LEHMAN BROTHERS
Fixed Income Research

# Value of Security Selection versus Asset Allocation in Credit Markets: A "Perfect Foresight" Study

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Lev Dynkin 212-526-6302
ldynkin@lehman.com

Peter Ferket* 31-10-224-2437
P.J.J.Ferket@robeco.nl

Jay Hyman 972-3-691-1950
jay@lehman.com

Erik van Leeuwen* 31-10-224-2543
E.M.H.van.Leeuwen@robeco.nl

Wei Wu 212-526-9221
wwu@lehman.com

## SUMMARY

- The increased focus on credit investing in Europe brought by EMU prompted us to quantify the relative merits of different investment styles in a limiting ideal case. At issue are early policy decisions on "bottom-up" versus "top-down" styles, allocation of research efforts, and risk budgets. We relied on the historical experience of the U.S. corporate market, rather than the pre-EMU European credit markets, based on the belief that the latter will develop in the direction of the former.

- For portfolios of credit spread securities managed relative to fixed income benchmarks, we investigate the value added by security selection and various asset allocation strategies in an ideal case of "perfect foresight." In conducting our historical study, we rely on the simulation of such strategies using the data for the Lehman Brothers U.S. Investment Grade Corporate Index. When simulating a given strategy, we remain matched to the Index in every dimension but one. The success of each strategy is evaluated based on the "information ratio"—a ratio of the strategy's outperformance of the index to the standard deviation of such outperformance.

- Our conclusions suggest that security selection with "perfect foresight" in a corporate bond portfolio is the single most effective way to generate steady outperformance relative to the index. This applies to both the "select winners" and the "avoid losers" cases. Yield curve timing, sector rotations, and credit rating selections may deliver more outperformance, but with higher variance. As the "perfect foresight" horizon extends further beyond the re-balancing period, the "information ratio" for all strategies declines, but the yield curve timing suffers the most. We also investigated the validity of the above conclusions over different parts of the economic cycle and their applicability to other credit markets. We showed our conclusions to be true over a recessionary period in the U.S. and for the dollar-denominated Eurobond market.

*This study represents a joint effort of Lehman Brothers and the Robeco Group. Peter Ferket is responsible for the non-government research and risk modeling at the Quantitative Research department of Robeco. Erik van Leeuwen is a senior portfolio manager at the Fixed Income department of Robeco.

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# 1. INTRODUCTION

## Motivation

With the advent of EMU, the European marketplace is changing. For those who have relied on currency allocations as a major source of outperformance, the number of opportunities to express such views has been drastically reduced. Besides, we have entered a new era in fixed income investing with structurally lower rates of inflation and lower interest rates. These two effects make investors eager for new investment styles to diversify portfolio risks and to achieve extra performance. At the same time, the increased liquidity that will come with the euro is expected to lead to significant growth in the issuance of corporate bonds. Until recently, corporate bond market activity had been curtailed by the tight spreads available on bank loans, particularly those made to long-standing clients of European banks. The syndicated loan market was a plentiful source of funds offered at competitive rates. Companies usually found it more economical to borrow from banks, rather than going to the bond market. This is changing rapidly. European banks are focused much more on returns on equity, resulting in wider spreads on loans. The supply of credit in the syndicated loan market is also down, with the near-total withdrawal of Japanese banks from this activity being the most notable development. In addition, demand for credit is rising, chiefly as a result of the heightened merger and acquisition activity in Europe. The combination of these factors will increase the importance of credit investing for European portfolio managers. The main questions are what strategy to follow, how to employ their limited research and investment capacity, and how to allocate the market risk assumed by the portfolio to specific investment strategies.

The two basic approaches to investment management, "top-down" and "bottom-up," require fundamentally different types of research efforts. In the "top-down" approach, which places the emphasis on high-level allocations to broadly defined asset classes, the goal of research is to form views on large-scale economic developments. These become the basis for asset allocation decisions. In the "bottom-up" approach, the focus is on finding individual investments that will perform well relative to their peer groups. Investors following this approach hope to outperform their benchmarks due to superior security selection while maintaining a neutral stance in terms of asset allocation.

Of course, investors need not commit explicitly to one camp or another. (Even the purest of asset allocators must implement decisions by purchasing individual securities.) However, each investor must decide how to allocate the budget among the different research modalities. This decision can depend strongly on the characteristics of particular markets. Thus, the research efforts of fixed income investors in the United States over the last few years have been very different from those of their counterparts in Europe.

Most fixed income investors in the United States have historically remained in a single-currency world. Their efforts to outperform their benchmarks have focused on yield curve placement, sector and quality allocations, and security selection. The style of market participants is expressed in the amount of risk assumed along each of these dimensions (as measured by the deviation from their benchmarks), and their research efforts are directed accordingly. In Europe, by contrast, the emphasis has historically been on government bonds of different currencies. Research has therefore been directed at the allocation of assets to currencies and positioning with respect to global interest rates.

This article presents a quantitative study of the relative merits of the various forms of fixed income research as applied to portfolio management relative to a benchmark. The conclusions could help both European and U.S. investors in defining a successful strategy for credit investing in indexed portfolios.

## The Idea of Perfect Foresight

The question of which form of research is more effective is a complex one. What added value can be expected from skillful analysts who can accurately predict the future movement of yield curves, sector spreads, or security prices? While the performance of individual portfolio managers can be measured and compared, this question cannot be answered in the abstract. To create a world in which we can quantify the results of each type of investment decision independently, we make use of the "perfect foresight" assumption. We simulate the historical performance of a portfolio that is managed with access to information about future market performance. We then measure the outperformance achieved versus the index, as well as the amount of risk taken. Due to the very nature of such a scheme, none of the investment strategies investigated here can actually be carried out. However, they are of interest because they represent the limiting case—the best possible results that could be obtained from such an investment strategy.

The strategies employed in this study have been crafted to isolate one mode of investment decisions (and hence line of research) at a time. In the first section, we follow a strategy that constructs a portfolio that is neutral to the Lehman Brothers Corporate Bond Index in term structure, sector, and quality allocations. Outperformance is to come from the choice of securities purchased to represent each segment of the corporate bond market in the portfolio. This study was carried out as realistically as possible, with parameters designed to limit the amount of turnover in the portfolio. The parameters of the study were modified to explore the changes in performance as the foresight became less than perfect in various ways.

In the next section, we take the opposite approach and simulate the performance of strategies that do not use any security selection at all. Rather, the portfolio is constructed by combining various market cells of the Corporate Index. If the portfolio purchases a given market cell, it is assumed to earn the return of the index on that market cell. (This can be interpreted as buying every bond in the index in the given market cell, in the same proportions as they have in the market-weighted index.) We investigate one strategy based solely on yield curve allocation, one based on sector allocation, and one on quality allocation. Additionally, we look at a strategy that allows the portfolio to diverge from the index in all three of these dimensions simultaneously.

## Selection Criterion: Excess Return

Ultimately, the success of an investment strategy is measured in terms of its total return relative to that of the benchmark. So, it would seem logical for the decision of what securities to purchase in the perfect foresight strategy to be based on advance knowledge of the total returns of each security. However, one problem with this approach is that this would not allow us to differentiate between various investment styles. During periods of yield curve rallies, such a strategy would favor bonds with long durations; in a downturn, it would shorten its duration dramatically. Its success would be due to the combination of security selection and yield curve timing.

To insulate our security selection decision from the effect of yield curve movement, we instead allow our strategy to have perfect foresight of *excess* (or curve-adjusted) *returns* rather than total returns. These excess returns are calculated as the difference between the total return of each corporate bond and the average total return on Treasuries of similar duration. (The Treasury universe is broken into $^1/_2$-year duration cells for this calculation, which is described in detail in Dynkin *et al* [1998].) The excess return arises from the spread over Treasuries, which provides a steady advantage in coupon return along with any price return (positive or negative) due to the spread tightening or widening. Security selection based on excess return will thus choose bonds with superior spread performance.

Note that the term "*excess return"* will be used throughout this paper to refer to this advantage over duration-matched Treasuries. This quantity is defined for individual securities and averaged based on market weights over a portfolio. It is not to be confused with the difference between portfolio return and the risk-free rate or the difference between portfolio and benchmark returns. The latter difference, which is indeed the focus of our performance measurement, will be referred to simply as *outperformance*.

## Evaluating Strategies: The Information Ratio

It has long been recognized that the "best" performing investment strategy is not necessarily the one that achieves the highest total return. Rather, investors often seek the strategy that earns the highest return per unit of risk taken. In this study, the various strategies are compared by their *information ratios*, which measure risk-adjusted return relative to a benchmark. The information ratio is defined as the ratio of the annualized mean outperformance of the benchmark to the annualized standard deviation of such outperformance, or tracking error.[1] For details on how to calculate and interpret the information ratio, we refer to Grinold and Kahn [1995] and Goodwin [1998].

Concerning the levels of information ratios, Grinold and Kahn state that a ratio of 0.5 is considered "good," 0.75 is "very good," and 1.0 is "exceptional." Goodwin presents empirical data based on the performance of active institutional money managers. He shows that for different markets and management styles, the characteristic ranges of information ratios can be very different, but that for most styles, the Grinold and Kahn criteria are rather demanding. For bond sector rotation funds benchmarked to the Lehman Brothers Aggregate Index, he finds that 20.5% achieve an information ratio over 0.5, and only 2.6% reach 1.0 or better. By contrast, the (unrealistic) strategies considered in this paper achieve much higher information ratios, some of them greater than 10.0. We do not mean to suggest that such numbers can be achieved in practice. Rather, we look at the information ratio

[1] When deriving conclusions about the magnitude of the differences in information ratios achieved by various strategies, please note that annualized ratios will magnify the differences by a factor of $\sqrt{12}$ as compared to monthly ratios.

achievable with “perfect foresight” along a particular decision axis as a measure of the potential for outperformance along this axis. Thus, comparison among the different varieties of perfect foresight results can help point out which investment styles may produce the greatest benefits.

### Outline

In Section 2, we offer a detailed methodology of our security selection strategy and analyze the results. In Section 3 , we discuss the asset allocation portion of the study and compare the two approaches. Our results show that the index-matched strategy based on security selection offers better performance on a risk-adjusted basis than any of the asset allocation schemes considered. To demonstrate the robustness of these results, we offer supplementary studies using different sets of data in Section 4. The first of these studies uses U. S. Dollar-denominated Eurobonds to help build our confidence in extrapolating the results to European credit markets. The second investigates the behavior of these strategies in a recessionary period, by extending the U. S. Corporate study back in time.

## 2. SECURITY SELECTION

### Methodology: Building a Cell-matched Portfolio

For our perfect foresight study of U. S. Corporate bonds, we divide the bond universe into three average life categories: 1-5 years, 5-10 years, and 10+ years. Within each average life range, issues are divided into four sectors: industrials, utilities, finance, and Yankees. Within each cell (average life x sector), we further subdivide this investment-grade universe into four credit quality ranges: Aaa, Aa, A, and Baa. This three-dimensional grid divides the corporate bond market into 48 (3 x 4 x 4) cells.

In our historical simulation, we maintain a portfolio that precisely matches the index in terms of allocations to these 48 cells, using just some of the bonds in each cell. To accomplish this, we repeat the following procedure within each corporate bond market cell for each month. First, we calculate the excess return that will be earned by each bond in this cell over the coming 12 months. (We will refer to this period of time, over which our strategy can forecast excess returns with perfect accuracy, as the “foresight horizon.”) The bonds are sorted in descending order of these excess returns, and the best five (or ten) percent of the bonds are selected as candidates for purchase. The projected excess returns of these candidate bonds are then compared to those of the bonds currently representing this market cell in the portfolio. To discourage excessive turnover, a new bond is purchased only if its excess return forecast exceeds that of a bond in the portfolio by more than a certain threshold. We have set this turnover threshold at 30%.

The number of bonds selected to represent a cell is a fixed percentage of the total number of bonds the index has in this cell. However, to make sure that every cell is represented in the portfolio, at least one bond is chosen for each non-empty cell. Similarly, to limit the overall number of bonds in the portfolio, we impose a maximum number of bonds that can be chosen from any given cell. For the 5% case, we allow a maximum of 10 bonds per cell; for the 10% case, the maximum is 20 bonds.

The total return for the portfolio includes transaction costs. The total return earned by the portfolio within each market cell is calculated as an equally-weighted average of the total returns of the selected bonds, subtracting 30 b.p. (for bid-offer spread) from the return of each newly purchased bond in the month of purchase. Returns of the individual cells are then weighted by their market weights in the Corporate Index to form the return on the portfolio. This corresponds to a cell-matched portfolio that is identical to the index in allocations to each market cell, but uses equal market values for each of the selected set of bonds *within* a given cell. Appendix 1 gives a detailed illustration of such a cell-matched portfolio and compares it to the Corporate Index in a single month for one of the security selection strategies.

### Data

This research was carried out using the U.S. historical index database of Lehman Brothers. This database contains monthly data at an individual security level for all bonds in the Lehman Brothers Aggregate Index (i.e., U.S. governments, corporates, ABS, and MBS[2]) since September 1988. The Corporate Bond Index includes all U. S. investment-grade corporate bonds with at least $100 million outstanding. (This threshold has increased over time from $25 million in 1988.) Credit quality ratings follow those by Moody’s Investor Service. For bonds not rated by Moody’s, ratings are obtained from Standard and Poors Corporation or Fitch Investor’s Service. Over the time period covered by this study, the number of bonds in this index varied between 3000 and 5000. The precise rules of index inclusion, as well as their evolution over time, are detailed in *A Guide to the Lehman Global Family of Fixed Income Indices* [1999].

[2] We did not incorporate mortgage backed securities in this study because we want to apply the results in Europe. U.S. experience in the mortgage market is not currently directly relevant to European investors.

The database contains prices, durations, and returns for each bond in each month. In addition to total returns, it also contains excess returns for each corporate bond. In our study, bonds are assigned to cells each month based on beginning-of-month duration and quality. Returns are obtained from trader pricing at the end of each month. We carried out the study using data from January 31, 1990 through April 30, 1998. As the last available 12-month forecast was as of April 30, 1997, the last month of performance shown is May 1997.

## Results

In Figure 1, we show the performance results of the security selection strategy with a 12-month perfect foresight horizon. Comparing results for the different performance tiers on the 12-month horizon, we see that while the "top 5%" strategy has the best average performance, the "top 10%" strategy does better on a risk-adjusted basis, with an information ratio of 3.32 versus 3.16 for the "top 5%" case. The information ratios of these two cases are similar because the risk reduction benefit of diversifying the portfolio over a larger number of securities outweighs the reduction in overall return. Comparing these results with ones that ignore the effect of transaction costs, we see that transaction costs reduce portfolio performance by 7 to 10 bp/month.

By comparing the results for the "top 5%" and "top 10%" cases, we can imply the return for the "second tier" (5-10%), which would consist of all bonds in the top 10% but not in the top 5%. We find that for this "second tier" both the average performance and the risk are much smaller than for the "top 5%" strategy, resulting in an information ratio that is only slightly smaller.

The mechanism that we have used to prevent excessive turnover requires a 30% improvement in expected performance to initiate a transaction swapping one bond for another. Nonetheless, we find that the turnover rate of the portfolio to be as high as 30% per month. Some of this turnover is unavoidable in our cell-based scheme. As soon as a bond chosen to represent a given market cell moves out of that cell (e.g., by a shortening of its remaining average life), another bond from the same cell must be selected to take its place. To measure the extent of this structural turnover, we carried out one simulation with an infinite turnover threshold. That is, no transactions were allowed except where required for structural reasons. On the last line of Figure 1, we see that the turnover was reduced to 8% per month in this case.[3] Outperformance of the index was cut roughly in half, from 0.31 to 0.16, as the portfolio was prevented from purchasing all of the securities recommended by the perfect foresight strategy. Interestingly, the more stable nature of the portfolio reduced portfolio risk as well, keeping the information ratio at about the same level as that of the strategy with the 30% turnover threshold.

A closer look at the details of these strategies reveals that they do not match the duration of the index exactly. This is because by its construction the portfolio matches index exposures to the three average life cells, but does not explicitly constrain the portfolio duration to match that of the benchmark. Figure 2 shows the difference between the duration of the portfolio and the index for the first strategy listed in Figure 1. The portfolio is longer in duration than the benchmark in some months and shorter in others. Indeed, in times of spread change the portfolio will tend to be short/long the index for the following reason. Excess return approximately equals spread change times spread duration plus spread itself. In times of spread tightening, longer bonds may exhibit better excess returns. The opposite is true in times of spread widening. However, later in this paper we will show that this bias

[3] "Structural" turnover is a result of shortening of the security's average life beyond the boundaries of a given market cell, new issuance, securities being called, credit rating changes (especially likely among the top performing securities of our "top 5%" strategy), and historical changes in the liquidity threshold of the index.

Figure 1. **Performance Summary for Security Selection Strategy,** 12-month perfect foresight horizon, 2/90-5/97

| **Foresight Horizon** (# mos.) | **Perf. Tier** (%) | **Turnover Threshold** (%) | **Trans Cost** (Y/N) | **Holding Period** (# mos.) | **Avg.Ret Index** (%/mo) | **Avg. Ret Portfolio** (%/mo) | **Ret. Diff.** (%/mo) | **Std. Dev. Ret. Diff.** (%/mo) | **Inform. Ratio** (anlzd.) | **Monthly Turnover** (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 5 | 30 | Y | 1 | 0.76 | 1.07 | 0.31 | 0.34 | 3.16 | 30 |
| 12 | 10 | 30 | Y | 1 | 0.76 | 0.99 | 0.23 | 0.24 | 3.32 | 26 |
| 12 | 5 | 30 | N | 1 | 0.76 | 1.16 | 0.40 | 0.33 | 4.20 | 30 |
| 12 | 10 | 30 | N | 1 | 0.76 | 1.06 | 0.30 | 0.23 | 4.52 | 26 |
| 12 | 5-10 | 30 | Y | 1 | 0.76 | 0.90 | 0.14 | 0.17 | 2.85 | - |
| 12 | 5 | Infinite | Y | 1 | 0.76 | 0.93 | 0.16 | 0.17 | 3.15 | 8 |

does not alter the conclusions. Figure 2 also shows the number of bonds in the portfolio. This number fluctuates between 140 and 190 and averages 163 over the total period. The two sudden drops in the number of bonds in the portfolio correspond to similar reductions in the number of bonds in the index, due to the raising of the minimum outstanding for index inclusion to $50 million in January 1992 and to $100 million in January 1994.

Figure 3 shows a steadily increasing performance advantage of all the security selection strategies over the index. While impressive, this “perfect foresight” approach did not produce returns as spectacular as expected. In fact, to our surprise, we found that there were several months in which the strategy underperformed the index. This is illustrated by the dips in the cumulative outperformance lines in Figure 3. Upon further investigation, we found that this was due to the discrepancy between the 12-month forward view used to select the portfolio and the one-month horizon for performance measurement and portfolio re-balancing . This is actually fairly reasonable in terms of what might be expected of a credit analyst—a correct long term call based on fundamentals does not necessarily pay off in the first month in which it is implemented, but rather further down the road.

The underlying strategy of the study was to choose bonds whose 12-month aggregate excess return exceeds all other similar bonds. In numerous cases, it was observed that bonds added to the portfolio due to foreseen large future excess returns did not perform well at all in the near term. Bonds fall out of the selected portfolio when they are replaced by superior issues. They also fall out if they mature or will be called within a year since they no longer have a 12-month excess return. This means that their superior returns are excluded from further consideration, reducing the total returns in those excluded months. For a truly “perfect foresight” case, we need to form purchase decisions at the start of each month based on the best performing bonds over the following month. We have thus included some cases based on a one-month forecast horizon as well. The results are shown in Figure 4.

The introduction of the truly perfect foresight case, using a one-month foresight horizon with a one-month holding period, shows a jump in outperformance from 0.31% per month to 0.89% per month, with only a small increase in risk. As a result, the information ratio jumps to 7.59. If we boost performance still further by ignoring transaction costs, the information ratio goes to 9.85.

Figure 2. **Characteristics for Security Selection Strategy,** Top 5%, 12-month Perfect Foresight Horizon

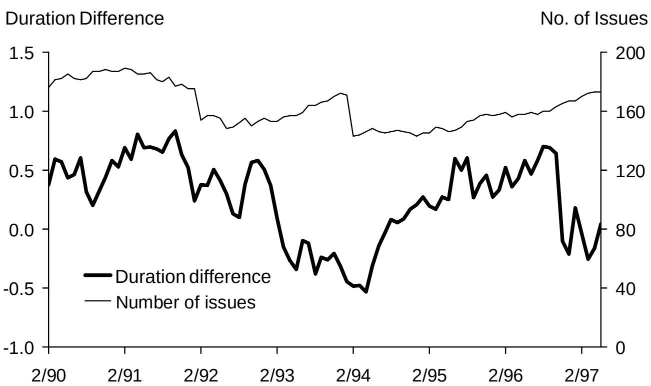



Figure 3. **Cumulative Outperformance for Security Selection Strategy,** Top 5%, 12-month Perfect Foresight Horizon, incl. Transaction Costs

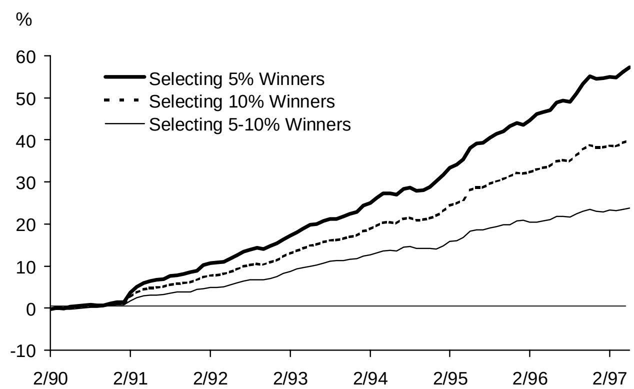



Figure 4. **Performance Summary for Security Selection Strategy,** 1-month perfect foresight horizon, 2/90-5/97

| **Foresight Horizon** (# mos.) | **Perf. Tier** (%) | **Turnover Threshhold** (%) | **Trans Cost** (Y/N) | **Holding Period** (# mos.) | **Avg.Ret Index** (%/mo) | **Avg. Ret Portfolio** (%/mo) | **Ret. Diff.** (%/mo) | **Std. Dev. Ret. Diff.** (%/mo) | **Inform. Ratio** (anlzd.) | **Monthly Turnover** (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5 | 0 | Y | 1 | 0.76 | 1.65 | 0.89 | 0.41 | 7.59 | 88 |
| 1 | 5 | 0 | N | 1 | 0.76 | 1.92 | 1.16 | 0.41 | 9.85 | 88 |
| 1 | 10 | 0 | N | 1 | 0.76 | 1.63 | 0.87 | 0.30 | 9.96 | 83 |
| 1 | 90 | 0 | N | 1 | 0.76 | 0.88 | 0.12 | 0.07 | 5.96 | 13 |
| 1 | 95 | 0 | N | 1 | 0.76 | 0.84 | 0.08 | 0.06 | 5.03 | 9 |
| 1 | 5 | Infinite | Y | 1 | 0.76 | 0.85 | 0.08 | 0.15 | 2.07 | 8 |

The “top 5%”, “top 10%”, and “second tier” strategies can be considered as “*picking winners*” with varying degrees of success. There is another approach to security selection, in which a diversified portfolio is selected, but careful attention is paid to “*avoiding losers.*” To measure the utility of such an approach, we tested the strategy at the 90% and 95% levels. In this way, the portfolio was composed of all of the bonds in the index, except for the worst performers in each cell.

The “avoiding losers” strategies, with the performance tier set at 90% and 95%, are shown to be extremely low-risk strategies, which pick up steady returns with minimal risk. Although the information ratio is significantly lower than that for picking winners using the same foresight horizon, it is still high enough (more than 5) to justify investors allocating a portion of their research budget to “avoiding losers.”

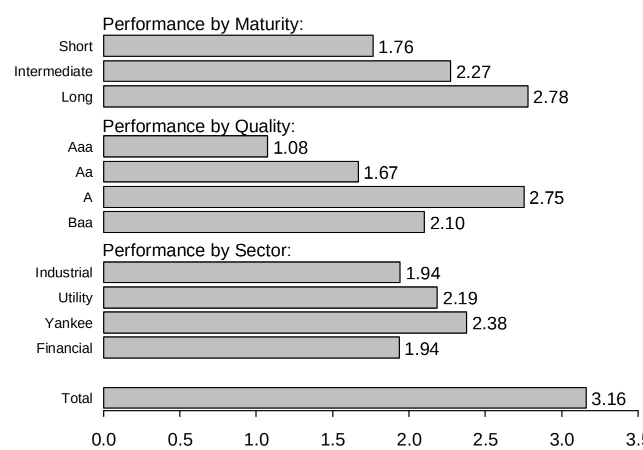
The last line of Figure 4 again shows results for the pure “structural turnover” strategy, the extreme case in which turnover is disallowed unless absolutely necessary. When imposed on the “top 5%” strategy with a one month forecast horizon, the effect of this constraint on performance was particularly severe. When turnover was unconstrained, this strategy had an average turnover of 88% per month, and outperformed the index by 89 bp/month to achieve an information ratio of 7.59. If turnover is supressed entirely except when bonds change cells, the turnover rate is cut to 8%, outperformance goes down to 8 bp/month, and the information ratio is reduced to 2.07. Despite having access to the same “perfect” forecasts, the turnover constraint prevents the strategy from taking advantage of them. One conclusion we can draw from this is that the more confidence one has in the quality of a forecast, the less one needs to focus on constraining turnover.

Even more telling is a comparison between the “structural turnover” cases of Figure 1 and 4. Although the one-month forecast horizon is a better information source (as evidenced by the higher returns and information ratios in the unconstrained case), the “structural turnover” case performed better when using the 12-month forecast horizon. Not only does it achieve a higher information ratio, but the average return is higher even in absolute terms. This is because whenever a structural change occurs, bonds selected by this strategy remain in the portfolio for a long time. The purchase decision should not be made based on which bond performs best over the coming month, but based on performance over the longer term. (The 12-month foresight horizon gives particularly good results for this reason. With an 8% “structural” turnover per month, almost the entire portfolio will turn over within 12 months, making the average holding period of each security approximately 12 months.) The conclusion is that the forecast horizon used for decision purposes should correspond to the average holding period for securities in the portfolio. If a portfolio is turned over almost in its entirety every month, then a one-month forecast is ideal. If constraints require a longer holding period, then the forecast horizon should be extended accordingly. Forecasts for longer horizons are best implemented by correspondingly longer holding periods.

## Analysis of the Results by Category of Risk

Figure 5 shows the performance of the security selection strategy as applied to specific sub-sectors of the corporate bond market (detailed results can be found in Appendices 2 and 3). If we divide the market into three cells by maturity, and separately apply our strategy to build a cell-matched portfolio for each one, we find the highest information ratio (2.78) in the longest maturity cell. This tells us that the most important focus for security selection is in the longer maturities. If we break down the index by quality, we find that the single-A range has the highest information ratio (2.75), and that security selection seems to be much less important in the AAA range. Our sector breakdown shows that the strategy does best within the Yankee sector. This is perhaps due to the fact that the Yankee sector is more diverse than the other groupings, making security selection more important.

Figure 5. **Information Ratios for “Picking Winners” Security Selection Strategy in Sub-sectors of the Lehman Brothers Corporate Bond Index,** 12-month Foresight Horizion, 1-month Holding Period, Top 5% of Securities, 30% Turnover Threshold, Transaction Costs Included



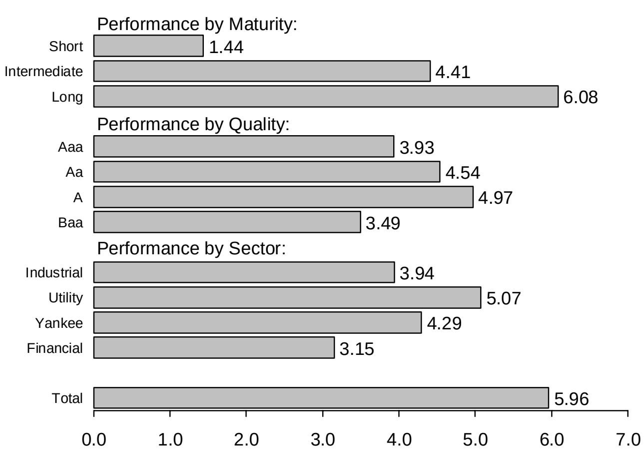
One of the messages to be derived from this breakdown is the benefit of diversification. The strategy's information ratio, when applied to the entire index, is higher than any of its sub-sectors. This is true because the success of the security picks in one sector is essentially uncorrelated with that in another sector. When two such portfolios are combined, the mean performance is just the average performance of the two, but the volatility of the combination is reduced by diversification.

Figure 6 breaks down performance by sub-category for the "avoiding losers" strategy which avoids the worst 10% of bonds in each cell, using only a one-month foresight horizon. Although this set of parameters represents a very different strategy than that shown in Figure 5, the same broad conclusions can be drawn. When applied to sub-categories of the corporate index, the strategy works best for long maturities, single-A qualities, and the Utility followed by the Yankee sectors.

## 3. PORTFOLIO ALLOCATION BY DURATION, SECTOR, AND QUALITY

In this section, we apply the "perfect foresight" methodology to the yield curve, sector, and quality allocation decisions for a U.S. corporate bond portfolio. We simulate a portfolio managed purely by setting allocations to market segments, with no security selection decisions. Here, our "perfect foresight" is applied to forecasts not of individual security returns, but of average returns on the various index sub-segments which comprise our set of asset classes. We assume that at any given time we can predict asset class performance over a future horizon period, and we allocate to the best performing sub-segments of the bond universe. These portfolio allocations are revised monthly.

Figure 6. **Information Ratios for "Avoiding Losers" Security Selection Strategy over Sub-sectors of the Lehman Brothers Corporate Bond Index,** 1-month Foresight Horizion, 1-month Holding Period, Top 90% of Securities, No Turnover Threshold, No Transaction Costs




Due to the more abstract nature of this study, we do not include the effect of transaction costs for changes in portfolio allocations. Similarly, we do not include any mechanism for limiting the changes in allocations from one month to the next.

For the allocation studies in this section, the corporate bond universe is divided into three-dimensional cells by average life (1-5 years, 5-10 years, and 10+ years), sector (industrials, utilities, finance, and Yankees), and quality (Aaa & Aa, A, and Baa), for a total of 36 cells (3 x 4 x 3). This cell structure is identical to that used in the security selection study, except that the Aaa and Aa quality ranges were merged for technical reasons.[4]

Two types of allocation strategies are considered in this section. In the first, we focus on one dimension of allocation at a time by forcing the portfolio to match index allocations to the other two dimensions. In the second, we allow the portfolio to take even more risk relative to the index by removing these constraints entirely.

### Methodology: Single Dimension Allocation Strategies

In this class of strategies, we choose the best performing segment by one factor while keeping the weights of the other factors matched to the index. For example, the sector allocation strategy begins by dividing the corporate index into cells by average life and quality. The portfolio will be constructed to exactly match the index as far as allocations to this grid. However, each such average life-quality cell (e.g. short-Baa) is further subdivided into four sector-based cells (short-industrials-Baa, short-utilities-Baa, short-finance-Baa and short-Yankees-Baa). We choose one of these sub-groups to represent our portfolio in this average life-quality cell, using our "perfect foresight" to choose the sector with the highest projected excess return. This decision is carried out separately each month within each average life-quality cell. (For example, we can invest the short-A portion in utilities and the long-Baa portion in industrials.)

[4] We merged Aaa and Aa quality cells in order to avoid any empty cells for all the time periods this study covers.

We take a similar approach to quality allocation. Within each average life-sector cell, the portfolio is represented by the single quality range which has the best projected excess return over the foresight horizon.

In the yield curve allocation, the method is somewhat different. We assume that the yield curve allocation decision should be made independently of sector and quality, based on a view on the Treasury yield curve. We first divide the treasury index into short, intermediate and long segments. For each month, we determine which segment has the highest *total* return over the foresight horizon. Next we divide the corporate index into sector/quality cells. In each sector/quality cell, we divide it into 3 average life cells (short, intermediate and long). Within each sector/quality cell, we choose one average life cell based on the choice we made for the Treasury index. This procedure gives an investment strategy which chooses only bonds from a single yield curve segment, but matches the sector/quality distribution of the index as a whole.

Appendix 4 gives a detailed illustration of the portfolio composition for each of these three strategies in a given month.

The reason for the slight differences in allocation criteria for the different allocation strategies should be clear. To choose between different yield curve segments, we use a (perfect) forecast of the total returns of each cell. For our sector and quality allocation schemes, we want to be sure that our allocation is not influenced by any knowledge of future yield curve movement. Therefore, we base our decisions on knowledge of the excess returns over duration-neutral Treasuries, as we did in the security selection strategies. This helps to correct for incidental duration differences between different market cells and allows us to focus more closely on spread sector allocations.

## Methodology: Unrestricted Allocation Strategies

We explored two additional allocation strategies, in which we removed all of the constraints designed to reduce tracking error versus the index. In the combined view (“perfect foresight” on everything at the same time), we divide the index into 36 average life-sector-quality cells, as defined above. We then allocate 100% of the portfolio to the single cell with the highest predicted total return over the forecast horizon. This approach should have the most freedom to outperform the benchmark, but does so by taking positions with major structural differences between the portfolio and the benchmark.

We also tried a variation of the yield curve allocation strategy, in which we break down the yield curve into finer subdivisions, but match neither index sector nor quality distribution. We divide the index into 10 average life cells (1-2, 2-3, 3-4, 4-5, 5-7, 7-10, 10-15, 15-20, 20-30, 30+). We then allocate 100% of the portfolio each month to the cell with the highest predicted total return over the forecast horizon. This approach can lead to sector and quality mismatches between the portfolio and the index (to the extent that the composition of the selected average life cell differs from that of the index as a whole), but not as drastic as those in the combined view strategy.

## Results

Figure 7 summarizes the performance results for all of the allocation strategies considered in this section and compares the results to comparable cases from the security selection strategy considered earlier (detailed results can be found in Figure 8).

Yield curve allocation foresight gives the highest return advantage over the index as compared to other allocation decisions. But this outperformance comes at the expense of large risk exposures. This can be seen both in the tracking errors and in the standard deviation of duration differences. To be sure, due to the “perfect foresight” assumed in our study, most of the volatility of the return difference (i.e., the tracking error) is volatility of outperformance. In fact,

Figure 7. **Information Ratios for Asset Allocation Strategies of Different Types,**
Using Different Foresight Horizons (with Comparison to Security Selection Strategy) vs. the Lehman Brothers Corporate Bond Index, 2/90-5/97

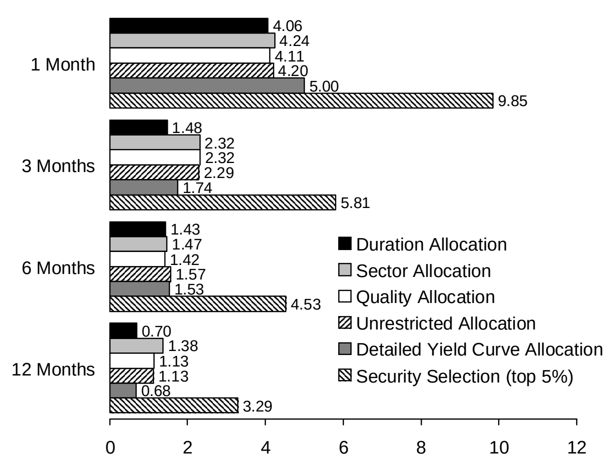


Figure 8. **Performance Summary for Asset Allocation Strategies of Different Types,** Using Different Foresight Horizons, (with Comparison to Security Selection Strategy), versus the Lehman Brothers Corporate Bond Index, 2/90-5/97

| View Placed | Horizon | Port. Avg. Return | Port. Avg. Duration | Ret. Diff vs. Index | TracError vs. Index | Dur. Diff vs. Index | Std.Dev of Dur. Diff | Information Ratio |
|---|---|---|---|---|---|---|---|---|
| Index | | 0.76 | 5.38 | | | | | |
| Duration | 12-mo. | 0.90 | 6.53 | 0.14 | 0.69 | 1.15 | 2.66 | 0.70 |
| | 6-mo. | 1.03 | 6.03 | 0.27 | 0.66 | 0.65 | 2.84 | 1.43 |
| | 3-mo. | 1.05 | 5.76 | 0.29 | 0.68 | 0.38 | 2.93 | 1.48 |
| | 1-mo. | 1.33 | 5.80 | 0.57 | 0.48 | 0.42 | 2.85 | 4.06 |
| Sector | 12-mo. | 0.85 | 5.46 | 0.09 | 0.23 | 0.08 | 0.21 | 1.38 |
| | 6-mo. | 0.86 | 5.43 | 0.10 | 0.24 | 0.05 | 0.21 | 1.47 |
| | 3-mo. | 0.92 | 5.44 | 0.16 | 0.24 | 0.06 | 0.24 | 2.32 |
| | 1-mo. | 1.01 | 5.43 | 0.25 | 0.21 | 0.04 | 0.25 | 4.24 |
| Quality | 12-mo. | 0.82 | 5.32 | 0.06 | 0.18 | -0.06 | 0.10 | 1.13 |
| | 6-mo. | 0.84 | 5.32 | 0.08 | 0.19 | -0.06 | 0.10 | 1.42 |
| | 3-mo. | 0.88 | 5.33 | 0.12 | 0.19 | -0.06 | 0.10 | 2.32 |
| | 1-mo. | 0.94 | 5.34 | 0.18 | 0.15 | -0.05 | 0.10 | 4.11 |
| Combined | 12-mo. | 1.21 | 7.00 | 0.45 | 1.39 | 1.62 | 2.38 | 1.13 |
| | 6-mo. | 1.37 | 6.81 | 0.61 | 1.35 | 1.42 | 2.70 | 1.57 |
| | 3-mo. | 1.58 | 6.24 | 0.82 | 1.24 | 0.85 | 3.10 | 2.29 |
| | 1-mo. | 2.04 | 6.31 | 1.28 | 1.05 | 0.93 | 2.93 | 4.20 |
| Detailed | 12-mo. | 0.92 | 6.49 | 0.16 | 0.83 | 1.11 | 3.07 | 0.68 |
| Yield Curve | 6-mo. | 1.10 | 6.32 | 0.34 | 0.77 | 0.94 | 3.21 | 1.53 |
| | 3-mo. | 1.17 | 5.67 | 0.41 | 0.80 | 0.29 | 3.39 | 1.74 |
| | 1-mo. | 1.56 | 5.63 | 0.80 | 0.55 | 0.24 | 3.35 | 5.00 |
| SecSel 5% | 12-mo. | 1.10 | 5.62 | 0.34 | 0.36 | 0.24 | 0.35 | 3.29 |
| | 6-mo. | 1.23 | 5.51 | 0.47 | 0.36 | 0.13 | 0.30 | 4.53 |
| | 3-mo. | 1.43 | 5.47 | 0.67 | 0.40 | 0.09 | 0.32 | 5.81 |
| | 1-mo. | 1.92 | 5.49 | 1.16 | 0.41 | 0.10 | 0.35 | 9.85 |
| SecSel 10% | 12-mo. | 1.04 | 5.58 | 0.28 | 0.25 | 0.19 | 0.31 | 3.87 |
| | 6-mo. | 1.12 | 5.48 | 0.36 | 0.25 | 0.10 | 0.26 | 5.09 |
| | 3-mo. | 1.27 | 5.44 | 0.51 | 0.28 | 0.06 | 0.28 | 6.44 |
| | 1-mo. | 1.63 | 5.44 | 0.87 | 0.30 | 0.06 | 0.31 | 9.96 |
| SecSel 90% | 12-mo. | 0.80 | 5.43 | 0.04 | 0.05 | 0.05 | 0.10 | 2.39 |
| | 6-mo. | 0.81 | 5.41 | 0.05 | 0.05 | 0.02 | 0.08 | 3.36 |
| | 3-mo. | 0.83 | 5.38 | 0.07 | 0.06 | 0.00 | 0.07 | 4.30 |
| | 1-mo. | 0.88 | 5.36 | 0.12 | 0.07 | -0.03 | 0.07 | 5.96 |
| SecSel 95% | 12-mo. | 0.78 | 5.41 | 0.02 | 0.04 | 0.03 | 0.08 | 1.71 |
| | 6-mo. | 0.79 | 5.40 | 0.03 | 0.05 | 0.01 | 0.08 | 2.36 |
| | 3-mo. | 0.81 | 5.38 | 0.05 | 0.05 | 0.00 | 0.07 | 3.28 |
| | 1-mo. | 0.84 | 5.36 | 0.08 | 0.06 | -0.02 | 0.07 | 5.03 |

in the one-month horizon case, the portfolio outperforms the index every month. However, the large standard deviation of duration shows that this strategy is very aggressive in positioning the portfolio to reflect its views, opening the door to significant losses if these views are wrong.

If the foresight horizon is longer than the rebalancing interval, both the performance advantage and information ratio of this strategy drop significantly. This shows that the duration projection is subject to high short-term volatility—that is, even a correct long-term call is not particularly helpful for short-term positioning.

Sector and quality decisions give similar results whether measured by outperformance, volatility or information ratio. By the latter measure, sector has a slight advantage. As the holding period becomes shorter than the foresight horizon, information ratios hold up much better than they do for the yield curve allocations.

Combining yield curve foresight with sector and quality foresight significantly increases outperformance to achieve the highest returns of all strategies considered. However, this unbalanced strategy takes significant risks in all dimensions. The resulting large volatility results in relatively low information ratios.

The detailed yield curve allocation strategy gives performance very similar to that of the index-matched version. The more detailed strategy, with greater flexibility along the curve, predictably earns higher returns than the index-matched study at every forecast horizon. However, these gains are accompanied by increased volatility, leaving the information ratios quite similar for the two schemes.

Security selection, as part of an index-matched strategy, is by far the best vehicle for outperformance. At a comparable foresight horizon and holding period, the “top 5%” strategy has a much higher return advantage over the index than any of the index-matched allocation strategies. On an information ratio basis, this strategy is by far the best of all those considered. As shown in Figure 8, even the more realistic “avoiding losers” strategies result in higher information ratios than the asset allocation strategies with corresponding foresight horizons. For example, the “top 95%” strategy with one-month foresight horizon delivers an information ratio of 5.03 as compared to 4.06 for the duration-based and 4.24 for the sector-based allocation strategies.

For any of these strategies, as we have already discussed, asset allocation based on a distant horizon without holding securities for the entire horizon period is not really “perfect” foresight. If we set allocation decisions based on a 12-month outlook and allow the portfolio to rebalance monthly, we may not get the full benefit of the foresight. The closer the holding period to the foresight horizon the better the performance. Re-balancing monthly based on a one-month foresight is truly “perfect”. However, it is instructive to see how quickly the information ratios degrade as the foresight horizon is increased for different schemes. Our two yield curve allocation schemes based on a one-month forecast give information ratios of 4.06 and 5.00, similar to the 4.24 ratio for sector allocation. However, if we step back to a 12-month forecast horizon, the information ratio for sector allocation (1.38) is roughly double those of our yield curve allocation strategies (0.70 and 0.68). The message here is that yield curve views should be short term. Sector rotations and security selection calls can play out over a longer time frame.

# 4. EXTENSION TO OTHER ASSET CLASSES AND TIME PERIODS

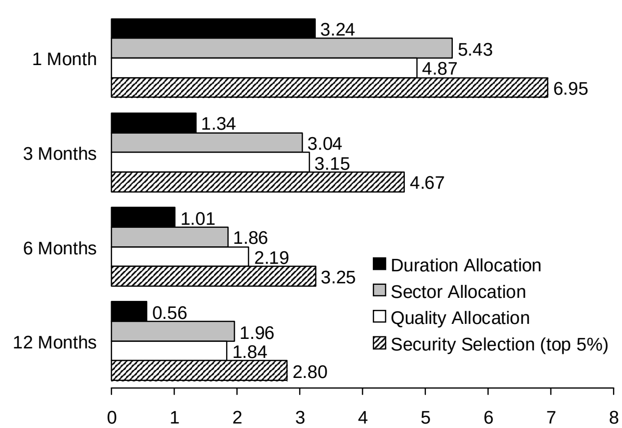
## Eurobonds

As mentioned in the introduction, many of the investors who have expressed interest in this study are looking to extrapolate results to the nascent Euro-denominated corporate bond market. While it is too early to test the validity of this approach there, we decided to apply the same methodology to an additional market to see if similar results are obtained. For this purpose, we have selected the dollar-denominated Eurobond market. For this study, due to the nature of the Eurobond market, we only divided the index into two buckets in terms of average life (1-3 years and 3+ years), but we defined six sectors (U.S. agencies, industrials, finance, sovereigns, supranationals, and other) and three quality ranges (Aaa, Aa, A ,and below). The results of the various strategies for this investment universe are shown in Figure 9 (detailed results can be found in Appendix 5).

In general, the conclusions from the Eurobond study are similar to the ones from the U.S. corporate study. The order of importance with respect to the information ratio is still: security selection, sector selection, quality selection and duration selection. However, the resulting information ratios are much smaller compared to those in the corporate index study. Let’s compare, for instance, the information ratios achieved by the “avoiding losers” strategies with 1-month foresight horizon. The reduction in information ratios is dramatic: they drop from 5.96 to 1.54 for the “90%” case and from 5.03 to 0.87 for the “95%” case (see last columns of tables in Figure 8 and Appendix 5).

The smaller information ratios can be explained by looking at the performance breakdown of the corporate index results, in Figures 5 and 6. The majority of the Eurobond index has an average life less than 5 years (64%) and also the majority of the Eurobond index is rated Aaa (50%) with the bulk of the remainder at Aa (35%) and a very small portion below Aa. Let’s look at the breakdown of the U.S. corporate study by quality and maturity in Figures 5 and 6.

Figure 9. **Information Ratios for Asset Allocation Strategies of Different Types,**
Using Different Foresight Horizons
(with Comparison to Security Selection Strategy)
versus the Lehman Brothers Eurobond Index, 2/90-9/97



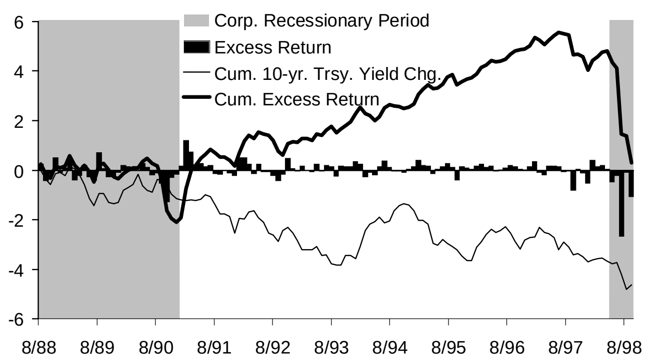
We see that the short maturity section has an extremely low information ratio compared to the intermediate and long sections and that Aaa and Aa are the quality cells with the two lowest information ratios. As the bulk of the Eurobond market is in these average life and quality cells, it is understandable that for Eurobonds we find much lower information ratios than for the overall corporate index.

## Recessionary Time Period

In order to demonstrate that this methodology and the conclusions drawn from the results are relatively stable and do not depend on the market environment, we repeated the corporate bond study over a recessionary period. We sought out a period of time during which excess returns were negative for the corporate market as a whole—that is, a period of spread widening. We selected the time period from September 1988 through January 1991, during which cumulative corporate excess returns were negative and reached their minimum. This is illustrated in Figure 10.

The detailed results for the recessionary period are shown in Figure 11. Compared with Figure 8, we can see that for all the different investment decisions the qualitative trends and the resulting information ratios for the two periods are very similar. One interesting exception is the quality allocation. For the first period studied, the results for sector allocation and quality allocation give very similar information ratios with sector allocation doing slightly better. However, for the recessionary period, sector allocation more clearly outperformed quality allocation, when measured either by information ratios or by absolute outperformance of the index. This seems to imply that the sector selection provides a more significant and consistent method for outperformance than selection of credit qualities.

Figure 10. **Illustration of the Choice of a Recessionary Period as Measured by Excess Return of Lehman Brothers Corporate Index**




We have noted that part of the outperformance achieved by our security selection strategy may be due to the fact that duration is not constrained to match that of the index. Thus, when the market sees a sustained rally in credit spread (as during most of the time period covered by section 2 of our

Figure 11. **Performance Summary for Asset Allocation Strategies of Different Types,** Using Different Foresight Horizons, (with Comparison to Security Selection Strategy), versus the Lehman Brothers Corporate Index for 9/88-1/91

| View Placed/ Horizon | Port. Avg Ret. | Port. Avg Dur. | Ret. Diff. vs. Index | Trac Err. vs. Index | Dur. Diff. vs. Index | S.D. of Dur. Diff. | Info Ratio |
|---|---|---|---|---|---|---|---|
| Index | 0.86 | 4.80 | | | | | |
| *Duration* | | | | | | | |
| 12-mo | 0.91 | 5.05 | 0.05 | 0.48 | 0.24 | 2.06 | 0.34 |
| 6-mo | 1.04 | 4.81 | 0.18 | 0.40 | 0.01 | 1.98 | 1.61 |
| 3-mo | 1.04 | 4.92 | 0.18 | 0.51 | 0.12 | 2.22 | 1.21 |
| 1-mo | 1.25 | 5.07 | 0.39 | 0.42 | 0.27 | 2.17 | 3.24 |
| *Sector* | | | | | | | |
| 12-mo | 0.95 | 4.83 | 0.09 | 0.24 | 0.02 | 0.20 | 1.28 |
| 6-mo | 0.98 | 4.88 | 0.12 | 0.24 | 0.07 | 0.25 | 1.71 |
| 3-mo | 1.05 | 4.94 | 0.19 | 0.24 | 0.13 | 0.27 | 2.75 |
| 1-mo | 1.16 | 4.88 | 0.30 | 0.19 | 0.08 | 0.30 | 5.53 |
| *Quality* | | | | | | | |
| 12-mo | 0.85 | 4.70 | 0.00 | 0.17 | -0.11 | 0.16 | -0.07 |
| 6-mo | 0.89 | 4.70 | 0.03 | 0.20 | -0.10 | 0.15 | 0.56 |
| 3-mo | 0.97 | 4.70 | 0.11 | 0.21 | -0.11 | 0.16 | 1.76 |
| 1-mo | 1.06 | 4.71 | 0.20 | 0.13 | -0.10 | 0.13 | 5.47 |
| *Combined* | | | | | | | |
| 12-mo | 1.19 | 5.49 | 0.33 | 1.32 | 0.69 | 1.95 | 0.86 |
| 6-mo | 1.38 | 4.91 | 0.52 | 1.32 | 0.11 | 1.89 | 1.37 |
| 3-mo | 1.52 | 5.16 | 0.66 | 1.22 | 0.35 | 2.10 | 1.89 |
| 1-mo | 1.97 | 5.14 | 1.11 | 0.91 | 0.33 | 2.12 | 4.20 |
| *Detailed Yield Curve* | | | | | | | |
| 12-mo | 1.01 | 5.21 | 0.15 | 0.83 | 0.41 | 2.45 | 0.63 |
| 6-mo | 1.30 | 5.06 | 0.44 | 0.72 | 0.26 | 2.53 | 2.14 |
| 3-mo | 1.32 | 4.36 | 0.46 | 0.73 | -0.44 | 2.77 | 2.21 |
| 1-mo | 1.64 | 4.43 | 0.78 | 0.53 | -0.38 | 2.71 | 5.09 |
| *SecSel 5%* | | | | | | | |
| 12-mo | 1.09 | 5.25 | 0.23 | 0.30 | 0.44 | 0.59 | 2.67 |
| 6-mo | 1.21 | 5.20 | 0.36 | 0.30 | 0.40 | 0.59 | 4.05 |
| 3-mo | 1.43 | 5.24 | 0.57 | 0.34 | 0.43 | 0.47 | 5.73 |
| 1-mo | 1.98 | 5.30 | 1.12 | 0.37 | 0.49 | 0.58 | 10.56 |
| *SecSel 10%* | | | | | | | |
| 12-mo | 1.06 | 5.15 | 0.20 | 0.21 | 0.34 | 0.43 | 3.26 |
| 6-mo | 1.15 | 5.11 | 0.29 | 0.24 | 0.30 | 0.45 | 4.26 |
| 3-mo | 1.32 | 5.10 | 0.46 | 0.25 | 0.29 | 0.34 | 6.42 |
| 1-mo | 1.72 | 5.12 | 0.86 | 0.28 | 0.31 | 0.43 | 10.67 |
| *SecSel 90%* | | | | | | | |
| 12-mo | 0.91 | 4.97 | 0.05 | 0.07 | 0.16 | 0.14 | 2.50 |
| 6-mo | 0.93 | 4.93 | 0.07 | 0.07 | 0.12 | 0.16 | 3.57 |
| 3-mo | 0.96 | 4.90 | 0.10 | 0.08 | 0.10 | 0.14 | 4.49 |
| 1-mo | 1.03 | 4.88 | 0.17 | 0.08 | 0.08 | 0.13 | 7.55 |
| *SecSel 95%* | | | | | | | |
| 12-mo | 0.89 | 4.96 | 0.03 | 0.06 | 0.16 | 0.12 | 1.70 |
| 6-mo | 0.91 | 4.93 | 0.05 | 0.06 | 0.13 | 0.13 | 2.56 |
| 3-mo | 0.92 | 4.91 | 0.07 | 0.07 | 0.11 | 0.12 | 3.43 |
| 1-mo | 0.97 | 4.90 | 0.11 | 0.07 | 0.09 | 0.12 | 5.74 |

study), the strategy can outperform merely by adding spread duration. This can be accomplished within the context of our study by matching allocation percentages to each cell, but selecting bonds with a higher spread duration than the index in each cell. If a major contributor to our strategy's performance is a systematic extension of spread duration to pick up spread contraction, then this strategy should backfire during the recession period. We should expect that during a recession there will either be less bias towards extending duration, or that such a bias, if present, is not successful. However, Figure 12 shows that our strategy continues to exhibit a bias towards longer durations even during this recessionary period, and nonetheless continues to perform well. For instance, the "top 5%" security selection strategy, with a one-month forecast horizon, achieved an information ratio of 9.85 during an extended rally, as shown in Figure 8, with average duration longer than the index by 0.10. During the recessionary period shown in Figure 11, the strategy's duration was longer than the index by 0.49, and the information ratio was 10.56. This shows that a systematic overexposure to spread duration can not be a main contributor to the outperformance achieved by security selection.

We observed that the "avoiding losers" strategies (top 90% and top 95%) showed unexpectedly large deviations from index duration during the recessionary period of Figure 11. Upon investigation, we found that this discrepancy occured only because we had equally weighted each bond in a cell. Thus, even if we would raise the parameter to 100% to choose all the bonds in the index, our portfolio would not exactly match the index. To eliminate the effect of the duration deviation, we therefore repeated the historical simulation using the same 90% and 95% strategies, but weighting the bonds in a cell by their market value.[5] Figure 12 shows the results of the 90% and 95% strategies for both historical periods (9/88-1/91 and 2/90-5/97). Both strategies matched the index in duration very closely for both time periods. In addition, the performance results (both mean outperformance and information ratio) are very similar to those reported previously, despite the fact that the duration bias has been greatly reduced.

[5] In the "picking winners" strategy, it is clearly desirable to use equal weightings for bonds within each cell, to prevent extremely large exposures to individual issues. In the "avoiding losers" strategy, we have until now imposed the same equal weighting approach for consistency. However, implementation of this strategy should probably use market weighting. This will ensure that the portfolio is aligned as closely as possible with the index, which is itself market-weighted.

Figure 12. **Performance Summary for Top 90% and 95% *Market Value Weighted* Strategies for the Period of 2/90-5/97 and 9/88-1/91**

| **View Placed/ Horizon** | **Port. Avg Ret.** | **Port. Avg Dur.** | **Ret. Diff. vs. Index** | **Trac Err. vs. Index** | **Dur. Diff. vs. Index** | **S.D. of Dur. Diff.** | **Info Ratio** |
|---|---|---|---|---|---|---|---|
| **2/90-5/97** | | | | | | | |
| Index | 0.76 | 5.38 | | | | | |
| *SecSel 90%* | | | | | | | |
| 12-mo | 0.79 | 5.42 | 0.03 | 0.03 | 0.04 | 0.05 | 3.57 |
| 6-mo | 0.81 | 5.40 | 0.05 | 0.03 | 0.02 | 0.04 | 4.92 |
| 3-mo | 0.83 | 5.38 | 0.07 | 0.04 | 0.00 | 0.04 | 6.14 |
| 1-mo | 0.88 | 5.36 | 0.12 | 0.06 | -0.02 | 0.03 | 7.13 |
| *SecSel 95%* | | | | | | | |
| 12-mo | 0.78 | 5.40 | 0.02 | 0.02 | 0.02 | 0.03 | 3.12 |
| 6-mo | 0.79 | 5.39 | 0.03 | 0.02 | 0.01 | 0.03 | 3.93 |
| 3-mo | 0.80 | 5.38 | 0.04 | 0.03 | -0.01 | 0.02 | 5.24 |
| 1-mo | 0.84 | 5.36 | 0.08 | 0.04 | -0.02 | 0.02 | 6.67 |
| **9/88-1/91** | | | | | | | |
| Index | 0.86 | 4.80 | | | | | |
| *SecSel 90%* | | | | | | | |
| 12-mo | 0.90 | 4.84 | 0.04 | 0.04 | 0.04 | 0.10 | 3.31 |
| 6-mo | 0.91 | 4.81 | 0.06 | 0.04 | 0.01 | 0.10 | 4.64 |
| 3-mo | 0.94 | 4.78 | 0.08 | 0.05 | -0.02 | 0.09 | 6.23 |
| 1-mo | 1.01 | 4.77 | 0.15 | 0.07 | -0.04 | 0.10 | 7.85 |
| *SecSel 95%* | | | | | | | |
| 12-mo | 0.88 | 4.84 | 0.02 | 0.03 | 0.03 | 0.09 | 2.37 |
| 6-mo | 0.89 | 4.81 | 0.03 | 0.03 | 0.00 | 0.09 | 3.48 |
| 3-mo | 0.91 | 4.79 | 0.05 | 0.04 | -0.02 | 0.08 | 4.76 |
| 1-mo | 0.96 | 4.77 | 0.10 | 0.05 | -0.03 | 0.08 | 6.40 |

We conclude that the duration freedom that was allowed in our security selection strategies was not a major factor in our outperformance. In addition, the relative performance of different strategies is similar in both rallying and recessionary periods.

## 5. DISCUSSION

Our studies to date have provided some clear conclusions. An index-matched strategy based on security selection within each market cell is clearly the most risk-efficient path to index outperformance in our perfect foresight world. Treasury yield curve allocation offers the largest potential for return, but is not risk-efficient beyond a short forecast horizon. Longer horizon forecasts are more applicable in the realms of security selection and sector and quality allocation than in timing of yield curve movements.

For investors ready to enter the European credit market, a bottom-up approach is the preferable strategy. This implies an effort to achieve diversification over rating and sector categories and a focus on active bond selection within the categories. The security selection strategies are most efficient for longer maturity bonds as well as the lower-rated classes.

As to the question of whether it is more important to select the winners or to avoid the losers, our results indicate that the first strategy leads to slightly better results, but it is much less realistic.

The above conclusions may seem counter to the perception that correct timing of yield curve movement is the single most effective method of generating portfolio performance. There are certainly investors who successfully utilize the "top-down" approach to portfolio management. The key here however, is that we evaluated various strategies based on the information ratio, which measures risk adjusted performance of a portfolio *relative to the benchmark*. A similar ratio measuring absolute portfolio return adjusted by its total variance is well known as the Sharpe ratio.[6] Figures 13 and 14 present both the information ratios relative to the Lehman Corporate Index and absolute Sharpe ratios achieved by various strategies (risk-free rates are approximated by one-month treasury term repo).

Figure 14 shows that a comparison of various strategies in terms of Sharpe ratios would find yield curve timing ("duration" strategy) to be one of the most efficient and certainly more efficient than the "avoid losers" strategies. As we noted before, advantages of the "duration" strategy quickly disappear as the foresight horizon increases beyond the holding period because of the volatile nature of yield curve movement. Sector and quality-based allocations exhibit much slower deterioration with lengthening foresight horizon because they are more "trending." In fact, all allocation decisions illustrated in Figure 14 appear to be much more efficient in comparison to security selection strategies than they do in Figure 13.

Most fixed income portfolios today are managed relative to some sort of benchmark, making the information ratio an appropriate measure of a strategy's success.

One major open issue is the perfect foresight assumption itself. We have taken as a given that these results are to be treated as an unattainable "best case," with performance far above that which can realistically be achieved. It would be interesting to investigate an "imperfect foresight" assumption, in which the algorithm sometimes randomly reaches the wrong decision. The effectiveness of research can then be modeled based on the relative probabilities of the selected view being right or wrong.

Figure 13. **Summary of Information Ratios for Various "Perfect Foresight" Strategies,** 2/90-5/97

| | | Pure | | | | Security Selection | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Hrzn.** | **Ind.** | **Dur.** | **Sect.** | **Qual.** | **Dur.** | **5%** | **10%** | **90%** | **95%** |
| 1-mo | - | 4.06 | 4.24 | 4.11 | 5.00 | 9.85 | 9.96 | 5.96 | 5.03 |
| 3-mo | - | 1.48 | 2.32 | 2.32 | 1.74 | 5.81 | 6.44 | 4.30 | 3.28 |
| 6-mo | - | 1.43 | 1.47 | 1.42 | 1.53 | 4.53 | 5.09 | 3.36 | 2.36 |
| 12-mo | - | 0.70 | 1.38 | 1.13 | 0.68 | 3.29 | 3.87 | 2.39 | 1.71 |

Figure 14. **Sharpe Ratios for Various "Perfect Foresight" Strategies,** 2/90-5/97

| | | Pure | | | | Security Selection | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Hrzn.** | **Ind.** | **Dur.** | **Sect.** | **Qual.** | **Dur.** | **5%** | **10%** | **90%** | **95%** |
| 1-mo | 0.80 | 2.10 | 1.39 | 1.23 | 2.84 | 3.55 | 2.90 | 1.10 | 1.00 |
| 3-mo | 0.80 | 1.38 | 1.19 | 1.11 | 1.76 | 2.41 | 2.06 | 0.97 | 0.91 |
| 6-mo | 0.80 | 1.30 | 1.04 | 1.00 | 1.46 | 1.94 | 1.69 | 0.92 | 0.87 |
| 12-mo | 0.80 | 0.95 | 1.00 | 0.95 | 1.00 | 1.59 | 1.44 | 0.88 | 0.84 |

[6] The usual definition of a Sharpe ratio (Sharpe, 1966) is

$$(R_{portfolio} - R_{risk\ free}) / \sigma_{portfolio}$$

i.e., portfolio return over the risk-free rate divided by standard deviation of portfolio return, all annualized.

**Appendix 1. Detailed Illustration of the "Top 5%" Security Selection Strategy with a 1-month Foresight Horizon for February 1997***

| | | | Index | | | | Portfolio | | | | Diff |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Term | Sector | Quality | No. of Sec. | Market Weight (%) | Total Return | Cntrb to Tot Ret | No. of Sec. | Market Weight (%) | Total Return | Cntrb to Tot Ret | CntrbTo TotRet |
| **Short** | | | | | | | | | | | |
| | Industrial | Aaa | 8 | 0.24 | 0.23 | 0.00 | 1 | 0.24 | 0.09 | 0.00 | 0.00 |
| | | Aa | 34 | 1.18 | 0.23 | 0.00 | 2 | 1.18 | 0.57 | 0.01 | 0.00 |
| | | A | 176 | 5.10 | 0.26 | 0.01 | 9 | 5.10 | 0.71 | 0.04 | 0.02 |
| | | Baa | 115 | 2.76 | 0.30 | 0.01 | 5 | 2.76 | 0.76 | 0.02 | 0.01 |
| | Utilities | Aaa | 7 | 0.14 | 0.25 | 0.00 | 1 | 0.14 | 0.62 | 0.00 | 0.00 |
| | | Aa | 25 | 0.51 | 0.20 | 0.00 | 1 | 0.51 | 0.43 | 0.00 | 0.00 |
| | | A | 91 | 1.75 | 0.27 | 0.00 | 4 | 1.75 | 0.75 | 0.01 | 0.01 |
| | | Baa | 82 | 1.62 | 0.30 | 0.00 | 4 | 1.62 | 0.89 | 0.01 | 0.01 |
| | Yankee | Aaa | 23 | 0.64 | 0.22 | 0.00 | 1 | 0.64 | 0.28 | 0.00 | 0.00 |
| | | Aa | 35 | 1.76 | 0.23 | 0.00 | 2 | 1.76 | 0.50 | 0.01 | 0.00 |
| | | A | 54 | 1.58 | 0.22 | 0.00 | 3 | 1.58 | 0.34 | 0.01 | 0.00 |
| | | Baa | 15 | 0.57 | 0.31 | 0.00 | 1 | 0.57 | 0.52 | 0.00 | 0.00 |
| | Financials | Aaa | 8 | 0.23 | 0.24 | 0.00 | 1 | 0.23 | 0.82 | 0.00 | 0.00 |
| | | Aa | 112 | 2.73 | 0.26 | 0.01 | 6 | 2.73 | 0.32 | 0.01 | 0.00 |
| | | A | 309 | 7.64 | 0.28 | 0.02 | 10 | 7.64 | 0.62 | 0.05 | 0.03 |
| | | Baa | 65 | 1.32 | 0.31 | 0.00 | 3 | 1.32 | 0.50 | 0.01 | 0.00 |
| **Intermediate** | | | | | | | | | | | |
| | Industrial | Aaa | 3 | 0.08 | 0.05 | 0.00 | 1 | 0.08 | 0.11 | 0.00 | 0.00 |
| | | Aa | 38 | 1.08 | 0.18 | 0.00 | 2 | 1.08 | 0.58 | 0.01 | 0.00 |
| | | A | 194 | 5.13 | 0.28 | 0.01 | 10 | 5.13 | 0.84 | 0.04 | 0.03 |
| | | Baa | 201 | 4.96 | 0.35 | 0.02 | 10 | 4.96 | 1.14 | 0.06 | 0.04 |
| | Utilities | Aaa | 11 | 0.25 | 0.31 | 0.00 | 1 | 0.25 | 1.56 | 0.00 | 0.00 |
| | | Aa | 33 | 0.68 | 0.29 | 0.00 | 2 | 0.68 | 1.32 | 0.01 | 0.01 |
| | | A | 107 | 2.27 | 0.27 | 0.01 | 5 | 2.27 | 0.99 | 0.02 | 0.02 |
| | | Baa | 83 | 1.95 | 0.42 | 0.01 | 4 | 1.95 | 1.60 | 0.03 | 0.02 |
| | Yankee | Aaa | 15 | 0.77 | 0.22 | 0.00 | 1 | 0.77 | 0.34 | 0.00 | 0.00 |
| | | Aa | 42 | 3.72 | 0.23 | 0.01 | 2 | 3.72 | 0.51 | 0.02 | 0.01 |
| | | A | 102 | 4.19 | 0.17 | 0.01 | 5 | 4.19 | 0.75 | 0.03 | 0.02 |
| | | Baa | 53 | 1.38 | 0.41 | 0.01 | 3 | 1.38 | 1.33 | 0.02 | 0.01 |
| | Financials | Aaa | 6 | 0.20 | 0.38 | 0.00 | 1 | 0.20 | 0.67 | 0.00 | 0.00 |
| | | Aa | 63 | 1.46 | 0.27 | 0.00 | 3 | 1.46 | 0.65 | 0.01 | 0.01 |
| | | A | 300 | 7.82 | 0.36 | 0.03 | 10 | 7.82 | 1.03 | 0.08 | 0.05 |
| | | Baa | 93 | 1.83 | 0.48 | 0.01 | 4 | 1.83 | 1.21 | 0.02 | 0.01 |
| **Long** | | | | | | | | | | | |
| | Industrial | Aaa | 8 | 0.30 | 0.53 | 0.00 | 1 | 0.30 | 0.96 | 0.00 | 0.00 |
| | | Aa | 36 | 1.20 | 0.67 | 0.01 | 2 | 1.20 | 1.18 | 0.01 | 0.01 |
| | | A | 278 | 7.69 | 0.59 | 0.05 | 10 | 7.69 | 1.61 | 0.12 | 0.08 |
| | | Baa | 187 | 4.92 | 0.89 | 0.04 | 9 | 4.92 | 3.19 | 0.16 | 0.11 |
| | Utilities | Aaa | 26 | 0.63 | 0.31 | 0.00 | 1 | 0.63 | 0.32 | 0.00 | 0.00 |
| | | Aa | 83 | 2.00 | 0.81 | 0.02 | 4 | 2.00 | 3.43 | 0.07 | 0.05 |
| | | A | 140 | 3.14 | 0.88 | 0.03 | 7 | 3.14 | 3.88 | 0.12 | 0.09 |
| | | Baa | 98 | 2.40 | 1.08 | 0.03 | 5 | 2.40 | 4.81 | 0.12 | 0.09 |
| | Yankee | Aaa | 17 | 0.55 | 0.38 | 0.00 | 1 | 0.55 | 0.80 | 0.00 | 0.00 |
| | | Aa | 35 | 1.41 | 0.53 | 0.01 | 2 | 1.41 | 1.25 | 0.02 | 0.01 |
| | | A | 87 | 3.32 | 0.39 | 0.01 | 4 | 3.32 | 1.63 | 0.05 | 0.04 |
| | | Baa | 40 | 0.84 | 0.57 | 0.00 | 2 | 0.84 | 2.35 | 0.02 | 0.01 |
| | Financials | Aaa | 8 | 0.26 | 0.43 | 0.00 | 1 | 0.26 | 0.61 | 0.00 | 0.00 |
| | | Aa | 28 | 0.62 | 0.44 | 0.00 | 1 | 0.62 | 0.95 | 0.01 | 0.00 |
| | | A | 104 | 2.81 | 0.65 | 0.02 | 5 | 2.81 | 2.16 | 0.06 | 0.04 |
| | | Baa | 20 | 0.39 | 1.02 | 0.00 | 1 | 0.39 | 2.14 | 0.01 | 0.00 |
| **Total** | | | 3698 | 100.0 | | 0.42 | 174 | 100.0 | | 1.31 | 0.89 |

Note that the percent of portfolio market value in each cell matches that of the index. The portfolio buys only a few top performing securities in each cell and achieves superior return and a steady return advantage over the index.

**Appendix 2.** **Performance Summary for "Picking Winners" Security Selection Strategy over Sub-sectors of the Lehman Brothers Corporate Bond Index,** 12-month Foresight Horizon, One-month Holding Period, Top 5% of Securities, 30% Turnover Threshold, Transaction Costs Included

**Performance by Maturity**

| | | Short | | | Intermediate | | | Long | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** |
| Monthly | Avg.Ret. | 0.85 | 0.67 | 0.19 | 1.06 | 0.79 | 0.27 | 1.27 | 0.85 | 0.42 | 1.07 | 0.76 | 0.31 |
| | StdDev | 0.86 | 0.78 | 0.37 | 1.51 | 1.51 | 0.41 | 2.14 | 2.06 | 0.52 | 1.49 | 1.42 | 0.34 |
| Annual | Avg.Ret. | 10.24 | 8.00 | 2.24 | 12.76 | 9.50 | 3.26 | 15.25 | 10.23 | 5.02 | 12.84 | 9.12 | 3.72 |
| | StdDev | 2.98 | 2.70 | 1.27 | 5.24 | 5.22 | 1.43 | 7.40 | 7.13 | 1.81 | 5.16 | 4.92 | 1.18 |
| | Info. Ratio | | | 1.76 | | | 2.27 | | | 2.78 | | | 3.16 |

**Performance by Quality**

| | | Aaa | | | Aa | | | A | | | Baa | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** |
| Monthly | Avg.Ret. | 0.95 | 0.73 | 0.22 | 0.90 | 0.75 | 0.15 | 1.01 | 0.77 | 0.24 | 1.37 | 0.80 | 0.58 |
| | StdDev | 1.77 | 1.42 | 0.71 | 1.45 | 1.47 | 0.30 | 1.50 | 1.46 | 0.30 | 1.76 | 1.50 | 0.95 |
| Annual | Avg.Ret | 11.39 | 8.74 | 2.64 | 10.76 | 9.01 | 1.75 | 12.12 | 9.27 | 2.86 | 16.48 | 9.55 | 6.93 |
| | StdDev | 6.12 | 4.92 | 2.46 | 5.03 | 5.10 | 1.05 | 5.21 | 5.07 | 1.04 | 6.10 | 5.18 | 3.30 |
| | Info. Ratio | | | 1.08 | | | 1.67 | | | 2.75 | | | 2.10 |

**Performance by Sector**

| | | Industrial | | | Utility | | | Yankee | | | Financial | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** |
| Monthly | Avg.Ret. | 1.20 | 0.79 | 0.41 | 1.01 | 0.77 | 0.23 | 0.97 | 0.78 | 0.19 | 1.02 | 0.74 | 0.28 |
| | StdDev | 1.63 | 1.52 | 0.73 | 1.57 | 1.61 | 0.37 | 1.60 | 1.57 | 0.28 | 1.46 | 1.23 | 0.51 |
| Annual | Avg.Ret. | 14.34 | 9.43 | 4.92 | 12.07 | 9.26 | 2.81 | 11.64 | 9.35 | 2.29 | 12.30 | 8.88 | 3.41 |
| | StdDev | 5.64 | 5.28 | 2.53 | 5.45 | 5.59 | 1.29 | 5.54 | 5.45 | 0.96 | 5.05 | 4.26 | 1.76 |
| | Info. Ratio | | | 1.94 | | | 2.19 | | | 2.38 | | | 1.94 |

**Appendix 3.** **Performance Summary for "Avoiding Losers" Security Selection Strategy over Sub-sectors of the Lehman Brothers Corporate Bond Index,** One-month Foresight Horizon, One-month Holding Period, Top 90% of Securities, 0% Turnover Threshold, No Transaction Costs

**Performance by Maturity**

| | | Short | | | Intermediate | | | Long | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** |
| Monthly | Avg.Ret. | 0.71 | 0.67 | 0.04 | 0.89 | 0.79 | 0.10 | 1.01 | 0.85 | 0.15 | 0.88 | 0.76 | 0.12 |
| | StdDev | 0.70 | 0.78 | 0.10 | 1.50 | 1.51 | 0.08 | 2.07 | 2.06 | 0.09 | 1.42 | 1.42 | 0.07 |
| Annual | Avg.Ret. | 8.51 | 8.00 | 0.51 | 10.72 | 9.50 | 1.22 | 12.09 | 10.23 | 1.85 | 10.58 | 9.12 | 1.46 |
| | StdDev | 2.44 | 2.70 | 0.36 | 5.21 | 5.21 | 0.28 | 7.18 | 7.13 | 0.30 | 4.99 | 5.06 | 0.25 |
| | Info.Ratio | | | 1.44 | | | 4.41 | | | 6.08 | | | 5.96 |

**Performance by Quality**

| | | Aaa | | | Aa | | | A | | | Baa | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** |
| Monthly | Avg.Ret. | 0.81 | 0.73 | 0.08 | 0.82 | 0.75 | 0.07 | 0.86 | 0.77 | 0.09 | 0.96 | 0.80 | 0.17 |
| | StdDev | 1.41 | 1.42 | 0.07 | 1.46 | 1.47 | 0.05 | 1.44 | 1.46 | 0.06 | 1.48 | 1.50 | 0.17 |
| Annual | Avg.Ret. | 9.73 | 8.73 | 1.00 | 9.85 | 9.01 | 0.84 | 10.32 | 9.27 | 1.05 | 11.57 | 9.55 | 2.02 |
| | StdDev | 4.90 | 4.91 | 0.25 | 5.05 | 5.10 | 0.19 | 4.98 | 5.07 | 0.21 | 5.11 | 5.18 | 0.58 |
| | Info.Ratio | | | 3.93 | | | 4.54 | | | 4.97 | | | 3.49 |

**Performance by Sector**

| | | Industrial | | | Utility | | | Yankee | | | Financial | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** | **Portfolio** | **Index** | **Diff.** |
| Monthly | Avg.Ret. | 0.92 | 0.79 | 0.13 | 0.88 | 0.77 | 0.11 | 0.85 | 0.78 | 0.08 | 0.81 | 0.74 | 0.07 |
| | StdDev | 1.50 | 1.52 | 0.12 | 1.60 | 1.61 | 0.08 | 1.55 | 1.57 | 0.06 | 1.20 | 1.23 | 0.08 |
| Annual | Avg.Ret. | 11.01 | 9.43 | 1.58 | 10.59 | 9.25 | 1.34 | 10.26 | 9.34 | 0.92 | 9.77 | 8.88 | 0.89 |
| | StdDev | 5.21 | 5.28 | 0.40 | 5.55 | 5.58 | 0.26 | 5.36 | 5.45 | 0.21 | 4.17 | 4.26 | 0.28 |
| | Info.Ratio | | | 3.94 | | | 5.07 | | | 4.29 | | | 3.15 |

## Appendix 4. Detailed Illustration of Four Asset Allocation Strategies with 1-month Foresight Horizon for February 1997*

| Mkt. Cell Sect / Qual | Index Total Ret. | Index Cell Weight (%) | Cell Weights (%) and Results for Perfect Foresight Allocation Strat. Allocation Dur. | Sector | Qual. | Unrestrict. |
|---|---|---|---|---|---|---|
| **Short** | | | | | | |
| Industrial | | | | | | |
| ≥Aa | 0.23 | 1.42 | 4.08 | 0.00 | 0.00 | 0.00 |
| A | 0.26 | 5.10 | 17.9 | 0.00 | 0.00 | 0.00 |
| Baa | 0.30 | 2.76 | 12.6 | 0.00 | 9.29 | 0.00 |
| Utilities | | | | | | |
| ≥Aa | 0.21 | 0.66 | 4.20 | 0.00 | 0.00 | 0.00 |
| A | 0.27 | 1.75 | 7.16 | 0.00 | 0.00 | 0.00 |
| Baa | 0.30 | 1.62 | 5.96 | 0.00 | 4.03 | 0.00 |
| Yankees | | | | | | |
| ≥Aa | 0.23 | 2.40 | 8.85 | 0.00 | 0.00 | 0.00 |
| A | 0.20 | 1.58 | 9.09 | 0.00 | 0.00 | 0.00 |
| Baa | 0.31 | 0.57 | 2.79 | 6.27 | 4.54 | 0.00 |
| Financials | | | | | | |
| ≥Aa | 0.26 | 2.96 | 5.50 | 7.43 | 0.00 | 0.00 |
| A | 0.28 | 7.64 | 18.3 | 16.1 | 0.00 | 0.00 |
| Baa | 0.32 | 1.32 | 3.54 | 0.00 | 11.9 | 0.00 |
| **Intermediate** | | | | | | |
| Industrial | | | | | | |
| ≥Aa | 0.18 | 1.17 | 0.00 | 0.00 | 0.00 | 0.00 |
| A | 0.27 | 5.13 | 0.00 | 0.00 | 0.00 | 0.00 |
| Baa | 0.36 | 4.96 | 0.00 | 0.00 | 11.3 | 0.00 |
| Utilities | | | | | | |
| ≥Aa | 0.30 | 0.93 | 0.00 | 8.24 | 0.00 | 0.00 |
| A | 0.27 | 2.27 | 0.00 | 0.00 | 0.00 | 0.00 |
| Baa | 0.42 | 1.95 | 0.00 | 0.00 | 5.14 | 0.00 |
| Yankee | | | | | | |
| ≥Aa | 0.23 | 4.48 | 0.00 | 0.00 | 0.00 | 0.00 |
| A | 0.16 | 4.19 | 0.00 | 0.00 | 0.00 | 0.00 |
| Baa | 0.42 | 1.38 | 0.00 | 0.00 | 10.1 | 0.00 |
| Fianacials | | | | | | |
| ≥Aa | 0.28 | 1.67 | 0.00 | 0.00 | 0.00 | 0.00 |
| A | 0.36 | 7.82 | 0.00 | 19.4 | 0.00 | 0.00 |
| Baa | 0.48 | 1.83 | 0.00 | 10.1 | 11.3 | 0.00 |
| **Long** | | | | | | |
| Industrials | | | | | | |
| ≥Aa | 0.63 | 1.49 | 0.00 | 0.00 | 0.00 | 0.00 |
| A | 0.60 | 7.69 | 0.00 | 0.00 | 0.00 | 0.00 |
| Baa | 0.90 | 4.92 | 0.00 | 0.00 | 14.1 | 0.00 |
| Utilities | | | | | | |
| ≥Aa | 0.69 | 2.62 | 0.00 | 6.95 | 0.00 | 0.00 |
| A | 0.88 | 3.14 | 0.00 | 17.0 | 0.00 | 0.00 |
| Baa | 1.08 | 2.40 | 0.00 | 8.55 | 8.16 | 100.00 |
| Yankee | | | | | | |
| ≥Aa | 0.49 | 1.97 | 0.00 | 0.00 | 0.00 | 0.00 |
| A | 0.39 | 3.32 | 0.00 | 0.00 | 0.00 | 0.00 |
| Baa | 0.57 | 0.84 | 0.00 | 0.00 | 6.13 | 0.00 |
| Financials | | | | | | |
| ≥Aa | 0.44 | 0.87 | 0.00 | 0.00 | 0.00 | 0.00 |
| A | 0.65 | 2.81 | 0.00 | 0.00 | 0.00 | 0.00 |
| Baa | 0.93 | 0.39 | 0.00 | 0.00 | 4.07 | 0.00 |
| Total Alloca. | | 100 | 100 | 100 | 100 | 100 |
| Total Return | | 0.42 | 0.26 | 0.52 | 0.54 | 1.08 |
| Outperformance | | | -0.16 | 0.10 | 0.12 | 0.66 |

*≥ in this table stands for a range of credit ratings higher or equal to Aa (from Aaa to all Aa).

As stated in section 3, for asset allocation strategies we select one of the three dimensions studied based on "perfect foresight" while keeping the portfolio neutral to the index in the other two.

Treasury yields rose in February 1997 with short Treasuries outperforming long ones for the month. As a result, our *duration allocation* strategy chose the shortest average life cell to represent each sector/quality combination. The table shows zero allocation to intermediate and long cells for the portfolio. For example, Baa-rated industrials (IND-Baa) are represented in the portfolio only by a 12.6% weight in the Short-IND-Baa cell. This weight equals the sum of index weights for Short-IND-Baa (2.76%), Inter-IND-Baa (4.96%), and Long-IND-Baa (4.92%). The return earned by the portfolio in the Short-IND-Baa cell is assumed to be equal to that of the index in the same cell (0.30). The return difference of -0.16 of this strategy relative to the index is due strictly to differences in allocation along the curve. How could "perfect foresight" have resulted in underperformance? This is due to the fact that the strategy chooses its yield curve positioning based on foresight of Treasury yields. In this particular month, however, long corporate securities outperformed the short ones even as long Treasury bonds underperformed.

In *sector allocation*, we match the index by average life and credit quality. For example, the Short-A cells in the portfolio are represented by only the financial sector. The market weight of 16.1% in the Short-FIN-A cell of the portfolio represents the sum of index weights in Short-IND-A (5.10%), Short-UTL-A (1.75%), Short-YAN-A (1.58%), and Short-FIN-A (7.64%). Note that the allocation to sectors is carried out separately for each average life/credit quality cell. Thus, while financials were chosen for the short-A cell, the long-A portion of the index is represented by the utilities sector. This is in contrast to the methodology used in duration allocation, where the choice of an average life cell is made once for all sub-categories of the corporate index and is based on "perfect foresight" of total returns in the treasury market.

Similarly, in *quality allocation* to long Yankees, we allocate 6.13% to Long-YAN-Baa. This is equal to the sum of the index weights for Long-YAN-Aa+ (1.97%), Long-YAN-A (3.32%), and Long-YAN-Baa (0.84%). In this month, it happens that the Baa quality range was selected as the best performing quality in every average life/sector cell.

In the *unrestricted allocation* strategy, all of the portfolio is assigned to the best-performing cell, the long Baa-rated utilities. By earning this cell's return of 1.08 on the entire portfolio, this strategy outperforms the index by 0.66.

## Appendix 5. Performance Summary for Asset Allocation Strategies of Different Types,

Using Different Foresight Horizons, (with Comparison to Security Selection Strategy), vs. the Lehman Brothers Eurobond Index, 2/90-9/97

| View Placed/ Horizon | Port. Avg. Ret. | Port. Avg. Dur. | Ret. Diff. vs. Index | Trac Err. vs. Index | Dur. Diff. vs. Index | S.D. of Dur. Diff. | Info Ratio |
|---|---|---|---|---|---|---|---|
| Index | 0.72 | 3.82 | | | | | |
| *Duration* | | | | | | | |
| 12-mo | 0.78 | 3.86 | 0.06 | 0.39 | 0.04 | 1.36 | 0.56 |
| 6-mo | 0.84 | 3.74 | 0.12 | 0.40 | -0.08 | 1.40 | 1.01 |
| 3-mo | 0.88 | 3.55 | 0.16 | 0.40 | -0.27 | 1.47 | 1.34 |
| 1-mo | 1.01 | 3.53 | 0.29 | 0.31 | -0.30 | 1.44 | 3.24 |
| *Sector* | | | | | | | |
| 12-mo | 0.77 | 3.87 | 0.05 | 0.09 | 0.05 | 0.26 | 1.96 |
| 6-mo | 0.77 | 3.87 | 0.05 | 0.09 | 0.04 | 0.23 | 1.86 |
| 3-mo | 0.80 | 3.84 | 0.09 | 0.10 | 0.02 | 0.31 | 3.04 |
| 1-mo | 0.85 | 3.81 | 0.14 | 0.09 | -0.01 | 0.27 | 5.43 |
| *Quality* | | | | | | | |
| 12-mo | 0.75 | 3.85 | 0.04 | 0.07 | 0.03 | 0.19 | 1.84 |
| 6-mo | 0.76 | 3.83 | 0.04 | 0.07 | 0.00 | 0.18 | 2.19 |
| 3-mo | 0.78 | 3.84 | 0.06 | 0.07 | 0.02 | 0.20 | 3.15 |
| 1-mo | 0.81 | 3.83 | 0.09 | 0.07 | 0.01 | 0.20 | 4.87 |
| *SecSel 5%* | | | | | | | |
| 12-mo | 0.94 | 4.69 | 0.22 | 0.27 | 0.86 | 0.67 | 2.80 |
| 6-mo | 0.99 | 4.37 | 0.27 | 0.28 | 0.55 | 0.73 | 3.25 |
| 3-mo | 1.10 | 4.29 | 0.38 | 0.28 | 0.46 | 0.66 | 4.67 |
| 1-mo | 1.28 | 4.23 | 0.56 | 0.28 | 0.41 | 0.69 | 6.95 |
| *SecSel 10%* | | | | | | | |
| 12-mo | 0.90 | 4.44 | 0.18 | 0.21 | 0.62 | 0.55 | 2.99 |
| 6-mo | 0.93 | 4.18 | 0.21 | 0.23 | 0.36 | 0.61 | 3.18 |
| 3-mo | 1.00 | 4.11 | 0.28 | 0.21 | 0.29 | 0.54 | 4.55 |
| 1-mo | 1.16 | 4.08 | 0.44 | 0.20 | 0.26 | 0.54 | 7.46 |
| *SecSel 90%* | | | | | | | |
| 12-mo | 0.73 | 3.69 | 0.01 | 0.06 | -0.13 | 0.13 | 0.78 |
| 6-mo | 0.73 | 3.61 | 0.01 | 0.07 | -0.21 | 0.12 | 0.60 |
| 3-mo | 0.74 | 3.58 | 0.02 | 0.08 | -0.24 | 0.11 | 1.06 |
| 1-mo | 0.76 | 3.56 | 0.04 | 0.08 | -0.27 | 0.11 | 1.54 |
| *SecSel 95%* | | | | | | | |
| 12-mo | 0.73 | 3.70 | 0.01 | 0.05 | -0.12 | 0.11 | 0.52 |
| 6-mo | 0.72 | 3.62 | 0.01 | 0.07 | -0.20 | 0.10 | 0.27 |
| 3-mo | 0.73 | 3.59 | 0.01 | 0.07 | -0.23 | 0.09 | 0.54 |
| 1-mo | 0.74 | 3.57 | 0.02 | 0.08 | -0.25 | 0.09 | 0.87 |

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