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# Value of Security Selection versus Asset Allocation in Credit Markets

*A "perfect foresight" study.*

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Fixed-income investors attempt to outperform their benchmarks by expressing views 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 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.

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 investors to define 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.

Given the nature of such a scheme, none of the investment strategies investigated here can actually be carried out. They are of interest, however, 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 portion of the article, 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 comes from the choice of securities purchased to represent each segment of the corporate bond market in the portfolio.

This study is carried out as realistically as possible, with parameters designed to limit the amount of turnover in the portfolio. The parameters of the study are modified to explore the changes in performance as the foresight becomes less-than-perfect in various ways.

Then, 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 represent 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. Therefore, it would seem logical for security purchase decisions in the perfect foresight strategy to be based on advance knowledge of the total returns of each security. One problem with this approach is that this would not allow us to differentiate among 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 half-year duration cells for this calculation, which is described in detail in Dynkin, Hyman, and Vankudre [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* is used throughout to refer to this advantage over duration-matched Treasuries. This quantity is defined for individual securities and averaged according to market weights over a portfolio. It should not 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, is referred to simply as *outperformance*.

## EVALUATING STRATEGIES: THE INFORMATION RATIO

It has long been recognized that the "best" 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.

We compare the various strategies 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. For details on how to calculate and interpret the information ratio, see Grinold and Kahn [1995] and Goodwin [1998].[1]

Grinold and Kahn state that an information 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.

The (unrealistic) strategies that we consider 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 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.

## 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: one to five years, five to ten years, and over ten years. Within each average life range, issues are divided into four sectors: industrials, utilities, finance, and Yankees. Within each cell (average life × 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 forty-eight ($3 \times 4 \times 4$) cells.

In our historical simulation, we maintain a portfolio that precisely matches the index in terms of allocations to these forty-eight 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 twelve months. (We 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 5% (or 10%) 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 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. 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 ten bonds per cell; for the 10% case, the maximum is twenty 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 basis points (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 sets of bonds *within* a given cell.

The appendix 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 is carried out using the U.S. historical index data base of Lehman Brothers. This data base includes 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) 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, and was raised to $150 million in June 1999.)

Credit quality ratings follow those by Moody's Investor Service. For bonds not rated by Moody's, ratings are obtained from Standard & Poor's Corporation or Fitch IBCA. Over the time period covered by this study, the number of bonds in this index varied between 3,000 and 5,000. The precise rules of index inclusion, as well as their evolution over time, are detailed in Berkley and Gendron [1999].

The data base provides prices, durations, and returns for each bond in each month. Besides total returns, it also gives excess returns for each corporate bond. Bonds are assigned to cells each month according to beginning-of-month duration and quality. Returns are obtained from trader pricing at the end of each month.

We carry out the study using data from January 31, 1990, through April 30, 1998. As the last available twelve-month forecast was as of April 30, 1997, the last month of performance shown is May 1997.

### Results

In Exhibit 1, we show the performance results of the security selection strategy with a twelve-month perfect foresight horizon. Comparing results for the different performance tiers of the twelve-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 per month.

By comparing the results for the top 5% and top 10% cases, we can infer 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 use to prevent excessive turnover requires a 30% improvement in expected performance to initiate a transaction swapping one bond for another. Nonetheless, we find 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.

**EXHIBIT 1**
**SECURITY SELECTION STRATEGY (TWELVE-MONTH PERFECT FORESIGHT HORIZON) — FEBRUARY 1990-MAY 1997**

| 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 (annualized) | 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 |

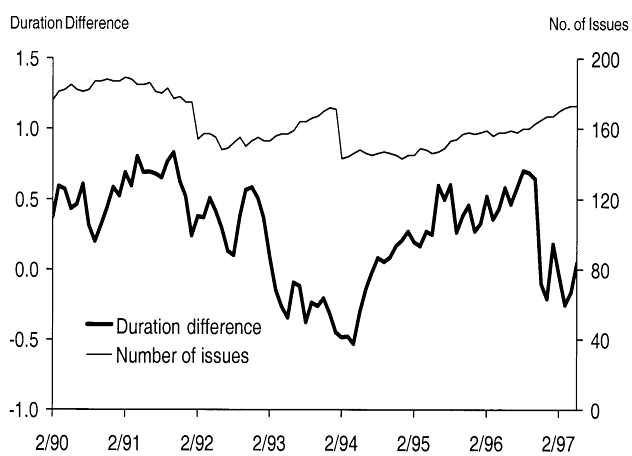
To measure the extent of this structural turnover, we carry out one simulation with an infinite turnover threshold. That is, no transactions are allowed except where required for structural reasons. The last line of Exhibit 1 shows that the turnover is reduced to 8% per month in this case.[2]

Outperformance of the index is cut roughly in half, from 0.31 to 0.16, as the portfolio is prevented from purchasing all the securities recommended by the perfect foresight strategy. Interestingly, the more stable nature of the portfolio reduces 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. Exhibit 2 illustrates the difference between the duration of the portfolio and the index for the first strategy listed in Exhibit 1.

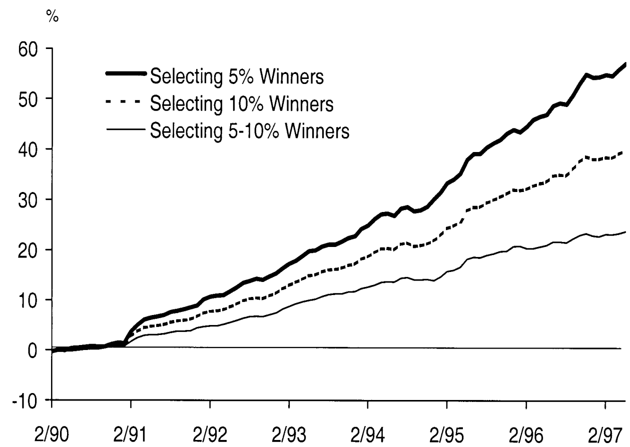
The portfolio is longer in duration than the benchmark in some months and shorter in others. Indeed, in times of spread change, the portfolio will tend to be short/long the index for this reason: Excess return approximately equals spread change times spread duration plus spread itself. In times of spread tightening, longer bonds may exhibit better excess returns. The opposite is true in times of spread widening. Later we show that this bias does not alter the conclusions.

**EXHIBIT 2**
**CHARACTERISTICS OF SECURITY SELECTION STRATEGY***




*Top 5%, twelve-month perfect foresight horizon.

**EXHIBIT 3**
**CUMULATIVE OUTPERFORMANCE OF SECURITY SELECTION STRATEGY***




*Top 5%, twelve-month perfect foresight horizon, including transaction costs.

Exhibit 2 also shows the number of bonds in the portfolio. The 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.

Exhibit 3 shows a steadily increasing performance advantage of all the security selection strategies over the index. While it is impressive, this "perfect foresight" approach does not produce returns as spectacular as expected. In fact, to our surprise, there are several months in which the strategy underperforms the index. This is illustrated by the dips in the cumulative outperformance lines in Exhibit 3.

Upon investigation, we find this is due to the discrepancy between the twelve-month forward view used to select the portfolio and the one-month horizon for performance measurement and portfolio rebalancing. 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 farther down the road.

The underlying strategy is to choose bonds whose twelve-month aggregate excess return exceeds all other similar bonds. In numerous cases, it is observed that bonds added to the portfolio due to foreseen large future excess returns do 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 twelve-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 on the basis of the best-performing bonds over the following month. We thus include some cases based on a one-month forecast horizon as well. The results are shown in Exhibit 4.

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.

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 test the strategy at the 90% and 95% levels. In this way, the portfolio is composed of all 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 for picking winners using the same foresight horizon, it is still high enough (over 5) to justify investors allocating a portion of their research budget to avoiding losers.

The last line of Exhibit 4 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 is particularly severe. When turnover is unconstrained, this strategy has an average turnover of 88% per month, and outperforms the index by 89 bp per month to achieve an information ratio of 7.59.

If turnover is suppressed entirely except when bonds change cells, the turnover rate is cut to 8%; outperformance goes down to 8 bp per 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 Exhibits 1 and 4. Although the one-month forecast horizon is a better information

**EXHIBIT 4**
**SECURITY SELECTION STRATEGY (ONE-MONTH PERFECT FORESIGHT HORIZON) — FEBRUARY 1990-MAY 1997**

| 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 (annualized) | 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 |

source (as evidenced by the higher returns and information ratios in the unconstrained case), the structural turnover case performs better for the twelve-month forecast horizon. Not only does it achieve a higher information ratio, but the average return is also 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 according to which bond performs best over the coming month, but according to performance over the longer term. (The twelve-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 twelve months, making the average holding period of each security approximately twelve months.)

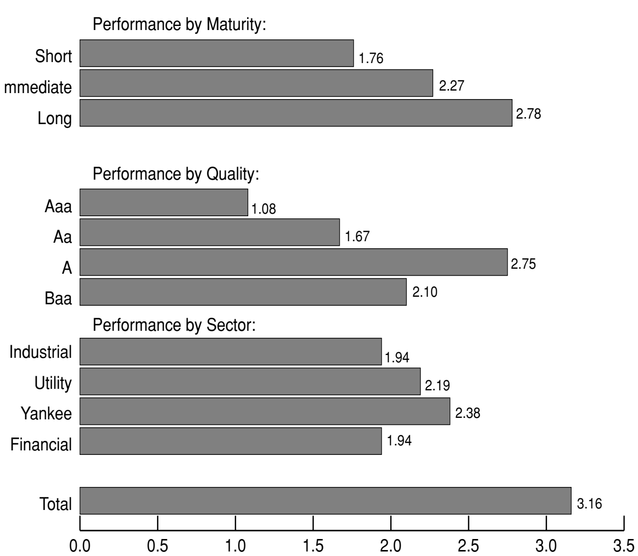
The conclusion is that the forecast horizon used for decision purposes should correspond to the average holding period for securities in the portfolio. If a portfolio is turned over almost entirely every month, then a one-month forecast is ideal. If constraints require a longer holding period, then the 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

Exhibit 5 shows the performance of the security selection strategy as applied to specific subsectors of the corporate bond market.[3] If we divide the market into three cells by maturity, and separately apply the 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.

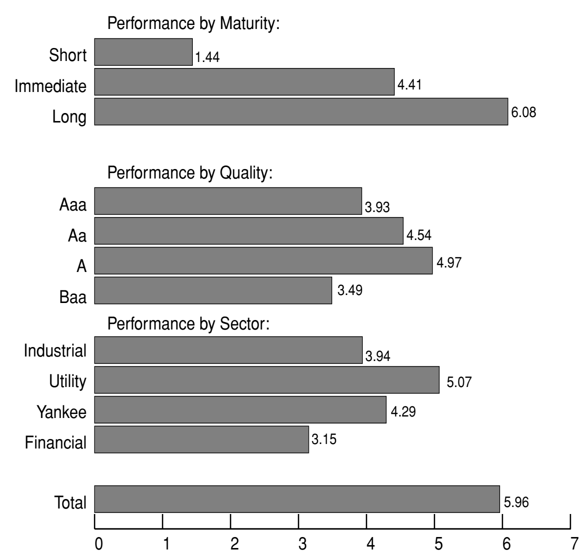
If we break the index down by quality, we find that the single-A range has the highest information ratio (2.75), and that security selection seems to be much less important in the AAA range. The sector breakdown shows that the strategy does best within the Yankee sector. This is perhaps due to the fact that the Yankee sector is more diverse than the other groupings, making security selection more important.

**EXHIBIT 5**
**INFORMATION RATIOS FOR "PICKING WINNERS" SECURITY SELECTION STRATEGY***




*Segments of Lehman Brothers Corporate Bond Index. Twelve-month foresight horizon, one-month holding period, top 5% of securities, 30% turnover threshold, transaction costs included.

**EXHIBIT 6**
**INFORMATION RATIOS FOR "AVOIDING LOSERS" SECURITY SELECTION STRATEGY***




*Segments of Lehman Brothers Corporate Bond Index. One-month foresight horizon, one-month holding period, top 90% of securities, no turnover threshold, no transaction costs.

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 subsectors. 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.

Exhibit 6 differentiates performance by subcategory 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 from that shown in Exhibit 5, the same broad conclusions can be drawn. When applied to subcategories of the corporate index, the strategy works best for long maturities, single-A qualities, and utility followed by Yankee sectors.

## PORTFOLIO ALLOCATION BY DURATION, SECTOR, AND QUALITY

To apply the perfect foresight methodology to the yield curve, sector, and quality allocation decisions for a U.S. corporate bond portfolio, we manage a portfolio 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 subsegments that constitute the 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 subsegments of the bond universe. These portfolio allocations are revised monthly.

Because of 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, the corporate bond universe is divided into three-dimensional cells by average life (one to five years, five to ten years, and over ten years), sector (industrials, utilities, finance, and Yankees), and quality (Aaa-Aa, A, and Baa), for a total of thirty-six cells ($3 \times 4 \times 3$). This cell structure is identical to that used in the security selection study, except that the Aaa and Aa quality ranges are merged for technical reasons.[4]

Two types of allocation strategies are considered. 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 the first 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 is constructed to exactly match the index in terms of allocations to this grid.

Each 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 subgroups to represent the 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.)

We take a similar approach to quality allocation. Within each average life-sector cell, the portfolio is represented by the single quality range that 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. Each sector-quality cell is divided into three 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 that chooses only bonds from a single yield curve segment, but matches the sector-quality distribution of the index as a whole.

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 the sector and quality allocation schemes, we want to be sure that the allocation is not influenced by any knowledge of future yield curve movement. Therefore, we base the decisions on knowledge of the excess returns over duration-neutral Treasuries, as we do 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

In two additional allocation strategies, we remove all 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 thirty-six 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 try a variation of the yield curve allocation strategy, in which we divide the yield curve into finer subdivisions, but match neither index sector nor quality distribution. We divide the index into ten 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

Exhibit 7 summarizes the performance results for all the allocation strategies and compares them to corresponding security selection strategies considered earlier (detailed results are in Exhibit 8).

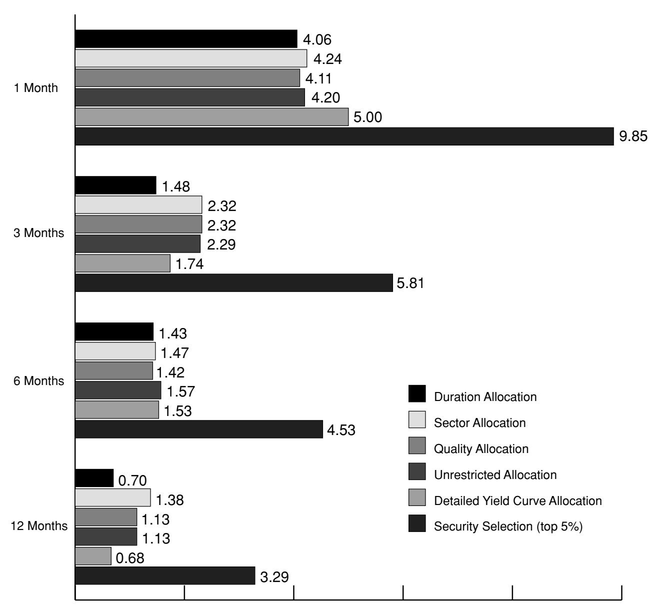
Yield curve allocation foresight gives the highest return advantage over the index as compared to other allocation decisions. But this outperformance comes at the expense of large risk exposures. This can be seen both in the tracking errors and in the standard deviation of duration differences.

Due to the perfect foresight assumed, most of the volatility of the return difference (i.e., the tracking error) is volatility of outperformance. In fact, in the one-month horizon case, the portfolio outperforms the index every month. Yet the high 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 the 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.

**EXHIBIT 7**
**INFORMATION RATIOS FOR VARIOUS ASSET ALLOCATION STRATEGIES VERSUS CORPORATE INDEX***




*Using different foresight horizons (with comparison to security selection strategy) February 1990-May 1997.

**EXHIBIT 8**
**PERFORMANCE SUMMARY FOR VARIOUS ASSET ALLOCATION STRATEGIES VERSUS LEHMAN BROTHERS CORPORATE BOND INDEX — FEBRUARY 1990-MAY 1997**

| View Placed | Horizon | Portfolio Average Return | Duration | Ret. Diff vs. Index | Trac Error vs. Index | Dur. Diff vs. Index | S.D. 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 Yield Curve | 12-mo. | 0.92 | 6.49 | 0.16 | 0.83 | 1.11 | 3.07 | 0.68 |
| | 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 |

Combining yield curve foresight with sector and quality foresight significantly improves outperformance and achieves the highest returns of all strategies considered. This unbalanced strategy takes significant risks in all dimensions, however. The resulting high 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. These gains are again 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.

Note in Exhibit 8 that 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 strategy and 4.24 for the sector-based allocation strategy.

For any of these strategies, as we have already noted, 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 according to a twelve-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. Rebalancing monthly based on a one-month foresight is truly "perfect."

Yet 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. If we step back to a twelve-month forecast horizon, however, the information ratio for sector allocation (1.38) is roughly double those of the 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.

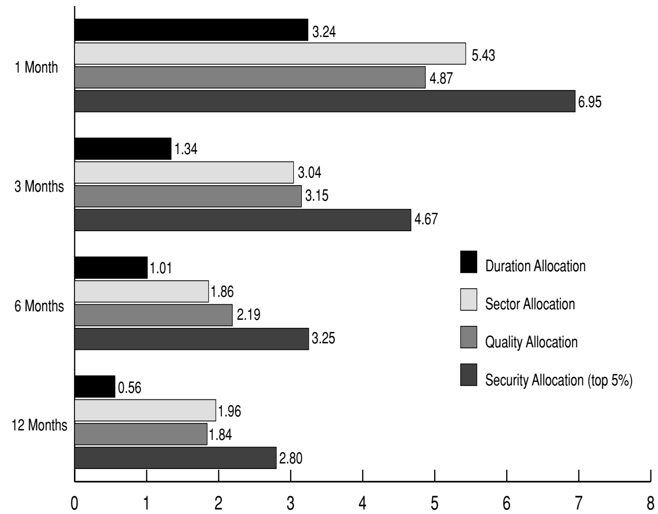
## EXTENSION TO OTHER ASSET CLASSES AND TIME PERIODS

### Eurobonds

Investors may want 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 applied the same methodology to an additional market to see if similar results are obtained. For this purpose, we select the dollar-denominated Eurobond market.

Because of the nature of the Eurobond market, we divide the index into only two buckets in terms of average life (one to three years and over three years), but we define six sectors (U.S. agencies, industrials,

**EXHIBIT 9**
**INFORMATION RATIOS FOR VARIOUS ASSET ALLOCATION STRATEGIES VERSUS EUROBOND INDEX***




*Using different foresight horizons (with comparison to security selection strategy) February 1990-September 1997.

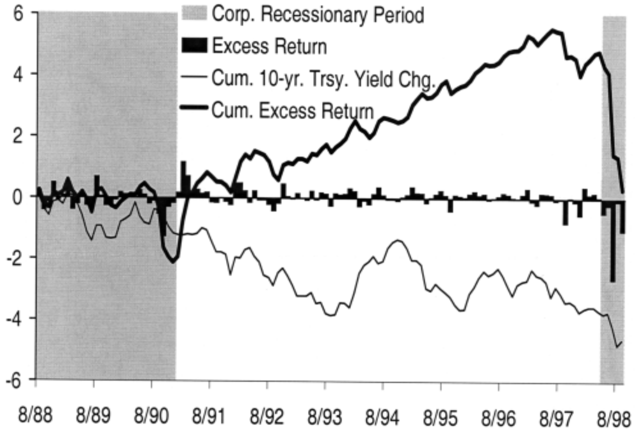
finance, sovereigns, supranationals, and other) and three quality ranges (Aaa, Aa, and A and below). The results of the various strategies for this investment universe are shown in Exhibit 9.

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, although the information ratios are much lower than those in the corporate index study.

Let's compare, for instance, the information ratios achieved by the avoiding losers strategies with one-month foresight horizons. 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.

The lower information ratios can be explained by looking at the performance breakdown of the corporate index results, in Exhibits 5 and 6. The majority of the Eurobond index has an average life of less than five years (64%) and is rated Aaa (50%), with the

**EXHIBIT 10**
**CHOICE OF A RECESSIONARY PERIOD***




*Measured by excess return of Lehman Brothers Corporate Index.

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 Exhibits 5 and 6. 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**

To demonstrate that this methodology and the conclusions drawn from the results are relatively stable and do not depend on the market environment, we repeat 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 select 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 Exhibit 10.

The detailed results for the recessionary period are shown in Exhibit 11. Comparing this with Exhibit 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. In the recessionary period, sector allocation more clearly outperforms quality allocation, when measured either by information ratios or by absolute outperformance of the index. This seems to imply that sector selection provides a more significant and consistent method for outperformance than selection of credit qualities.

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 our first examples), 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 the strategy's performance is a systematic extension of spread duration to pick up spread contraction, this strategy should backfire during a recession period. We should expect that during a recession there will either be less bias toward extending duration, or that such a bias, if present, is not successful.

Exhibit 12, however, shows that the strategy continues to exhibit a bias toward longer durations even during a recessionary period, and nonetheless continues to perform well. For instance, the top 5% security selection strategy, with a one-month forecast horizon, achieves an information ratio of 9.85 during an extended rally, as shown in Exhibit 8, with average duration longer than the index by 0.10. During the recessionary period shown in Exhibit 11, the strategy's duration is longer than the index by 0.49, and the information ratio is 10.56. This shows that a systematic overexposure to spread duration cannot be a main contributor to the outperformance achieved by security selection.

We can see that the avoiding losers strategies (top 90% and top 95%) show unexpectedly large deviations from index duration during the recessionary period of Exhibit 11. Upon investigation, we find that

**EXHIBIT 11**
**PERFORMANCE SUMMARY FOR VARIOUS ASSET ALLOCATION STRATEGIES FOR RECESSIONARY PERIOD***

| View Placed/ Horizon | Portfolio Average Return | Portfolio Average Duration | Return Diff. vs. Index | Tracking Error vs. Index | Duration Diff. vs. Index | Std. Dev. of Duration Diff. | Information 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 |

*Using different foresight horizons (with comparison to security selection strategy), versus the Lehman Brothers Corporate Index for September 1988-January 1991.

**EXHIBIT 12**
**PERFORMANCE SUMMARY FOR TOP 90% AND 95% MARKET VALUE-WEIGHTED STRATEGIES — FEBRUARY 1990-MAY 1997 AND SEPTEMBER 1988-JANUARY 1991**

| View Placed/ Horizon | Portfolio Average Return | Portfolio Average Duration | Return Diff. vs. Index | Tracking Error vs. Index | Duration Diff. vs. Index | S.D. of Duration Diff. | Information Ratio |
|---|---|---|---|---|---|---|---|
| February 1990-May 1997 | | | | | | | |
| 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 |
| September 1988-January 1991 | | | | | | | |
| 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 |

this discrepancy occurs only because we equally weight each bond in a cell. Thus, even if we choose 100% of the bonds in each cell, the portfolio would not exactly match the index.

To eliminate the effect of the duration deviation, we therefore repeat the historical simulation using the same 90% and 95% strategies, but weighting the bonds in a cell by their market value.[5] Exhibit 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 match 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.

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

## DISCUSSION

We can draw 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 greatest 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

**EXHIBIT 13**
**INFORMATION RATIOS FOR VARIOUS "PERFECT FORESIGHT" STRATEGIES — FEBRUARY 1990-MAY 1997**

| | | Pure | | | | Security Selection | | | |
|---|---|---|---|---|---|---|---|---|---|
| Horizon | Ind. | Duration | Sector | Quality | Duration | 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 |

**EXHIBIT 14**
**SHARPE RATIOS FOR VARIOUS "PERFECT FORESIGHT" STRATEGIES — FEBRUARY 1990-MAY 1997**

| | | Pure | | | | Security Selection | | | |
|---|---|---|---|---|---|---|---|---|---|
| Horizon | Ind. | Duration | Sector | Quality | Duration | 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 |

selection within the categories. The security selection strategies are most efficient for longer-maturity bonds as well as lower-rated classes.

As to 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.

These 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 use the top-down approach to portfolio management. The key here, however, is that we evaluate various strategies on the basis of 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 known as the Sharpe ratio. Exhibits 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).[6]

Exhibit 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 strategies 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 Exhibit 14 appear to be much more efficient in comparison to security selection strategies than they do in Exhibit 13. It is important to remember, however, that the information ratio is a more appropriate measure of risk-adjusted performance for benchmarked portfolios.

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 performance that can realistically be achieved. It would be interesting to investigate an "imperfect foresight" assumption, in which the algorithm sometimes randomly makes a wrong decision. The effectiveness of research can then be modeled according to the relative probabilities of the selected view being right or wrong.

**APPENDIX**
**ILLUSTRATION OF "TOP 5%" SECURITY SELECTION STRATEGY WITH A ONE-MONTH FORESIGHT HORIZON FOR FEBRUARY 1997***

| Term | Sector | Quality | Index No. of Sec. | Index Market Weight (%) | Index Total Return | Index Cntrb to Tot Ret | Portfolio No. of Sec. | Portfolio Market Weight (%) | Portfolio Total Return | Portfolio Cntrb to Tot Ret | Diff Cntrb to Tot Ret |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Short | | | | | | | | | | | |
| | Industrials | 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 |
| | Yankees | 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 | | | | | | | | | | | |
| | Industrials | 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 |
| | Yankees | 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 | | | | | | | | | | | |
| | Industrials | 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 |
| | Yankees | 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 | | | 3,698 | 100.00 | | 0.42 | 174 | 100.00 | | 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.

## ENDNOTES

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[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.

[2]"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.

[3]More detailed results for this strategy and others are available from the authors upon request.

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

[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. A real 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.

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

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

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

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