds. Is there a connection between a distressed bond's price at the end of its distress month and its subsequent cumulative excess return? In other words, do bonds that get hit hardest in price at the outset tend to have worse subsequent cumulative excess returns? Is there a "knife-edge" end-of-distress-month price below which bonds tend never to recover? Figure 39 shows the association between a bond's price at the end of its distress month and its subsequent cumulative excess returns (versus Treasuries).

Figure 40 graphically presents the information in Figure 39. The knife-edge (for cumulative twelve-month excess returns) is clearly at a price of 50 for both the before-2001 and since-2001 vintages.

Figure 38. **Price of Distressed Issue at End of Distress Month**
January 1990 – August 2003; Observations sorted by distress month



Return Performance Assuming Recoveries on Bonds That Default

So far, we have assumed a default price of zero at the default month. This is perhaps an extreme assumption, as most defaulted issues have at least some recovery value. To see how sensitive our results are to the default price assumption, we re-ran our numbers assuming a recovery value equal to the lesser of the bond's price at the end of its default month and 20% of par. Although we label this scenario "default price = $20," in many cases, we use the bond's price at the end of its default month which was less than $20.

Figure 39. **Performance of Distressed Bonds**
Cumulative Twelve and Twenty-Four Month Performance Period
Excess Returns vs. Price at End of Distress Month
1990 – 2003 (Returns data through September 2003 for bonds distressed through August 2003. Prices for defaulted bonds set to zero at end of default month.)

Distress Month Price Bucket	# issues	Twelve-Month Cumulative Excess Return	Twenty-Four Month Cumulative Excess Return
1990 - 2003			
80 >= P > 70	435	8.45%	16.76%
70 >= P > 60	98	12.73%	17.32%
60 >= P > 50	28	6.65%	8.07%
50 >= P	19	-86.27%	-80.80%
Prior to 2001			
80 >= P > 70	192	2.59%	15.33%
70 >= P > 60	46	14.56%	27.09%
60 >= P > 50	7	-1.64%	7.91%
50 >= P	5	-63.77%	-60.97%
Since 2001			
80 >= P > 70	243	13.08%	17.88%†
70 >= P > 60	52	11.10%	8.67%†
60 >= P > 50	21	9.41%	8.13%†
50 >= P	14	-94.31%	-87.88%†

† Many observations since 2001 do not have a full twenty-four month performance period.

Figure 40. **Performance of Distressed Bonds**
Cumulative Twelve Month Excess Returns vs. Price at End of Distress Month
Before-2001 Vintages vs. Since-2001 Vintages
(Returns data through September 2003 for bonds distressed through August 2003. Prices for defaulted bonds set to zero at end of default month.)

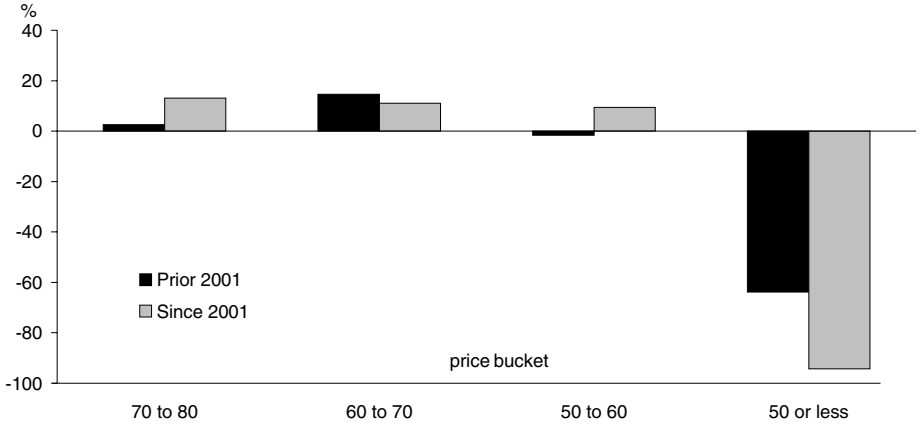


Figure 41 presents the twelve- and twenty-four month excess returns for distressed bonds assuming default price = $20. (Figure 41 corresponds to Figure 34. For ease of comparison, twelve- and twenty-four month excess returns assuming default price = $0 are repeated (in grey) in Figure 41.) As expected, the performance of distressed bonds improves, especially for the more recent vintages. The twelve-month cumulative excess returns for the combined vintage years 2001–2003 increase from 7.98% to 11.71%. For vintage years prior to 2001, the improvement is from 3.34% to 5.45%. For all vintage years combined, the twelve-month excess return over Treasuries for distressed bonds improves from 5.98% to 9.01%.

Figure 42 shows the twenty-four month cumulative excess returns of distressed bonds versus a quality-, duration-, and sector-matched composite corporate index assuming default price = $20. (Figure 42 corresponds to Figure 36. For ease of comparison, twelve- and twenty-four month excess returns assuming default price = $0 are repeated (in grey) in Figure 42.) For the combined vintage years 2001-2003, the twenty-four month performance period cumulative excess returns to corporates increase from 4.02% to 9.43%. For vintage years prior to 2001, the improvement is from 12.36% to 15.03%. While assuming a non-zero default price improves the results, it is not the key to the story. Distressed investment-grade bonds outperform duration-matched Treasuries and quality-, duration-, and sector-matched corporates irrespective of the assumed default recovery value.

Figure 41. **Performance of Distressed Bonds**
Cumulative Total Returns and Cumulative Excess Returns vs. Duration-Matched Treasuries
Twenty-Four and Twelve Months (if available) after Distress Month
Results by Vintage Year: 1990 – 2003
Default recovery is assumed equal to MIN[price at end of default month, $20]

		Default Price = $0		**Default Price = MIN[price at end of default month, $20]**	
Vintage Year	**# issues**	Twenty-Four Month Excess Return vs. duration matched UST	Twelve Month Excess Return vs. duration matched UST	**Twenty-Four Month Excess Return vs. duration matched UST**	**Twelve-Month Excess Return vs. duration matched UST**
1990	50	31.58%	7.67%	31.67%	7.67%
1991	14	44.61%	29.74%	44.61%	29.74%
1992	1	24.43%	17.37%	24.43%	17.37%
1994	1	36.36%	23.78%	36.36%	23.78%
1995	5	38.63%	14.21%	38.63%	14.21%
1996	1	78.93%	62.39%	78.93%	62.39%
1998	29	21.19%	13.90%	24.58%	17.30%
1999	10	11.98%	-20.06%	11.98%	-20.06%
2000	139	4.82%	-2.45%	8.88%	0.63%
2001	54	-17.13%†	-32.53%†	-5.72%	-26.06%
2002	271	16.80%†	15.79%†	21.11%†	19.05%†
2003*	5	21.94%†	21.94%†	21.94%†	21.94%†
Vintage Years prior to 2001	250	15.76%	3.34%	18.43%	5.45%
Vintage Years Since 2001	330	11.32%†	7.98%†	16.73%†	11.71%†
All Vintage Years	580	13.24%†	5.98%†	17.47%†	9.01%†

* Updated through 30 September 2003 using bonds that became distressed by 31 August 2003.
† Issues of the 2002 and 2003 vintages do not generally have a full twelve months of returns since their distress month. Issues of the 2001-2003 vintages do not have twenty-four months of returns since their distress month.

Figure 42. **Performance of Distressed Bonds Cumulative Excess Returns vs. Quality- and Duration-Matched Credit Index**
Twenty-Four Months (if available) after Distress Month, Results by Vintage Year
Default recovery is assumed equal to MIN[price at end of default month, $20]

Vintage Year	# issues	Default Price = $0 Twenty-Four Month Excess Return vs. quality-, duration, and sector-matched credit index	**Default Price = MIN[price at end of default month, $20]** **Twenty-Four Month Excess Return vs. quality-, duration, and sector-matched credit index**
1990	50	22.16%	22.26%
1991	14	34.65%	34.65%
1992	1	22.64%	22.64%
1994	1	33.15%	33.15%
1995	5	35.71%	35.71%
1996	1	77.59%	77.59%
1998	29	10.86%	14.26%
1999	10	17.23%	17.23%
2000	139	5.02%	9.08%
2001	54	-20.76%	-9.36%
2002	271	8.71%†	13.03%†
2003*	5	17.28%†	17.28%†
Vintage Years prior to 2001	250	12.36%	15.03%
Vintage Years since 2001	330	4.02%†	9.43%†
All Vintage Years	580	7.61%	11.84%

* Updated through 30 September 2003 using bonds that became distressed by 31 August 2003.
† Issues of the 2001, 2002, and 2003 vintages do not generally have twenty-four months of returns since their distress month.

Is it better to sell or hold distressed investment grade issues? To provide some support for this portfolio decision, we identified all distressed issues in the Lehman Investment-Grade Index from January 1990-August 2003 and calculated their subsequent twenty-four month total and excess returns. We found that distressed bonds *as a group* have generally produced positive excess returns. This result is a bit surprising considering that we conservatively assume that recovery values for defaulted issues equals zero. We also find that distressed bonds outperform a quality- and duration-matched credit benchmark.

We show that the post-December 2000 bonds have recovered to a great extent, though it appears that the 2001 vintage itself will probably never fully recover. (The poor performance of the 2001 vintage is due to Enron.) We find little relationship between the duration of a distressed issue and its subsequent performance. In addition, we find that when an issue becomes distressed, its price at the end of its distress month has been roughly unchanged since 1990, indicating that the loss experienced by the investor up to the end of the distress month has not changed much over the years. Finally, we also show that the "knife-edge" price, i.e., the end-of-distress-month price level below which a distressed bond is unlikely to recover, has remained at approximately $50 for both pre- and post-2001 vintages.

Other questions come to mind that we have not yet addressed. What happens to distressed bonds after the 24-month recovery period? Is their recovery sustained, or do the prices of these bonds tend to sink again? Once a bond has become distressed, are there any leading indicators that give us some idea whether or not the bond will recover? How applicable are these conclusions in markets outside the U.S.? We leave these questions for future studies.

Conclusion

To the relief of many, the credit markets have performed extraordinarily well in 2003. Many investors have handsomely outperformed their credit benchmarks. For many credit portfolio managers, years 2001 and 2002 will be remembered as the most horrible years of their management careers. While many would prefer to let the period of credit market trauma recede into the history books, many valuable lessons were learned and new portfolio management strategies were adopted that will remain standard portfolio management practice for the foreseeable future.

In response to the stressful credit markets, investors have re-examined their approaches to risk management and portfolio construction. In particular, many investors and plan sponsors now closely examine their benchmarks for large single issuer concentrations. While issuer-capped portfolios have long had a portfolio management role to play, issuer-capped indices are new and are here to stay. Lehman Brothers has developed the index construction tools to allow investors to construct a wide variety of issuer-capped indices.

We have learned that care must be taken when constructing issuer-capped benchmarks as the cap level and the redistribution rule can have significant impacts on the risk and return performance of the benchmark. We find that imposing a 1% cap would have improved the excess return performance over the past few years but that caps levels greater than 1% provided only a marginal excess return improvement. However, the magnitude of any improved performance is dependent upon the redistribution rule used to distribute the excess market weight from large issuers to smaller ones. In addition, depending on how the issuer-capped benchmark is constructed, the degree of "sloshing" can have an impact on the replicability of the index.

The period of stressful credit markets also drew attention to the issue of replicability of the Corporate Index. In particular, there was concern that the Corporate Index's quality requirement and the removal of fallen angels at the end of their downgrade month produced a "survivorship bias" that made the index extremely difficult for credit managers to replicate. Does the index possess a performance advantage because it can immediately remove fallen angels whereas a manager needs time to sell?

In response to this issue some investors have expressed interest in downgrade tolerant indices that allow fallen angels to remain in the Credit Index for a period of time following downgrade. We measured the magnitude of the survivorship bias and found that the bias is typically small, but not negligible. However, the bias is volatile and can, at times, be positive or negative. The bias is generally a decreasing function of the tolerance period. For example, the bias is largest if the index held onto fallen angels for three months or less. However, the bias disappears and turns negative at the six month tolerance period reflecting the general recovery of fallen angels. The most important lesson learned during the study of downgrade-tolerant indices is if plan sponsors are willing to give managers time to work out of downgraded issues, then they should give managers at least six months to do so.

The performance of fallen angels subsequent to downgrade was a popular, if unpleasant, topic with many credit investors. In particular, since many investment-grade investors are required to eventually sell fallen angels, when was the best time to sell? We examined the optimal holding period and performance of fallen angel issues across many dimen-

sions: issuer size, post-downgrade rating, post-downgrade price level and time since downgrade (i.e., the "seasoning" period). We found that the performance results vary greatly across fallen angel issues. There were no clear decision rules as to which type of fallen angels to hold or sell, or the best time to sell. We did find an overall improvement in the risk-adjusted forward performance of fallen angel issues as seasoning increases. However, we found no strong evidence to support an optimal seasoning period as an indicator of future performance.

While fallen angels were a nasty problem that generated headlines, the more prevalent problem for credit managers was what to do about the many distressed investment-grade issues in their portfolio? To help managers formulate an investment strategy for distressed issues we examined the historical (since 1990) performance of distressed investment-grade bonds after their distress month. We tracked the return performance of each distressed issue for up to twenty-four months after its distress month. Overall, we found that distressed bonds as a group have tended to produced positive excess returns both versus Treasuries and versus quality and duration-matched credit peer groups. However, while this outperformance can be substantial, it can take time, up to twenty-four months. Additionally, we found, somewhat to the surprise of many credit managers, that an issue's price drop during its distress month has remained unchanged since 1990, and the "knife-edge" price, below which a distressed issue is unlikely to recover, has remained stable at about $50.

The past several years have taught us much about how to deal with stressful credit markets. This paper examined many of these lessons: custom benchmark design to limit issuer exposures, dealing with "survivorship bias" (perceived and real), and better-informed investment strategies for fallen angels and distressed investment-grade issues. With luck, these lessons will make us more prepared for the next period of stressful credit markets.

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