CHAPTER 43

Bond Portfolio Strategies for Outperforming a Benchmark

BÜLENT BAYGÜN, PhD
Head of Global Quantitative Strategy, Barclays Capital

ROBERT TZUCKER
Inflation Trading, Barclays Capital

Abstract: The performance of a fund is typically assessed relative to some benchmark market index. In order to make this a meaningful comparison, the benchmark should be selected carefully with due consideration given to several factors, such as relevance to the fund's investment goals. Once an appropriate benchmark has been identified, either among the generic offerings from index providers or through a customized index creation process, the objective is to beat the benchmark. Outperformance in a bond portfolio is effected through a combination of fixed income asset class preferences, as well as duration and curve positioning choices, relative to the composition of the benchmark. These choices are typically driven by a top-down approach, starting with views on the economy and the projected change in asset valuations. Surely, when considering measures of performance relative to the benchmark, return is but one aspect, the other being the risk taken to achieve the return. Effective portfolio management requires a framework that allows one to quantify risk versus return, and balance one against the other subject to the investment guidelines of the fund.

Keywords: optimization, benchmark selection, alpha generation, portfolio management, tactical asset allocation, strategic asset allocation, scenario analysis

Increasingly, fund managers and more importantly chief investment officers are looking to measure the performance of portfolios and portfolio managers in an objective fashion. We believe that the best way to approach the problem is to adopt a "beat the benchmark" approach. The first question that this approach raises is: "What is an appropriate benchmark?" We address this in this chapter where we discuss six widely recognized academic principles of a good index and also look at a quantitative technique to achieve this goal. A good index should be:

- Relevant to the investor
- Representative of the market
- Transparent in rules with consistent constituents
- Investible and replicable
- Based on high data quality
- Independent

The second question that we address in this chapter follows naturally from the first, which is: "How does one beat a benchmark?" There are countless strategies that can be employed to outperform a benchmark. In this chapter we focus on balancing the risk versus return in a portfolio by employing a constrained optimization decision framework. This strategy involves taking views on:

- Forward interest rates
- Economic scenarios
- Yield curve
- Asset allocation
- Duration
- Risk tolerance
- Issue selection
- Spread relationships

SELECTING THE BENCHMARK INDEX

Selecting a benchmark by which to measure performance can be as important as the individual investment decisions themselves. The benchmark index is the basis against which all allocation decisions are made, including duration and curve positioning among others. Not only is the index used as a way to evaluate the relative performance of the manager, but it should be considered the best "passive" way to achieve the goals of the fund. If an inappropriate benchmark is selected relative to the goals of the fund, the manager may perform well against the index but fall short of the desired level of return of the fund. We discuss examples of this later in the chapter.

In the current environment there are myriad index providers, each with a different set of qualifying criteria defining the market. Selecting the appropriate index depends upon the needs of the fund. There are some widely recognized academic principles of what constitutes a good index. The major ones are discussed in the following sections. Later in the chapter, we discuss the pros and cons of defining a custom index and methods to accomplish that task while applying the principles given below.

Principle 1: Relevance to the Investor

Any index chosen as a benchmark must be a relevant investment for the investor. One of the most common examples of relevance is the quest to avoid a "natural concentration" between the business risk of the sponsoring entity and the invested portfolio. For example, a defense contractor would seek to benchmark its pension fund to an index with a low concentration of defense-related businesses. For this purpose many investors use custom indices, excluding specific industries that cause natural concentration, while creating a benchmark. Another example that continues to gain traction is the choosing of an appropriate benchmark for a pension fund. In order to reduce volatility in its funding gap (or limit the possibility of creating a large funding gap), a pension fund manager may wish to use a portfolio of liabilities as a benchmark. The characteristics of the portfolio should closely resemble those of the actual pension fund liabilities. If, for example, the pension fund benchmarks to an index with too short of a duration (pension liabilities typically have very long durations), a move lower in rates could adversely affect its funding gap, even if the fund happens to outperform the index.

Principle 2: Representative of the Market

A good benchmark should provide an accurate picture of the market it claims to represent. For example, if in a market most of the issues of a particular rating or industry sector are below the index size threshold, the performance of the index will be very different from the performance of the market. Hence two indices, with different minimum thresholds, could exhibit vastly different industry and/or ratings distribution and consequently a vastly different risk/return profile.

Principle 3: Transparent Rules and Consistent Constituents

One of the definitions of a bond index is that it is a rules-based collection of bonds. It is, therefore, imperative that the rules defining the index are transparent and are applied objectively and in a consistent fashion. It is often tempting to bend the rules to accommodate particular market situations such as avoiding undue concentrations of a particular issuer or industry. For example, the downgrade of KPN in September 2001 left it teetering on the edge of the investment-grade threshold. This raised concerns among some high-yield fund managers that KPN would account for over a quarter of the euro high-yield universe were it to make the transition into high yield. These investors sought changes in the index in the form of sector and issuer caps to address this particular situation. If such caps are implemented, they violate the principles that define a good index.

The treatment of unrated paper for investment-grade indices falls under this category. Many index providers include unrated paper in investment grade indices on the premise that if these instruments were to be rated they would end up in the investment grade. The other area where many index providers often vary from each other is the treatment of split-rated bonds, both for the rating tier they represent, as well as to determine whether they form part of the investment grade universe or not.

Principle 4: Investible and Replicable

An investor should be able to replicate the index and its performance with a small number of instruments as well as with relatively low transaction costs and without moving the market too much. For this reason the index constituents should be a set of bonds that have standard features, are liquid and trade actively in the secondary market. The ability to invest in the index through derivative instruments such as futures and total return swaps is an added attraction of an index.

Indices with higher threshold levels typically contain fewer illiquid instruments and are thus easy to replicate for obvious reasons, and very often easy to beat as well. The reason for the latter is explained by the presence of a liquidity premium. Everything else being the same, bonds which are more liquid tend to trade at tighter levels than bonds which are less liquid, and the difference is known as the "liquidity premium." Indices that have more liquid bonds have lower yields than those with less liquid bonds, and consequently generate lower returns, which in turn implies that they are easier to outperform.

Principle 5: High-Quality Data

It goes without saying that an index is only as good as the data—both prices and static information—that is used to calculate it. Even a well-constituted and well-calculated index is unlikely to represent the moves of the market if it uses distorted prices. Unlike the equity market, where price transparency is high, there have historically been major impediments for getting true market prices for bonds and other over-the-counter (OTC) instruments. Most bond indices are proprietary indices that use in-house pricing, and are hence highly susceptible to be distorted by the presence/absence of long/short positions on the trading book. Often, bonds where the trader has no position are not marked actively and reflect an indicative price and, for that reason, produce erroneous results for return and other calculations. To avoid these pitfalls it is therefore important to ensure that index pricing is from an accurate and reliable source.

Principle 6: Independence

One of the reasons equity indices are so popular is that the prices used to calculate them are from an independent and a quasi-regulatory source. Independent indices also make index and bond-level data available from multiple sources. This encourages the development of after-index products including derivatives, as there are multiple dealers active in the market and the resulting competition is good for all participants.

As many market participants observe, the above-mentioned principles are not entirely compatible, and thus create the need to strike the right balance. For example, in the quest to be representative of the market one could sacrifice liquidity of the instruments constituting the index. However, when striking the balance, one has to consider that for an index to be used as a benchmark, the ability to buy the constituent instruments is paramount. Therefore, we argue that principle 4 is more important than principle 2.

CREATING A CUSTOM INDEX

It may be that there are no indices currently constructed that meet the exact needs of the investor. In this case, constructing an index from scratch or combining multiple indices may very well be worth the time and effort in order to determine the appropriate benchmark. There are several methods that can be employed to create the benchmark index. We will discuss creating a rules-based index as well as using mean-variance frontier analysis to create the appropriate asset class mix within the index.

Rules-Based Indices

For this exercise we take a look at an actual index, the rules used to create the index, and how the index can be customized to better suit individual managers. We start by examining the Barclays Capital Global Inflation-Linked Bond Index. This index is a market value–weighted index that tracks the performance of inflation-linked bonds meeting specific credit and issue specific criteria. In the next sections, we look at some of the individual rules governing this index and describe the relevance of each to the above mentioned principles. These rules are reasonably common in creating indices and can be applied in many situations.

Market Type

In this index, the debt must be domestic government only, meaning that it must be issued by a government in the currency of that country. This rule pertains to principles 2, 3, and 4 above in that it is a clear description of the type of debt allowed (principle 3), representative of the market of inflation-linked debt (principle 2), and can be invested in easily through cash or total return swaps (principle 4).

Inflation Index

The inflation index of each issue must be a commonly used domestic inflation measure. For example, in the United States, not seasonally adjusted CPI would be an acceptable index. This rule eliminates the risk of having a bond that uses a suspect means of indexing, following principle 3, increasing transparency.

Rating

The rule for this index requires the foreign currency debt rating of the country to be AA–/Aa3 or better to be included in the index (S&P or Moody's, whichever is lower). This would exclude certain sovereign debt such as Greece, which meets the first two index rules, but has only a single-A rating. The Barclays Global Inflation-Linked Index is designed to have only high-grade sovereign issuance and, therefore, excludes higher-risk sovereigns.

Aggregate Face Value

The aggregate face value of any particular debt issue meeting the other rules must be at least worth $1 billion. In order to create stability and keep bonds from entering and leaving the index frequently, a rule can be imposed that if the bond falls below 90% of that lower limit it will be removed. This prevents bonds from arbitrarily dropping out due to routine currency fluctuations. Rules of this nature are typically devised under principle 4 to reduce transaction costs and increase the replicability of the index.

Percentage of Index

Issues meeting all the previous criteria will be included in the index based on their market value weight in U.S. dollars at the rebalancing date (typically, the last day of the month). This market value weighting scheme is very popular among indexers for various reasons. First, it is easy to replicate. Second, typically relative market size will also determine relative liquidity. As a result, a smaller market has smaller weights; so, to replicate the index, a manager does not have as much problem sourcing the issues, which keeps costs lower. Although it is a useful rule, it may be problematic with principle 1, as the construction using market weights may not be an optimal benchmark for an active manager. We explore this issue further in the next section.

Perhaps a manager has a global inflation-linked mandate but is not permitted to invest in issues that have longer than 10 years to maturity. Using the Global Inflation-Linked Index as a benchmark would violate principle 1 discussed previously due to the irrelevance of the index. It would be unfair to evaluate a manager's performance relative to this benchmark because in the case of a rally, the longer bonds would likely outperform and the portfolio would unfairly be penalized. Likewise, a sell-off would favor the portfolio as longer duration assets underperformed. Instead, a rule can be created to bucket the index into maturities of less than 10 years and maturities of greater than 10 years. Now, the manager can be benchmarked more appropriately and performance more accurately measured. This is a relatively simple example of how rules-based index creation can be used to customize an index, so we will move on to more complicated problems next.

Using Mean/Variance Analysis to Customize an Index

Portfolio theory can play an important role in setting a benchmark for measuring performance. Traditionally, managers use efficient frontiers as a way of determining the most appropriate allocation of assets given either certain return targets or risk limits. Because historical data can only yield one efficient frontier with multiple efficient portfolios, by defining risk limits or targeted returns, the efficient portfolio can be used as a passive benchmark against which to perform tactical asset allocation. Rather than benchmarking against an index that uses arbitrary weighting based on the market value of the constituents, this method allows a manager to make decisions versus a historically efficient allocation, perhaps improving the decision making process. A custom index can also be useful when trying to optimize allocation in concert with the core operations of a business. For example, a bank with a core loan portfolio that would like to use its excess capital to generate returns to supplement their income may need to include that loan portfolio as an asset in the mean/variance analysis construct the most appropriate benchmark.

Setting Up the Problem

In order to create a custom index using mean/variance analysis, certain restrictions will have to be placed on the amount of the index that can consist of a given asset. This prevents, for example, U.S. agency bonds from becoming such a big part of the index that it is impossible to replicate in any size. If so desired, constraints on the size of the assets can also keep at least a nominal allocation to assets that may disappear from the solution if not otherwise constrained. Using minimum inclusion constraints makes sense to a manager that has a mandate to diversify into a certain asset or number of assets to some degree. Once the constraints have been determined, the efficient frontier can be solved using iterative solving software.

Several decisions have to be made before performing the mean variance analysis. First, and arguably most important, the asset classes need to be chosen. In this example, we take the view of a fixed income portfolio manager that is mandated to invest in a combination of non-callable U.S. agency bonds (Fannie Mae, Freddie Mac, Federal Home Loan Bank, etc.), TIPS (Treasury inflation securities), and U.S. Treasuries. Because there are few indices that describe this universe, creating a custom index may provide the best alternative in this case.

The next step is to determine the constraints that should be imposed on the asset classes to make certain that the index meets the investible and replicable criteria from the previously described rules. The most straightforward way to determine appropriate maximum weights for each asset class is to look at the securities' weight as a proportion of the total weight of all of the asset classes and make a judgment as to a realistic percentage that could be invested based on the size of assets under management. For this exercise, we assume we have $5 billion under management. Comparing this number to the size of each of the classes of assets we are using looks very small. Table 43.1 shows the relative sizes of our investible asset classes. It is immediately clear that our $5 billion under management is dwarfed by the size of securities outstanding, so we are not necessarily constrained by size. However, for the sake

Table 43.1 Gauging the Size of the Market

Asset Class	Market Value Outstanding ($ billion)	Percentage of Total
U.S. Treasuries (>1 year to maturity)	2,000	66%
TIPS	320	11%
U.S. agency noncallable	690	23%

Source: Barclays Capital, *The Yieldbook*.

of prudence, our index should not consist entirely of one asset, so we will limit the analysis to use no more than 80% of any asset.

Finally, we set up the problem statement so that we can solve for the most efficient index allocation. To accomplish our goal, we perform a constrained optimization by minimizing the variance (risk) of the portfolio for different levels of returns (Markowitz model). The problem we are trying to solve is:

Minimize:

$$w_T C w$$

Subject to:

$w^T \mu = \mu_P$
$w_i \quad \leq 0.8$
$\Sigma w_i = 1$ for all i
$w_i \quad > 0$

where:

$w \ =$ asset weight vector
$C \ =$ covariance matrix
$\mu \ =$ expected return vector
$\mu_P =$ targeted expected return

The next step is to solve the problem. If a desired return target or a desired risk level is known, the problem can be solved for just one desired return level. If the desired level of return or risk is unknown, the frontier can be created and an efficient mix chosen after evaluating the different portfolio constructions. One thing to remember is that the portfolio return cannot be higher than the highest returning asset as long as no short positions are allowed, which is an assumption we are making, nor can it be lower than the lowest returning asset. To keep things simple and illustrate the point, we have decided to use the minimum risk portfolio as the benchmark. Figure 43.1 shows the efficient frontier as well as the market value–weighted index on a historical risk/return basis. It is obvious that the market value–weighted index is less than efficient, falling far below the frontier. The minimum risk portfolio gives us an advantage on expected return and expected risk.

The minimum risk portfolio consists of 26% Treasuries, 54% agencies, and 20% TIPS. This contrasts starkly from the market value–weighted index which consisted mostly of Treasury debt. One clear advantage of using this new benchmark is that if we choose to have no tactical views and purely match the benchmark, the expected performance of our portfolio is much better than with a market value weighted index. Another advantage is that the additive value of tactical asset allocation choice can clearly be measured in terms of additional return or reduced risk versus the frontier, which takes into account much more information than a market value weighted index when constructed. An investor using this technique can develop a custom benchmark for almost any purpose—whether it is to balance risk with the core business or to assist in asset liability management—and generate a meaningful investment hurdle with which to measure performance.

BEATING THE BENCHMARK INDEX

Once the index is selected, the next step is to manage the portfolio around that index while trying to outperform it—or *generate "alpha"* The starting point in a typical investment strategy is a core view on the economy (GDP growth, inflation expectations, consumer behavior, employment picture, etc.), which forms the basis of calls on asset prices going forward. For instance, in an environment where employment is rising, inflationary pressures are building, and there is a general surge in asset valuations, the Fed is likely to react by hiking rates, which in turn should give rise to higher rates and a flattening along the entire yield curve. Under these assumptions one could surmise, based on historical relationships, that high-quality asset spreads to Treasuries should widen. Therefore, a portfolio that is structured for this scenario (our

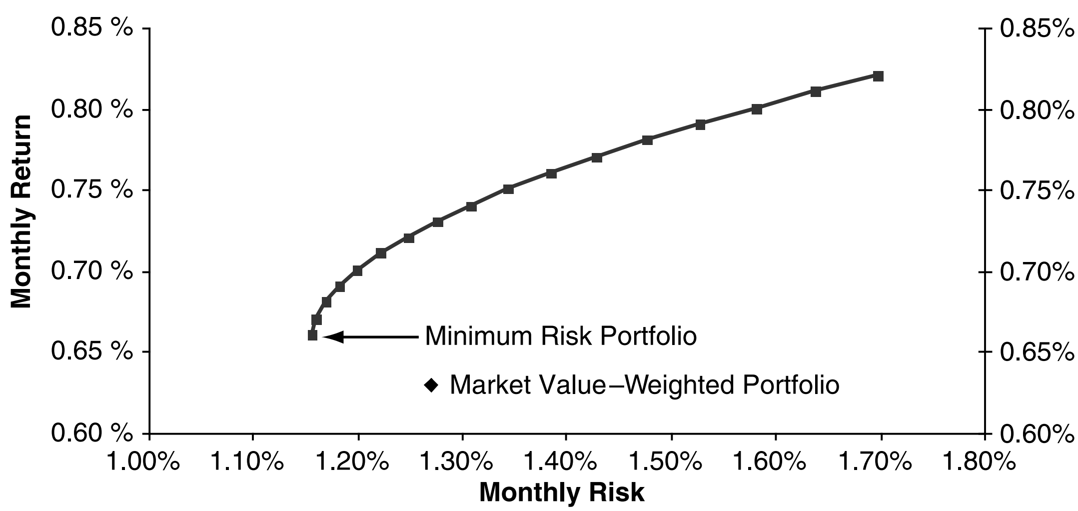

Figure 43.1 Efficient Frontier and the Minimum Risk Portfolio
Source: Barclays Capital, *The Yieldbook*.

Table 43.2 Three-Month Treasury Forecasts for Different Scenarios

	Yield Levels (%)	Yield Changes (bps)				
	Current on 6/21/05	Base Case	Stable Inflation	High Inflation	Growth Slowdown	Forwards
2 yr	3.70	35	10	55	−10	10
5 yr	3.84	36	1	71	−19	7
10 yr	4.06	29	−16	74	−31	4
30 yr	4.34	21	−24	76	−34	2

Source: Barclays Capital.

"base case") likely would have a short duration bias relative to the index, have curve flattening exposure, and be underweight spread products.

So far the above approach has taken into account only one dimension of investment decisions, namely return. Before executing the strategy, we would want to assess the risks to the portfolio should the markets behave differently than what is depicted in the base case scenario. Typically, that involves stress-testing the portfolio under alternative (risk) scenarios. In other words, one would shock the curve and spreads in different ways and monitor the performance of the portfolio. If performance fell short of the risk guidelines, then one would go back and fix the portfolio in such a way to mitigate the problem—more often than not using ad-hoc techniques—and then run the stress test on the revised portfolio. This process would be repeated until desirable risk characteristics are obtained. As an alternative to this iterative process, one could adopt a more formal quantitative framework that aims to optimize some performance criterion, incorporating the base case as well as the risk scenarios at the same time. That is the approach we will describe below, as we have found it to be a very effective way to make informed investment decisions.

Choosing Scenarios for the Optimization

The forwards should play a central role in the selection of the scenarios. This is a very subtle but important point that may be easily overlooked. Let us explain with some examples: If all the scenarios considered had rates higher than the forwards, the resulting optimal portfolio would undoubtedly have a short duration bias. Similarly, if all the scenarios gave rise to, say, flatter curves than the forwards, then one would end up with flattener positions in the portfolio. That is because in this framework risk assessment is limited to the scenarios under consideration. When all the scenarios are stacked on one side of the forwards it is tantamount to saying "there is no risk of rates being lower (or the curve being steeper) than the forwards." As a result, it would appear as if a portfolio that is short duration (or is fully loaded in flatteners) does not have any potential downside risk—the very characteristic of being optimal. However, it is clear that the portfolios constructed using these lopsided scenarios do not capture the risks in a realistic manner. The same is true when selecting the spread and breakeven scenarios for a portfolio that involves agencies and TIPS.

With this in mind, we consider four scenarios that bracket the current forwards. (All pricing is as of June 21, 2005.) We will not provide a description of the economic backdrop for each one of the scenarios, but suffice it to say that each one depicts significantly different economic conditions giving rise to a broad range of rate and spread changes for the third quarter of 2005 (see Tables 43.2, through 43.5). In particular, there are two bearish and two bullish scenarios. In terms of curve movements, two of the scenarios depict a flattening of the curve across all maturities (vis à vis the forwards), while one subsumes a steepening, and another one has steepeners in the front-end and flatteners from the five-year on out. Similarly, swap spreads to Treasuries and Agency/ London Interbank Offered Rate (LIBOR) spreads, as well as TIPS breakevens encompass enough variety across the breadth of the scenarios.

Choosing the Optimization Criterion

Now that the scenarios are defined, the next step is to define the criterion for *optimization*. The parameters to optimize over are the market value weights of the issues in the universe of eligible securities. Popular choices for the optimization criterion include the following:

- *Maximize expected return*. This approach requires assigning (subjective) probabilities to the various scenarios. This approach has the advantage of being intuitive: most people already have some sense of what scenarios are more likely than others, and like to be able to impose

Table 43.3 Three-Month Swap Spread Forecasts (bps) for Different Scenarios

	Current	Base Case	Stable Inflation	High Inflation	Growth Slowdown
2 yr	35	34	32	42	30
5 yr	40	42	37	47	34
10 yr	40	42	37	48	34
30 yr	42	43	38	50	34

Source: Barclays Capital.

Table 43.4 Three-Month Agency-LIBOR Spread Forecasts (bps) for Different Scenarios

	Current	Base Case	Stable Inflation	High Inflation	Growth Slowdown
2 yr	−18	−20	−18	−22	−16
5 yr	−19	−20	−19	−23	−17
10 yr	−7	−9	−4	−12	−3
30 yr	−4	−6	−2	−9	0

Source: Barclays Capital.

those biases in the way they run their portfolio. Furthermore, it is easy to see the connection between the structure of the portfolio and the probabilities. The disadvantage is that because the criterion is based on average performance across the scenarios, one could not be assured of risks staying below allowable limits in specific scenarios unless there are additional explicit constraints. Another potential downside is that guessing some sensible probabilities adds another layer of subjectivity to what is already a rather subjective process—that is, the choice of a set of scenarios.

- *Maximize return under a specific scenario*. This is a very effective criterion when one has a strong conviction about a certain scenario. The remaining scenarios are treated as risk scenarios, for which underperformance constraints are imposed. The existence of those constraints allows one to balance risks versus return.
- *Maximize the worst case return (maxmin).* This is the most conservative approach that one would employ when (1) the objective is primarily to replicate the benchmark as closely as possible, say for liability matching; or (2) one does not proclaim to have a strong view about the market. Instead of investing based on a specific view, the investor aims for gains across all the scenarios, however modest they may be. This is not the approach that will generate home runs. As long as the scenarios are representative of a broad range of outcomes, the investor should be able to generate modest but consistent returns versus the benchmark.

In our experience, we have found that the maxmin criterion, by its conservative nature, helps limit the volatility of the returns over time. However, the margin of outperformance may be less than desirable for some investors, despite the attractive risk characteristics. Therefore, we leave that criterion aside for now, though we note that it may be an invaluable approach for liability management applications in particular.

There is an interesting relationship between the other two criteria. More specifically, in the absence of any risk constraints under the other scenarios, maximizing return under a specific scenario (e.g., the base case) would be equivalent to assigning a 100% probability to that one scenario and maximizing expected return. Surely, performance could well be dismal under some of the risk scenarios, in particular those that are the "opposite" of the favored scenario. Think of what maximizing return for a bearish scenario would do to performance if a bullish scenario were to materialize. On the other hand, if one were to impose some loss constraints in the risk scenarios, and make those constraints ever more stringent, there would come a point where the optimal portfolio begins to change character and look more like a portfolio driven by the risk scenarios rather than the base-case scenario. At the extreme, where one constrains the portfolio to have a high positive return in the risk scenario, while still maximizing the base case, the result would be the same as if one were maximizing expected return while assigning 100% probability to the risk scenario. In other words, there is a correspondence between the probabilities assigned to various scenarios in the expected return maximization case and the risk constraints in the single-scenario maximization case. As a side note, the two approaches are classified as linear optimization problems, in that both the objective functions and the constraints are linear functions of the optimization parameters (that is, the market value weights).

We prefer the criterion of maximizing return under a specific scenario subject to loss constraints under the risk scenarios. The reason is twofold: we like to be able to impose the loss constraints explicitly (as we want a clear handle on the risks we are taking) and we do not want to create another layer of subjectivity by having to guess probabilities. Yet, we emphasize that what we are doing would be equivalent to maximizing expected return **under a specific choice of probabilities**.

Table 43.5 Three-Month TIPS Breakeven (%) and Inflation Forecasts for Different Scenarios

	Current	Base Case	Stable Inflation	High Inflation	Slow Growth
Jan 07	2.49	2.53	2.35	2.63	2.82
Jan 10	2.43	2.50	2.30	2.61	2.61
Jan 15	2.34	2.43	2.27	2.60	2.42
Jan 25	2.52	2.58	2.43	2.79	2.52
NSA CPI					
June		194.8	194.7	195.0	194.9
July		195.1	194.8	195.4	195.7

Defining the Constraints

There are several dimensions in which one could impose constraints on the portfolio. These include duration bands, partial duration bounds, sector allocation constraints, issue weights (both in terms of the percentage of the portfolio, and relative to the float available in the market) and loss constraints as we discussed above.

Duration Bands

Most real-money portfolios cannot deviate significantly from the benchmark duration. The typical band would be 0.25 to 0.5 on either side of the benchmark duration. (Sometimes the band is expressed as a percentage of the benchmark duration.) The duration decision is facilitated by gauging how much the base-case performance improves for an incremental change in duration; that is, if the improvement is marginal beyond a certain duration deviation, then taking additional duration risk is not warranted.

Partial Duration

Typically, unless one imposes some explicit constraints, the optimal portfolio has allocations in all but a few maturity buckets. As a result, the portfolio has an implicit underweight (relative to the benchmark) in those buckets where there is no allocation. If that is not desirable, for fear that relative valuation changes not accounted for in the scenarios may cause tracking error, then one might choose to constrain the partial durations to remain close to those of the benchmark. Of course, curbing potential mismatch comes at a cost: the more constraints one imposes, the less the portfolio can deviate from the benchmark, limiting its upside potential.

Asset Allocation Weights

In a multiasset portfolio, such as one comprised of Treasuries, agencies, and TIPS, the portfolio manager typically overweights or underweights a specific asset relative to the benchmark to generate alpha. The deviation from the benchmark, especially in spread products, typically has some bounds on it, such as between 90% and 110% of the benchmark allocation, and so on. For example, if agencies were 54% of the benchmark, then the allocation into agencies would have to stay between 48.6% and 59.4% of the portfolio.

Loss Constraints

As we discussed above, the objective is to maximize performance under a base-case scenario, subject to loss constraints under the risk scenarios. The more stringent the constraints, the more the portfolio has to honor them and move away from a structure geared for optimal performance under the base case alone. The choice of the loss constraint depends on how it affects performance under the base case. For instance, if by allowing an incremental loss of 10 bps in the risk scenarios, performance in the base case improves by more than 10 bps, then one should relax the loss constraint. However, if the performance improvement is significantly less than the potential incremental risk one takes on, then it is better to use the more restrictive loss constraint.

Issue Weights

In general, one would be better served diversifying the holdings in a portfolio across a large enough set of issues, rather than having concentrated allocations into just a handful of them. Furthermore, when defining the issue size limits in the portfolio, one may need to take into account the total float available in each issue and ensure that no more than a certain percentage of the float is owned by the portfolio. This makes intuitive sense as it will help prevent the portfolio from being subject to technical anomalies in one or two issues. In short, we believe it is advisable to impose a constraint such as "no issue should be more than 10% of the portfolio or 20% of the float."

Putting It All Together: The Optimal Portfolio

We demonstrate the process we have outlined so far with a couple of specific examples. To illustrate the duration decision, separately from the sector allocation decision, we use the Citigroup Treasury Index as the benchmark. As a second example, we turn to sector allocation and choose the minimum risk portfolio defined earlier as the benchmark. To recap, the benchmark consists of 26% Treasuries, 54% agencies, and 20% TIPS in market value terms. In both optimization problems, our objective is to construct a portfolio that is projected to outperform the benchmark in the base case, subject to the following constraints:

- Duration: Within −0.5 to 0.5 years around the benchmark.
- Asset allocation weights: Within ±20% around the benchmark allocation.
- Allowable losses: Up to −30 bps versus the benchmark.
- Issue weights: No one issue to be more than 10% of the portfolio size in market value terms.

The Duration Decision

There is interplay between the duration decision and the maximum losses allowed. The final decision depends on the improvement in performance in the base case. Figure 43.2 illustrates the point. Each one of the profiles corresponds to a different level of losses allowed (the loss constraint) and shows the excess return versus the benchmark as a function of the duration deviation. Clearly, when no losses are allowed (the bottom profile), base-case performance improves as duration is shortened—after all, the base case is a bearish move in rates—but up to a certain point. For instance, when duration is matched to the benchmark, the projected excess return is 10 bps, while with a –0.1-year duration deviation the excess return reaches 15 bps. However, in going from –0.1 to –0.2-year, the improvement is a mere 2 bps. Furthermore, there

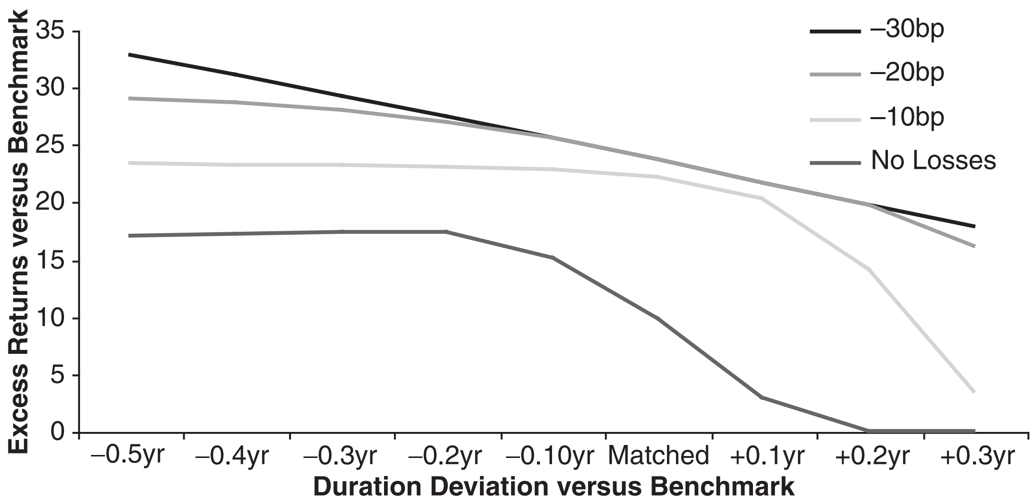

Figure 43.2 Excess Return as a Function of Duration and Loss Tolerance

is no incremental improvement for shortening duration past –0.2-year. Therefore, if one favored a very conservative strategy and allowed no losses, shortening duration by 0.1 year would be the way to go.

If the loss constraint is relaxed, there is a marked improvement in performance. For instance in the case where a 10 bp loss is allowed and portfolio duration is matched to the benchmark, excess return is 22 bps. In other words, the return pickup relative to the "no loss" case is 12 bps (22 – 10 bps), 2 bps higher than the concession given in terms of loss tolerance. It does not seem to make sense to shorten duration in this case, as performance is topped out at 23 bps with any kind of duration mismatch.

Now comes the judgment call. Using the no-loss, matched-duration case as the baseline, we can either (1) boost performance by 12 bps, by taking on the risk of a 10 bps loss but no duration; or (2) add 5 bps of return, by taking on a 0.1-year duration short but no projected losses. We would contend that the latter is a better choice in this case as it does not require making a compromise in terms of loss tolerance (at least within the confines of the scenarios used). However, one could easily argue that targeting a bigger upside potential while relaxing the risk constraints by a small margin is preferable, especially considering that the gains could be attained with no duration mismatch. Having stated our preference, we leave the decision to our readers.

The Optimal Portfolio in a Multiasset Setting

When constructing the portfolio that comprises Treasuries, agencies and TIPS, we arrive at a clear conclusion following a similar reasoning as in the Treasury-only case: there is no need for duration mismatch, or for

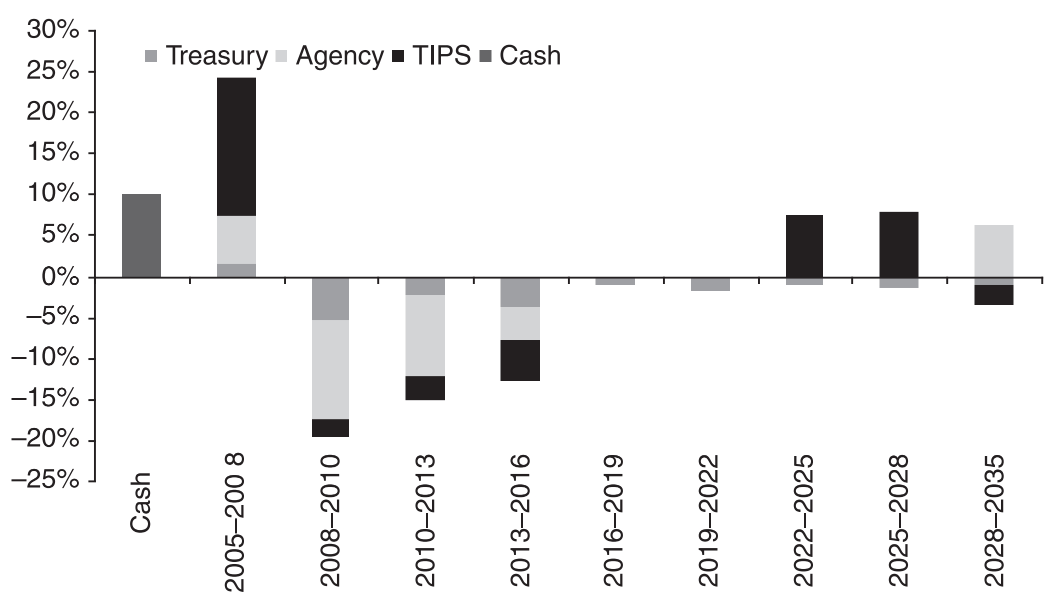

Figure 43.3 Optimal Portfolio Market Value Over/Underweights along the Yield Curve

Table 43.6 Percentage of the Market Value Allotted into Each Asset

	Portfolio	Benchmark	Overweight (Underweight)
Treasury	11%	26%	−15%
Agency	40%	54%	−14%
TIPS	39%	20%	19%
Cash	10%	0%	10%

allowing losses. The reason is that there are more degrees of freedom in this optimization, as one can enhance performance by choosing to overweight/underweight assets versus one another in addition to, or in lieu of, taking on duration and curve positions.

Because of the asset allocation weight constraints, no one asset can be fully excluded from the portfolio, which makes for good diversification characteristics. Table 43.6 shows the allocation into each one of the assets in the optimization universe. In this case, the portfolio maintains an overweight in TIPS, and an underweight in Treasuries and agencies versus the benchmark, and also has an allocation into cash (10%). The reason for the inclusion of cash is that the portfolio benefits from having a barbelled curve position (that is, overweight in short and long maturity buckets, underweight in intermediate maturities) since the base case involves curve flattening. By taking a position in cash, and coupling that with a bigger position (further out) in the back end of the curve, one can improve exposure to flattening, which is what is happening here. Table 43.5 shows the allocation into different maturity buckets along the curve in each one of the assets, relative to the benchmark composition. It is interesting to note that in the 2022–2028 maturity bucket, the optimal portfolio consists of overweights in TIPS versus Treasuries—roughly, a long TIPS break-even position. In the longest maturity bucket, there is a preference for agencies versus Treasuries and TIPS, which is essentially a long spread position.

SUMMARY

The selection of a benchmark index is a process that can carry as much importance as the optimization of the portfolio itself. Above all else, the index should be relevant to the investor. The goals of the fund should be considered and, if necessary, a customized index should be created to meet the specific needs of the manager. When constructing an index using a rules-based method, it is always important to take into account the replicability of the index, the transparency of the rules created and it should be representative of the market. Construction of a custom index can be achieved through mean/variance analysis to meet the needs of almost any investor. Using this method allows the manager to measure performance against the most efficient "passive" allocation of assets, which should eventually lead to better, more informed investment decisions.

Once the benchmark is selected, using optimization techniques is a very potent approach to balance risk versus return in a portfolio versus the benchmark. It allows one to change risk parameters, monitor the associated change in excess returns, gauge the interplay between duration, curve positioning and asset allocation, all in a well-defined and consistent framework. Notwithstanding the fact that the framework is highly quantitative, there are certainly some steps in the analysis that require a judgment call, such as the choice of certain constraints, the decision about what duration/risk tolerance combination to use, etc. The choice of the scenarios to be used in the optimization is also critical, in that one should ensure that they cover a wide range of possibilities, bracketing the forwards. The projected performance numbers, and more to the point, the risk assessment, is only as good as the quality of the set of scenarios selected. Once intuition is gained about how to generate realistic scenarios, and what kind of risk constraints to employ, the discipline of analyzing risks and returns in a unified framework proves invaluable.

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