Overview: Fixed-Income Management for the 21st Century

Kathryn Dixon Jost, CFA
Vice President, Educational Products

During the past few decades, the shift toward intensive use of quantitative models has made fixed-income management an increasingly complex and sophisticated task. Conference moderator William Nemerever joked that when he began his career in the 1960s, "most of us couldn't spell Ph.D.," but he observed that almost half the speakers at the conference held this degree.

The fixed-income markets, particularly the U.S. fixed-income markets, are among the most efficient in the world. Virtually all players in these markets have access to the same information and analytics. As a result, fixed-income investors have had to seek ever more refined concepts and tools for adding value, thereby generating a self-perpetuating cycle that seems to have reached a point of diminishing returns. Because the prospect of adding value in fixed income has become problematic, many clients are shifting away from fixed income and increasing their allocations to other asset classes, whether to equities, hedge funds, or even private equity. The rise of core-plus strategies, alpha transfer, and the increasing emphasis on risk management are, in part, reactions to this set of circumstances.

Given such a state of affairs, one might expect a fixed-income conference to offer more of the same—more abstruse models, more innovative approaches, and more modification of fixed income's investment role. The presentations in this proceedings, however, share an emphasis on the practical rather than the radical. Although innovation is necessary, the ultimate value of novel methods and insights depends on their applicability. By and large, the authors in this proceedings are arguing for (some explicitly, some implicitly) a hybrid approach to fixed income that marries conceptual and technological advances with traditional wisdom. When new analytics are demanded, it is for the purpose of solving actual problems, not for the sake of visionary ingenuity.

Even the most advanced tools can do little good if not in the hands of someone with a mastery of those tools' capabilities and an intelligent strategy for implementing them. Perhaps fixed income has evolved to the point at which the approach is not as important as the approach to the approach (after all, most of the methodologies are already highly evolved). If so, the presentations in this proceedings offer a pragmatic guide to critical considerations and best practices in fixed-income management today.

The Future of Fixed Income

Organizing and managing a fixed-income management firm for the future is a challenge fraught with uncertainty. Of all the major decisions—such as scale, scope, product mix, and compensation—the central decision is which vision of the future to believe. Laurence Smith argues that the golden age of equities is over, the "new paradigm" is dead, and fixed income will only grow in importance. Hence, the familiar question of how to get more return out of a fixed-income portfolio will acquire even greater significance. Smith provides five answers to that question: reducing credit quality, extending duration, sacrificing liquidity, allocating to the "plus" asset classes, and going global. Such future developments, however, will stress firms' organizational structures, and Smith focuses on three particular challenges: communication, marrying micro and macro insights, and managing technology effectively. In essence, these concerns are about making decisions, which means that success ultimately depends on people.

Eugene Flood identifies the most significant areas of change in fixed income as globalization, consolidation, breadth-of-product expertise, and product-design issues. Globalization is likely to be the dominant trend of the next decade, and the growing appeal of cross-border investing will lead to an increase in securitization and the universe of credit-sensitive securities. Consolidation is not only a matter of firms gaining size and scope but the trend of the top 20 firms increasing their market share of new mandates. Combined with globalization, consolidation means special challenges for mid-sized firms; neither multifaceted leviathans nor small niche players, such firms will have to focus on strategies of collaboration. The growing demand for product breadth can severely strain the ability of an organization to manage portfolio risks and meet compliance guidelines. According to Flood, a crucial part of the solution lies in creating better coordination between portfolio management and research.

The Role of Quantitative Strategies

The past few decades have seen a profound evolution in the role of quantitative strategies in fixed-income management. According to Peter Knez, quantitative portfolio-construction tools are best used in fixed-income management to enhance the quality of intuitive judgments, not to supplant subjective analysis altogether. Recent improvements in five major areas (computational power, software, availability of data, comprehension of economic and market dynamics, and visualization of the past) have led to great advances in quantitative tools for investors. In particular, such advances will enable dynamic extensions of the traditional static mean–variance model. This change will constitute a critical development because of the existence of nonnormality and nonlinearity in financial time series—phenomena that cannot be accommodated in traditional mean–variance analysis.

Yong Zhu contends that pure quantitative strategies do not work well in traditional fixed-income portfolio management and that a hybrid model offers a better way to exploit investment opportunities and control risk. Exemplifying this with his firm's use of hybrid quantitative strategies, Zhu shows how such models can provide a quantitative valuation and risk management framework for fundamentals-based investment analysis. Such an approach, argues Zhu, can adequately capture market activity and thus help managers avoid the risks associated with fundamentals-based strategies.

Global Asset Allocation

In the past five years or so, the movement to core-plus strategies has gained a lot of momentum. The plus part of the mandate is broad and can include high-yield bonds, currencies, emerging market debt, convertibles, or even equities. Naturally, such breadth has significant implications for the investment process. Michael Assay explains that in order to effectively manage a global fixed-income (i.e., core-plus) portfolio with a wide array of possible benchmarks, certain adjustments are required to prevent the process from becoming excessively labor intensive. A critical change is simplifying the approach to global asset allocation. Asay describes how his firm employs two main methods to address this challenge: first, using the portable alpha concept to run a core-plus portfolio in an efficient manner and, second, analyzing portfolios on a risk factor basis.

Risk Management

Investment professionals define and manage risk in a variety of ways.

Asha Joshi asserts that no matter how risk is defined or managed, the true risk for managers is failing to meet client expectations. Thus, quantitative models, if solely relied on, typically will not generate the optimal portfolio risk management solution. In order to incorporate client preferences and monitor the panoply of potential portfolio risks, a complementary and more practical approach is demanded. Using specific examples, Joshi shows how one can use such an approach to manage interest rate, credit, prepayment, and benchmark risk.

Kevin Maloney observes that risk management is playing an increasingly prominent role in the investment process. Because fixed-income portfolio management is inherently a risk allocation business, choosing the right risk management system is critical. The challenge is incorporating appropriate tools into each step of the investment process (rather than simply applying risk management in the form of post-investment-decision monitoring or crude limits on the portfolio managers), and a central element in achieving this goal is applying analytics that portfolio managers can use to manage and reallocate risk. Maloney then explains the approach his firm has taken in developing such a process.

Alpha Transfer and Hedge Funds

Because fixed-income markets are so efficient, many clients and managers seek to add value to traditional fixed-income portfolios by importing alpha from other markets. Hedge funds are popularly targeted as a potential source of alpha because of the perception of low-volatility, market-neutral returns. But transferring added value from hedge funds to a fixed-income portfolio is not without risks, whether seen or unseen.

John Liew acknowledges that a portable alpha strategy can be readily applied to a fixed-income mandate—that is, if alpha can indeed be generated from more-productive areas. But he argues that, although hedge funds are widely seen as a good potential source of uncorrelated alpha, research indicates that the broad universe of hedge funds may be more correlated with the market than many think. Investors must cautiously examine hedge funds' reported returns to identify potential defects in the data, particularly with regard to lags in mark-to-market valuations.

Andrew Lo focuses on the implicit assumptions—the what, where, when, why—involved in transferring alpha from hedge funds to fixed-income portfolios. In particular, investors must be aware that not only are returns transferred but so are risks. This point is crucial, observes Lo, because alpha is a random variable, not a number that can be extrapolated

based on historical patterns. Lo identifies three important areas for future development: new risk models for hedge fund investments (particularly the ability to measure liquidity risk), the relative efficiency of alpha transfer mechanisms, and the ability to model investment cycles.

Credit Analysis

"Remember," states Martin Fridson, "financial reporting is a mechanism for inducing investors to part with their capital too cheaply." A veteran credit analyst is one who has learned from his or her own mistakes as well as the mistakes of others. Fridson advises that credit analysts can never be too cautious, especially given the current environment in which financial reporting abuses have become more prevalent. Recognizing the disparity between a company's reported earnings and its true economic profit requires a healthy dose of skepticism, a broad perspective, and knowledge of the techniques of ratio analysis that best uncover financial reporting problems.

Christopher Gootkind expects good credit risk analysis to increase in importance in the future. Many opportunities currently exist to improve credit risk analysis and add value to fixed-income portfolios. Because the credit markets have grown markedly in recent years and volatility has increased as well, the need for adequate bond covenants has grown commensurately. Credit analysts also must look beyond credit ratings to measure credit risk. Gootkind discusses three ways to measure default probability and raises the possibility of using capital structure convergence as a new tool in credit analysis.

The Evolution of Trading Platforms

The development of effective e-trading platforms has been slow and remains an incomplete task. Dwight Churchill describes how bond trading evolved from a telephone-based, "voice-trading" system through a spectrum of electronic trading mechanisms (from single-dealer systems to multidealer hubs to single-log-in multidealer trading platforms) to its current state—on the verge of another evolution to a fully automated exchange. Churchill argues that, although the drivers of e-trading growth are pushing the market toward that end, significant dampers on progress exist. Regardless of the future form that e-trading assumes, market structure will continue to change. Adopting new approaches for inventory management, protocol development, and straight-through processing will be necessary. Perhaps the most important factor affecting the future viability of e-trading is the attitude of market participants, particularly on the buy side.

The Changing Role of Fixed Income in a Modern Portfolio

Laurence R. Smith, CFA
Global Chief Investment Officer
Credit Suisse Asset Management
New York City

Because the golden age of equities seems to have ended, the familiar question of how to get more return out of a fixed-income portfolio will acquire even greater significance. Managers can add value by reducing credit quality, extending duration, sacrificing liquidity, allocating to the "plus" asset classes, and going global, but these efforts will stress firms' organizational structures. Communication, marrying micro and macro insights, and managing technology will therefore become ever more important.

This speech involves a bit of a throwback to my past. I headed the Fixed-Income Group at J.P. Morgan Investment Management from 1990 to 1994 before moving into a broader role. In preparing this discussion, I did not delve into as many of the details as I might have in the past, but I did spend a lot of time thinking about the concept of a total portfolio. To that end, this presentation is intended to share a broader perspective.

This presentation has three main sections. The first is whether fixed income will grow in importance. The future is going to change for fixed income, and it will change in a material way. The second is how we can get more out of the fixed-income portfolios that we manage and that our clients ask us to manage. The final section is something I could forever wax poetic about—the organizational challenges in managing fixed income in this brave new world. (I have one caveat to add: Please do not confuse my comments in this presentation with tactical decisions that we are making in our portfolios at Credit Suisse Asset Management [CSAM]. These comments are about strategic decisions that are more structural and long term in their outlook.)

Fixed Income Is Growing in Importance

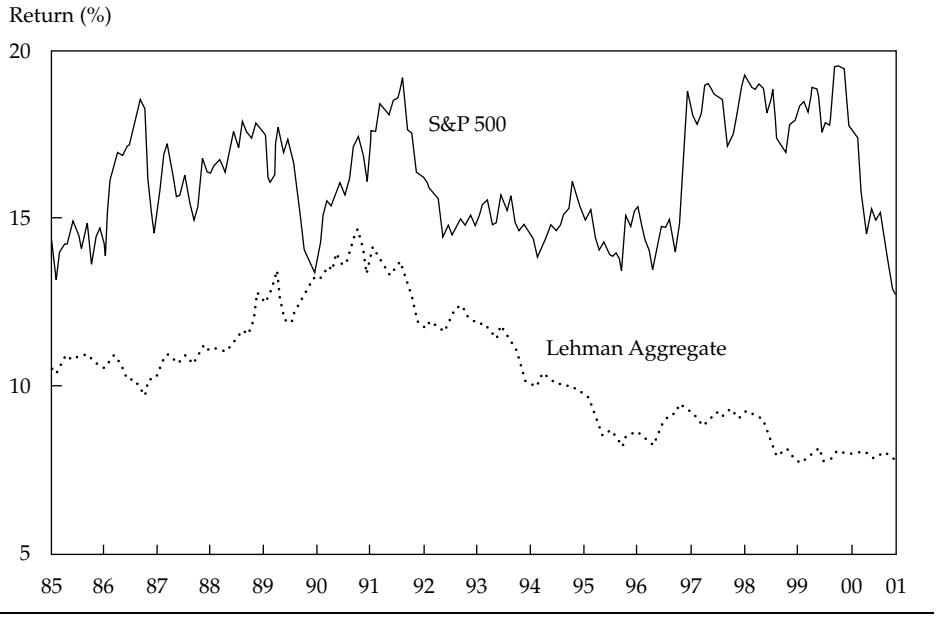
Everybody basically agrees that equities outperform bonds. You can ask anybody on the street which is the higher-returning asset class and the answer is always the same: equities. Equities always outperform bonds, and I am sorry to say to a fixed-income audience that from 1975 to the present, all rolling 10-year returns were higher for U.S. equities than for bonds.

I got excited when I first saw the chart shown in **Figure 1** because the solid line, which represents the S&P 500 Index, seemed to dip down below the fixed-income line at 1989 or 1990. Unfortunately, the line missed crossing over the dotted line that represents the Lehman Aggregate by mere basis points. For the monthly data covering the past 15 periods—and, therefore, going back 25 years—there is not a rolling 10-year period in which bonds have outperformed equities. As a result, people have tended to look at fixed income as the anchor to windward (i.e., the only reason to hold fixed income is to reduce the risk of their portfolio).

However, the golden age for equities appears to be behind us—for three reasons: earnings growth, P/E multiples, and dividend yields. Those three add up to total return for equities, and the future for these three does not look as bright as the past.

Earnings Growth. The first thing I would say about earnings growth is that the "new paradigm" is dead. It is difficult to find people who are wild about the new paradigm anymore. The notion that technology improvements would continue to provide cost efficiencies so that corporations could indefinitely grow earnings at double-digit rates, despite top-line growth that was in the mid-single digits, is folly and very much behind us.

Figure 1. Lehman Aggregate versus S&P 500, 1985–2001
(10-year rolling annualized returns)



Note: Data through September 30, 2001.
Source: Based on data from Lehman Brothers, Bloomberg, and CSAM.

Although corporations are still doing a lot of good things with technology, the notion that corporations could take out 10 percent of the cost base every year ad infinitum is completely unrealistic and not likely to be part of people's lexicon in the future. The new paradigm spoke about 4 percent structural GDP growth; these numbers are currently being revised down. When GDP growth is strong, people raise long-term "structural" growth estimates; in a recession, people lower them. I never bought into the 4 percent argument and do not think 4 percent is realistic in the future. The number is more likely to be 2 1/2 to 3 percent. When combining lower top-line growth in the economy with efficiencies that may continue to grow but not at the pace at which they grew for the second half of the 1990s, the new paradigm is hard to believe, at least with regard to corporate earnings.

The accounting distortions that artificially boosted earnings are well known. They have been enormous, especially for the technology, media, and telecommunications sector. The accounting treatment of stock options, to a certain extent, has now become a headwind, not a tailwind. Then there is the globalization tailwind—the idea that the Coca-Cola Company was going to grow earnings forever by capitalizing on the billion plus people in China. Unfortunately, September 11 will have some structural impact, at least on the margin, because people are staying closer to home. As a result, structural earnings growth will not reach double digits. In the United States, we will be hard-pressed to meet the 7 percent long-term average nominal growth rate in earnings that we have seen for the past few decades.

P/E Multiples. A lot of multiple expansion was driven by the secular disinflation that helped to lower interest rates. Interest rates could certainly fall further (just look at Japan), but the likelihood of significant interest rate declines has dropped dramatically, if for no other reason than simple arithmetic. On the inflation front, I do not expect inflation to return and become a major problem, despite the stimulative reversal of government policy. But at the same time, inflation improvements are likely to be less in the future. Therefore, future returns from multiple expansion are likely to be modest, if at all positive.

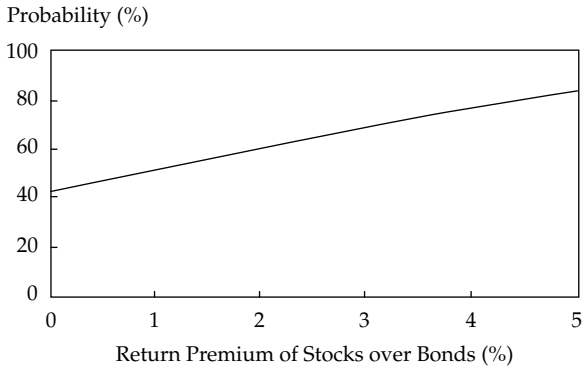
The new paradigm is dead. Everything goes through fads. I have a client who used to love to tell the story about walking across the street in the middle of the afternoon to a mall, where she would go upstairs to the local pretzel place. As she was waiting in line one day for a pretzel, a man laden with a lot of plumber-like tools and materials walked up behind her. The pretzel guy screamed out, "Hey Joe, what's the market doing?" And the plumber said, "Wait a second." He looked at the pager clipped to his belt and said, "The Dow is up 80, but the S&P is off a little bit." The pretzel guy said, "Alright, thanks. See you later." Such stories abound. Owning equities,

although absolutely legitimate in the context of a long-term portfolio, became a fad. But the idea that equities always go up and, therefore, one should always buy equities is starting to fade.

Dividends. Finally, to complete the arithmetic, dividends are obviously at very low levels. Equities did well for a long period of time, and I am not here to say that equities will do poorly. Equities will just perform less well. In mathematical terms, that means that the probability of stocks outperforming bonds over any reasonable horizon is decreasing. As that probability falls, the implication is that a lot of people who may tactically be allocating money to the equity market are not going to be as comfortable with a 70 or 75 percent equity allocation as they were in the past. More money will be allocated to fixed income, which is good news for a lot of fixed-income managers.

Looking at the expected stock versus bond returns chart in **Figure 2**, I have a trick question. For a zero percent risk premium, why is the probability of stocks outperforming bonds not 50 percent?

Figure 2. Probability of Stocks Outperforming Bonds over 10 Years



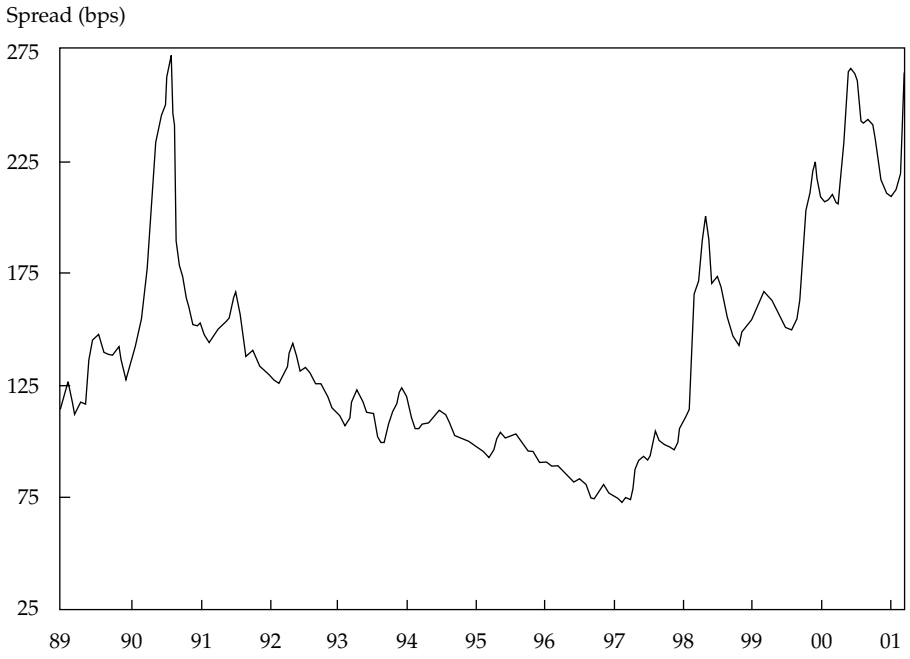
Source: Based on CSAM data.

How Do We Get More Out of Fixed Income?

If people are going to invest more in fixed income than they have in the past, how do we get more out of a fixed-income portfolio? I'd like to discuss five possible ways: (1) reduce credit quality, (2) extend duration, (3) sacrifice liquidity, (4) allocate to the "plus" asset classes, and (5) go global. Some of these strategies overlap.

Reduce Credit Quality. Credit spreads are currently very wide relative to historical levels, as shown in **Figure 3**. Many people were surprised when credit spreads did not compress meaningfully in 2001. In 1991, when the high-yield sector did well, default rates continued to be high but yield spreads narrowed appreciably. A lot of people expected the same thing to happen in 2001, and the recent blowout in

Figure 3. U.S. BBB Rated Spread, 1989–2001



Note: Data through June 30, 2001.

Source: Based on data from Lehman Brothers.

spreads took everybody by surprise. But those are day-to-day arguments. Longer term, I am hard-pressed to say anything but that credit spreads are currently wide, not only in the BBB and high-grade sectors but also in the high-yield sectors. **Table 1** lists yield spreads versus the five-year average for as long as we were able to get data. Spreads are wide, which is no great insight, but should certainly not be ignored.

Table 1. Yield Spreads by Fixed-Income Sector, 1996–2001

	Sector Spread	
Sector	September 30, 2001	5-Year Average
U.S. dollar swaps (10 year)	70 bps	75 bps
ABS	90	72
European corporates[a]	80	49
CMBS[b]	116	117
Mortgage pass-through OAS	87	72
U.S. corporates	180	110
U.S. high yield	1,020	561
Emerging markets (Emerging Markets Bond Index)	1,005	789
European high yield[c]	1,350	774

[a]Data since January 1, 1997.
[b]Data since June 30, 1999.
[c]Data since February 1, 1999.

Source: Based on data from Bloomberg, Lehman Brothers, and J.P. Morgan Chase & Company.

■ *Corporate versus Treasury issuance.* The more interesting question is why spreads are currently wide. There are four main reasons. The first is that corporate issuance vis-à-vis Treasury issuance has changed dramatically. Generally, corporations like to issue when spreads are tight, but the accumulation of corporate issuance recently has been very heavy despite wide spreads, as shown in **Table 2**. Corporate issuance has dropped off from the torrid pace earlier in the year; $650 billion in corporate debt is not likely to be issued this year, but the number will be big. Now, that decline in itself is not a problem, except when compared with **Figure 4**, which shows net Treasury issuance.

We have all seen the miraculous comeback of the government budget, from a deficit situation with the potential to burden our grandchildren to, "We're in the money." This is another example of people extrapolating from the past. To that end, **Figure 5** shows the forecast by the Congressional Budget Office (CBO) as of May and August 2001. Although the forecast has been ratcheted down quite a bit because of a lowering

Table 2. U.S. Investment-Grade Corporate Bond Issuance
(billions)

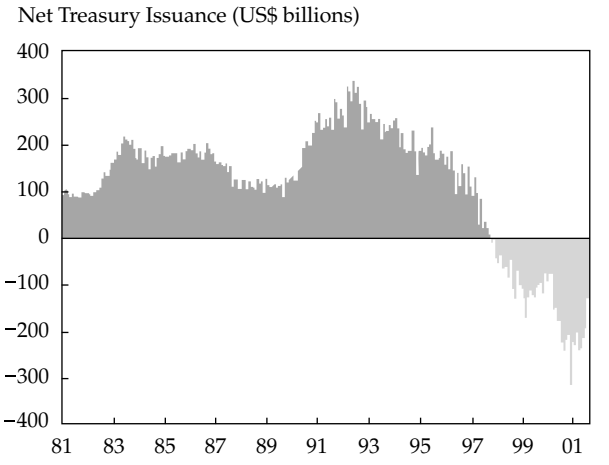
Year	Amount
1995	$126.3
1996	149.0
1997	149.7
1998	289.5
1999	313.5
2000	325.6
2001	650.1[a]

[a]Data through July 31, 2001.

Source: Based on data from Lehman Brothers.

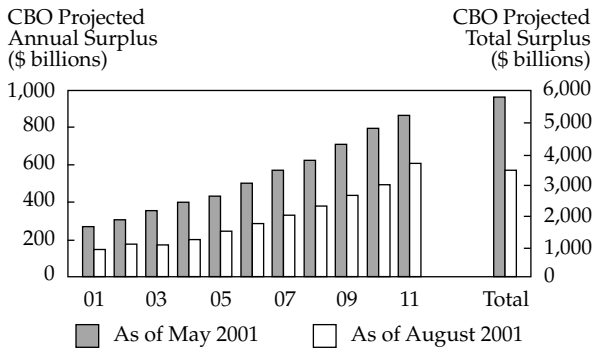
of the expected growth rate in the economy, the expected surplus is nevertheless significant. Then, just a few months later, a front-page headline in the *New York Times* announced that the budget surplus was expected to become a deficit. The current CBO forecast is more optimistic, but a lot of people are expecting a deficit (and frankly, that is what we are expecting at CSAM). It is hard to see how the budget surplus can continue. Government spending will increase, which will be a structural change for the next five years or so. Think about things like military spending. The worst thing that ever happened to the military was the raving success of the Persian Gulf War. When weapons work, new weapons are no longer needed. As a result, cutting a lot of items out of the budget was easy. In the future, however, many previously questionable military expenditures will be back on the table.

Figure 4. Net Treasury Issuance, 1981–2001
(trailing 12 months)



Note: Data through June 30, 2001.
Source: Based on U.S. Treasury data.

Figure 5. CBO Projected Annual Surplus (and Total), 2001–2011



Source: Based on U.S. Treasury data.

At CSAM, we are not looking for a shock like the changes to monetary policy in October 1979, but a sea change is taking place on a number of fronts that all point toward the attractiveness of corporate bonds. The bottom line is that the supply–demand equation is changing quite a bit.

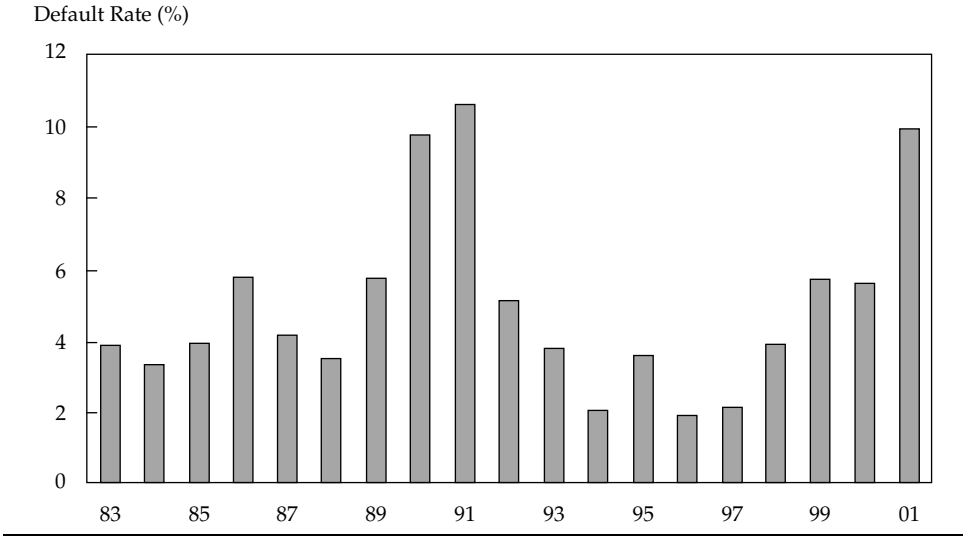
■ *Default rates.* Default rates are up dramatically, as shown in **Figure 6**. In the high-yield market, default rates are at recessionary levels. They are expected to be around the same level in 2001 as they were in 1990 and 1991. The most staggering information in Figure 6 is the default rate in 1999. In the midst of a roaring bull market when the economy was growing at a remarkable pace, default rates rose dramatically. Some of the increase was the result of sector-specific influences. Nonetheless, people became concerned about defaults, and now that a genuine recession has begun, default rates are high and are likely to remain high.

Typically, investment-grade securities do not go bankrupt; they do, however, get downgraded. As shown in **Figure 7**, from 1992 to 1997, no bankruptcies occurred for securities officially rated Baa or higher by Moody's Investors Service. This pattern changed in 1998 and 1999, and defaults have continued to increase.

Perhaps more enlightening is **Figure 8**, which shows the ratio of upgrades (downgrades) to downgrades (upgrades). There was a lot of internal discussion about how to format Figure 8 because you would typically see the ratio of downgrades to upgrades. I said, "Well, you know, I took a lot of math classes. If you do that, it is going to intentionally skew the data because 0.5 equates to 2. So, why don't we say that if upgrades are more than downgrades, we are going to have the ratio of upgrades over downgrades. But if downgrades are greater than upgrades, we are going to have the ratio of downgrades over upgrades and get rid of that skew." I thought the problem was probably solved. But when you look at the data, the skew is there anyway. The fact of the matter is there are far more downgrades than upgrades.

This cycle, however, was much better for corporate bondholders than the last cycle. From 1994 to 1997, corporate bonds did well, with more upgrades than downgrades. I do not have data going back to the early 1980s, but my recollection is that you did not see more upgrades than downgrades for any significant period of time in previous cycles. There

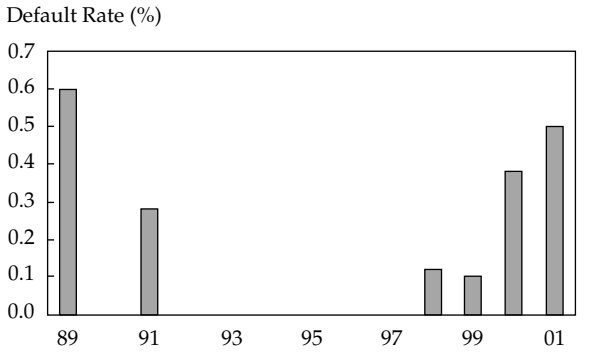
Figure 6. Moody's Speculative-Grade Annual Default Rate, 1983–2001



Note: 2001 data estimated.

Source: Based on Moody's Investors Service data.

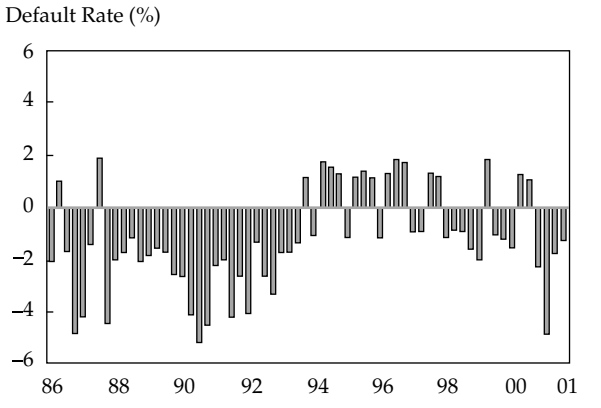
Figure 7. Moody's Baa or Higher Annual Default Rate, 1989–2001



Note: 2001 data estimated.

Source: Based on Moody's Investors Service data.

Figure 8. Ratio of Number of Upgrades (Downgrades) to Downgrades (Upgrades), 1986–2001



Note: Data through September 30, 2001.

Source: Based on Moody's Investors Service data, number of issuers.

was a secular trend toward lower credit quality, up until the last few years. I take heart from Figure 8 and believe that corporations are doing a better job managing their balance sheets. Prior to this cycle, there was a sense that more leverage was better because it increased ROE and earnings over a very short period of time. People were willing to sustain higher levels of risk in the past than they are now. The times are uncertain and the volatility at the individual company level is extraordinary. As a result, even though we have seen a downturn recently in terms of credit quality for high-grade securities, looking out over the next 10 years, I feel pretty good about Figure 8, which is a big change from a decade ago.

■ *Economic slow down.* Economic growth has turned down cyclically in a material way. The biggest fear I have from the economic growth forecast is that I have yet to find an economist who is not forecasting that the fourth quarter of this year will be the worst quarter in this cycle. People are saying that the uncertainty has been taken out of the data. I do not believe that, and my contrarian instincts are such that I have to believe there will be some surprise in the economy. The fourth quarter will be either better or worse than people expect. But thinking that things will bounce back after a two-quarter downslide can also be naive.

At CSAM, we are focused on three specific risks to the economy. The first risk is consumer spending. Whether the savings rate is –1 percent or +1 percent does not matter; the savings rate is too low. At some point, the savings rate will rise and the consumer will be a drag on economic growth. The big question is whether it takes three to five years for the savings rate to move from 1 percent to 5 or 6 percent or whether the adjustment occurs in three or four quarters. If the latter happens, look out, because 2002 is going to be a much deeper recession than people expect. Nobody knows what the lasting impact of September 11 is likely to be, but everybody is appropriately focused on it. The near-term consumer data has been encouraging, but this looms as a large risk, the number one thing to monitor on the landscape.

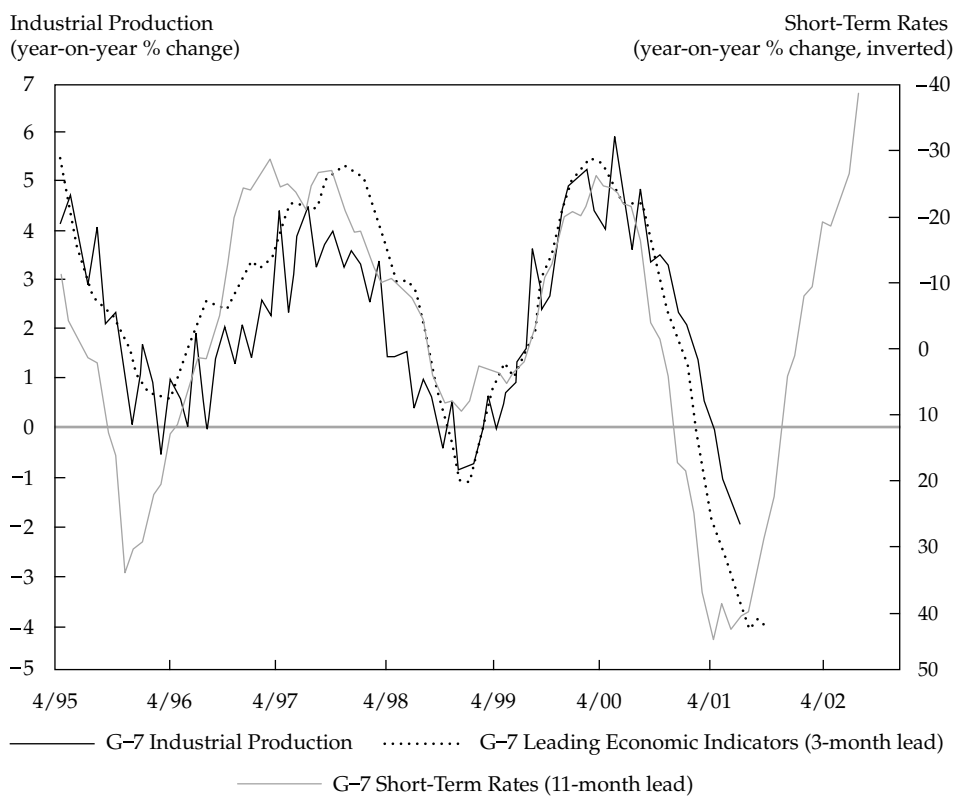
The second risk to the economy is capital spending, specifically, technology spending. The growth in technology spending has fallen substantially and will continue to fall, although the future is likely to hold fewer negative surprises and less uncertainty. The naive spending in the technology sector has stopped, so I am not overly concerned, though it still looms as a risk.

The third risk to the economy is the U.S. dollar. One of the things supporting the economy is the Fed's ability to lower interest rates as precipitously as it has. If the dollar starts to crumble, the Fed will have to curtail its easing policy to offset the inflationary impact of a falling dollar. One of the levers that the Fed has in stimulating the economy would be removed, which is a significant risk.

Having said that, I am heartened by the recent activity in currency markets. Although currency values have changed, I do not see anything yet that tells me currency risk is imminent. But the risk remains.

At CSAM, we are reasonably positive about the economy because of the data illustrated in **Figure 9**. The latest data point shows that G–7 short-term interest rates are 40 percent lower than they were a year ago. Interest rates lead the G–7 Leading Economic Indicators (LEI) data series by eight months. In turn, the LEI leads G–7 industrial production by three months. This chart speaks strongly of a cyclical relationship that, throughout the past five or six years, has held together tightly. The data indicate that the declines in economic activity are not a surprise and

Figure 9. G–7 Leading Economic Indicators, April 1985–April 2002



Source: Based on data from the U.S. Federal Reserve, Organization for Economic Cooperation and Development, Bloomberg, and CSAM.

that the bottom is near. Although I would not use such a tool to precisely predict the timing of a "bottom," this chart points to resumption of economic growth within the next 12 months. At some point, probably in the second half of 2002, economic growth will start surprising people on the upside rather than the downside. We are therefore fairly positive about economic growth, although a lot of risks with regard to the short-term data still exist.

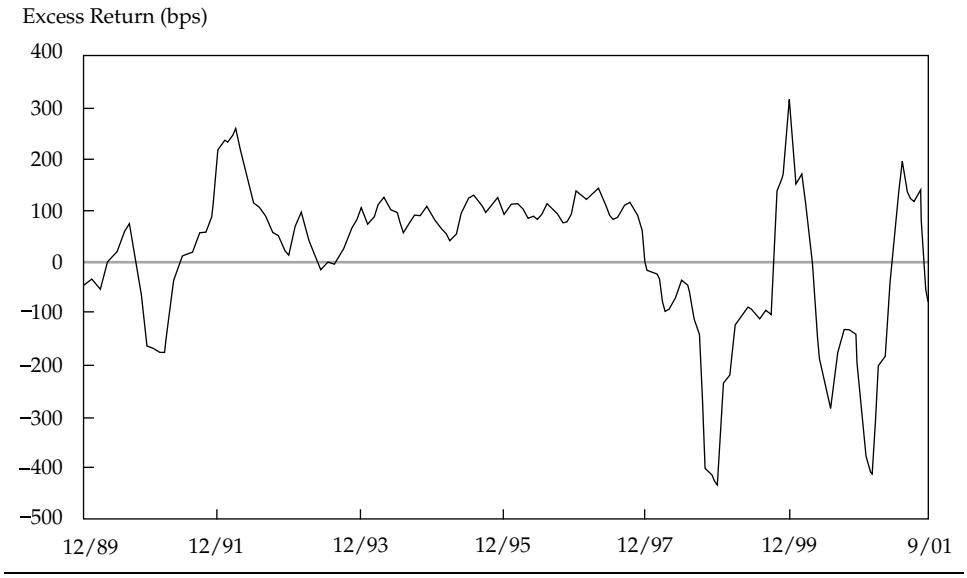
Credit volatility. **Figure 10** is an extraordinary chart that illustrates the volatility of the credit sector. It shows credit sector returns over Treasuries. Life was pretty wonderful for corporate bond managers for the five- or six-year period leading up to 1998. But in 1998, Russian debt and Long-Term Capital Management changed all that. The volatility, however, did not end when the markets bounced back. In 1999, although the equity market was extraordinary and a lot of liquidity existed in all markets, the volatility of corporate bond returns continued to be extremely high. A change in the landscape as to the level of volatility in the credit sector seems evident.

Figure 11 plots what I would call an explanatory regression rather than a predictive regression. Three variables explain the lion's share of what has happened to spreads: equity market volatility, consumer confidence, and the shape of the yield curve. These three variables indicate that credit spreads should be wide at this point in time. If each of those explanatory variables returned to more normal levels, the impact would be profound. Spreads would probably rally on the order of 50 bps, enough to capture everybody's attention. The estimated normal range in Figure 11 is a bit of a loose concept because we do not have sufficient data to tightly estimate this range. Nonetheless, Figure 11 makes the interesting statement that the spreads in the mid-1990s were too low. It also indicates that current spreads are too high.

Putting all these facts together in an intermediate time frame, I think corporate spreads are likely to narrow and that the case for reducing credit quality is currently quite strong.

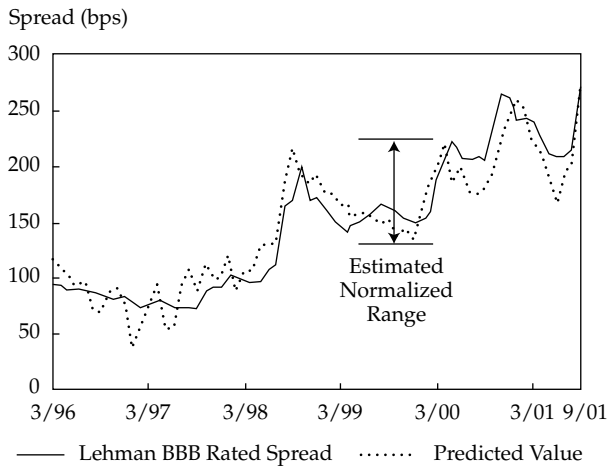
Extend Duration. The return to extending duration using strip curve data, shown in **Figure 12**, illustrates a healthy increase in return per unit of risk—slightly less than a 1 percent increase in return for a 1 percent increase in risk. The scales on the *x*- and *y*-axes are completely different, so the relationship does not appear as dramatic as it truly is. There

Figure 10. Lehman Credit Index, December 1989–September 2001
(12-month cumulative excess return over U.S. Treasuries)



Source: Based on Lehman Brothers data.

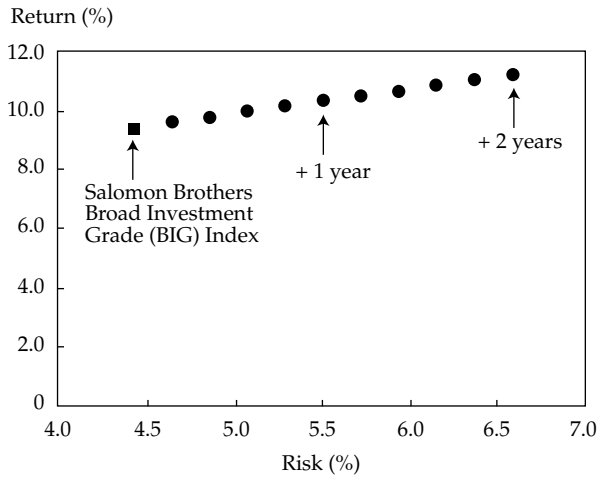
Figure 11. BBB Rated Corporate Bond Spreads, March 1996–September 2001



Note: $R^2 = 0.88$.

Source: Based on data from Lehman Brothers, Conference Board, and CSAM.

Figure 12. Risk–Return Trade-Off for Extending Duration

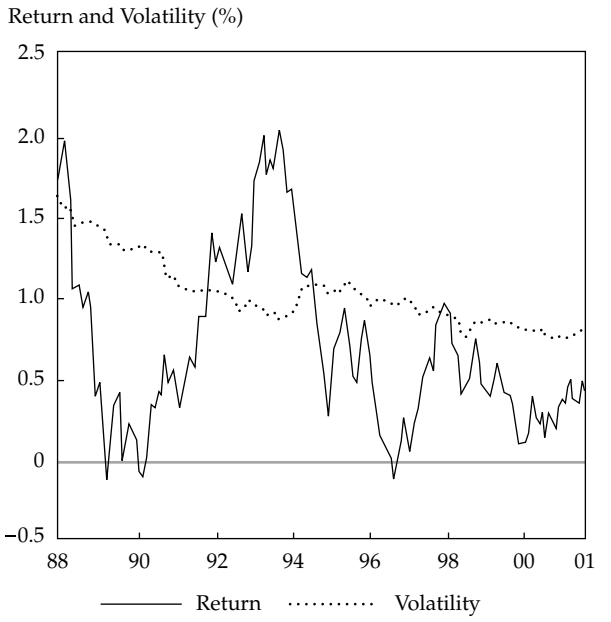


Source: Based on data from Salomon Brothers, Merrill Lynch & Company, and CSAM.

is a 12 percent spread on the *y*-axis but only a 3 percent spread on the *x*-axis. The benefit from extending duration during the 1985–2001 period came from a secular decline in interest rates. As I mentioned earlier, I would not expect this secular decline in interest rates to continue at the pace we have seen in the past. We are running out of room on the downside for interest rates. The return per unit of duration on a rolling three-year basis has actually come down quite a bit since the recession in 1990, as illustrated in **Figure 13**.

I am lukewarm on the concept of extending duration to improve return for other reasons. Typical long-duration mandates, when the manager can own only bonds with a maturity greater than 10 years, restrict the investment universe and the ability to actively manage a portfolio. A better means of

Figure 13. Rolling Three-Year Return and Risk per Unit of Duration, 1988–2001



Note: Data through September 30, 2001.
Source: Based on Bloomberg and CSAM data.

extending duration is to use futures. Not only do futures increase the size of the investable universe, they also facilitate taking advantage of the points on the yield curve where the risk–return relationship is greatest. These points have typically been at the shorter, rather than longer, end of the yield curve. The idea of borrowing cash and lending it at a four- or five-year duration makes a lot more sense than naively extending out the yield curve.

In a broader context, some people, typically pension plan sponsors, historically thought about extending duration as a risk-reducing tool relative to liabilities, but I have not heard one of those arguments in a long time. I still think those arguments are valid and true, but they have disappeared from mainstream fixed-income management. Unfortunately, the notion of asset–liability matching seems to have faded.

Sacrifice Liquidity. I always have been and always will be a big fan of sacrificing liquidity to improve return. One area in which liquidity is sacrificed fairly dramatically is in the bank loan market. **Table 3** shows that the bank loan market (leveraged loans) has a significantly higher Sharpe ratio than other fixed-income asset classes. I do not believe that the actual volatility of this leveraged loan index was 2.02 percent. I am sure the proverbial asynchronous trading took place during this period of time. But I do believe in the spirit of what is being shown, which is that the risk–return relationship in categories such as leveraged loans was, in fact, higher than that for high-yield debt or investment-grade bonds. The correlation matrix in **Table 4** shows that the correlations are fairly low. Again, the data may be skewed because of asynchronous trading, which would tend to lower the measured correlations. However, it is not just a data problem. It is realistic to think that these securities are good diversifiers, although I would acknowledge that the correlation has risen since 1998.

Table 3. Leveraged Loan Risk–Return Characteristics, 1992–2000

	1992–2000 (annualized)		Sharpe
Asset	Return	Volatility	Ratio
Leveraged loans[a]	7.52%	2.02%	1.57
High-yield debt securities[b]	8.07	5.86	0.59
Investment-grade bonds[c]	7.49	4.90	0.59
U.S. intermediate Treasury	6.63	4.59	0.43

Note: Annualized data.
[a]CSFB leveraged loans.
[b]CSFB high-yield bonds.
[c]Merrill Lynch corporate master.
Source: Credit Suisse First Boston (CSFB) and Ibbotson Associates.

Table 4. Correlation Between Various Asset Classes, 1992–2000

	Leveraged Loans	High-Yield Debt Securities	U.S. Intermediate Treasuries	Investment-Grade Bonds
Leveraged Loans[a]	1			
High-Yield Debt Securities[b]	0.32	1		
U.S. Intermediate Treasuries	−0.03	0.16	1	
Investment-Grade Bonds[c]	0.07	0.42	0.90	1

[a]CSFB leveraged loans.
[b]CSFB high-yield bonds.
[c]Merrill Lynch corporate master.
Source: Credit Suisse First Boston (CSFB) and Loan Pricing Corporation.

Finally, an important part of the story for a lot of our clients is the recovery rates, shown in **Table 5**. Because of the protective built-in covenants and the collateral that usually comes along with these securities, the recovery rates are much higher for bank loan debt than they are for other fixed-income instruments. In the high-yield market, the recovery rates have dropped dramatically this cycle. We are not seeing that type of drop in leveraged loans; they have provided much better protection. So, it is an interesting asset class that is reflective of the liquidity premium in the marketplace. This has been the case in the past, and I believe it is likely to continue to be the case in the future.

Allocate to "Plus" Classes. Allocating to "plus" asset classes (i.e., fixed-income asset classes that are in the high-grade indexes) is another possible strategy for adding value in a portfolio. I started doing the analysis presented in **Figure 14** close to a decade ago. Here I have analyzed high-yield and emerging market debt. All I have done is to turn around a typical efficient frontier. I started with a 60/40 domestic efficient frontier—60 percent in the S&P 500 and 40 percent in the Salomon Brothers Broad Investment Grade (BIG) Index. I calculated the level of risk and then added a third asset class. That third asset class in Panel A of Figure 14 is high yield. And then I asked myself the following question: If I wanted a 10 percent allocation to high yield, what level of return would I need from this high-yield asset class to keep my risk constant but end up with a 10 percent allocation to high yield in the optimization? The answer is only about a 1.1 percent return greater than the Lehman Aggregate. This graph is remarkable because with current spreads at 800 bps, and even considering that defaults will lower the realized return, there is ample reason to believe that high-yield returns will easily exceed 110 bps over the Lehman Aggregate over any reasonable horizon. The correlation of high yield to the Lehman Aggregate is only 0.36 and to the S&P 500, 0.53, so the hurdle rate to justify including high yield in a portfolio is surprisingly low.

Panel B of Figure 14 shows the same analysis but for emerging market debt. In this case, the efficient frontier has more curvature. This curvature comes from the lower correlation—0.21—of emerging market debt and the Lehman Aggregate. To consider adding emerging market debt to your fixed-income portfolio in the context of a total portfolio, you need only a 1 percent increase in expected returns. As with high yield, with spreads around 1,000 bps, it is easy to justify including emerging market debt.

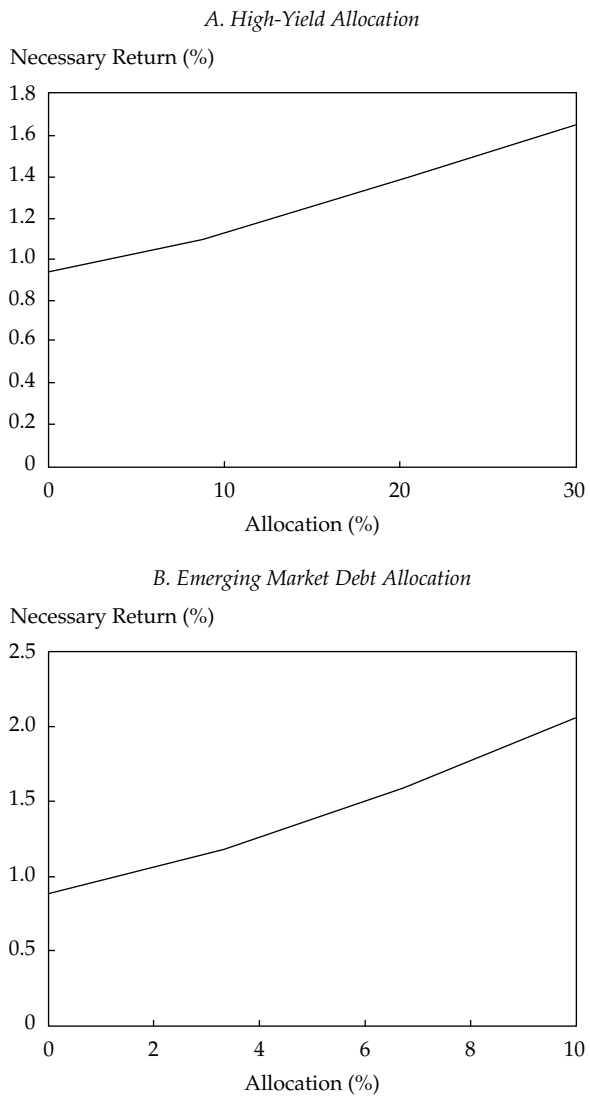
The economics are compelling with regard to expanding a fixed-income portfolio to include these

Table 5. Average Recovery Rates by Debt Class

Debt Class	Percent of Par Value
Loans	86.2
Senior secured bonds	70.3
Senior unsecured bonds	53.5
Senior subordinated bonds	36.4
Subordinated bonds	31.1

Source: S&P/Portfolio Management Data loan loss recovery database; data 1988–2000.

Figure 14. Necessary Return Advantage of a "Plus" Allocation



Source: Based on CSAM data.

other asset classes. People tend to look to optimize the equity part of their portfolio with the thought that the fixed-income part is the anchor to windward. Just as many people's perspectives have changed in becoming an investor versus being a saver—on taking a defined-contribution plan and investing a certain percentage of assets in equities—we also need to start changing people's perspectives at this level.

Higher-risk fixed income makes a lot of sense. The amount of incremental return you need, given the risk characteristics, is not that high. People think it is high because they tend to view each asset class in isolation and focus on the bad years and bad stories—and there are a lot of bad years and bad stories. But any reasonable assumptions about high yield and emerging market debt would support including these asset classes at a much higher level of allocation than they are currently.

Go Global. Finally, I have some thoughts on going global. The biggest issue in regard to going global, and the one we hear about from clients the most, is the choice of a benchmark. It is hard to justify including a global fixed-income or an international fixed-income mandate that is all Treasuries. It is an uninteresting asset class economically, but when we start talking about the Lehman Brothers Global Aggregate or Global Aggregate ex-United States, it starts getting interesting. **Table 6** shows the country allocation in the Global Aggregate Index and the Global Treasuries Index. Interestingly, the U.S. allocation rises from 23 percent of the Global Treasuries universe to 42 percent of the Global Aggregate universe. In addition, Japan, home of zero percent interest rates, is reduced in the Global Aggregate from 30 percent to 22 percent. A lot of clients jump for joy when they see this.

Table 6. Global Aggregate Index versus Global Treasuries Index, September 30, 2001

Country	Global Aggregate	Global Treasuries
United States	42%	23%
Euro zone	25	35
Japan	22	30
United Kingdom	3	5
Canada	2	3
Other	7	4

Source: Based on data from Lehman Brothers and CSAM.

On September 30, 2001, the duration of the Global Aggregate was almost three-quarters of a year shorter than that of the Global Treasuries, yet the yield was higher by 83 bps. While 18 of the Global Aggregate's 83 bps yield advantage comes from differences in market exposure (e.g., less in Japan and more in the United States), the remaining 65 bps represents the "true" yield advantage of investing in non-Treasury securities.

As a result, at CSAM, we are bullish on the Global Aggregate. Strategic advantages arise from the improvements in the Global Aggregate. The first advantage stems from the historical data on credit securities in the United States, which is compelling. Although any asset class may have bad years, over any long-term period, based on the historical data, it is difficult to argue against including corporate securities. If anything, the wide current spreads, make the case for credit securities more attractive versus history.

Another advantage is the result of new markets that are included in the Global Aggregate. Whenever new securities have been issued in the marketplace, there has generally been a reward for taking on the risk of a new security. This pattern is not universally true, but it was true for many mortgage-backed securities (MBS) and asset-backed securities (ABS) in the United States, including such things as planned amortization class (PAC) bonds. A lot of people got burned with interest-only (IO) and principal-only (PO) securities, but people who were able to see that the sum of IOs plus POs equaled, in some cases, three or five points more than the underlying collateral avoided getting burned. Nonetheless, generally new securities in the marketplace—securities that are not well understood—have, I believe, offered an increase in return. The European credit sector is one such area.

Look at how credits are being analyzed in Europe. Things in Europe still differ greatly from what is happening in the United States, where people have a lot more experience with credit. Most companies are sending people in the United States to Europe, or at least giving people in the United States direct responsibility for Europe. Considering what has happened in the European high-yield market, the case for active management is clear.

On the tactical side—and by tactical I am referring to the ability to add value through active management—I see a negative for the government sector and a positive for the nongovernment sector. On the government side, there used to be 17 or 20 currencies, depending on how you viewed the world, but not anymore. The number of bond markets and currencies has decreased dramatically with the advent of the monetary union in Europe (EMU). With lower levels of volatility and fewer independent bond markets like those of Italy and Spain in the recent past, the ability to add value through a pure government mandate has decreased dramatically. I

am not going to suggest the information ratio has fallen, although theoretically it has.

In summary, we (and this statement also applies to pension managers) can get more out of fixed income primarily by reducing credit quality, sacrificing liquidity, and allocating to "plus" assets. I also advocate going global but am lukewarm about extending duration. A case can be made for getting excited about improving fixed-income portfolios. We are likely to get a more receptive ear from many more of our clients than we have in the past.

Organizational Challenges

Three major organizational challenges remain: communication, marrying macro and micro insights, and utilizing technology effectively.

Communication. The problem with regard to communication is that in looking at all these securities around the world, managers say things like, "We want our analysts close to the companies that they follow." This tendency is certainly true on the equities side. It is less true, but still true, on the fixed-income side. You end up with people in Europe, Japan, and Australia, and the geographical dispersion turns out to be a major challenge.

At the end of the day, investing is an information-sharing and information-creating business based purely on communication. Being flooded with information from Bloomberg and other sources is both good and bad. Sifting through that information and making sure you know what is salient and what is noise is critical. When you go global, you tend to suffer from communication overload. On top of this flood of information and the requisite 150 e-mails a day, you might have to call someone in Tokyo or Europe. You need to figure out how to handle all this communication with multiple time zones and limited hours in a day.

Several potential insights may help with these issues:

- *Do not bite off more than you can chew*. It is nice to think that our asset management companies are global, and we want to be fair to all markets and peoples around the world. Nonetheless, the vast majority of the non-U.S. credit markets that are being developed are in Europe. The focus that people should have, therefore, is on pulling together the United States and Europe. The United States and Europe overlap by four or five hours throughout the day, so you have roughly half a day every day to communicate in real time, which is probably enough. When you start introducing the Far East, such as South East Asia, Japan, and Australia, the problems increase dramatically. So, my first recommendation is not to bite off more than you can chew. The extra load is not necessary, and you have to walk before you can run.
- *Ensure leadership has a global agenda and travels frequently.* Videoconferencing is a wonderful technology, and I use it all the time. But it does not replace getting on the road and making sure that you have a good working relationship with people by taking them out to dinner and talking about things you were not able to talk about in a one-hour videoconference. Senior people should visit the different offices. I am not a big fan of saying that people have to be on the road 50 percent of the time, but if three months pass and people do not see each other, problems can arise.
- *Motivate resources to act globally*. Getting people to be globally aware is a major challenge because of the strong local pull in the investment management business. If an organization has both a New York and London office, the New York people no doubt think that their only job is to make their New York business profitable and successful, and vice versa. Each office typically regards the other office as inferior. Those walls must be torn down because the fragmentation that results will inevitably become the biggest hurdle to improving communication links.

Moving people around in an organization is positive. A global way of thinking has to be part of compensation, and the leadership has to believe in it.

- *Balance formal and informal communication*. We tend to be meeting-myopic. Meetings serve an important function, but if you rely on meetings as the primary form of communication, you have failed. People need to call other people elsewhere in the world and say, "Hey, I had an idea. What do you think about this?" Once that happens, everything else flows and meetings become more productive and efficient. The tendency is to wait until a planned meeting to speak to someone in Europe, but that is a disaster. Making sure that there is as much, if not more, informal communication than formal communication is vital.

Marrying Macro and Micro Insights. On the macro versus micro issue, the problem is simple: The more decisions that are made, the more difficult it is to pull them together. Diversifying decision risk is a good thing, but being able to prioritize decisions and then getting them into a portfolio is increasingly difficult as we move from a domestic to a truly global framework.

The first way to meet the challenge of macro versus micro decision making is to establish a small leadership team that shares incentives. If you have five teams around the world that have 3 people each, you end up with 15 people, which is too many. You have to be the bad guy at some point and say, "You three people are now responsible for this global

product. End of story." People will grumble and you may even lose people, but the downside of not doing it is more significant.

Second, clearly articulate the responsibilities of the leaders. These responsibilities should be more focused than broad. The leaders should know that their job is to produce alpha in a Global Aggregate portfolio and that they do not have to worry about the domestic mandates that will be siphoned from that aggregate. The more clearly the responsibilities of the leaders are articulated, the better the chances are of pulling together the macro and micro decisions.

As a subpoint, I have always found everybody in this business to be very bright. Nonetheless, people's skills, their strengths and their weaknesses, vary. Some people at my shop are terrific on the macro side but do not have a clue on the micro side, and vice versa. Getting them in the same room and getting them to agree to be on the same team, to become blood brothers, is the only way to get the job done. Again, fragmentation can be disastrous.

Clearly articulating the investment process is crucial. Whether your organization is a macro or micro player, or both, know what your discipline is, stick to it, and execute it. If you execute your discipline, you will succeed. Being tactical and opportunistic is nice, but when you start by making macro decisions, move to micro decisions, and then try to pull them together at the end of the day, you add a greater level of complexity; people wind up feeling rudderless. Clearly articulating the investment process will help other than just investment management. You can barely have a conversation with a consultant unless you have done so.

The Technology Challenge. Finally, create analytical tools to support the investment process—that is, tools that address both return and risk. Tools that deal with risk can be a double-edged sword as many of these tools become overly complex. A significant percentage of our colleagues have doctorates, but most of us have lowly master's or bachelor's degrees. Our colleagues with doctorates may say things that are mathematically impressive, but we should not confuse a quantitative tool—and I am an old quant—with an investment process. Such confusion has led to the downfall of many a risk tool.

Choose one risk model. Whether you choose the multifactor route with three global duration factors, three global durations times X number of countries, key rate durations, or bucketing, pick one method and do not steer away from it. People who use more than one risk model are doomed to failure because they are always questioning their decisions. If you think you can enhance a model, go ahead, but throw away the old model once you do so.

Risk models should confirm intuition. Quantitative tools in general should confirm intuition, not replace it. If you do not understand a certain quantitative tool, do not use it. Chances are the tool is wrong. I feel strongly about this because the world changes. We all know that quantitative tools are powerful yet limited. If they are not intuitive, they are not of use.

Ensure that leadership is fully supportive of the tools used. Often, two out of six people think these quantitative tools are cool and insightful. They want to use them, but the other four do not. The result is fighting about which tools to use instead of where to invest your money.

Recognize how quickly the world is changing. Having a covariance matrix that goes back to 1926 is nice, but it is not particularly appropriate or useful. Find the right balance between having enough data for statistical significance versus making sure the data are accurate. I have gone back and forth with regard to the optimal horizon of the data. Ten years is too long, and RiskMetric Group's monthly forecast is too short. Something in the middle makes sense, perhaps three years. But the world does change, and part of our jobs as investors is to ensure that we do not get pulled down by the burden of history as the world changes.

Finally, people, not analytical tools, should make decisions. Analytical tools should support people, not vice versa; sometimes people forget that basic truth.

Question and Answer Session

Laurence R. Smith, CFA

Question: What are leveraged loans? Are they asset-backed securities? Are leveraged loans less liquid than high-yield bonds, and how is the bid–ask spread measured?

Smith: Let me start with a disclaimer. The stuff I know the least about is leveraged loans. In fact, I would not know anything about leveraged loans if it was not for the fact that Credit Suisse First Boston (CSFB) bought Donaldson, Lufkin & Jenrette (DLJ), where managing loans was part of asset management operations. An individual named John Popp and his group from First Dominion had recently joined DLJ and now are part of Credit Suisse Asset Management.

These are bank loans, and as a result, they have the typical covenant protection of bank loans. Bank loans are not asset-backed securities and do not have similar collateral. Leveraged loans are generally issued by noninvestment-grade companies and are secured by all or most of the assets of that company. Typically, high-yield issuers are also issuers of bank loans.

With regard to liquidity, leveraged loans are relatively illiquid. They are not quite as fickle as the high-yield market, in which liquidity can go from being great to nonexistent, but leveraged loans are not a market in which you can call someone, say "Give me a bid on 20 million bank loans," and they do it on the wire. Generally, orders get worked. Are they more or less liquid than high yield? Over market cycles, I would suggest that they are less liquid, but I would also suggest that there are periods within the market cycle during which they are probably more liquid. When high yield is completely out of favor, some high-yield managers turn to bank loans as a surrogate, which brings some money into the market. The big difference continues to be the lower relative volatility of the loan asset class. A similarity with high-yield securities is the tendency to gap down when bad news comes out about the company.

Question: With regard to global fixed income, do you deal with the currency risk on a hedged, unhedged, or partially-hedged basis?

Smith: Currency is a wonderful topic, and one in which the typical analyses can be improved. Currency is separable from the underlying asset classes and, as such, needs to be modeled as a separate asset class. As a general rule, for a U.S. investor with a broadly diversified global total portfolio, the first 15 percent of investment out of the United States, whether stocks or bonds, should be unhedged. Although currency adds risk to the local asset class, it also lowers the correlation such that an unhedged portfolio is a much better diversifier. This fact is important as you begin to add that asset class to a portfolio from a zero percent allocation. Once you get above around 15 percent, the case becomes strong to hedge the incremental exposure because the high level of volatility of currency starts to dwarf the amount of diversification that the lower correlation provides.

This analysis, however, is general. I can't answer the question specifically without more information. I can't say that all global fixed-income portfolios should be hedged or all Global Aggregate portfolios should be hedged or unhedged; you have to consider it within the context of the total portfolio. I am a fan of currency overlays. Value can be added by actively managing currency, and it makes sense to separate such mandates from the underlying portfolio. At the same time, how much currency you should have in your benchmark should be the result of a more rigorous asset allocation study.

Question: Do the opportunities you mentioned in credit increase the asymmetric return profile of credit investments? In other words, is security selection a tougher game?

Smith: The case for greater asymmetry stems from the belief that new markets, such as leveraged loans and high yield in Europe, will see hot money that exacerbates volatility. I'm not sure I believe in this premise. I think a lot of new investors are long-term investors and won't prove to be any more fickle than investors tend to be generally.

As for default rates, there will always be fads, and the recent dot-com craze and lower-quality telecom debt issuance are good examples. Although they provided a lot of volatility, I'm not sure they caused a great deal of asymmetry. In addition, I don't see the current environment as being full of speculative bubbles, at least not any more. Default rates are quite high currently, but I'm encouraged by the improved credit quality management that we saw in the 1990s. Although changes in economic growth will asymmetrically influence default rates, I don't see anything new on this front of any significance.

With regard to active management, the rapidly changing environment means that you need to stay ahead of change. We need to figure out what a changing environment means for the markets.

Change is good, because without change, there is no opportunity for active management. But change creates risks as well as opportunities. I don't see any material change in the ability of an active manager to add value. If anything, the ability will increase, because the environment is likely to continue to change at a rapid pace.

Question: Which is better for the economy, higher consumer saving or higher consumer spending?

Smith: The answer is yes. Seriously, this question has a short-term and long-term answer. The long-term answer is that consumer saving—as we were all taught in Economics 101—is a driver of future economic growth. Greater investment in the economy should lead to stronger growth in the future. But the reality is that from year to year, the consumer is two-thirds of the economy. If savings rates go from 1 percent to 6 percent in two years, that would be good for economic growth in the long term, but it takes 5 percent times two-thirds—or 3.33 percent—out of economic growth in the short term, which is just the direct impact.

Question: If rates are not going down, how can bonds outperform?

Smith: The reason, simply put, is that equities may not do well in that environment. The duration of equities is much higher than the duration of bonds. Equities actually have (at least) two durations. They have a real rate duration and an inflation duration. The inflation duration, in theory, is about zero, but in practice, it is anything but zero. The real-rate duration is the nominal duration—1 divided by the dividend yield. The dividend yield is pretty low these days, and 1 divided by the dividend yield is a big number. If the interest rate drop is halting, especially real rates, that remarkable tailwind for the equity market goes away. If real interest rates rise, you have quite a formidable headwind. So, that is one way for bonds to outperform.

Nominal rates of return are coming down dramatically. The days of double-digit returns being a normal phenomenon are likely behind us. Having said that, we have just come off of a 30 or 40 percent decline in almost every stock market. A significant bounce may occur, but looking out over the next 10 years, equity returns are likely to be in the single digits, not the double digits. Therefore, bonds have a much better chance of outperforming.

Key Trends in Fixed-Income Investment Management

Eugene Flood, Jr.
President and CEO
Smith Breeden Associates, Inc.
Chapel Hill, North Carolina

To meet the challenges posed by significant change in the fixed-income market, fixed-income managers must understand the intricacies of securitization and credit and manage strategic alliances. For future success, firms must rise to the demands of globalization and consolidation. And by acquiring breadth-of-product expertise and addressing product-design issues, investment firms can build the infrastructure necessary to manage portfolio risks and meet compliance guidelines.

The fixed-income landscape becomes more difficult to navigate with each passing year. As a result, managers need to understand the topography of the landscape, how it is likely to change, and how the changes can affect the industry. This presentation addresses the most important trends in the marketplace today—globalization, consolidation, breadth-of-product expertise, and product-design issues—and their implications for the organization of the fixed-income investment management firm.

Globalization

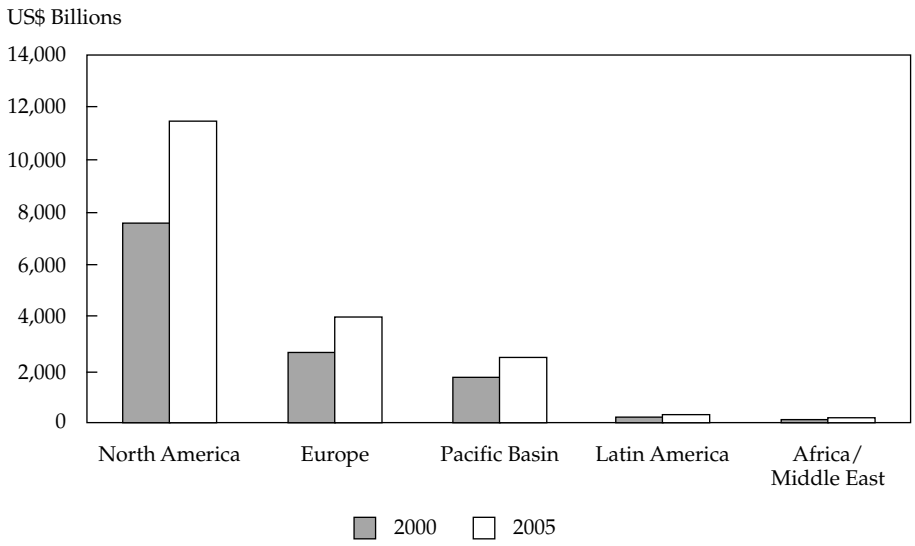
Arguably, the most important issue in fixed-income asset management today is globalization. Global pension asset growth seems destined to continue at a fast pace, although investors will probably begin to see equalization of growth rates between countries. To date, growth has been concentrated in a few countries, primarily those in North America and Europe. In addition, as cross-border investing heats up, securitization is becoming increasingly popular, and the universe of credit-sensitive securities is expanding.

Figure 1 graphs the forecasted growth in pension fund assets from 2000 to 2005. The gray bars show pension assets in 2000 by geographic region, and the white bars indicate the forecast by region for 2005. The expected growth is good news for management firms. Pension asset growth in the North American countries has been highest, running at about 14 percent a year, but in the next five years or so, the annual growth rate is likely to approach 9 percent, which is similar to other regions of the globe.

Historically, most of the world has relied on a variety of "pay-as-you-go" retirement systems. A pay-as-you-go system, such as the U.S. social security system, uses funds that are paid into the retirement system today by the current workforce to pay the retirement benefits of current retirees. In such systems, no funds are invested for the long term; there is no figurative lockbox. In recent years, a move away from such systems has been evident, as a growing number of countries have been developing prefunded pension systems that emphasize setting aside assets for the long term. As investors put money in a 401(k) or a defined-benefit or defined-contribution plan, assets are essentially earmarked for these individual investors and tracked over time. As a result, the industry is moving away from shorter-term assets, managed on an interim basis by the government plan sponsor, into longer-term assets, such as equities and long-duration fixed-income assets. The

I want to thank friends and colleagues from Morgan Stanley, Merrill Lynch & Company, Institutional Investor, and InterSec Research Corporation for their work on the data for this project. For feedback on the ideas in this presentation, I want to thank Tom Bennett, head of global fixed income at Morgan Stanley Asset Management; Steve Francis, vice chair of Fischer Francis Trees & Watts; and Dick Wilde, chief operating officer at Pacific Investment Management Company.

Figure 1. Predicted Total Pension Fund Assets by Region



Source: Based on data from InterSec Research Corporation.

private sector typically gets the mandate to manage these types of assets, which is why this trend interests fixed-income managers in particular.

Cross-border investing of retirement assets is also on the rise and is projected to be highest in pension funds in the United States, Japan, the United Kingdom, the Netherlands, and Canada. Together, these countries compose about 90 percent of total global pension assets. Cross-border investing has increased because investors appreciate the importance of diversification not only by asset class but also by geographic region. Periodic regulatory changes have also prompted funds to diversify more. The most recent change occurred when the euro zone was formed. In those European countries that require a large percentage of pension assets to be invested domestically, the definition of "domestic" was broadened to include the entire euro zone. Plan sponsors are no longer forced to invest within their native country and can invest in any nation in the euro zone. Thus, more assets have been moved across borders.

Market environment changes have also induced plan sponsors to diversify across borders. For example, Japan currently has a growing appetite for cross-border investing because Japanese interest rates are extremely low. Pension funds are looking outside the country for better investment opportunities. A strategy that is currently popular in Japan is cross-border investing without actually going outside the country. An asset management firm will strike a deal with a Japanese distributor to create a LIBOR-plus asset in dollars. If the asset management firm can beat LIBOR in dollars, it can take the result, swap it into yen, and generally beat yen LIBOR rates. Because cross-border investing has increased, firms with expertise in this area will experience a growing demand for their services.

A corollary to cross-border investing is the growing need for securitization and credit expertise in Europe and Japan. **Table 1** shows the significant diversification in European asset-backed securities (ABS) issuance in 2000. The residential mortgage-backed securities market (RMBS) constitutes a little more than half of the total issuance, with the remainder composed primarily of collateralized loan obligations (CLO), commercial mortgage-backed securities (CMBS), leases, and consumer loans. Europe's ABS issuance was $81 billion in 2000. By comparison, U.S. ABS issuance in 2000 was about $200 billion, and mortgage-backed securities (MBS) issuance was about $400–$450 billion. Although Europe's numbers are not as high as those of the United States, they have increased enough to warrant serious attention.

Table 1 also shows that Japan has been coming on strong in the ABS market. Just as Europe experienced rapid growth during the past eight years in the ABS market, Japan's ABS market is quickly following in Europe's footsteps. Japan is on the front end of the ABS wave—a lot of commercial real estate is in trouble and is headed for securitization. Japan also has many consumer loans that will likely be securitized. I was in Japan in September 2001 and saw the broker/dealers staffing up with people who know the securitization and credit businesses. Teams who have done this work for the past five years in Europe are now being moved to Japan. From an investment

Table 1. ABS Issuance, 2000

Europe	
RMBS	49%
Lease/auto/aircraft	14
CLO	13
CMBS	7
Consumer loans/cards	6
Other	11
Total	100%
Japan	
CMBS	28%
Equipment lease	17
RMBS	16
Auto loan	10
Consumer loans	10
CBO/CLO	10
Other	9
Total	100%

Note: CBO = collateralized bond obligation; CLO = collateralized loan obligation.

Source: Based on data from Morgan Stanley and Merrill Lynch & Company.

management perspective, those firms that understand the intricacies of securitization and credit will be the ones most highly demanded in the future.

Consolidation

The second trend shaping the fixed-income asset management world is consolidation. The market share for the top 20 U.S. asset managers has risen during the 1994–2000 period from about 40 percent to about 50 percent. Consolidation has occurred in part because many firms have simply been merged. But the issue is more profound than just mergers.

During the same time period, the top 20 firms have increased their share of new mandates from 35 percent to 55 percent. These new mandates are being awarded to the larger, multiproduct firms. Understandably, the largest plan sponsors favor fewer and broader manager relationships. The industry currently resembles a barbell, with the bigger firms on one end and the smaller niche firms on the opposite end. While the large firms focus on scale, distribution, and franchise building and emphasize low management fees, the smaller firms, mostly hedge funds, emphasize high-margin business and spend little time on long-term franchise building. Thus, many larger firms are significantly influenced by the distribution side of the firm, whereas smaller firms tend to concentrate relatively more on building a better mousetrap (concentrating on the investment side), an effort that is driven by the investment managers. The recent barbell phenomenon of firm size in the fixed-income asset management industry mimics a similar market pattern that has occurred in the banking industry.

For firms falling somewhere in the middle of the size barbell, such as Smith Breeden Associates, surviving in the same water where the big fish feed is a challenge. As an alternative to merging and in order to gain a greater competitive advantage, smaller and mid-sized firms are seeking strategic partners for collaboration and for access to investment skill, distribution, and capital. The ability to manage these types of business alliances has grown in importance. For example, Smith Breeden focuses on investment skill. We chose our spot in the market and have achieved excellence in that area, and to play the rest of the game, we collaborate. Subadvisory relationships have been around for a long time, especially for retail asset management firms that subadvise on assets for other retail firms. In recent years, the retail asset management business has become dominated by huge retail-oriented firms, such as Fidelity Investments and the Vanguard Group, with massive distribution capabilities. A new and interesting variation on the subadvisory relationship is for a primarily institutional, mid-sized firm, such as Smith Breeden Associates, to penetrate the retail side of the business with the goal of competing for defined-contribution assets by gaining distribution through a corporate or public plan sponsor. This type of collaboration helps smaller or mid-sized asset management firms compete with firms that have more-powerful distribution channels.

The fund-of-funds business is another way to get wider distribution at a low cost. Money has been pouring into the alternative asset classes, but many plan sponsors worry about giving money to a single manager that might have, say, two senior people in the firm and not much firm infrastructure. Rather than trying to find several strong individual hedge funds to invest in, the better alternative is a central outlet, a fund-of-funds that will perform the due diligence and administration.

Access to capital is another important factor in the partnering, or collaboration, that is occurring in the fixed-income asset management business. A good example of this phenomenon is the collateralized bond obligation (CBO) market. Many firms that would like to issue a CBO do not have access to the equity capital necessary for the deal. If this challenge can be overcome through collaboration with a partner with access to capital, the CBO can provide a great distribution opportunity for the asset management firm because the broker/dealer that underwrites the

transaction typically also handles the distribution of the bonds, which are 95 percent of the deal. Thus, the asset management firm focuses its effort on managing the assets (its comparative advantage) and the broker/dealer focuses on the distribution of the bonds (its comparative advantage). If the bonds are managed successfully over time, the provider of the capital receives a healthy return and all the collaborators are better off.

For all of these reasons, asset management firms have a growing need to manage strategic alliances. As a result, managers in these firms are spending more of their time managing the various alliances formed in the course of business.

Breadth-of-Product Expertise

A third trend in the market is the breadth-of-product expertise that has become a prerequisite for a fixed-income asset management firm's success. As an example, a typical ABS collateralized debt obligation (CDO) reveals the extent of the breadth needed. Some of the major asset groups that are considered standard fare include aircraft and equipment leases; CMBS; credit card and automobile receivables; franchise, restaurant, and food service receivables; home equity loans; manufactured housing; and residential mortgages. To achieve the required diversity scores for these deals, however, some combination of a variety of minor asset groups must also be represented: for example, bank-guaranteed or wrapped obligations, CBOs and CLOs, health care receivables, mutual fund fees, REIT (real estate investment trust) debt securities, student loans, tax liens, timeshares, and tobacco settlements. The economics of these securities can be attractive from an investment manager's standpoint.

The amount of infrastructure required to manage the diversity of these assets has made risk management and compliance critical elements in the management of investment firms. The widening scope of products has pushed firms into less familiar areas, thus increasing business (legal and financial) risk for asset manager and client portfolios. Moreover, the lack of uniformity in many OTC instruments makes pricing, risk management, and accounting more difficult and costly to centralize. Counterparty and vendor risks have grown in size and complexity, and as a result, risk management systems have increased in importance and complexity. Compliance challenges must be faced as well. Because of these considerations, asset management firms are beginning to look more like the sell-side firms of the 1980s, when securitization started rolling at high speed and sell-side firms worked hard to keep up with the infrastructure required to manage all the new securities being issued. The asset management firms do not yet have the large infrastructure that the sell-side firms have acquired, but they are comparable in terms of the plethora of assets they are asked to manage. Maintaining the infrastructure at the level currently demanded by the business has been difficult for the asset management industry.

So, the implication for the investment management firm that arises from the need for broad product expertise within the firm is that well-functioning and diverse product teams are imperative. At Smith Breeden, we spend much more time now building links between portfolio management and research: Our goal is to coordinate the focus of both teams—their thinking, incentives, and methods—and to enhance their exchange of information to aid internal communication so that whether we are talking to a research analyst or a portfolio manager, we hear the same opinion and strategy. One of my colleagues, who manages fixed income for one of the largest investment management firms in the world, said he was similarly trying to coordinate his technology people and portfolio managers. In both cases, our goal is for the incentives in the organization to encourage multiple teams to work toward the same end. If the portfolio managers and analysts sit in the same meetings, they are more likely to communicate in the same way. The aim is to get these diverse teams to function as one.

For a firm to succeed, it needs good business managers who understand the markets, analytics, and technology and who have the wherewithal to handle the regulatory and compliance issues along with everything else. A firm cannot specialize in every aspect of the market, but it must be able to understand and react to changes in any one of those areas in order for its products to be successful. Increasingly, we are looking for managers with those types of skills and that type of mind-set.

Product Design

Of the issues under discussion, product design development is the least path-breaking in the fixed-income landscape. Nevertheless, product design, client guidelines, and investment management interests merge in several areas, such as benchmark proliferation, the use of assets outside of the client's benchmark, and defining risk limits.

We are in discussions with clients on a day-to-day basis because of benchmark proliferation. After doing their asset–liability studies and choosing the benchmark they believe best matches their liability stream, clients come to us with the benchmark they want us to manage against. Our clients have been performing increasingly sophisticated asset–liability

studies and will sometimes choose radically different benchmarks. More often than not, even though a client may recognize that the firm cannot manage against too many different benchmarks, clients perceive themselves as special and want us to make an exception for their benchmark. In a few cases, this demand is understandable, but if every client had a special benchmark, we would be managing against dozens and dozens of different benchmarks and the quality of our service, not to mention our performance, would fall. The battle to keep these opposing views on benchmarks in check creates a tension that will persist between those of us who actually manage against the benchmarks and the clients who want us to manage against them. This tension will never disappear.

Managing out-of-benchmark assets is another product-design issue that the industry is wrestling with. Many of the most widely used benchmarks do not include the newest products and market developments. Managing these newer products that are not included in most client benchmarks can be highly profitable because few managers are either willing or able to deal with the challenges associated with the pricing and management risks of these asset groups. With out-of-benchmark assets, however, the manager must constantly go back to the clients to ask for permission.

Clients, not surprisingly, will frequently respond with apprehension when approached about venturing into new investment product areas. Adding more out-of-benchmark assets is an educational process for both managers and clients. The manager wants to cook up excess returns in client portfolios, and the recipe for the special sauce calls for many seemingly odd out-of-benchmark assets. The result is a constant negotiating process between client and manager about exactly how much special sauce the manager can use. As managers have sought to include a growing proportion of out-of-benchmark assets in core fixed-income strategies, the notion of core-plus strategies has become quite popular. Depending on the manager's skill set and the client's appetite, the "plus" in core-plus can be anything from high-yield and emerging market debt to structured debt securities, such as CBOs.

Another challenge with product design is setting boundaries on the amount of risk a client wants to bear. Even a concept as straightforward as leverage can be hard to define. For example, if I manage $100 million for a client who wants to invest in MBS, I can simply pay cash for the securities and then let them sit with a custodian. Most people would agree that the transaction I just described involves no leverage. Alternatively, I could gain the exposure of those MBS by buying them forward. If I do the transaction in the forward market, I can make the agreement today to take on the MBS exposure, buying them on a to-be-announced basis. Over the course of the month, I have the $100 million of MBS exposure but have not put up any cash. The cash remains "uninvested." The question is: Does this transaction constitute leverage because I have both $100 million in mortgage-backed exposure and $100 million in cash? Most people would say that is not leverage. If the client allows for some flexibility with the cash, I can extend the duration of the cash and perhaps enhance the yield by investing in commercial paper instead of cash until I have to pay for the MBS. In that case, during the month, I would have $100 million in mortgages and $100 million in commercial paper, which is almost cash but carries a little credit risk. Again, is that leverage?

Exactly how much latitude I can get on investing the cash depends on the negotiation process with the client. Different clients have different comfort levels, but the more latitude I can get on managing the cash, the better the returns will generally be. At the same time, however, each time the definition of cash is stretched, the transaction generally also involves more risk. Eventually, in pushing the boundaries of how cash is defined, I reach the point at which the MBS-and-cash-alternative combination constitutes leverage in the client's mind, and if the client will not agree to leverage, then I cannot use that strategy.

Clearly, defining a concept as simple as leverage can be complicated. The discussion can be boiled down to how much risk or exposure a client is targeting. Actually, the metric of leverage is only a rough proxy for a set of more fundamental economic exposures that defines the risk of a fixed-income portfolio (i.e., interest rate duration, sensitivity to interest rate volatility, sensitivity to changes in the slope of the yield curve, and so forth). Typically, clients define the set of exposures they are seeking to target by dividing the portfolio into buckets for each acceptable asset class and then specifying how much of each asset class can be put into each bucket. For instance, 20–40 percent of the portfolio can be invested in MBS, 10–20 percent can be invested in investment-grade U.S. corporates, and so forth. Although this approach is a convenient shortcut to specifying exposures, it is not accurate. Moreover, it can at times conflict with a manager's ability to fully take on desired economic exposures in the most cost-effective asset class.

For example, a client might prohibit all derivatives in a portfolio because she feels that derivatives are frequently used with leverage and she wants a "low-risk" strategy. Now, suppose that at some point, interest rate volatility looks expensive. In anticipation

of interest rate volatility falling, the manager decides to short volatility. Ideally, the manager might prefer simply to write options. If derivatives are prohibited in the portfolio, however, the manager might instead buy MBS that will tend to outperform in a falling volatility environment. So, the manager has found a way to work around the constraint, but that solution might be an inefficient way to trade volatility because the manager has taken on other risks by buying MBS, and those risks might be difficult to hedge. In this case, the client might have been better off by specifying for the manager her desired total variability of portfolio returns and then allowing the manager to choose the most effective set of securities to achieve the desired results.

This point generalizes to all measures of risk. The economic exposures—the duration, spread duration, convexity, prepayment risk, and so forth—are the true measures that define the risk of a portfolio. Ideally, the client does not tie the hands of the portfolio manager or the investment firm by specifying the buckets for each permissible type of security. Rather, the client specifies the range of economic exposures that the manager can take and then the manager chooses the mix of securities that most efficiently accomplishes the portfolio objectives. Over time, this mix of securities will change, sometimes radically, as market conditions change. In delving into these discussions with clients, our client service managers have to know as much about the characteristics of the various securities, portfolio exposures, and risk management as our risk managers so that they can educate clients about these issues and negotiate these parameters with them.

Conclusion

Over the next several years, as the investment management industry continues to experience significant growth, several issues will require careful attention. Globalization is perhaps the most important. The trend toward cross-border investing, with an increased focus on securitized and credit-sensitive securities, will be a hallmark of the next decade. Firms with skills in these areas will almost certainly gain a competitive advantage. Another set of important issues for the industry will be consolidation and collaboration. As was the case in the banking industry, this set of issues will touch almost all firms. Successful firms will be ones that deal with these issues proactively. Specifically, for firms in the middle of the size barbell (neither large multifaceted firms nor small niche players), collaboration issues should be at the forefront of their strategic agendas. Finally, as more products are managed by fixed-income asset management firms, many firms will find it difficult to expand their infrastructure at the required pace. To be sure, these new product areas provide exciting opportunities, but investors and managers should not underestimate the risks associated with managing new, diverse, and illiquid asset groups.

Question and Answer Session

Eugene Flood, Jr.

Question: How important is capital in the investment management business?

Flood: Capital is of critical importance because of the need for infrastructure. Clients are requiring more infrastructure, and asset managers need more infrastructure to handle risk management and meet compliance guidelines. These things are expensive. We have also discussed globalization, which is another expensive proposition but one that can be handled in steps. The first step is sourcing assets globally, and the second more complicated step is investing globally. The third step is putting offices overseas. Each one of these steps is expensive, but the third is the most costly.

Question: Why collaborate instead of merge?

Flood: The primary driver of a collaborative relationship (versus merging) is flexibility. By collaborating, a firm has the flexibility to pursue things that might not be possible if it was formally merged with another firm. A difficult issue is making sure that incentives are aligned between the two partners so that both are working together in every way possible. In larger organizations, a struggle can ensue because collaboration can affect brand recognition in the marketplace. For example, PIMCO Advisors and Nicholas-Applegate Capital Management are now under the same umbrella but have decided to keep the PIMCO brand separate from Nicholas-Applegate. They collaborate in certain areas yet maintain some separation.

Question: How receptive are clients to the idea of using risk exposures, or perhaps tracking error, in defining investment guidelines rather than buckets?

Flood: Right now, most clients prefer using the bucket approach in their guidelines. But I expect that using risk exposures to define risk will become a reality. If you had talked to market participants 20 years ago and asked, "Would you be willing to negotiate the guidelines for your account based on a notion like beta?" they would have likely said, "No, that idea seems pretty theoretical and academic." But the concept of beta has come rather far. Over time, as such economic notions are digested and refined by the investment community, they become more and more useful. The risk exposures concept is moving in that direction.

Question: To what extent do regulatory agencies need to sharpen guidelines on leverage, and how far behind are they in doing so?

Flood: Regulatory agencies should probably not be involved in specifying acceptable leverage levels, because when people talk about leverage, they often mean the amount of risk that they want to take. But leverage does not equal risk. For example, you could use quite a bit of leverage when buying, say, eurodollar futures contracts and not get much risk, whereas in leveraging Nasdaq stocks, you could get a lot of risk. It is hard to take a notion as simple as leverage and use it to express the concept you really want to address, which is the variability of returns. So, leverage would be difficult to regulate, and focusing on it would not be a wise path for regulatory agencies to follow.

Issues and Trends in Fixed-Income Portfolio Construction

Peter J. Knez
Chief Executive and Science Officer, Incapture LLC
Adjunct Professor, Northwestern University
Chicago

Quantitative portfolio construction tools are best used to enhance the quality of intuitive judgments, not to supplant such analysis altogether. Recent advances in the technology available for the construction of modern fixed-income portfolios have enabled dynamic extensions of the traditional, static mean–variance model. These changes constitute a critical development because research shows that nonnormality and nonlinearity exist in financial time series, which are phenomena that cannot be accommodated in traditional mean–variance analysis.

This presentation addresses recently developed tools and methods in fixed-income portfolio construction and the trends expected in the next 3–5 years. Looking ahead, I anticipate rapid improvement in the applicability of techniques and methods of portfolio construction. Although to call the next several years a renaissance period would be an exaggeration, the period will likely be characterized by rapid growth in terms of the applicability of quantitative tools or methods.

Developments in Modern Fixed-Income Portfolio Construction

Five major developments have occurred in the construction of modern fixed-income portfolios. First, the rapid increase in computational power has brought about a dramatic improvement in the tools available for portfolio construction. Limited computational capacity used to be an enormous restriction on the practical applicability of many conceptual tools.

Second, new software, together with computational advances, has made model simulation much easier. As a result, managers do not have to rely on closed-form models. Closed-form models make such strong assumptions that their applicability in practice is limited.

Third, as Laurence Smith mentioned, the availability of data—good, daily, high-frequency, fixed-income data (other than for government bonds)—is crucial.[1] Market dynamics cannot be studied and modeled if no data are available. Being able to get good data about corporate credits on a daily basis, for example, is a relatively new development. Some of the figures in this presentation make use of data that have only recently become available.

Fourth, in the past 10 years, the profession has learned much more about economic and market dynamics. As a student, I was trained in mean–variance optimization and the capital asset pricing model (CAPM), which were static one-period models. Students would ask how these models worked in practice, and the answer was to think about the model as being repeated—that is, the means and variances would consistently be repeated. Over time, however, the economic environment evolves rather than repeats. Features from the past repeat, but new, crucial characteristics occur each period. Significant progress has occurred in our comprehension of market dynamics, so we now understand that stationary assumptions are too restrictive. The advances made in understanding and in modeling will make their way into the portfolio-construction process in the next five years.

The final development, and one with great potential benefit to investment decision making, is the improvement in the way the past is visualized. Portfolio managers have to form judgments based on the past, place bets in a portfolio, and monitor the

[1] See Mr. Smith's presentation in this proceedings.

performance of the bets. Wall Street uses historical charts and tables to justify and explain their judgments to investors.

With improvements in bandwidth, datastreaming, visualization, and software, both managers and clients will become much better and faster at viewing, monitoring, and comparing past market movements to form relevant judgments regarding the future. For example, in the wake of September 11, investment professionals had to continue managing their clients' portfolios. Most managers probably turned to charts as the most obvious tool to compare the 1990–91 market with the 2001–02 market and then to look back at the 1960s, 1940s, and so on. In the future, with the benefit of more advanced software and visualization techniques, this task will be performed in a much more sophisticated way.

Improvements in investment tools and the way managers use these tools will help managers form judgments and construct optimal portfolios. To provide a perspective on recent developments in fixed-income portfolio construction techniques, I will begin where modern portfolio construction begins—with the Markowitz mean–variance framework and its more modern expression in value-at-risk (VAR) terms. I will then address these models' limitations and extensions. I will also illustrate some of the newer portfolio-construction tools in a case study about the credit market using high-grade corporate bonds and then conclude with a discussion of the future direction in portfolio-construction techniques for fixed-income portfolios.

The Markowitz Mean–Variance Framework and VAR

The well-known portfolio construction scheme is $\underset{\beta}{\text{Max}}\ \beta' E(R) - (\gamma/2)\beta'\Omega\beta$, where

- β = $n \times 1$ vector of investment judgments
- α = excess return relative to benchmark so that $\alpha = \beta' E(R)$
- γ = relative risk tolerance for tracking error
- τ = tracking error so that $\tau^2 = \text{VAR}(\alpha) = \beta'\Omega\beta$

Most investment managers run their portfolios relative to a benchmark, so their goal is to find a set of investment judgments (i.e., beta) to maximize their alpha (i.e., portfolio return relative to a benchmark). In essence, managers are trying to earn the largest possible alpha relative to portfolio tracking error and want to make this alpha systematic.

In theory, this is a relatively straightforward exercise. For example, a mean–variance optimization is a common approach for tackling this problem. **Table 1** illustrates a two-sector mean–variance optimization for which a manager needs minimal inputs. In an "unadjusted" straight mean–variance optimization using the mortgage/agency and corporate sectors, if the manager chooses reasonable spreads and a reasonable correlation and risk tolerance, the result is to allocate all resources to the corporate sector. Reiss, Trainer, and Uysal went through this exercise and explicated the limitations of straight mean–variance optimization.[2] Using this quantitative tool in accordance with risk tolerance to achieve mean–variance optimization by trading off alpha for tracking error skews the portfolio toward corporates. Most managers would be suspicious of such an allocation. The reality is that the standard mean–variance optimization is an insufficient quantitative tool. Managers are forced to apply their judgment and experience to the allocation decision and adjust the output of the model, which in this case is a 100 percent allocation to the corporate sector.

Table 1. Mean–Variance Optimization: A Two-Sector Illustration
(with a sector correlation of 0.8 and a risk tolerance of 25)

Sectors	Spread	Volatility	Scenario	Allocation
Mortgages/ Agencies	85 bps	31 bps	60	0%
Corporates	170	42	120	100

This simple framework assumes that dispersion or risk is well approximated by the standard deviation of returns. Therefore, the model tacitly states that the standard deviations are equally good approximators of the dispersion in both sectors (corporates and agencies), despite different contracts and levels of government involvement supporting the debt service of the two sectors. In addition, even if the manager alters the model's parameters by changing the expected corporate spread change and adjusting the correlation, the model will nonetheless produce the rather dramatic allocation to corporates. This effect is a limitation of the mean–variance framework when purely applied, which is why it is not used in practice and scenario analysis is preferred.

VAR, Risk Budgets, and Scenarios

More recently, analysts have expressed the mean–variance framework in terms of a standard VAR analysis, which indicates the probability of a given amount of loss over a given horizon. VAR analysis

[2] Jonathan Reiss, Francis H. Trainer, Jr., and Enis Uysal, "Revisiting Mean–Variance Optimization," *Journal of Portfolio Management* (Summer 2001):71–82.

asks: What is the monetary risk associated with a given portfolio? This question has two dimensions: the confidence level desired by the manager regarding the probability of loss for a given horizon and the magnitude of the expected loss. The function of the risk budget is to limit the probable loss to an acceptable level, and the function of the confidence level is to control the expected frequency of loss.

For example, if I pose a risk budget of, say, 25 bps, I do not want to underperform my benchmark in any given month by more than 25 bps. And if I want to be 98 percent confident I will not violate the risk budget in the context of the central scenario (moderate volatility and minimal spread narrowing), the top panel of **Table 2** shows the acceptable spread duration (the sensitivity of the corporate bond price to a change in its credit spread) for a given forecasted volatility (15 bps) and spread change (–5 bps). In other words, the expected return distribution of the portfolio is characterized by volatility (standard deviation) and spread change. If, on the other hand, I am happy with a confidence level of 85 percent, I would be accepting more spread duration and hence more volatility but I would be expecting a higher return. The second and third panels in Table 2 capture the market under two other scenarios: Alternative A, a high-volatility and market-sell-off scenario, and Alternative B, a low-volatility and slow-spread-narrowing scenario.

Table 2. VAR, Risk Budgets, and Scenario Analysis

Degree of Confidence in Satisfying Risk Budget	Acceptable Spread Duration	Portfolio Volatility	Expected Return on Portfolio
Central scenario			
85	3.7	56 bps	18%
90	2.8	42	13
95	2.0	30	9
98	1.5	23	7
Alternative scenario A			
85	1.3	26	–13
90	1.1	22	–12
95	0.9	18	–10
98	0.8	15	–8
Alternative scenario B			
85	4.7	47	9
90	3.6	36	7
95	2.7	27	5
98	2.1	21	4

Mean–variance optimal portfolios, or efficient portfolios, can be reexpressed in terms of the probability of loss of a given amount for a certain horizon by simply turning the problem around and using the estimated return distribution for a given level of volatility to quantify the risk budget. This change allows the manager to express how much risk can be put in a portfolio. Of course, if the estimated return distribution is wrong—if a different distribution comes to pass in the next nine months—the risk budget may well be violated. This potential for error is the problem that has to be resolved. In a sense, risk management is inherently a forecasting problem, not an inference problem. The problem is not about estimating parameters in a regression. It is about forecasting a distribution that will hold over a given horizon and whether that dispersion is well approximated. If the forecast is correct, portfolio performance is likely to fall within the expected parameters. If it is wrong, performance will suffer. Well-known examples exist of hedge funds that operated with the wrong dispersion estimate, and the outcome was unfavorable. In particular, the tail of the distribution was much thicker than anticipated, which means the dispersion was not well approximated by the standard deviation. An accurate forecast requires more than the standard deviation.

Benefits of a Formal Mean–Variance Framework

Harry Markowitz changed the way the profession thinks about stock selection. His powerful—and simple—insight has had three primary benefits. The first benefit is that he reframed the entire stock-selection problem. As a student, when I initially learned about mean–variance analysis, or diversification, and the concepts that go along with modern portfolio theory, I was amazed. I interpreted these concepts as meaning that if stocks or bonds were grouped together in a portfolio rather than each being managed in isolation, a benefit would accrue in almost every case. Rather than simply picking stocks without regard to their relationship with other stocks, building portfolios of stocks is a smart idea.

The second benefit is that Markowitz's approach is computationally simple. At the advent of modern portfolio theory in the 1950s and 1960s, computations were made with slide rules and basic computers, so any approach had to be simple enough to conform to the technology of the time; if the computations were too complicated, the approach simply could not be done.

The third benefit is that Markowitz provided structure to a research agenda aimed at testing and

generalizing the stock-selection framework. Markowitz's mean–variance analysis established the structure for later advances in portfolio construction.

Limitations and Extensions

Unfortunately, for all the benefits associated with mean–variance analysis, the single-period stationary framework is conceptually and empirically insufficient. Conceptually, the stochastic dynamic program developed by Merton and Sharpe suggests that optimal asset allocation depends on time and market conditions.[3] These conceptual models generalize the static, stationary framework, but they have not been used much in practice. In the past 10 years, the academic profession has moved away from the view that the world is stationary and returns are constant—that debate has largely been resolved.

Empirically, strong evidence supports the existence of time-varying investment opportunity sets and the predictability of returns (as shown by Klemkosky and Bharati, Lo, and Alt-Sahalia and Brandt)[4], and such conditioning information should be used to form portfolios. For example, managers who want to forecast the economy or market outcomes over the next nine months can use conditioning information; they can, for instance, incorporate their opinion of the low probability that the Fed will raise rates in the next three to four months.

Despite the great increase in complexity in mean–variance and VAR frameworks that limits their practical use, recent advances in computing power and simulation technology will reduce the need for dimension reductions and increase applications.

Important extensions of the mean–variance and VAR frameworks are found in two main areas: first, quantitative information and, second, normality and linearity.

Quantitative. There are three main quantitative extensions of the frameworks: Bayesian priors, behavioral decision making, and predictive distributions.

- *Bayesian priors*. On a day-to-day basis, managers incorporate their subjectivity into the judgments they form and the judgments they put in portfolios—not only because they are paid to make these judgments but because they think they know something about the market that is not fully priced. The standard mean–variance framework did not have a vehicle for expressing subjective views and applying them in the construction of an optimal portfolio. The fact of the matter is that some individuals' subjectivity should probably be celebrated, not excluded. Some managers are good at connecting the dots, and with relatively little information, some managers can form judgments that have practical value. The process that these managers use can be quite analytical, even though it is unspecified. Thus, a framework is needed that allows managers to apply their judgments in a consistent and flexible manner.

  The earliest work on developing such a framework was probably the Black–Litterman model.[5] Recent advances in simulation have greatly improved the applicability of Bayesian analysis, but more work is needed because Bayesian analysis requires significant computing power and simulation technology. Bayesian analysis is still too restrictive, particularly the priors, but this situation is changing quickly.

- *Behavioral decision making*. Behavioral decision making involves the incorporation of nonexpected utility maximization, such as prospect theory's loss aversion and rules of thumb for portfolio optimization schemes, as in the behavioral portfolio theory set forth by Shefrin and Statman in 1994.[6] The debate has evolved so that managers are now generally open to the idea that behavioral decision-making rules can be valuable and should be incorporated in portfolios. The possibility of behavioral decision making was outside the Markowitz framework.

- *Predictive distributions*. Finally, as I mentioned, managers sorely need a quantitative framework that helps guide their judgments about an expected return distribution over a given investment horizon. Is dispersion measured well? Is return measured well? And how should the manager form the portfolio described by that dispersion? The predictive distribution summarizes the information in the prior distribution, the likelihood, and the observed data for future observations. In the future, the emphasis will be on explicit judgment formation and forecasting.

The Markowitz framework is a frictionless model that has certain limitations, not the least of which

[3] Robert C. Merton, "An Intertemporal Capital Asset Pricing Model," *Econometrica* (September 1973):867–887; William F. Sharpe, "Integrated Asset Allocation," *Financial Analysts Journal* (September/October 1987):25–32.

[4] Robert C. Klemkosky and Rakesh Bharati, "Time-Varying Expected Returns and Asset Allocation," *Journal of Portfolio Management* (Summer 1995):80–88; Andrew Lo, *Market Efficiency: Stock Market Behavior in Theory and Practice* (London: Edward Elgar Publishing, 1997); Yacine Alt-Sahalia and Michael W. Brandt, "Variable Selection for Portfolio Choice," *Journal of Finance* (August 2001):1297–1349.

[5] Fischer Black and Robert Litterman, "Asset Allocation: Combining Investors' Views with Market Equilibrium," *Journal of Fixed Income* (September 1991):7–18.

[6] Hersh Shefrin and Meir Statman, "Behavioral Portfolio Theory," Working paper, Santa Clara University, 1994.

affects corporate bond investors. Corporate bonds can be highly illiquid and thus limit the practical use of mean–variance and VAR analysis. A manager cannot optimize a portfolio without incorporating some notion of liquidity in the form of bid–ask spreads.

Normality and Linearity. Normality, which is probably the most popular of the possible distributions, is used frequently in VAR and mean–variance optimization technology. Much evidence has been produced by Wall Street, notably J.P. Morgan Chase & Company, as well as academics, on the excess kurtosis and skewness relative to a normal distribution.[7] Excess kurtosis and skewness have a profound impact on many commonly used, standard portfolio-construction tools. The problem affects Sharpe ratios, mean–variance optimization, VAR, measures of correlation, and even bootstrap analysis. Bootstrap analysis breaks down when there is a heavy tail distribution. A heavy tail distribution is a disruptive empirical phenomenon to the standard tools.

Empirical evidence suggests that the dynamic behavior of financial time series varies in different regimes.[8] Basically, scenario analysis specifies regimes. Managers say, Well, I think this regime or that regime might happen, because they think the world will be different if one regime plays out versus the other. Managers would like to be able to explicitly incorporate that expectation into the portfolio-construction process. Techniques are being developed now that make such an approach possible, which will increase the applicability of scenario analysis.

Credit Market Illustration

Thus far, I have discussed where we have been, the paths we are likely to take in the future, and the reasons behind taking those paths. This section illustrates how some of these techniques can be applied in augmenting the standard kind of VAR or mean–variance framework. I also address the torpedo problem—that is, the rapid perceived deterioration in fundamentals that causes a sudden corporate-spread widening.

Consider these issues in the context of a theoretical portfolio assignment: to outperform the Salomon Brothers Broad Investment Grade (BIG) Index by 25 bps. The manager can choose among three asset classes (agencies, mortgages, and high-grade corporates) and three industries (industrials, utilities, and financials) and can do credit analysis to aid in security selection. Suppose the manager had a position in J.C. Penney Company bonds whose option-adjusted spread (OAS) widened by 400 bps from October 1999 to April 2000. Beginning as early as the fall of 1998, some investors investing for the first time in or already holding the J.C. Penney bond may have watched the spread continue to widen, comforted by their opinion that the spread was wide by historical standards.

As **Figure 1** shows, however, the already historically wide spread blew out as the months progressed, which is why the torpedo problem can be devastating to a portfolio. The reason the normality assumption in the estimated dispersion is so inadequate is that for an investor who held J.C. Penney bonds in October 1999 and in April 2000, the 400-bp-wider OAS impacted the portfolio by producing a loss of 43 bps in yield. The portfolio exposure can be calculated in the following way:

Portfolio exposure (0.108 years) =
$Spread duration of portfolio (1 percent × 12)
– $Spread duration of index (0.2 percent × 6).

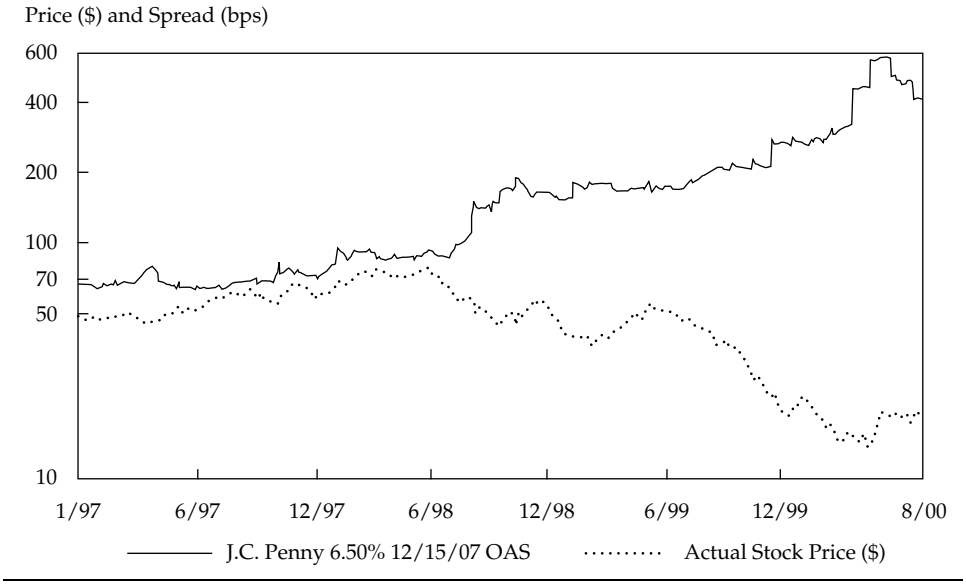
So, a manager who had a 100 percent allocation to corporates, as indicated by the standard mean–variance optimization, and who had to beat the index by only 25 bps would have found that one torpedo from the bond of a traditional retailer (in particular, the J.C. Penney bond) would have destroyed the portfolio's performance. The standard optimization lacks some important information.

Contingent Claims Approach. I want to consider a contingent claims approach to corporate bond valuation. Merton's contingent claims approach is based on the concept that holding a corporate bond is the same as being long an equivalent riskless asset and simultaneously short a put option with a strike price equal to the nominal value of the bond. We can analyze corporate bonds by looking at the equity market and evaluating the walk-away option; in other words, the owners of the firm have the option to walk away from their equity interest and leave the company with the bondholders. The formal payoff equivalence means the value of the default option on the risky bond—and hence corporate spreads—depends on five variables: the market value of the firm's assets, the face value of the loan, short-term interest rates, the volatility of the market value of the firm's assets, and the maturity of the bond. For example, an increase in the volatility of the underlying assets increases the price of the put option, thus reducing the value of the corporate debt and causing

[7] See, for example, Philip Hans Franses, *Time Series Models for Business and Economic Forecasting* (Cambridge: Cambridge University Press, 1998).

[8] Philip Hans Franses and Dick van Dijk, *Nonlinear Time Series Models in Empirical Finance* (Cambridge: Cambridge University Press, 2000).

Figure 1. J.C. Penney: Stock Price and Spread, January 1997–August 2000



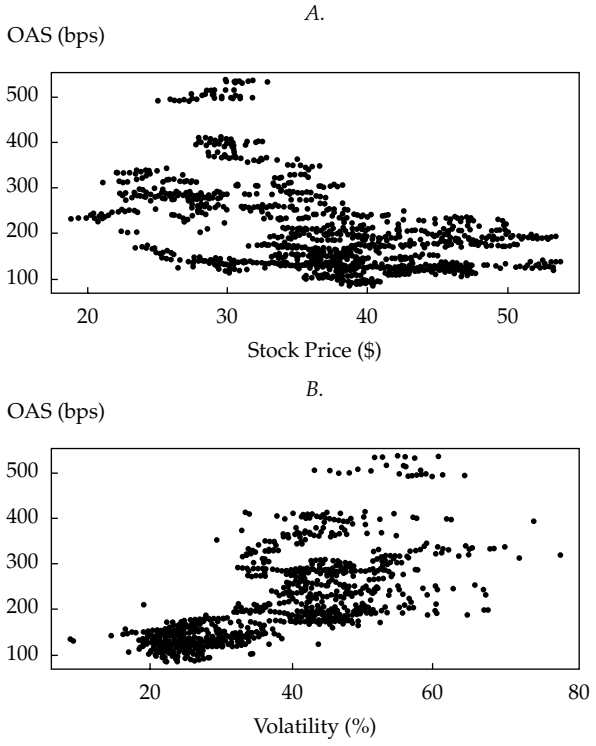
the corporate spread to widen relative to the Treasury rate.

To understand how these variables relate to the OAS, consider a visual analysis using Georgia-Pacific. In Panel A of **Figure 2**, the stock price and OAS seem to be related, although in statistical terms, this relationship is highly heteroscedastic. In other words, the dispersion gets wider as the stock price falls. Panel B of Figure 2 shows that as volatility rises, the OAS also rises and that this relationship is also highly heteroscedastic.

A better visual analysis of the explanatory variables arises by plotting debt to market capitalization and price to volatility (P/V), as shown in Panel A of **Figure 3**. Think of volatility as a measurement of the market's assessment of the future uncertainty of earnings and the price the investor is willing to pay for the uncertain earnings stream. The torpedo environment is the walk-away environment, the environment in which the market is not willing to pay much for the earnings relative to the volatility. Thus, P/V captures the willingness to pay versus the uncertainty about the revenue streams. In Panel A of Figure 3, a tight relationship is obvious between P/V and leverage. This relationship seems encouraging. Look at P/V compared with the OAS, which is plotted in Panel B of Figure 3. This figure graphs the willingness to pay versus the uncertainty of the revenue stream. After P/V falls below 1, the probability of a wider OAS is much higher.

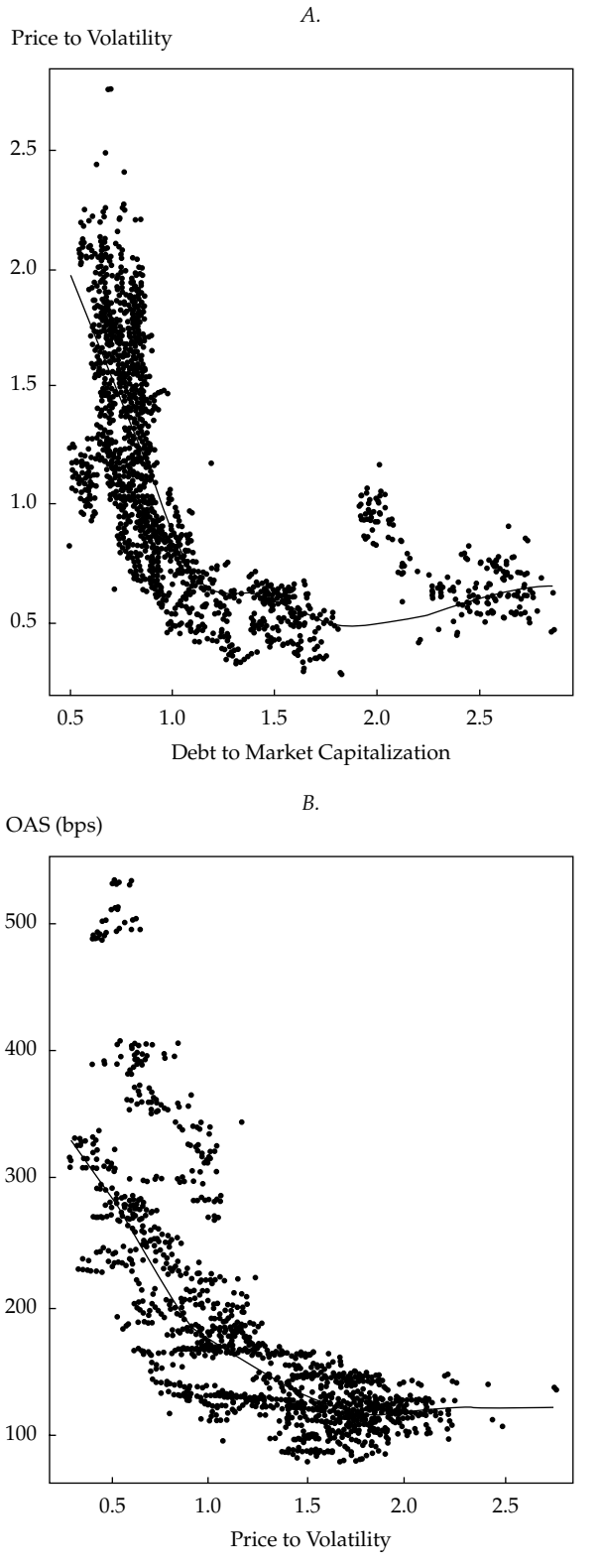
As investors, we are seeking some type of indicator, some kind of threshold that might denote, for example, a change in regime—an abrupt change in which the market moves, rightly or wrongly, a credit's spread much wider. Investors need a model or tool that reacts quickly to regime shifts and is easy to compute (unlike financial accounting data, for which a lag exists between the initial market reaction and the indication from the data).

Figure 2. Visual Analysis of Explanatory OAS Variables for Georgia-Pacific



When the P/V (Panel B of Figure 3) falls below the threshold of one, the OAS distribution has a much higher probability of wider spreads. In particular, the

Figure 3. Visual Analysis of Explanatory OAS Variables: Debt



spread distribution constructed from OAS observations with a P/V below 1 has much fatter tails.

Regime-Switching Models. Managers can also move to regime-switching models. These models have state-dependent dynamic behavior, such as the mean, variance, or autocorrelation, that depends on a particular regime. The probability of spread widening depends on a regime that can be determined by the threshold variable, P/V. In other words, there is another scenario that the manager has to worry about. If alternative scenarios can be incorporated into portfolio construction by viewing regimes as scenarios, the analytical framework can integrate scenario analysis into spread forecasting. If portfolio optimization is conducted with stochastic regime switching, the asset allocation will change dramatically because it will be calculated as the probability of a distribution that can be highly disruptive to performance.

Extreme Value Theory. Finally, another possible approach involves using one of the newer tools—extreme value theory. Extreme value theory is the analog to the normal distribution in VAR technology and augments the standard VAR with an estimate of the expected shortfall. ES is the expected loss size, given that the VAR is exceeded. Using the generalized Pareto distribution, the distribution of excess losses over a high threshold is given by

$$\widehat{\mathrm{ES}} = \frac{\widehat{\mathrm{VAR}}}{1-\xi} + \frac{\hat{\beta}-\hat{\xi}}{1-\xi},$$

where ξ is the shape parameter and β is the scaling parameter.

This method is concerned with getting a better estimate of the tail of the distribution for the purpose of managing risk, because it is the tails that kill performance. Investors need a threshold to indicate where the tail begins. One approach is to use P/V as a threshold estimator and say, "Okay, when P/V falls within a specific range, that is where the tail of the distribution begins and that will be my measure of risk." The mere standard deviation—or in technical terms, the mere second moment—is not enough to define risk in terms of extreme risk of loss or capturing true underlying risk. The idea would be to apply this concept, as a guide in forming judgments, to a portfolio and thus change the way portfolios are constructed. Extreme value theory improves the approximation of risk by explicit estimation of the tail area of the distribution.

Conclusion

Portfolio construction tools are relevant if they help investors form judgments and monitor those judgments systematically. Simply being quantitative per se is not the answer. Quantitative analysis can cause as many problems as can random judgments. The next few years may not bring a revolution in quantitative investment management, but investors will benefit from rapid growth in terms of the applicability of quantitative tools and methods.

The original, static mean–variance framework was powerful and easy to compute but ultimately incomplete for most portfolio management assignments. The dynamic extensions I discussed are both conceptually important and empirically relevant yet not widely used in practice. Increases in computing power, simulation technology, and data availability will dramatically improve applicability in these areas. Strong empirical evidence supports nonnormality and nonlinearity in financial time series. These phenomena dramatically affect the applicability of the standard risk management and portfolio optimization tools currently being used. Enhancements in visualization tools (providing the ability to visualize dynamics that cannot be written down) will allow investors to maximize the quality of their subjective judgments.

Hybrid Quantitative Strategies

Yong Zhu, CFA
Portfolio Manager
DuPont Capital Management
Wilmington, Delaware

Pure quantitative strategies do not work well in traditional fixed-income portfolio management, but a hybrid model offers a way to exploit investment opportunities and control risk. Such models, by providing a quantitative valuation and risk management framework for fundamentals-based investment analysis, can adequately capture market activity and thus help managers avoid the risks associated with fundamentals-based strategies.

Many pure quantitative strategies are not directly applicable in traditional portfolio management. A hybrid approach that dynamically combines fundamental analysis and quantitative models can enhance investment performance. At DuPont Capital Management, we use such a hybrid method to add alpha and reduce risk to traditional portfolio management.

In this presentation, I first review the differences between fundamentals-based strategies and pure quantitative strategies and the challenges associated with applying pure quantitative strategies in portfolio management. Next, I explore DuPont's hybrid quantitative strategies and how they have been applied. I conclude that successful quantitative portfolio management requires both modeling/programming skills and profound knowledge in fundamental market dynamics.

Fundamentals-Based versus Pure Quantitative

The core strategies of fixed-income portfolio management are fundamentals-based and qualitative. Examples are duration bets; sector allocation among Treasuries, mortgages, and corporates; and strategic or tactical allocation to such core-plus products as high-yield bonds and emerging market debt. Most of these strategies start from fundamental analysis of macro variables—such as the domestic and global economy, monetary policies, fiscal policies, inflation forecast, and commodities trends—so that investors can develop views on these macro dimensions and predict corresponding market implications. Then, investors usually apply statistical, quantitative, or historical analyses, in combination with the portfolio manager's wisdom acquired from market experience, to evaluate investment opportunities and to develop strategies. Most of these strategies represent clear market views and could produce a high return as underlying macro conditions change. Fundamentals-based strategies can generate a good profit but are usually associated with high volatility of return, as demonstrated by the low information ratio for most duration bets.

Pure quantitative strategies, on the other hand, begin with mathematical models. The past three decades have produced significant developments in quantitative modeling. The most important progress is the 1970s Black–Scholes–Merton model for option pricing. In the 1980s, great strides were made in the development of interest rate models. Scientists joined forces with Wall Street to design models and programs to price various complex products, such as interest rate derivatives, collateralized mortgage obligations (CMOs), and (recently) credit derivatives. Wall Street firms have extensively used these models and research in hedging activities and risk management. Since the 1980s, these quantitative models have been applied to develop pure quantitative strategies, such as market-neutral arbitrage trading, starting with Salomon Brothers and Long-Term Capital Management (LTCM).

Examples of pure quantitative strategies include Treasuries/futures arbitrage based on term-structure models, mortgage arbitrage using option-

adjusted spread (OAS) and mortgage-prepayment models, and equity volatility arbitrage from volatility models. These underlying quantitative models typically are developed based on abstract risk factors (such as volatility surface) that have no clear fundamental implication. Thus, pure quantitative strategies usually are market neutral and adopt a mean-reverting methodology. Investors apply these models primarily to identify pure arbitrage opportunities and to control risk dynamically. As a result of quantitative risk management, these strategies usually have high information ratios for a period of time. Pure quantitative strategies, however, tend to blow up in the presence of rare events, secular changes, or early cyclical changes, as shown by the failure of LTCM and many other quantitative hedge funds in recent years.

Challenges of Applying Quantitative Strategies

Despite the significant contributions made by quantitative research to the investment process in recent years, applying quantitative strategies to portfolio management still presents many challenges. At DuPont Capital Management, we have been developing and running security analytics and portfolio risk management based on our proprietary quantitative models, such as multifactor term-structure and mortgage-prepayment models, for the past 10 years. A variety of evaluation and risk models are developed to analyze futures, options, mortgage-backed securities, international bonds, and emerging market securities. In the investment process, we have used quantitative models for security selection and optimization.

It is difficult, however, to effectively apply these quantitative models for the core of fixed-income strategies because fixed-income portfolio management is a macro-fundamentals-based process that always has been—and still is—highly qualitative. Many of those existing pure quantitative strategies were specifically developed for Wall Street trading (the sell side) and take a narrow market focus; they are hardly applicable for buy-side firms. Most of these pure quantitative strategies have no market view (market neutral); their absolute returns are usually small, perhaps 5–10 basis points. Therefore, achieving substantial alpha requires leverage, which is neither popular nor allowed by many clients. Another challenge for pure quantitative strategies is that markets are getting increasingly more efficient because many investors have acquired skills to analyze complex securities. Thus, pure arbitrage opportunities have become smaller and more limited, especially for buy-side portfolio managers.

In 1998, LTCM's explosion illustrated other philosophical problems with pure quantitative strategies, especially those based on a mean-reverting/double-done methodology. The LTCM case reveals huge potential risks for pure quantitative strategies from unexpected secular or cyclical changes or rare events. Pure quantitative strategies tend to work well in a low-volatility environment, but when the unanticipated *tsunami* crashes down on the market, the reliability of mean-reversion collapses.

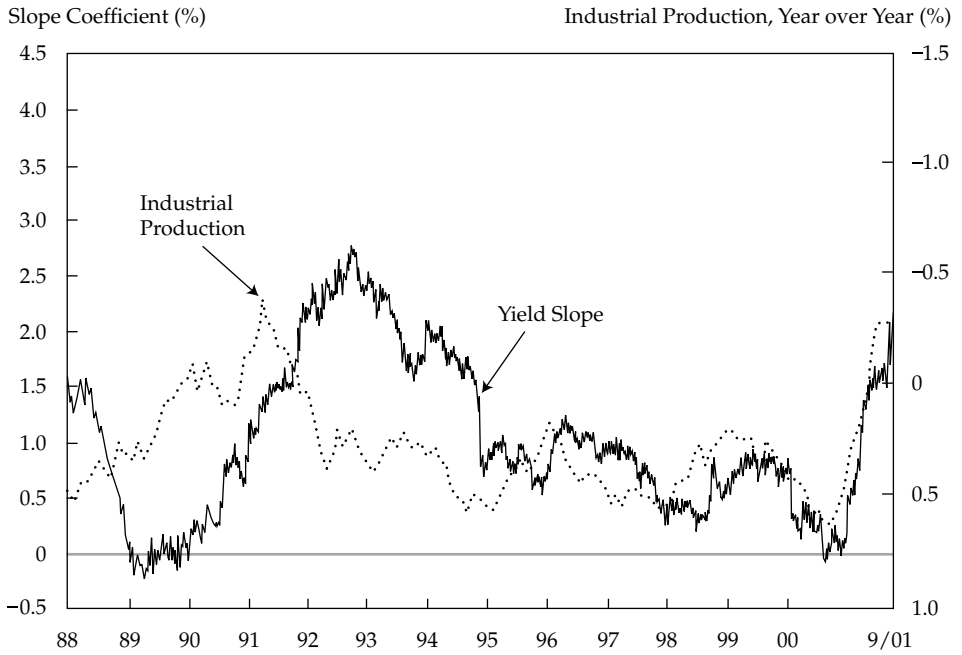
Take a look at a simple example illustrating the problem of pure mean reversion. **Figure 1** plots the slope coefficient (the difference between the short rate and the long rate) of the U.S. Treasury yield curve from 1988 to September 2001 as calculated by a DuPont term-structure model. From 1995 to the beginning of 2001, the slope coefficient exhibits a clear market-neutral mean-reverting pattern. In March 2001, it moved to above one standard deviation, and from a mean-reverting perspective, the model indicated that the market was attractive and cheap. A user of the model would have expected the slope to move lower, back toward the mean. But instead of narrowing since March, by September 2001, the slope coefficient had widened dramatically, bringing a significant loss to any investor who had shorted the slope based simply on its mean-reversion pattern during the past six years.

Extending the data in the model back to 1988 reveals that the slope coefficient is actually cyclical and is highly correlated with the economic cycle. The correlation between the yield-curve slope and the ebb and flow of the economy is easy to see when compared with industrial production (as a proxy for economic strength), which is also plotted in Figure 1. The slope was also historically high in the 1992–93 period, a result of the expansionary monetary policy used to combat the 1990–91 recession. Thus, the short-term mean-reversion relationship of the past six years is merely an *accidental phenomenon*; in actuality, the yield slope is clearly a cyclical parameter. This example illustrates the danger of applying quantitative models without understanding their fundamental implications.

Hybrid Quantitative Strategies

At DuPont Capital Management, to effectively apply quantitative strategies to qualitative fixed-income portfolio management, we have created hybrid quantitative strategies—a combination of fundamental analysis and quantitative models that quantifies the qualitative market dynamics. We developed quantitative models that describe fundamentals-driven market dynamics. We use these models to better exploit traditional fixed-income investment opportunities

Figure 1. Treasury Yield-Curve Slope Coefficient and Industrial Production, 1988–September 2001



and to better control risk. We also use fundamental variables in the quantitative model to reduce the problems of pure quantitative strategies. The hybrid quantitative models provide a quantitative valuation and risk management framework for fundamentals-based investment analysis. Therefore, hybrid quantitative models and strategies can be widely applied in traditional fixed-income portfolio management.

Development. Instead of using existing quantitative models, which are usually inadequate for portfolio management (as I have already explained), we first develop our models for hybrid quantitative strategies. The model creation process starts with fundamental analysis: We try to understand the securities and the markets, from which we isolate the most important variables that influence security valuation. For example, in fixed-income portfolio management, most of these variables are macro variables, such as interest rates, inflation, monetary policy, fiscal policy, and commodity prices.

After the initial fundamental analysis, instead of immediately going to the model with the mathematics and forgetting the fundamental meaning, we create qualitative pictures. The objective of this step is to identify the significant independent variables and to create a raw qualitative model that explains how these independent factors affect the security price and how they interact with each other. Only after we understand these qualitative relationships do we go to the third step. The third step involves framing this whole picture in mathematical terms and assigning stochastic processes or deterministic processes to each of the important risk variables. After the picture has been framed in mathematics, we finally solve the model.

Benefits. Compared with pure quantitative strategies, this new hybrid model has the following advantages:

- *Fundamentals-based risk factors.* Independent variables of the model are abstracted from fundamental analysis and have investable fundamental meanings. Thus, the hybrid quantitative models can effectively analyze the fundamentals-based investment process for traditional fixed-income portfolio management. Investors can easily link their macro views with the hybrid quantitative models in the process of strategy design and portfolio management.
- *Quantitative framework for fundamental analysis.* The quantitative models built from the fundamental processes help portfolio managers to better understand market dynamics and investment opportunities. These models provide investors a unique valuation platform, from which investors can quantitatively analyze the fundamentals-based market dynamics and quantify traditional fixed-income investment opportunities. Because its risk factors are based on economic variables, the quantitative framework enhances portfolio managers' understanding of

macro investment opportunities and helps them to express macro views in quantitative terms.

- *Risk segregation.* In the hybrid quantitative framework, market dynamics and security valuation are modeled using a limited number of quantifiable independent factors, each corresponding to a unique fundamental meaning. Based on the hybrid quantitative analysis, portfolio market risk is decomposed into the dimensions of these independent factors. Investors can effectively manage their risks by controlling the portfolio exposure in each risk factor. This allows portfolio managers to design strategies that purely represent their market views and to avoid the accidental risks usually experienced in fundamentals-based strategies.
- *Portfolio construction.* Hybrid quantitative models calculate portfolio allocations in different sectors for specific risk exposure. They help portfolio managers build and rebalance portfolios.
- *Quantitative risk management.* Hybrid quantitative models define and measure market risks with mathematical precision. Risk management becomes a systematic and coherent part of the investment process. Risks are fully quantifiable and have clearly fundamental implications, which enhances the portfolio manager's ability to manage risk and take measurable bets.

Application. At DuPont Capital Management, we are applying the hybrid quantitative methodology to yield-curve strategies. We developed hybrid term-structure models because the typical quantitative yield-curve models—principal-component and stochastic models—have not adequately captured market activities. The principal-component method derives the most important modes of the curve movement based on historical correlation. It is very useful in risk management but is of limited value when applied to find trading opportunities in the yield curve because the model is purely statistical—it has no dynamics and thus cannot project how the yield curve will behave in the future. In addition, the model itself does not explain the origin of the principal modes. Because stochastic models, such as the Vasicek and Heath–Jarrow–Morton models, use stochastic variables, they have dynamics and are successful in pricing fixed-income derivatives.

Nonetheless, most of these stochastic models make oversimplified assumptions about yield-curve movements. For example, most short-rate equilibrium models assume a simple mean-reverting lognormal stochastic process for the short-term interest rate. In reality, however, the short rate is controlled by the U.S. Federal Reserve, whose action is much better described by the Taylor rule than by unrealistic simple mathematical assumptions. These stochastic models are capable of pricing derivatives because the no-arbitrage option price is independent of the actual future path of interest rates. These oversimplifications, however, make most stochastic models of rather limited use in predicting future interest rate movements and finding yield-curve opportunities.

DuPont's hybrid quantitative yield-curve model improves on the deficiencies of pure statistical and stochastic models. We created a new stochastic term-structure model that describes the dynamics of the yield curve driven by fundamental factors. As I explained previously, the first step involved in hybrid quantitative modeling is fundamental analysis—discovering the most important factor determining the curve movement. Our research indicates that monetary policy or Fed action is the most important force driving the yield curve, especially the short end. The intermediate sector of the curve is dominated by economic cycles. The economic cycle coefficient (an indicator of economic strength), as calculated from our model, is shown in **Figure 2**. The economic peaks in 1989 and 2000 and the recession in the early 1990s are obvious. The most critical factors in the long end of the curve are the risk premium and the inflation expectation. The risk premium describes the investor's appetite for risk.

Figure 3 charts the yield spread between the 10- and 30-year T-bond against the Nasdaq 100 Index from October 1998 to September 2001. An amazing correlation exists between these two time series, and this correlation is partially explained by the risk premium. As Figure 3 shows, in March 2000, when equity investors were feverishly buying, they pushed the Nasdaq 100 over 4,500. The 10- to 30-year yield spread inverted at almost the same time as bond investors enthusiastically chased the long-duration 30-year bond, the yield of which was already sliding as a result of the Treasury buyback. This coincidence indicates an extremely low risk premium assumed by both equity and bond investors at that time.

After identifying the important independent variables, we create a qualitative model explaining how these fundamental variables determine the yield curve's movements. Based on that finding, we develop a multifactor stochastic term-structure model. Each of the factors in the model is derived directly from the qualitative picture and has a clear fundamental meaning. Historical evolution of each factor coefficient is calculated from the model, from which we can conduct relative value rich/cheap analysis. Based on this model, we can easily combine fundamental analysis and relative value analysis to exploit investment opportunities.

An example of the hybrid quantitative yield-curve strategy is a trade that DuPont Capital

Figure 2. Economic Cycle Coefficient, 1987–August 2001

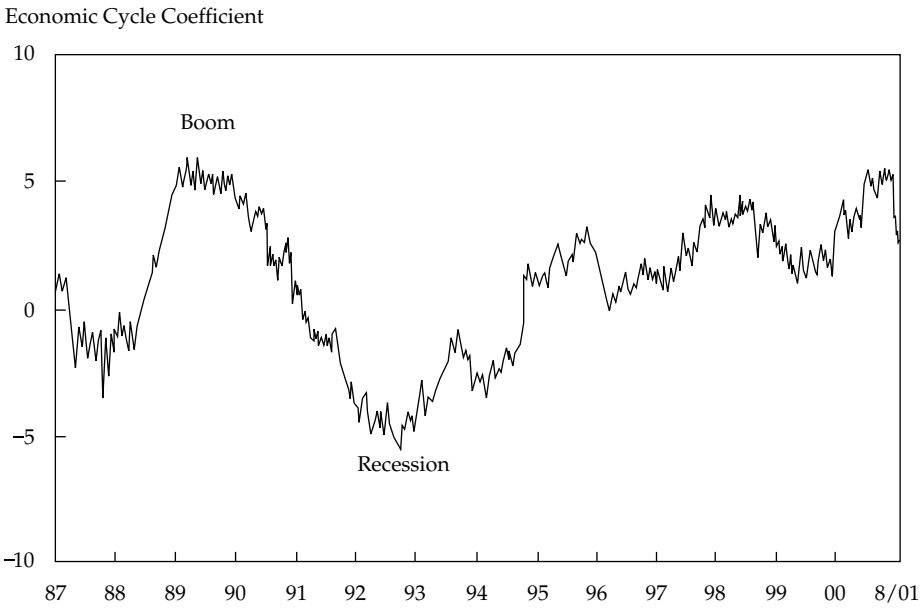
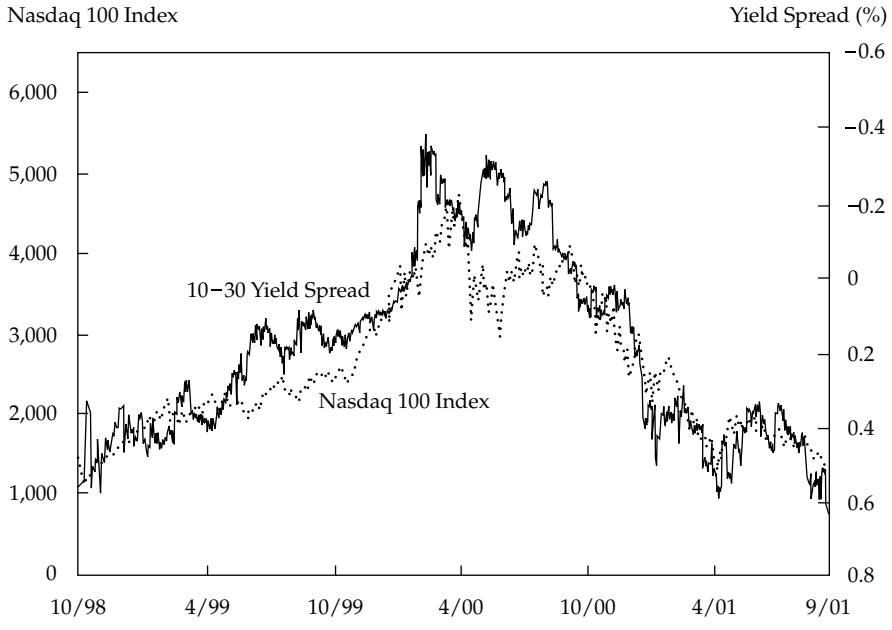


Figure 3. Risk Premium Factor, October 1998–September 2001



Management undertook at the end of 2000 in the risk dimension of the economic cycle. As shown in **Figure 4**, the yield curve moved dramatically in the first eight months of 2001 as the U.S. economy quickly sank into recession and the equity bubble in technology burst. By August 31, 2001, the 2-year rate had dropped about 160 bps, the 5-year rate had dropped about 60 bps, but the 10- and 30-year rates remained nearly unchanged. At the end of 2000, the economy had already begun to show signs of weakness, which made long-duration bonds attractive. If investors had simply chosen to go long in the 10-year or 30-year sectors, they would have lost money during the first half of 2001—even though the short-term interest rate dropped by 250 bps! This incredible volatility in the yield curve illustrates the importance of a good term-structure model in yield-curve trading and duration management.

Our hybrid term-structure model, a quantitative model with clear fundamental meaning, exhibits its

Figure 4. Yield Curve and Change in 2001

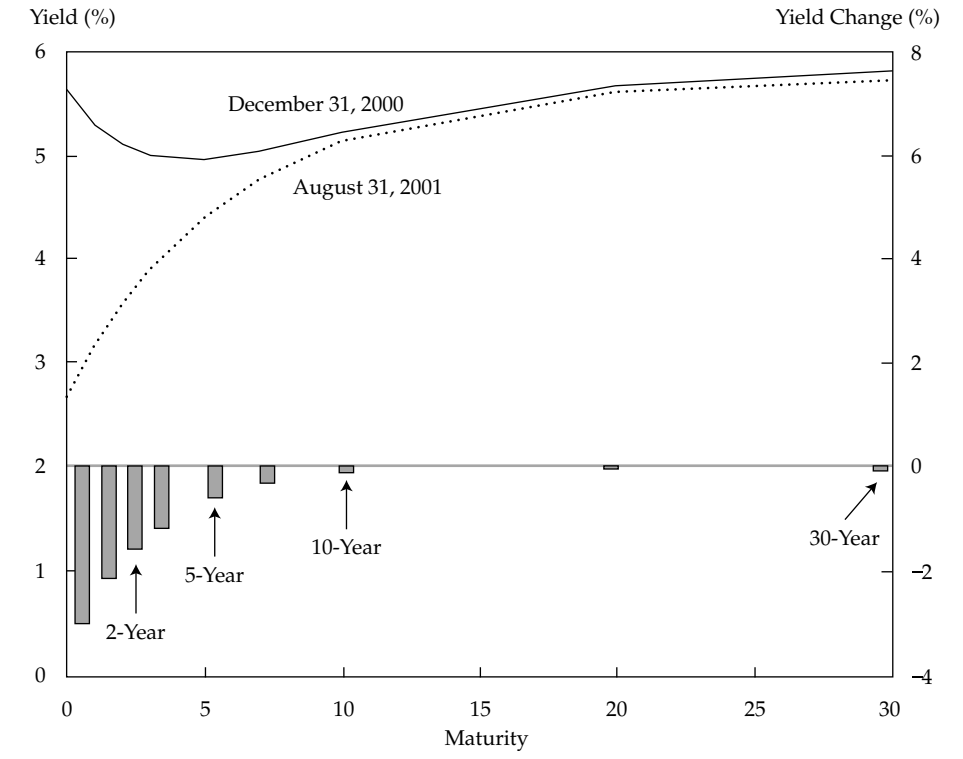
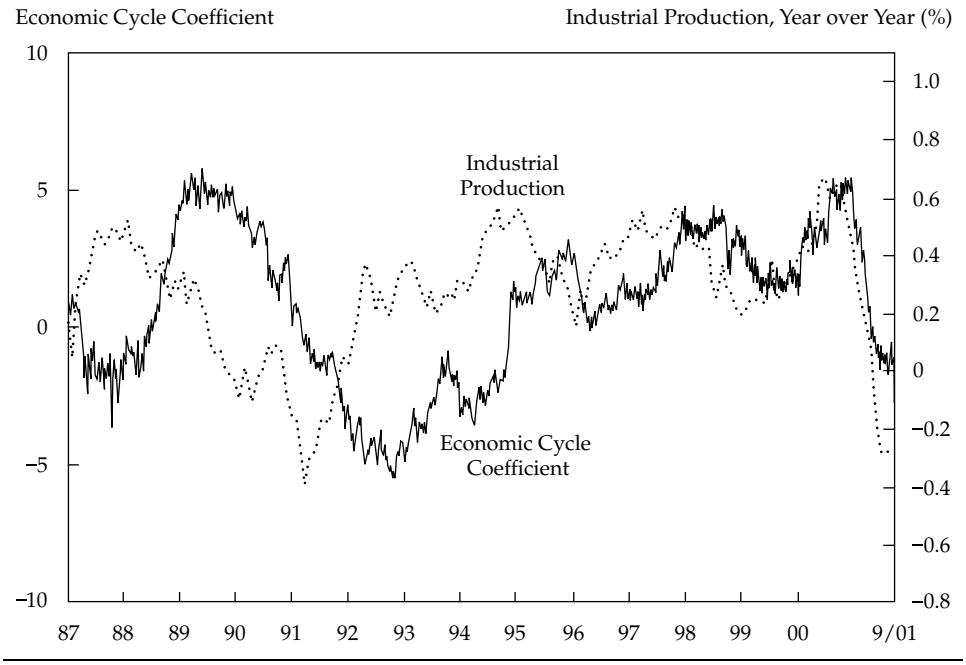


Figure 5. Economic Cycle Coefficient and Industrial Production, 1987–August 2001



comparative advantage during this volatile time when the yield curve is moving dramatically because of rapid changes in fundamentals. In **Figure 5**, industrial production (again, the proxy for economic activity) is charted against the economic cycle coefficient from the hybrid term-structure model over the period from 1987 to third quarter 2001. At the end of 2000, industrial production had started to drop swiftly,

which indicates that, from a fundamental view, the economy was quickly weakening.

The yield curve, however, was telling a different story, as indicated by the high value of the economic cycle coefficient. The mismatch between the economic cycle coefficient and the economic fundamental indicated a very attractive investment opportunity from both fundamental and relative value perspectives. Based on the hybrid quantitative model, we put on a trade where the model indicated it was most attractive, betting that the economic cycle coefficient would drop. The trade position was calculated from the term-structure model so that it would be fully hedged against the movement of the other factors of the yield curve. The most significant component of the trade was a steepening position in the intermediate sector of the curve. As shown in Figure 5, by the end of September 2001, the indicator had weakened from about 5 to about –3.

Summary. Hybrid quantitative strategies seek to effectively apply quantitative strategies in traditional fixed-income portfolio management. By introducing fundamental factors into the quantitative analysis, the hybrid quantitative model addresses market and risk issues that buy-side portfolio managers face. Hybrid quantitative models quantify the dynamics of how fundamental variables determine security valuation. Thus, this new quantitative methodology can be widely applied in many traditional fundamentals-based strategies, such as duration bet, yield-curve trading, and mortgage strategies. This presentation shows an example of a hybrid quantitative strategy in yield-curve trading. The hybrid term-structure model, developed from fundamental analysis of yield-curve movements, explains in quantifiable terms how fundamental risk factors drive yield-curve dynamics. This hybrid term-structure model enables us to apply both fundamental analysis and relative value analysis to better understand market dynamics and identify investment opportunities. Additionally, hybrid quantitative models allow portfolio managers to analyze the market impact of secular and cyclical changes and to use fundamental analysis to reduce the risks of quantitative strategies.

Conclusion

Good quantitative models help investors who use them to analyze market dynamics and exploit trading opportunities, thus giving these investors a competitive advantage over participants who do not use them. Successful quantitative portfolio management, however, is about more than just building models. More important is the comprehensive knowledge of fundamental market dynamics and risk factors that are used to develop practical mathematical models, such as the hybrid quantitative strategies. Quantitative investors need both modeling/programming skills and market expertise acquired from broad participation in the market in order to develop and effectively apply quantitative strategies.

Investment management is not a natural science. The financial world is created based on expectation. The outcome is never fully predictable. All quantitative models are merely mathematical simplifications of an uncertain financial world. Assumptions are always embedded in the models—assumptions that are likely to become invalid after significant market changes. Quantitative portfolio managers who develop their own models have a competitive advantage because they are aware of their model's assumptions and can make the proper adjustments as market changes occur.

Question and Answer Session

Yong Zhu, CFA

Question: Will the U.S. Treasury issue more 30-year bonds, and what will be the likely impact on the Treasury yield curve?

Zhu: The tragedy of September 11 and its significant impact on the economy will probably force the U.S. government to issue more T-bonds to fight both the recession and the terrorists. This effect, however, is not the major reason for the significant yield-curve steepening after September 11. Instead, the curve steepening results mostly from the disruptive increase in the risk premium, as demonstrated by the volatile global equity market and also partially from excessive liquidity in the short end of the curve as a result of the actions of the Federal Reserve.

In order to have a long-term market view, we need to distinguish cyclical changes from secular trends. The Treasury buyback and subsequent bond richness in 2000 have turned out to be short-term cyclical events. The Treasury curve has steepened enormously in 2001, and the 10-year/30-year yield spread is not far away from its widest historical level. Right now, because of counter-cyclical fiscal policy, the increased Treasury supply is a cyclical event. In other words, increased supply comes with economic recession and will dissipate when the economy turns around. What is the impact on the Treasury yield curve? The yield curve steepens during economic recessions, but there is no convincing reason for the new Treasury supply to come only in the 30-year sector, which would steepen the yield curve. Actually, issuance in the five-year sector is more appropriate for the counter-cyclical objective, especially when the five-year note is trading at a 3–3.5 percent yield, which is almost 200 bps cheaper than the yield on the long bond and also has an attractive real yield. Therefore, increasing Treasury supply will not have a significant long-term effect on the Treasury yield curve. Remember, we probably are still in the long-term secular trend of fiscal surplus and global disinflation. Increasing Treasury supply might have more impact on other dimensions of the market, such as swap spreads.

Question: How do quantitative models relate to other market factors, such as investor psychology?

Zhu: Because of the nonlinear relationship between price and yield, fixed-income instruments are generally more complex and require advanced mathematics and models. But the core of fixed-income investment is the same as any other investment; it is more alchemy than pure science because greed and fear push the market to constant instabilities. The merit of quantitative models is to provide investors a systematic and more precise platform with which to understand the markets and analyze investment opportunities. Valid quantitative models offer fair valuation for the long-term horizon. In the short to intermediate time horizon, other available methods for taking the market's temperature, such as demand and supply analysis, are important for controlling risk. All of these skills are required for successful quantitative portfolio management. Otherwise, you could be forced off course, even if you are correct in your long-term perspective.

Global Fixed Income: Asset Allocation

Michael R. Asay
Senior Vice President
Pacific Investment Management Company
Newport Beach, California

In order to effectively manage a global fixed-income portfolio with many benchmarks, certain adjustments are required to prevent the process from becoming excessively labor intensive. A critical change is simplifying the approach to global asset allocation. Pacific Investment Management Company uses two main methods to address this challenge: first, using the portable alpha concept to run a core-plus portfolio in an efficient manner and, second, analyzing portfolios on a risk-factor basis.

Three portfolio managers run the global fixed-income core portfolios (or, more correctly, core-plus portfolios) at Pacific Investment Management Company (PIMCO), and this presentation will focus on how we use modern portfolio theory to run these portfolios. Our global fixed-income mandates include about 96 portfolios equal to about $20 billion in assets as of September 2001. For those 96 portfolios, we have about 40 different benchmarks. Because we have many portfolios with many benchmarks, we found we needed to simplify our global asset-allocation processes. This discussion will cover how we try to simplify our methods and some of the core-plus strategies that have emerged from this endeavor.

Portfolio Management Objectives

PIMCO's primary portfolio management objective is to maximize alpha. Other objectives are to integrate risk management into investment decisions, find efficient investments, and create optimal portfolios. Key portfolio management policies are that the processes be understandable and scalable, in the sense that they can be applied for a larger number of mandates. Scalability is necessary because if each of the 96 portfolios we manage was run on a unique basis, the process would be so labor intensive that PIMCO would never make any money, at least not from the fees generated in the business today.

Risk and Return Measurement. The two classic types of risk analytics, or risk measurement, are deterministic and statistical. The deterministic versions take the form of mathematical models. The standard deterministic model is the present value model for calculating duration, convexity, and the "Greeks" (delta, gamma, vega), which are derived from option-pricing models. Term-structure models are another type of deterministic model.

The statistical form of risk measurement includes mean–variance analysis, tracking-error analysis, principal-components analysis, factor decomposition, and other similar methods. For PIMCO's domestic portfolios, we concentrate on the deterministic versions; for our global portfolios, we tend to blend the deterministic and statistical methods.

The key to understanding portfolio risk and return is parsimony: Make the task as simple as possible while still accurately reflecting the risk and return characteristics of the securities or portfolio. For example, the fixed-income world in the Lehman Brothers Global Aggregate Index (Lehman Global Aggregate) includes, in its grandest version, 14,000 securities. But if every security is viewed as a different asset or as posing a different risk, understanding where money can be made or what risks are being taken is impossible. A parsimonious way is needed to distill the problem so that it is manageable.

To simplify the analysis of portfolio risk and return, PIMCO represents yield curves with only a few parameters and uses the concept of portable alpha.

Term-Structuring Model. The specific characteristics of 14,000 bonds can be distilled into term-structure factors. For example, yield curves can be represented in a parsimonious way. A three-factor

model, for instance, can explain about 95 percent of the market's movements; therefore, three factors, not 14,000, can be used to characterize the 14,000 securities in the Lehman Global Aggregate. **Figure 1** shows a parsimonious two-factor model for two countries using yield and slope of the yield curve. The circles and squares represent the prices at which bonds are actually trading, and the lines through them are the estimates of what we think the values of the securities ought to be. Note that the fits are close; that is, the method can be used to determine relative value as well as risk characteristics. At PIMCO, we manage most of our portfolios using such a two-factor model. Indeed, a large part of the estimation of bond yields can be represented by fairly simple functional forms.

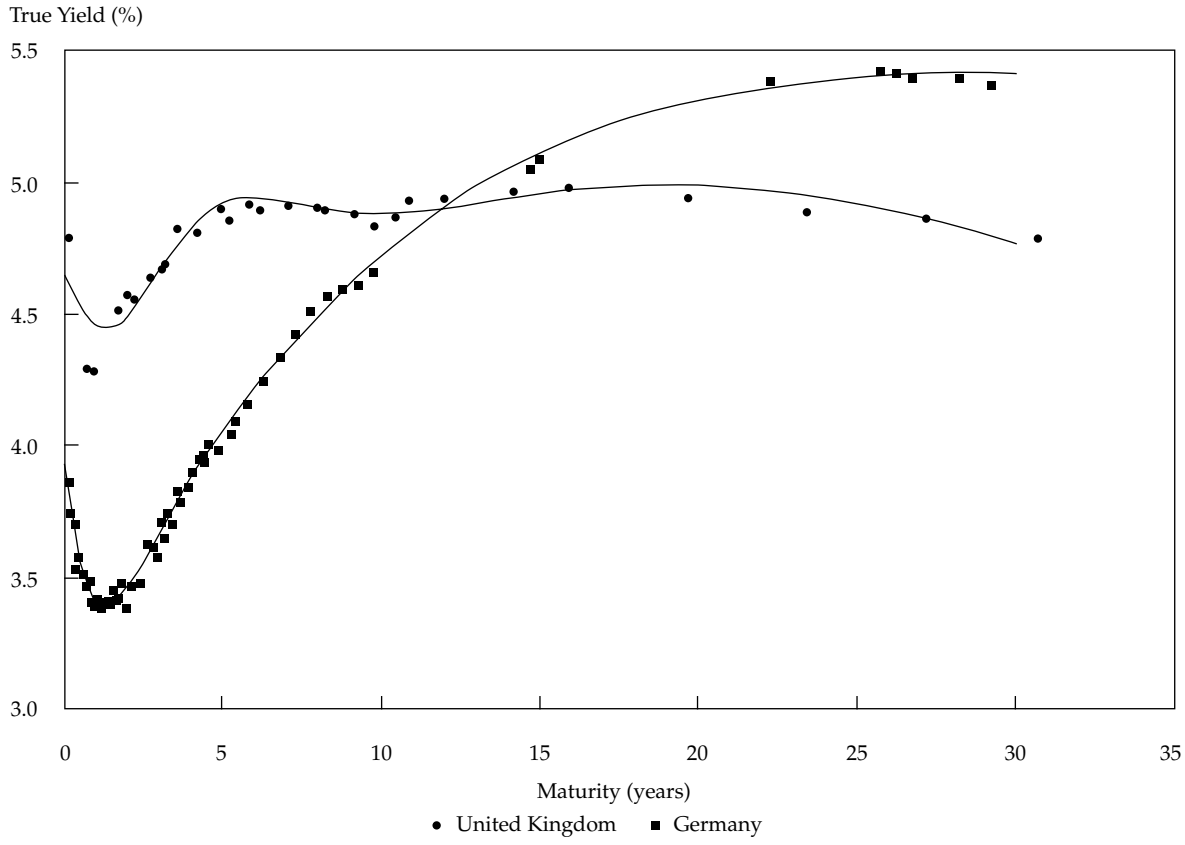
Portable Alpha. Any portfolio can be decomposed into an index portion and an overlay, or alpha, portion. We characterize all portfolio positions as part of the benchmark, or as an excess position that is more or less than the benchmark holding. The position excess to the benchmark—the alpha portfolio—is the only source of risk in the portfolio (the benchmark has no excess risk or return). **Table 1** demonstrates the concept. It lists three geographical/currency blocs—the euro bloc, the Japanese yen bloc, and the U.S. dollar bloc—and shows the index weights and the portfolio weights in each. The last two columns show that the portfolio can be rewritten as the index plus alpha, alpha being the deviation of the portfolio weight from the index weight.

From this perspective, what a particular index looks like does not really matter. If the model for the alpha portfolio is the last column in Table 1, that alpha portfolio can be overlaid on any indexed portfolio—a LIBOR Lehman Brothers domestic index or any other index.

Table 1. Portfolio Composed of Index and Alpha Portfolio Positions

Country/Bloc	Index	Portfolio	Alpha Portfolio
Euro	40%	35%	–5%
Yen	15	10	–5
U.S. dollar	45	55	+10

Figure 1. Two-Factor Model of Yield Curve for the United Kingdom and Germany



Note: Data as of October 2, 2001.

The alpha overlay approach creates parsimony in the investment process because an investment committee can focus singularly on what the overlay portfolio should be without regard to the benchmark. Of course, the overlay portfolio can contain out-of-index bets if the index does not contain a particular sector or market that is included in the overlay portfolio. Because client guidelines may limit the use of out-of-index bets, it is not always literally true that the overlay portfolio is the same for all clients.

These two approaches—reducing the yield curves of individual bonds into a set of two factors and using the portable alpha concept to distill the securities into a single overlay portfolio that contains all the active bets—provide scalability. Once these steps—the deterministic piece of the process—are completed, we then turn to the statistical piece: We seek to optimize the alpha portfolio.

Portfolio Optimization

PIMCO runs portfolios a bit differently from the classic, traditional mean–variance approach, which is becoming more and more complicated. In traditional portfolio optimization, managers put the expected returns, correlations, and volatilities of all their securities into a portfolio optimizer. The optimizer then spits out the optimal investment allocations (mean–variance-efficient allocations). This process is, of course, sensitive to small changes in the estimates of the expected returns, correlations, or volatilities, so it has never really taken hold in practice.

What investment managers tend to do is work the traditional process in reverse. That is, instead of estimating what the returns will be and solving for an optimal allocation, a practitioner inputs two out of the three variables (volatilities, correlations, and portfolio weights) and then calculates the third.

At PIMCO, we run the model to solve for the expected returns for the portfolio. This approach yields much more stable results than traditional mean–variance optimization because the manager does not have to estimate the expected returns for every asset class used. All the manager needs are the returns associated with the positions that he or she believes will be significant in generating excess returns. Furthermore, we run the analytics only on the alpha portfolio, which tends to be much less complicated than the index or main portfolio. As a result, the solutions are more palatable than those with mean–variance optimization.

Calculating Tracking Error. At PIMCO, we have developed a "portfolio tracking-error calculator" to monitor our portfolios. **Table 2** is an example, using the PIMCO Foreign Bond Fund, of the spreadsheet that shows the output of the calculator. Listed on the left of the table are the factor exposures for various countries or blocs and also the spread exposure for the corporate and mortgage sectors. The duration and curve exposures and the currency weights are indicated for each country or bloc. In the example portfolio, Japan has a duration underweight of –0.18 of a year and the bloc of 11 countries in the EMU has a duration overweight of about 1.22 years. At the time this spreadsheet was created, the United Kingdom had a massive steepening bias in its yield curve, and we thought the curve would soon revert to a more normal slope. Therefore, the curve exposure was overweighted 0.50 percent (a 100 bp steepening in the 2- to 30-year spread will generate 0.50 percent alpha with such an exposure). Table 2 also shows the spread exposure as being underweight in corporate bonds by a quarter of a year and overweight in mortgages by half a year. The investment committee determines the factor positions that are reflected in the tracking-error calculator.

If a particular variance–covariance matrix is assumed, the tracking-error calculator will generate a set of tracking-error contributions associated with each portfolio position. For example, in the EMU-11 bloc, the 1.22-year duration overweight is providing 69 bps of the total portfolio tracking error of about 168 bps (as shown in the tracking-error section of the table.)

The far right side of Table 2 contains a set of "implied views" on yield levels and yield-curve shape. For example, to justify the 1.22-year overweight in duration for the EMU position, interest rates in the EMU block need to fall by 46 bps. Portfolio managers can look at the views implied by the positions and consider whether they think they are logical or consistent with the views assumed when they formed the portfolio position in the first place. Note that this matrix is sparse. We are not expressing a huge number of views, at least relative to all possible bonds or positions. In all, there are 12 portfolio bets, so only 12 market views need to be examined. For risk management purposes, forming views on every position in the universe is unnecessary. We need views only on those positions that we take, which distills the portfolio forecasting, decision-making, and monitoring process into a manageable framework for managers.

Clients also benefit from seeing this type of output on a regular basis. For example, **Table 3** is the spreadsheet with the output of the tracking-error calculator for PIMCO's Total Rate of Return Fund that could be shown to clients. The Lehman Global Aggregate is the benchmark for this fund. Note that this portfolio holds the same positions as the global

Table 2. Output of Tracking-Error Calculator for Foreign Bond Portfolio, as of June 1, 2001
(continued on next page)

	Exposure		Currency	Tracking Error					Implied Yield Change		
Region	Duration	Curve	Weights	Level	Curve	Currency	Total	Region	Level	Curve	Currency
A. Tracking error by bloc/country and type											
Pacific											
Australia	–0.03	–0.01	0.0%	–0.02%	0.00%	0.00%	–0.02%		–0.40%	0.22%	
New Zealand	0.05	0.03	0.0	0.02	0.01	0.00	0.03			0.08	–1.92%
Japan	–0.18	0.17	–1.0	–0.03	0.02	0.02	0.01				–0.01
Hong Kong	–0.68	–0.25	–2.3	0.04	–0.02	0.00	0.02		0.04		
Singapore	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.05%			
Europe											
Denmark	0.04	–0.02	0.0	0.02	0.00	0.00	0.02		–0.44		
EMU-11	1.22	0.11	5.4	0.69	0.01	0.22	0.93		–0.46	0.11	3.32
Greece	0.00	0.00	0.0	0.00	0.00	0.00	0.00				
Norway	0.00	0.00	0.0	0.00	0.00	0.00	0.00				
Sweden	0.00	0.00	0.0	0.00	0.00	0.00	0.00				
Switzerland	0.00	0.00	–3.6	0.00	0.00	–0.10	–0.10				
United Kingdom	–0.14	0.50	–0.1	–0.08	0.17	0.00	0.09	0.93%		0.28	
Emerging market											
Asia	0.00		0.0	0.00		0.00	0.00		1.72		
Latin America	0.00		0.0	0.00		0.00	0.00		0.08		
Europe	0.00		0.2	0.00		0.01	0.01				
Africa/Middle East	0.00		0.0	0.00		0.00	0.00	0.01%			
Spread exposure											
Corporate	–0.23			0.00			0.00				
Mortgage	0.53			–0.03			–0.03	–0.03%			
Americas											
Canada	–0.13	–0.02	0.0	–0.08	0.00	0.00	–0.08				
United States	1.10	0.39	1.5	0.72	0.08	0.00	0.81	0.73%	–0.53	0.17	
Total	1.25	0.90	0.0%	1.26%	0.27%	0.15%	1.68%				

Note: This portfolio is $6 million, the currency measurement is the U.S. dollar, and the benchmark is the J.P. Morgan Government Bond (non-U.S., hedged) Index.

Table 2. (continued)

Risk/Tracking Error	Portfolio	Benchmark	Net
B. Summary of tracking error			
Bond level	4.34%	3.37%	1.30%
Bond slope	0.44	0.25	0.27
Bond spread	–0.03	0.00	–0.03
Currency—developing markets	0.12	0.00	0.14
Emerging market	0.01	0.00	0.01
Net	4.88%	3.62%	1.68%

portfolio in Table 2 (short Japan, long the EMU, and a steepening trade in the United Kingdom), which is a reflection of the fact that our alpha portfolio is the same for all types of portfolios. Each of these trades is an out-of-index trade for this fund.

Closer examination of the portfolio tracking-error calculation has raised a number of potentially confusing issues that we have had to address. For example, the output of the model reflected in Table 3 says that a short position in Japan with duration of one-third of a year represents only 2 bps of tracking error. But the portfolio is running 134 bps in total tracking error. Why does only 2 bps of that tracking error come from the short position in Japan? At first glance, it does not make sense because the volatility of Japanese interest rates is about 60 bps a year. If a one-year duration is worth 60 bps and the position is one-third of a year, should this position's potential tracking error not be worth more on the order of 20 bps? The confusion lies in the fact that the volatility of that position is not 2 bps; rather, the position's contribution to the total volatility of the portfolio is 2 bps.

Volatility. In addition to the marginal contribution of a particular position to the portfolio's total tracking error, the tracking-error calculator computes the total volatility of an individual position. **Table 4**, for example, lists similar trades as those in the tracking-error report illustrated in Table 2 and Table 3, but they are organized as individual trades. Each trade can be broken down into country/bloc and duration or curve exposure. Alternatively, these individual bets can be combined and reported as trades. The Japan duration, for example, is an outright short (or underweight) position in Japan; that is, it is not part of a spread trade. Table 4 shows that the (yield) volatility of the position itself is 57 bps, but the contribution to total portfolio risk is only 2 bps. The diversification associated with the portfolio construction has reduced the risk of the Japan position by 86 percent.

Managers become skeptical of such a sizable reduction in risk because they question whether, in fact, that reduction can be realized. The far right column in Table 4 is intended to provide a sense of whether the diversification benefits indicated by the tracking-error model are real. Does portfolio diversification, because of the assumed correlations and volatilities between the positions, artificially lower the calculated level of risk? One way to make a judgment about the true diversification benefits is to eliminate the negative correlations in the variance–covariance matrix. If a negative correlation between assets does not seem to be a repeatable event and the correlation would more typically be positive, then take out the negative correlation.

A second problem arises when trades are highly correlated. When two positions are highly correlated, the marginal risk associated with one of the positions is difficult to assess. For example, the portfolio shown in Table 2 is short Hong Kong by more than two-thirds of a year (–0.68) and long the United States by duration a little over one year (1.10). That is a spread trade between Hong Kong and the United States, but Hong Kong pegs its currency to the U.S. dollar. Therefore, the correlation between Hong Kong interest rates and U.S. interest rates would be expected to be extremely high. From a statistical vantage point, with highly correlated assets, the ability to ascribe risk to any one of those positions is low—a basic multicollinearity problem. It cannot be said with certainty that the tracking error of 72 bps shown on Table 2 can be attributed solely to the U.S. position, because the risk cannot be independently ascribed to the U.S. and Hong Kong positions in light of their high degree of co-linearity. For this reason, combining the various positions into actual trades as shown in Table 4, rather than the traditional type of evaluation in which they are grouped by country and yield-curve exposures, is useful.

A final problem that occurs for variance–covariance matrixes is that in downturns in the global economy, variances all rise while correlations all move to 1. This phenomenon contributed to the problems that triggered the Long-Term Capital Management debacle several years ago. For this reason, credit diversification is an important contributor to risk management. Most investment guidelines PIMCO deals with allow a concentration of no more than 5 percent in an A rated credit. But what happens if that A rated credit falls to CCC? A 5 percent concentration in Pacific Gas & Electric Company, for example, would not have been considered a risky position in 2000, but as **Figure 2** shows, when PG&E's rating recently fell to CCC, the price of the PG&E 7 3/8 due November 1, 2005, dropped from close to par ($1,000 per bond) to $300–$350 per bond. This drop represented a loss of 65–70 bps, or $650 to $700 per bond, which would have been a substantial hit for a 5

Table 3. Output of Tracking-Error Calculator for Total Rate of Return Fund, as of June 1, 2001
(continued on next page)

	Exposure		Currency	Tracking Error					Implied Yield Change		
Region	Duration	Curve	Weights	Level	Curve	Currency	Total	Region	Level	Curve	Currency
A. Tracking error by bloc/country and type											
Pacific											
Australia	0.00	0.00	0.0%	0.00%	0.00%	0.00%	0.00%				
New Zealand	0.00	0.00	0.0	0.00	0.00	0.00	0.00				
Japan	–0.31	–0.04	–2.6	0.02	0.00	0.08	0.10		0.04%	–0.02%	–2.55%
Hong Kong	0.00	0.00	0.0	0.00	0.00	0.00	0.00				
Singapore	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.10%			
Europe											
Denmark	0.00	0.00	0.0	0.00	0.00	0.00	0.00				
EMU-11	0.34	0.09	2.2	0.17	0.01	0.06	0.24		–0.40	0.08	2.21
Greece	0.00	0.00	0.0	0.00	0.00	0.00	0.00				
Norway	0.00	0.00	0.0	0.00	0.00	0.00	0.00				
Sweden	0.00	0.00	0.0	0.00	0.00	0.00	0.00				
Switzerland	0.00	0.00	0.0	0.00	0.00	0.00	0.00				
United Kingdom	0.60	0.24	–0.1	0.41	0.08	0.00	0.48	0.72%	–0.54	0.26	
Emerging market											
Asia	–0.01		0.0	0.00		0.00	0.00				
Latin America	–0.03		0.0	0.00		0.00	0.00		–0.65		
Europe	0.01		0.0	0.00		0.00	0.00				
Africa/Middle East	0.00		0.0	0.00		0.00	0.00	0.00%			
Spread exposure											
Corporate	–0.24			0.00			0.00		0.00		
Mortgage	1.39			0.09			0.09	0.09%	–0.05		
Americas											
Canada	0.00	0.00	0.0	0.00	0.00	0.00	0.00				
United States	0.52	0.49	0.5	0.36	0.07	0.00	0.43	0.43%	–0.56	0.12	
Total	1.15	0.78	0.0%	1.04%	0.16%	0.14%	1.34%				

Note: This portfolio is $48,620 million, the currency measurement is the U.S. dollar, and the benchmark is the Lehman Global Aggregate.

Table 3. (continued)

Risk/Tracking Error	Portfolio	Benchmark	Net
B. Summary of tracking error			
Bond level	5.15%	4.27%	0.95%
Bond slope	0.16	0.04	0.16
Bond spread	0.00	0.01	0.09
Currency—developing markets	0.10	0.00	0.14
Emerging market	0.00	0.00	0.00
Net	5.40%	4.32%	1.34%

percent position. At PIMCO, we estimate that in our core-plus portfolios, we can generate an alpha of 100–150 bps in a year. If we had held a 5 percent position in PG&E bonds, that one position would have cost us two years of alpha for the portfolio. Thus, we do not hold more than 1 percent of the portfolio in an A rated credit.

Another example of the danger in holding too much of the portfolio in an A rated credit is the General Motors Acceptance Corporation bonds that were collateralized by the World Trade Center. The first tranche was 80 percent collateralized, which means the bondholders owned the top 20 percent of the mortgage. If this portion of the mortgage had not been insured, those bonds would have been worth zero. Because the mortgage was insured, these bonds are now trading at a price of 80. So, a 1 percent position in that AAA asset-backed, floating-rate note cost the portfolios that held it about 20 bps in one month!

At PIMCO, we have learned from all the recent credit downgrades that not only are good credit analysts a necessity but also concentrated positions in individual credits are not prudent. That realization presents dilemmas for managers who are running portfolios against the Lehman Global Aggregate because this index has a lot of credit-risk exposure. With a small account, achieving adequate credit diversification with such an index is difficult; the positions need to be large enough to trade easily, but large positions often impinge on prudent credit limits.

Conclusion

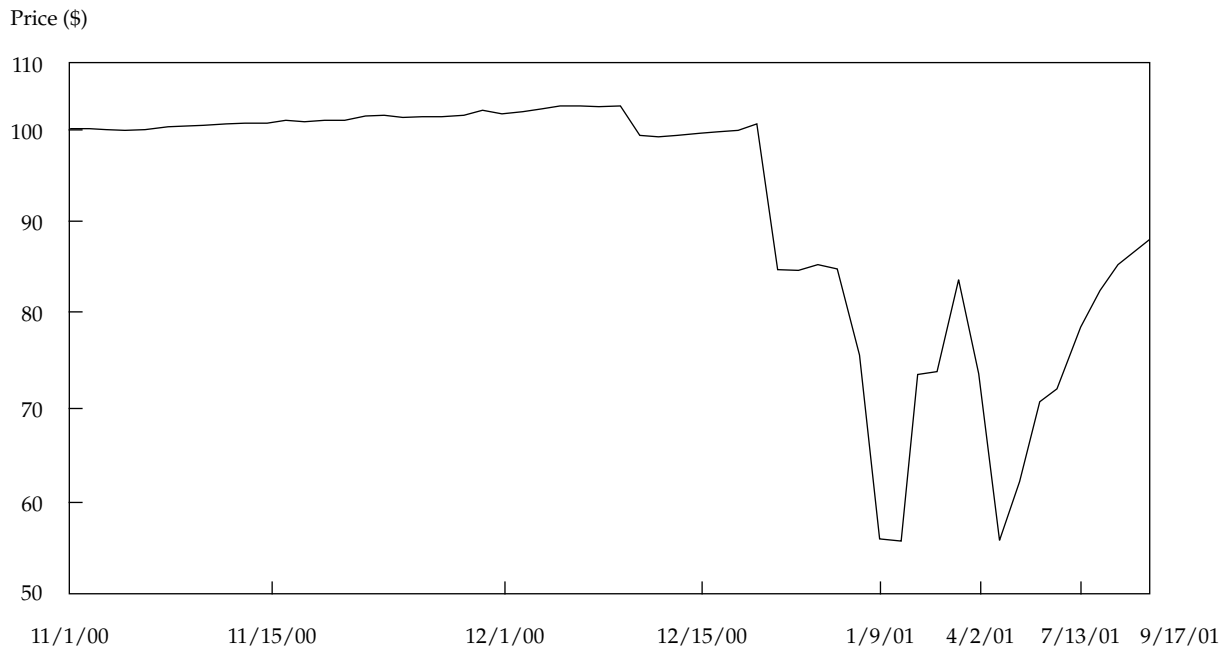
PIMCO's investment management process follows two key policies that enable us to manage large core-plus fixed-income portfolios benchmarked against a large variety of indexes. First, we use the portable alpha concept to run a core-plus portfolio in a parsimonious way—a way that allows us to follow consistent investment themes in portfolios independent of the index the portfolio is being run against. Second, these portfolios are analyzed on a risk-factor basis rather than either a maturity bucket basis or a bond-by-bond basis. The factor approach is derived from a yield-curve model and is effective in explaining the returns to the various risks in the portfolio.

Table 4. Output of Tracking-Error Calculator for Trades in PIMCO Model Portfolio

Trade Description	Trade Type	Trade Duration (years)	Spread/Yield Volatility	Position Volatility	Trade MCTE	Spread Yield Implied Change	Diversification Benefit
U.S. curve duration	Spread	2.8	0.54%	0.27%	0.16%	0.26%	0.61
Swap & agency spread duration	Spread	5.8	0.38	0.58	0.34	0.18	0.60
Mortgage spread duration	Spread	5.8	0.46	0.23	0.12	0.20	0.53
Europe duration	Bond	4.4	0.68	0.34	0.22	0.35	0.64
Japan duration	Bond	2.0	0.57	0.14	0.02	0.07	0.14
U.K. front-end exposure	Bond	2.8	0.84	0.42	0.23	0.36	0.54
Short HKD/USD	Spread	4.3	0.53	0.37	0.16	0.19	0.44
Long euro/short U.K. swaps	Spread	10.5	0.59	0.30	0.08	0.12	0.26
Long euro vs. CHF	Currency	1.0	2.87	0.23	0.05	0.48	0.21
Long euro vs. JPY/USD	Currency	1.0	6.49	0.19	0.06	1.61	0.31
Emerging markets	Emerging market	1.0	9.14	0.14	0.02	1.26	0.17
Long Brazil/short Argentina	Emerging market	1.0	0.38	0.01	0.00	0.06	0.21

Note: MCTE = marginal contribution tracking error.

Figure 2. Price Movement of Pacific Gas & Electric 7 3/8 Due November 1, 2005, November 2000–September 2001



Source: Data from Bloomberg.

Question and Answer Session

Michael R. Asay

Question: Can you expand on the process PIMCO uses to make out-of-benchmark allocations to sectors and countries?

Asay: The investment committee that makes these decisions is an amalgam of individuals from various disciplines: high-yield specialists, emerging market and global specialists, and municipal bond specialists. We also have members who specialize by every type of fixed-income instrument, including convertible bonds. These people meet on a regular basis to form a model portfolio—the alpha portfolio. To the extent that the portfolio guidelines permit, the model (alpha) portfolio will then be applied to all the portfolios in the firm; regardless of whether they are U.S. domestic mandates, high-yield mandates, or global mandates, all the portfolios may have, for example, German bond exposure.

Question: Do you replicate the alpha portfolio separately within each account?

Asay: Ideally, you would run the alpha portfolio as a fund and then buy an investment in the fund for each of the managed portfolios. For example, the U.S. portfolios would include specialty funds for high-yield bonds, international bonds, emerging market bonds, municipal bonds, and so on. If the separate accounts allowed an investment in the fund, then you would simply take a pro rata share of the fund. But because many accounts won't allow investing in funds of funds, we wind up having to replicate the positions in the individual portfolios.

Question: What sort of tracking error do you run in your core-plus portfolios?

Asay: The tracking error runs 150–200 bps.

Question: In your core-plus portfolios, how large a position, if you were quite bullish, would you take in emerging market debt or high-yield debt?

Asay: We've done some statistical studies to try to answer this question. We looked at three-year rolling windows of returns against such indexes as the Lehman Global Aggregate. We started by asking the question: Do periods exist in rolling one-, two-, or three-year windows in which a three-year track record, for example, would be impaired by taking X amount of exposure in emerging market debt? Our internal intuitive limit was that we wouldn't take more than a 5 percent exposure in either one of those asset classes. Statistically, over a rolling three-year window, a 5 percent position in either one of those asset classes would not alone have caused us to underperform the index—even with the four of the five crises that we've had in emerging market debt. If you look at a one-year rolling window, however, those positions would have extremely volatile returns. Those positions may cause you to underperform the index by a couple of percentage points on many different occasions in the short term, but the reversals are fast enough in both asset classes that the underperformance and the reversals average out over three years. The problem is that no client will give you that three-year window.

Managing Risk in a Changing World

Asha B. Joshi, CFA
Managing Principal
Payden & Rygel
Los Angeles

Quantitative models, if solely relied upon, typically do not generate the optimal portfolio risk management solution. A complementary and more practical approach is actually demanded in order to incorporate client preferences and monitor the panoply of potential portfolio risks. Specific examples of how to manage interest rate, credit, prepayment, and benchmark risk illustrate how to go beyond a quantitative approach to avoid underperforming client expectations.

As investment managers, we are expected to manage risk not only as those risks are continually changing but also when the definition of risk is not always clear. At Payden & Rygel, we take a practical approach to managing risk and always try to be cognizant of the fact that risk has many faces. Kevin Maloney focused on the quantitative models used to measure and monitor risk.[1] This presentation focuses on the next step and describes how we interpret the numbers generated by our systems and how we incorporate practical considerations into our process. My goal is to demonstrate our philosophy through concrete examples of how we have implemented some of our ideas and how they are working.

Defining Risk

Before I get into the details of our risk management process, it may be useful to take a step back and think about what risk really is. As investment managers, most of us define risk in terms of some sort of benchmark. We can often be so benchmark focused, however, that we lose sight of the client's true objective. Whereas one client might not care about an index or what the tracking error is, another might have a single-minded focus on the benchmark. Some clients are simply averse to negative returns, period. Others may want to closely manage their accounting numbers, particularly as they affect earnings per share. Total return is not the primary goal of these clients; the accounting implications are equally, if not more, important. Similarly, some clients are credit-rating focused and will not invest in any security rated below A. Other clients are averse to nondollar bonds, even those that are of a higher quality and are far less risky than BBB rated domestic bonds.

Typically, when investment professionals refer to risk, they think in terms of the standard deviation of returns or some measure of risk relative to a benchmark, such as tracking error. But other major risks for investment professionals are not so easily quantifiable—the violation of client guidelines, for example. Although a manager may not be fired for having higher volatility than a benchmark, violating a client guideline could be considered far more egregious and may result in termination of the manager.

From a practical standpoint, a major risk is event risk, which may not always be captured by the benchmark. Price action resulting from event risk, as happened in the crises of 1998 or September 11, 2001, would most likely be captured in the benchmark, but risks arising from such factors as concentration, internal controls, and operational problems may not be.

In short, the true risk is underperforming client expectations. Perhaps the real bogey is not the benchmark but a peer group of competing managers. In an attempt to capture these multiple concepts of risk, managers tend to use a shorthand risk measure—a benchmark. For this reason, whenever we think about a benchmark, we should be aware that the benchmark is only shorthand for the ultimate risk we are managing. In other words, the benchmark is whatever the client defines it to be. Therefore, in designing a risk management system and process,

[1] See Kevin Maloney's presentation in this proceedings.

Editor's note: The joint Question and Answer Session of Asha B. Joshi and Kevin Maloney follows Mr. Maloney's presentation.

the client's own preferences must be kept in mind. This principle translates into the practical approach used in our process, a process that goes beyond the numbers and computer models and challenges us to ask, "What if we are wrong? How will the client react?"

Our fixed-income investment process begins with the investment policy committee that sets the broad framework for how the portfolios should look. Sector specialists and strategists work along with portfolio managers to implement these policies. Because our portfolio managers are the key client contacts, they represent the client internally, and as a result, the client is closely integrated into the investment process. We are also cognizant of the nonmarket risks that plague our profession and try to mitigate those risks with strict internal controls. We believe that some combination of computers and people is imperative in any control system. For example, in addition to several pairs of eyes monitoring client guidelines through our online systems, our software is programmed to automatically reject any trade outside the guidelines. Each rejection is reviewed to ensure that it was rejected for the right reason, because guidelines are subject to interpretation and change. In any event, to override the system, the compliance officer would have to be involved and the portfolio manager would have to sign off on the trade and provide documented justification. Relying solely on a computerized system to perform such an important function can be dangerous.

Sources of Risk

Now that I have defined risk to be as clear as mud, take a brief look at some of the more traditional sources of market risk in fixed-income portfolios. The point is to look at some of the challenges we face in managing these risks, despite all our fancy tools and models. I will then discuss a few of these risks in greater detail and give some examples of how we tackle them.

Interest Rate Risk. Duration, which is the simple way to quantify interest rate risk, is relatively easy to measure and monitor: a longer duration equals greater risk and vice versa. But we cannot simply look at duration. Key rate duration has become more prevalent as a tool to measure interest rate risk because it tells us exactly where on the yield curve a portfolio's duration is coming from. Particularly in a year like this one (2001), where we have hardly seen any parallel yield-curve shifts, measuring exposure along the curve becomes critical.

Sector (Spread) Risk. A firm can model its spread risk in different sectors, but all bets are off if a "flight to quality" or some sort of contagion occurs in the markets to disrupt the projected sector relationships. For example, if a manager was overweight or underweight corporates and most of the duration contribution is coming from corporates, that manager would be more exposed to corporates than would be implied by the percent allocation to the sector. Therefore, monitoring duration in addition to spread risk to pinpoint where the spread duration is coming from is extremely important.

Credit Risk. All practitioners know that ratings do not tell the whole story. Therefore, monitoring credit metrics and doing basic, old-fashioned fundamental credit analysis is more important than ever. We assign our own credit ratings in addition to using those of Standard & Poor's (S&P) and Moody's Investors Service. This approach helps create an early-warning system with the objective of getting us out of bad credits before a downgrade and identifying the upgrade candidates before our competition. But even the most sophisticated of credit management processes have to sometimes deal with surprises, as on September 11.

Prepayment Risk. Negative convexity makes a mockery of duration. Particularly in periods of rapidly changing interest rates, prepayment risk, or extension risk, makes duration management a moving target. A dramatic example of this effect is mortgage durations in 2001, which have gone from four or five years in the first half of the year to two years in the second half of the year. The problem with this is that just when you want duration to work for you (as interest rates are falling), your duration is disappearing. The flip side of that problem is even more troublesome from a risk standpoint. As interest rates rise, mortgage duration extends, and when you least want duration in your portfolio, that is exactly what is handed to you. To add insult to injury, models spit back only what is put into them—the prepayment assumption.

Structure Risk. Structure risk is another important source of risk in fixed-income portfolios. As new securities are continually being created to provide added yield, they bring with them nontraditional risks arising from their structure, such as optionality, implied leverage, and asymmetric risk. More-sophisticated systems and resources to monitor these risks are essential. But once again, the output of those models is only a reflection of the manager's assumptions.

Liquidity Risk. Liquidity risk is practically impossible to quantify, and its importance should not be underestimated. Since 1998, Wall Street has been much more wary of taking risk in the fixed-income markets. Mega mergers have reduced the number of market makers, and as these market makers face pressure to reduce their earnings volatility, they are less willing to put their capital at risk. Therefore, dealers are reduced to being mere brokers, not holding anything in inventory but playing the role of middlemen between buyers and sellers. Consequently, you may not be able to find the bonds you are looking for as easily as before, and even more disturbing, you may not have as enthusiastic a buyer when you are ready to liquidate your position. As a result, it is prudent to consider the size and support of a given issue and the depth of the market in that security. Additionally, it is wise to ask whether the liquidity of the security is appropriate for the type of assets being managed.

Currency Risk. We typically do not choose to take much currency risk, given the extreme volatility in the currency markets and the secular uptrend in the U.S. dollar. Our currency exposure depends largely on our clients' needs. If the client is domiciled in the U.S., with liabilities in U.S. dollars, any currency exposure would most often be hedged into U.S. dollars. One argument against this logic is that unhedged correlations are lower than hedged correlations so unhedged portfolios thus provide better diversification. Here is another example of theory versus practicality and client orientation, the latter being more typical of our approach. The added volatility of currency risk defeats the purpose of holding a bond portfolio. In other words, if the client can tolerate that magnitude of volatility, we have better instruments to put them in, such as equities and emerging market bonds.

Country Risk. In global portfolios, country risk can be the major risk factor, particularly in emerging markets. In developed markets, country correlations are now high, and irrespective of the diversification argument, when markets experience event risk or a flight to quality, diversification does not help combat country risk. There is no magic bullet to combat this risk, so the manager must be vigilant about the potential for event risk and contagion. Besides carefully researching the data on countries in which we invest, we visit them regularly to meet with residents engaged in various capacities to get a deeper, first-hand understanding of the country risks.

Counterparty Risk. This risk is sometimes forgotten. Counterparty risk needs to be monitored regularly. We pay close attention to trading partners and derivatives counterparties to limit and control our exposure to this type of risk.

Benchmark Risk. Because of the strong focus on performance relative to a benchmark, the composition of the benchmarks themselves must be monitored to ensure they represent the kinds of risks that we and our clients are willing to accept. The examples in the next section demonstrate the importance of paying close attention to benchmarks.

Approach to Risk Management

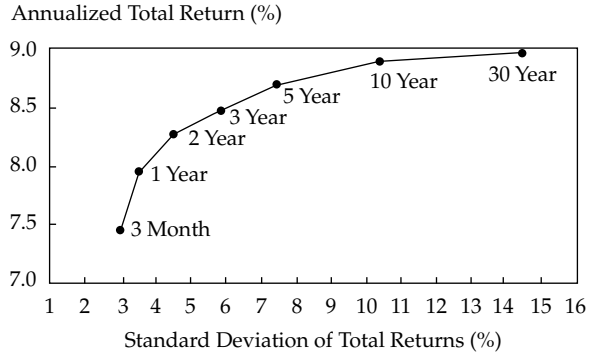
Our approach to risk management has three critical components:

- the quantitative/theoretical framework (e.g. mean–variance analysis, analyzing structural risks, simulations);
- the qualitative/real-world component that is based on experience and judgment outside the confines of a model; and
- client-specific factors, such as the client's time horizon, liquidity preference, risk tolerance, and tracking-error sensitivities.

Our objective is to have a well-diversified portfolio that can perform without delivering negative surprises to our clients. The following examples illustrate our practical approach to managing interest rate risk, spread/credit risk, prepayment risk, and benchmark risk.

Interest Rate Risk. In short-term portfolios, duration is a major driver of return. **Figure 1** shows that, based on the relationship of return to the standard deviation of returns for the past 30 years, the best risk–reward trade-off for the investor is in the

Figure 1. U.S. Treasuries: Return versus Risk



Notes: Data based on 30 years ending December 31, 2000. All Treasury returns based on constant maturity Payden & Rygel Index data.

one- to three-year part of the Treasury yield curve. Since our inception, we have used this strategy to our advantage, successfully outperforming cash and other short-term indexes.

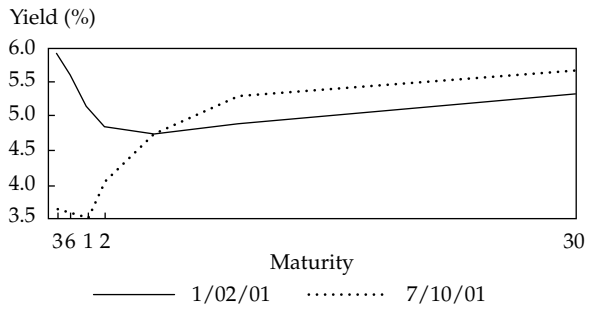
From January 2001 until the middle of July 2001, the yield curve was inverted, with money market rates at 6 percent or more and the two-year yield a little greater than 5 percent, as shown in **Figure 2**. At first blush, in January 2001, the most attractive area of the curve was its highest-yielding point (the three-month bill). In fact, some clients were frustrated that their longer-duration assets were being invested at lower yields and wanted to move to a money-market strategy. We did not agree.

When analyzing the curve, we look for potential total return. Our outlook was bearish on the economy, and we expected the Fed to lower rates more than implied by the yield on the two-year T-bill and Eurodollar forward rates. This expectation meant that the high money-market yields were going to disappear and that the five percent yield on the two-year T-bill was going to look fairly good at some point in the near future. In January 2001, we decided to overweight the one- and two-year parts of the curve. As of the end of June, the annualized return was 2.7 percent on the three-month T-bill, 4.1 percent on the one-year T-bill, and 3.8 percent on the two-year T-bill. Clearly, being in the one-year part of the curve was the best place to be as short rates dropped in the first half of 2001.

In July 2001, the yield curve was steepest in the one- to two-year maturity area; thus, the two-year part of the curve was the most attractive from the standpoint of rolling down the yield curve. What is the best strategy at this point? I would love to tell you that answering this question requires rocket science, but it does not. One of the analyses we perform is a simple break-even analysis to determine the best place to be on the curve. **Table 1** compares a one-year note (Portfolio 1) with a two-year note and a portfolio of cash (Portfolio 2)—in other words, a bullet (one-year note) versus a barbell (two-year note and cash). Both portfolios have the same duration (0.92), but the barbell has a higher yield than the bullet (3.85 percent versus 3.69 percent). The break-even analysis, for both parallel and nonparallel shifts, indicated that in almost every interest rate scenario, Portfolio 2 (the barbell strategy) would be the better-performing strategy.

With perfect hindsight, consider how Portfolio 2 actually performed. During the third quarter of 2001, the three-month bill (the proxy for the cash portfolio) earned an unannualized return of 1.1 percent, the one-year note earned an unannualized return of 2 percent, and the two-year note earned an unannualized return of 3.6 percent. Thus, the unannualized return on the barbell portfolio in the third quarter of 2001 was 2.3 percent. In hindsight, investing in the barbell was a good decision.

Figure 2. Yield Curve: January 2, 2001, and July 10, 2001



Source: Based on data from Bloomberg.

Table 1. Barbell versus Bullet Strategy: Break-Even Analysis

Parallel curve shifts: total return under each scenario

	–150 bps	–100 bps	50 bps	0 bps	50 bps	**100 bps**	150 bps
Portfolio 1	5.146%	4.708%	4.272%	3.838%	3.406%	**2.976%**	2.548%
Portfolio 2	5.559	5.066	4.538	4.013	3.493	**2.978**	2.466

Nonparallel curve shifts: total return under each scenario

	50 Bull Steepener	25 Bull Steep	Bull Flat	Unchanged	25 Bear	Bear Steep	Bear Flat
Portfolio 1	4.237%	4.034%	3.985%	3.838%	3.622%	3.808%	3.755%
Portfolio 2	4.421	4.216	4.153	4.013	3.753	3.866	3.835

Note: Shaded numbers show better alternative. Bold numbers show the break-even point for the analysis.

For long duration portfolios, as for short duration portfolios, the shape of the curve is also important in decision making. Given a longer duration, positioning on the curve is critical. For example, from August 31, 2001, to September 25, 2001, the 5-year yield fell 55 bps, the 10-year yield fell 12 bps, and the 30-year yield *rose* 20 bps. If you had invested in the 10-year, your price appreciation would have been 90 bps, and given the duration impact, the 30-year would have handed you a negative return of a whopping 290 bps. You can see that knowing where on the curve your duration comes from can make a big difference to performance.

Using a condensed version of the output of some of our analytics helps us monitor where our bets are on the yield curve**. Table 2** shows the difference between the key rate durations for a sample portfolio and the Salomon Brothers Broad Investment Grade (BIG) Index. Key rate durations quantify not just the overall portfolio duration but also the bets along the curve. For instance, Table 2 shows (in bold) that the portfolio's duration exceeds the duration of the index by 0.71 years and that the majority of the overweight is in the 10-year part of the curve, which was not the place to be during the period just discussed (August 31, 2001, to September 25, 2001). Table 2 shows that, although managers have many different models to define where on the curve bets have been placed, none of these models defines where to place the bets. In other words, alas, we do not have a crystal ball. If we have a strong view, however, these models help us express it in a clear and targeted fashion.

Spread and Credit Risk. Duration alone worked extremely well as a value-adding tool for portfolios in the 1980s and even in the early part of the 1990s, with interest rates at high levels and trending lower. For example, 5-year yields fell 640 bps in the 10 years from 1984 through 1993. An additional year of duration on an intermediate portfolio would have added roughly 2.3 percent a year of return during that 10-year period and a 100 percent allocation to investment-grade corporates would have added just under 1 percent a year in return during the same period. In the subsequent period from 1994 to 2001, 5-year yields fell only 90 bps. Applying the same standard, an additional year of duration would have added only 40 bps per annum during that eight-year period. This reality overlaid on an environment of generally lower interest rates underscores the diminished value of duration. Concurrently, sector management has been growing in complexity, with new structures and products and new risks being introduced into the capital markets. Recognizing these shifts in the environment, we have been regularly adding significant resources in the analysis of spread product. We continue to invest in people and systems to cover a broad range of fixed-income securities, and today, we believe strongly in the added value of diversification across sectors.

Table 3 is a matrix that shows the correlations between sectors and is a tool that enhances our insight into the underlying risk characteristics of a portfolio. Take a look at some of the lower-correlated sectors—for instance, the 14 percent correlation between nondollar and BB corporates. These sectors make a strong argument for the core-plus portfolios that we manage. Given the core-plus focus that has grown increasingly popular in the last few years, the monitoring and managing of sector, credit, and spread risk has become critical. Because correlations between sectors change over time depending on market conditions, we recognize the limits of correlation statistics and focus on forward-looking relationships.

Sector allocation also plays a role in duration management. Even though a sector may be neutral to a benchmark in terms of the market-value percentage weighting, the contribution of the sector to a portfolio's duration is more telling. For example, **Table 4** shows that we are overweight corporates (36 percent for the portfolio compared with 26 percent for the index) and have a neutral weight to Treasuries (25 percent). The bottom of the chart in Table 4 shows the contribution to duration. Of the portfolio's total duration, 2.01 years is coming from Treasuries, compared with 1.49 years for the index. This overweight is designed to hedge the corporate exposure against a flight to quality. The idea is that if we experience a flight-to-quality event, corporate spreads will widen and Treasuries will rally, so the longer duration of the

Table 2. Key Rate Durations by Maturity

	Total	1 Year	2 Year	3 Year	5 Year	10 Year	20 Year	30 Year
Portfolio	4.92	0.15	0.10	0.37	1.05	**1.84**	0.68	0.73
Index[a]	4.21	0.20	0.21	0.41	0.89	1.06	0.90	0.54
Difference	**0.71**	–0.05	–0.11	–0.04	0.16	0.77	–0.21	0.19

[a]BIG Index.

Table 3. Correlations between Fixed-Income Sectors

	Asset-Backed Securities	Governments	Mortgage Pass-Throughs	AAA Corps.	AA Corps.	A Corps.	BBB Corps.	BB Corps.	B Corps.	Nondollar	Emerging Markets
Asset-Backed Securities	100%										
Governments	95	100%									
Mortgage Pass-Throughs	84	87	100%								
AAA Corporates	94	98	88	100%							
AA Corporates	93	98	88	99	100%						
A Corporates	89	92	83	94	94	100%					
BBB Corporates	88	88	79	92	92	88	100%				
BB Corporates	76	49	51	58	58	58	65	100%			
B Corporates	50	28	36	36	37	36	43	87	100%		
Nondollar	62	67	58	64	65	58	55	33	14	100%	
Emerging Markets	42	64	40	52	54	58	49	60	62	51	100%

Treasuries adds relatively greater value than competing strategies.

Another way we limit our credit risk is by having very low limits on individual credits. For investment-grade corporates we have a maximum allocation of 2 percent per issuer; for high yield, the maximum is 0.5 percent per issuer. These internal guidelines mitigate risk in two main ways: First, they diversify the risk, and second, they give us the ability to operate under a strict sell discipline. The risk mitigation achieved through our guidelines has been particularly useful given the softness in the corporate sector and the number of fallen angels, whose credit rating downgrades lagged their weak fundamentals. For example, in the early part of 2000, Xerox Corporation was still rated A, even though the company was already in trouble. Because we had a 2 percent exposure to Xerox, we could liquidate when it was still trading in the high 90s, without a major perturbation to portfolios. Xerox was downgraded to BBB later that year, and eventually, Xerox bonds dropped to 50 cents on the dollar and were downgraded to below investment grade. This dramatic example highlights the importance of independent credit research, rather than relying solely on external rating agencies.

Because high yield is where the rubber meets the road when it comes to credit expertise, I thought I should discuss our high-yield risk management approach. We have never had any defaults in our high-yield holdings, despite the 8 percent default rate in the high-yield market. Furthermore, our upgrade-to-downgrade ratio is high relative to the industry—1.8 to 1 versus the universe's 0.5 to 1. Our sell discipline and our focus on higher-quality credits help support our strong track record. This track record does come at a price. In periods of "irrational exuberance," we tend to underperform, but because we tend to avoid problems in periods of crisis, this underperformance is acceptable to us and to our clients. Even with a strict risk management stance, we have done well since inception, with a cumulative return of 10.46 percent (net of fees) for our strategy versus 6.23 percent for the Merrill Lynch High Yield Index and –3.12 percent for the Lipper Median (400+ funds). I do not mean to imply we are geniuses by any means, but our example shows how a practical approach can pay off.

Of course, these returns reflect the recent tough environment for high yield. To provide a perspective on our approach to managing risk in this area, I thought it would be helpful to use the telecommunications industry as a case study. The high-yield telecom sector has particularly experienced unprecedented volatility during 2001, and many of the bonds in the sector are down 40–60 percent for the year to date. Our exposure to the telecom sector has been low, which of course helped relative performance. We have about 5–6 percent of our high-yield allocation in the telecom sector, versus an index weight of 25–30 percent if cable is included. Of that 5-6 percent, we focus on the top players—the names that have some financial backing and access to capital, one of which is Nextel Communications. It has good leverage numbers, good interest coverage, and a strong business model. We believe the Nextel story is compelling and continue to hold the position.

We make mistakes, but when we do, we expect our sell discipline to kick in and limit our risk. We bought Winstar Communications (a dot-com-type company) in early 2000 based on the company's then-prodigious liquidity and solid business prospects. Our decision was not influenced by its financial ratios and interest coverage because the company did not have any income. As Winstar's situation began to deteriorate, we were able to liquidate the position relatively early because of our sell discipline. We sold Winstar bonds in March 2001 for approximately $40; as of October 2001, they were trading at $1.

Table 4. Comparison of Portfolio with Index by Market-Value Weights and Contribution to Duration

	Total	Treasuries	Govt. Agency	Asset-Backed Securities	Mortgage Pass-Throughs	CMOs[b]	Total Corporates	Cash	Money Market
Percentage of market value									
Portfolio	100.00%	25.00%	11.10%	20.70%	26.50%	1.60%	36.00%	–24.90%	4.00%
Index[a]	100.00	25.00	11.40	1.50	36.60	—	26.20	—	—
Contribution to duration									
Portfolio	5.45	2.01	0.36	0.51	0.53	0	2.03	—	0
Index[a]	4.25	1.49	0.52	0.06	0.78	—	1.42	—	—

[a]BIG Index.
[b]Collateralized mortgage obligations.

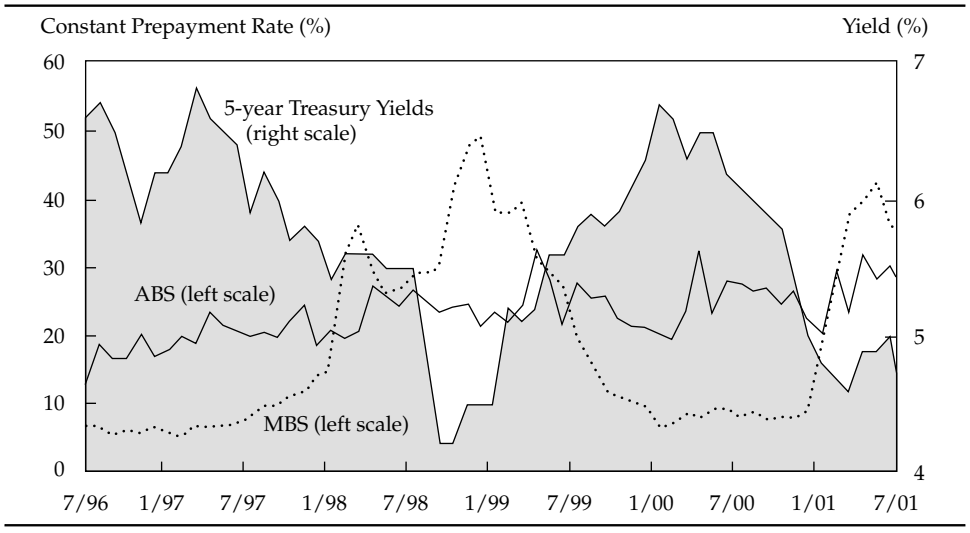
Prepayment Risk. Prepayment risk can be quantified in a myriad of ways, but as with all models, the rule of "garbage in, garbage out" applies—if the prepayment assumptions are wrong, then the output of the model is of little value. In rapidly declining interest rate environments, such as the one that occurred this year, we look for alternatives to traditional fixed-rate mortgage-backed securities (MBS). Asset-backed securities (ABS) have worked well as a substitute for MBS. **Figure 3** shows how volatile the prepayment rate has been for MBS compared with that for ABS. In short portfolios, we have used ABS as substitutes for collateralized mortgage obligations (CMOs). In longer portfolios, however, we have used commercial mortgage-backed securities (CMBS).

CMBS are a relatively new addition to the Lehman Brothers Aggregate Bond Index, but we liked them even before their inclusion in the index. CMBS are well diversified geographically, and they have virtually no prepayment risk because commercial mortgages typically have prepayment penalties (and as a result, their prepayment experience has been much lower than that for conventional fixed-rate MBS). We are currently in a heavy prepayment environment, but even so, year to date through August 2001, CMBS had a 10.1 percent unannualized return, versus 8.1 percent for fixed-rate MBS. In the Lehman Aggregate, the durations of these sectors are 5.1 years for CMBS and 2.6 years for fixed-rate MBS, which reflects the greater prepayments in the fixed-rate product.

A more concrete example with actual securities offers a better perspective on the prepayment risk. At the beginning of the year, the durations of the Fannie Mae 6.5% fixed and the Bear Stearns conduit CMBS were both 3.7 years. Today, the duration of the Fannie Mae 6.5% has fallen to 2.7 years but the CMBS duration is 3.3 years. Through the third quarter of 2001, the unannualized return on the Fannie Mae is 6.5 percent, compared with 9.2 percent for the CMBS. Earlier in the year, we placed about 25 percent of our mortgage exposure in our core bond portfolios in CMBS, in lieu of fixed-rate mortgages. The outperformance of the CMBS in this heavy prepayment period has paid off so far.

Benchmark Risk. More often than not, the benchmark is taken for granted, but benchmarks can present unwanted risk to a portfolio and the manager. The availability of the bond issues in the benchmark and the liquidity of those issues can both be stumbling blocks for managers in replicating the index. In 1998, market participants realized that the Lehman Aggregate did not have a lot of liquidity. About 95 percent of the Treasuries in the Lehman Aggregate were off-the-runs (i.e., not recently issued Treasuries and hence less liquid) and traded 20–30 bps wider than on-the-runs (i.e., recently issued Treasuries), even though their projected cash flows were not materially different from the on-the-runs. At that point, if a manager's Treasury exposure was achieved primarily through on-the-runs, the manager would have underperformed the benchmark. In general, pricing of securities in the index could present a problem, particularly on the less liquid issues. If a security has not traded in a while, how is it priced? Is that price real? So, your performance is

Figure 3. Automobile ABS versus Fannie Mae 7.5% MBS, July 1996–July 2001



being measured against a benchmark with theoretical prices on certain securities. Is your out- or underperformance real?

A final problem with benchmarks is their changing composition. Portfolio managers should continually monitor the composition of benchmarks. As the composition changes, the benchmark may not be reflective of the risk the managers or their clients want to accept. For example, **Figure 4** shows the changing composition of the Lehman Aggregate from December 31, 1990, to August 31, 2001. Declining Treasuries are clearly a major factor in the changing composition of the Lehman Aggregate. Part of the weight once given in the index to the Treasury sector has been shifted to the mortgage sector, and with more mortgages comes more prepayment risk. Figure 4 also shows two new asset classes that have been added to the index since December 1990—CMBS (ERISA eligible) and ABS. As shown in **Figure 5**, the benchmark now also has more credit risk, with few Aaa credits and increasing percentages of lower-rated corporate securities. Client guidelines and expectations also have to be managed in light of benchmark composition.

The challenge of a shifting composition in the benchmark can be illustrated by two more examples: The Salomon Brothers World Government Bond Index (WGBI) and the J.P. Morgan Emerging Markets Bond Index (EMBI+). In stock indexes, when a sector is hot, its weight in the index increases, only to decrease as that sector loses steam. For example, technology stocks increased to 34 percent of the S&P 500 Index in August 2000 but have now decreased to about 17 percent. Bond indexes demonstrate the phenomenon that the riskier components of the indexes tend to increase as their relative riskiness increases.

Figure 6 shows selected components of the WGBI and their respective index weights at December 1992, December 1995, and December 2000. Japan's allocation has increased within the WGBI from December 1992 to December 2000, from just over 15 percent to 28 percent; it could rise to 35 percent in a few years, even though the Japanese bond market has been struggling for the past 10 years. Japan has a high debt-to-GDP ratio (130 percent, and expected to rise to 175 percent) and is on the watch list for a possible downgrade from its AA rating. Although the United States is a better credit (AAA rated and with a debt-to-GDP ratio of 60 percent), its weight has decreased within the index over the same period of time, from more than 40 percent in December 1992 to 27 percent in December 2000. It seems that as countries experience economic and financial problems, they tend to increase their debt issuance. As a result, the poorer credits become a bigger part of the index.

The EMBI+ is the most widely used emerging market bond index. The weights for the various countries in the EMBI+ are shown in **Table 5**. The allocation to Latin America is 71.4 percent, and managers

Figure 4. Sector Composition of the Lehman Aggregate, December 31, 1990, to August 31, 2001

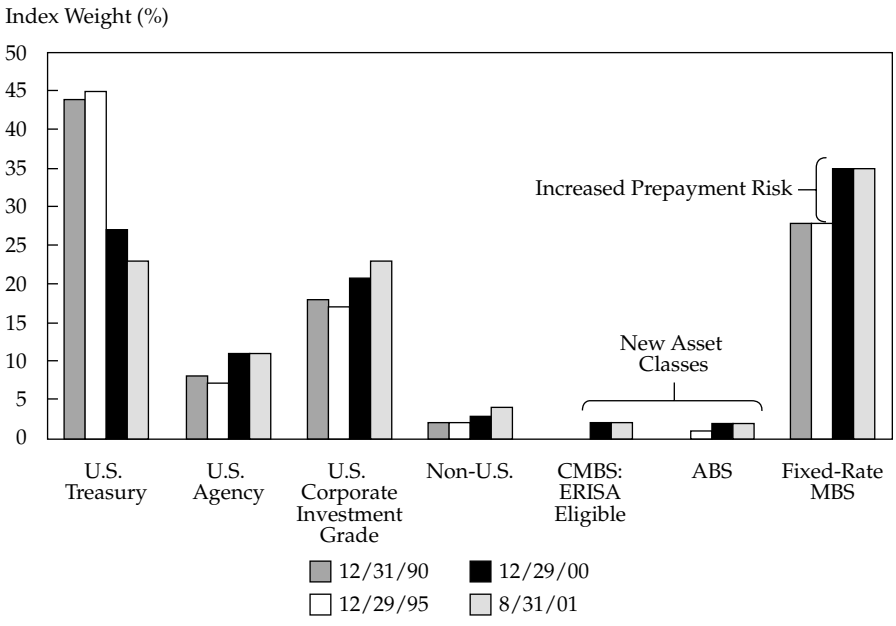
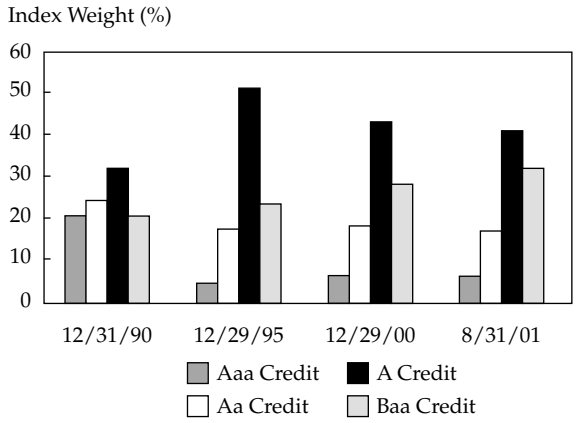


Figure 5. Credit Composition of the Lehman Aggregate, December 31, 1990, to August 31, 2001



managing against the EMBI+ have to ask themselves whether they want to have that high a percentage in Latin America in their emerging markets portfolios. Latin America (at 71 percent) is subject to contagion and is dependent on the vagaries of the oil industry. Note that 23 percent of the Latin American weight is in Argentina—a country that has external debt to exports on the order of 500 percent and high default potential. Brazil, which is not far behind Argentina at 21 percent, is subject to contagion from Argentina. The EMBI+ clearly has serious problems of concentration that portend high risk. Additionally, are those who manage against the EMBI+ comfortable having only 20 percent in Europe and 5 percent in Asia, as in the index?

The way we have dealt with benchmark risk is another example of Payden & Rygel's practical approach to risk management. We have rejected the EMBI+ as the benchmark for our emerging market bond portfolios and have created a "normal" portfolio, more akin to the J.P. Morgan EMBI Global Constrained Index. As shown in Table 5, this is a much more diversified alternative, with 57 percent in Latin America and 14 percent in Argentina. Table 5 also shows our portfolio allocation as of August 31, 2001, which is even more diversified than the normal portfolio weighting, and the allocation to Argentina in the current portfolio is extremely small compared with the normal portfolio.

Summary

It is important to define risk from as many points of view as possible while always remaining conscious of the fact that the benchmark is only a shorthand measure of risk and that, in reality, the true risk resides in underperforming client expectations. Therefore, we use a practical approach to risk management by taking into consideration both market and nonmarket risks, particularly liquidity and event risk. At Payden & Rygel, we quantify downside risk by running stress tests and "what if" scenarios; we ask ourselves, "What if we are wrong? How will the client tolerate the worst case?" Finally, we do not rely solely on model results. Judgment is paramount in the final analysis.

Figure 6. Salomon Brothers World Government Bond Index

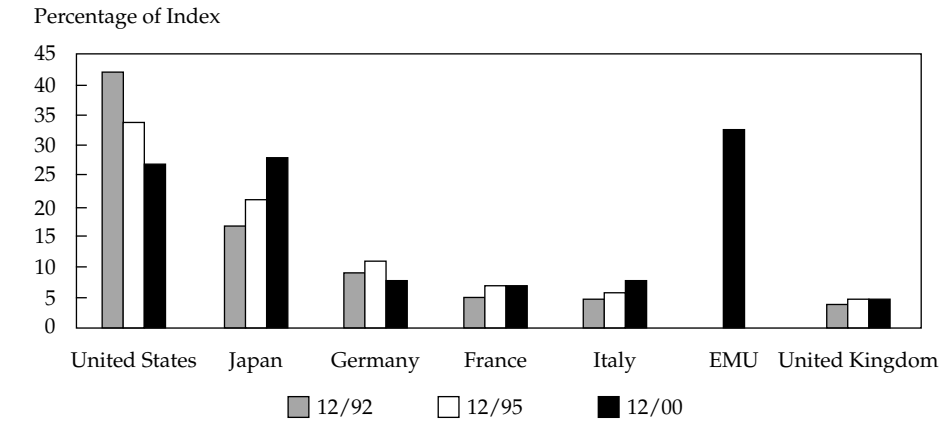


Table 5. Emerging Market Bonds: Country Weightings

Country	J.P. Morgan EMBI+	Payden & Rygel Normal Portfolio	Payden & Rygel Current Portfolio
Latin America			
Argentina	22.9%	14.0%	3.6%
Brazil	21.0	14.0	8.3
Chile	0.0	1.0	0.0
Colombia	1.7	0.0	0.0
Ecuador	1.2	1.0	2.2
Mexico	16.5	14.0	18.2
Panama	1.9	3.0	5.0
Peru	1.41	3.0	3.5
Uruguay	0.0	0.0	2.0
Venezuela	4.8	7.0	7.2
Total	71.4	57.0	50.0
Europe			
Bulgaria	2.2	3.0	5.0
Croatia	—	2.0	1.5
Poland	2.1	3.0	5.0
Russia	13.0	10.0	13.3
Slovakia	0.0	0.0	2.0
Turkey	2.8	3.0	0.0
Total	20.1	21.0	26.8
Asia			
China	0.0	1.0	0.0
India	0.0	0.0	1.3
Indonesia	0.0	2.0	0.0
Malaysia	0.0	3.0	3.7
Philippines	2.6	4.0	5.0
South Korea	2.6	5.0	5.0
Thailand	0.0	0.0	2.2
Total	5.2	15.0	17.2
Africa/Middle East			
Algeria	—	1.0	0.0
Lebanon	—	0.0	0.0
Morocco	0.9	2.0	0.0
Qatar	1.6	0.0	0.0
South Africa	0.0	2.0	2.5
Nigeria	0.8	0.0	0.0
Total	3.3	5.0	2.5
Cash	0.0	2.0	3.5

Question and Answer Session

Asha B. Joshi, CFA
Kevin Maloney

Question: What steps did you take to get portfolio managers to buy into the risk management mind-set at Putnam?

Maloney: Portfolio managers focus on what is likely; risk managers focus on what is possible. Because portfolio managers have a different starting point for their analyses from that of risk managers, the most important step was to listen to the portfolio managers as they discussed what they pay attention to in their investment processes.

The factor structure within our model starts from a framework of how we look at our industry exposures—including credit exposures, mortgage portfolio exposures, and so on. We then determine whether that is a good robust basis for the factors in our risk model. If it is, we go forward; if it isn't, we examine the framework in more detail. We might discover that what we think of as an industry bet is really just a security-specific bet. That is, different securities might not exist in that area because not enough different patterns, other than what are unique company events, are present. We then go back and discuss these issues with the portfolio managers.

Thus, our approach to creating this risk system involves a combination of methodological rigor on my team's part and conversations with the portfolio management teams. If we just hand portfolio managers risk reports, they will not use them unless the reports align with their investment processes.

Question: How successful are credit risk models, such as those produced by KMV, in identifying and managing credit risk?

Maloney: The KMV system resembles an internal rating system. Public ratings provide a framework of differences among issuers, but they are after-the-fact determinations; they're late. KMV has a more generic framework that tries to use information on equity prices to predict future volatility. Based on a combination of traditional fundamental analysis and stock market information, it creates an internally generated rating scheme.

Most firms have some kind of internal scoring system that then gets translated into a single rating, such as a Moody's A rating. KMV is merely a third-party example of the same idea.

Question: What is your plus allocation in your core-plus portfolios?

Joshi: We're currently not too enamored of the higher-quality nondollar issues because the United States now holds better value than Europe. In the 1990s, we had a good ride with the convergence trade, as European yields converged while the EMU was being formed. Since then, we've been waiting for the nonsovereign debt market to take off, but in the meantime, we see better value in U.S. non-Treasury markets. Swap spreads, an indication of credit premiums, are still much tighter in Europe than in the United States. We do like nondollar agencies, such as German Pfandbriefe and Swedish mortgages, but their spreads are minimal. So, our allocation to nondollar agencies in core-plus portfolios is close to zero at this time. Relatively speaking, our allocation to high yield is quite high (15–20 percent). Historically, it's not a bad place to be. And after seeing the problems with Argentina, we have pared down emerging markets from 5 percent to 2 percent.

Maloney: We have many different core-plus, aggressive frameworks. Using the core-plus Lehman Aggregate institutional product as an example, we basically have a neutral allocation to emerging markets. We are slightly overweight with high yield, but we do have a high-quality bias in our portfolios. We are underweight traditional mortgage pass-throughs and hold other structured assets to make up for that underweighting, such as CMBS. We definitely have an overweight in ABS.

Question: How do you deal with high yield in Putnam's risk model?

Maloney: High yield is modeled in the same hierarchy or architecture as investment-grade securities. The factor sets for the two are similar but not identical. The industry groupings that we use for high-yield and investment-grade securities are different, which is partly a function of the concentration of industries in the different segments of credit financing.

The high-yield portfolio managers were the most skeptical about this type of framework. They think of high yield as an individual bond credit analysis story, and that's a huge part of the process. But you'd be surprised at how often high-yield managers end up with common themes in their

portfolios, as they do in all individual credit-type stories. A lot of high-yield managers were overweight telecommunications in 1999. A lot of them had correlated returns. Although high-yield managers will look at the correlation as a bunch of stories that blew up, a common element to that phenomenon was present.

We've done a few things in the model that are unique to high yield. We don't model the distressed area of the high-yield bond market as bonds or as contributions to duration and spreads. We model distressed debt as if it were equity. So, we use price return factors, not spread return factors. For higher-quality distressed debt, we use spread return factors, just as we do in the corporate bond market. Moreover, the returns of high yield and corporate credit in general are asymmetrical; simply relying on a standard deviation number isn't enough. We need to calculate a standard deviation to fit in the context of the overall risk framework, but using skewness measures, we also separately measure the asymmetry of the return pattern for high yield and corporate credits.

Question: How well do key rate durations capture mortgage price performance?

Joshi: Capturing mortgage price performance with key rate durations is a challenge, and prepayment obviously is the major factor with MBS. As a result, we do not look at key rate durations for mortgages as much as we do for the other sectors. Key rate duration analysis is helpful when comparing against mortgages in the benchmark. In that case, we can compare the contribution across the curve for a given prepayment assumption on an apples-to-apples basis. But in the final analysis, this tool is most reliable with bullet bonds. Looking at key rate durations on an overall portfolio basis is also more meaningful than for mortgages per se.

Question: What is the downside of having too many factors in a risk model?

Maloney: A great statistical and investment process debate has ensued about how many factors you need—10 factors, or 1 or 2 factors in a particular area. We think of our model as a hierarchy of groupings of factors. Some of the correlations between specific, precisely defined factors are time varying, and yet the factors in the broader aggregate asset class perform similarly.

If you want to get detailed risk decomposition into the hands of the portfolio managers who are thinking about very fine groups of securities, you have to go down to a level that matches their investment process. From a statistical standpoint, you must be careful about the way you aggregate those factors together in a risk calculation. Thus, through this hierarchical framework, we take the math out of the portfolio managers' realm so they don't have to worry about it.

Correlations and volatilities are dynamic; they change through time. But they do capture the patterns of industries becoming more or less similar. People spend a lot of time worrying about correlations being noisy, but the real benefit is a better understanding of basic trends and patterns. Take the term-structure factor, for example. Without a risk model, people usually add up contributions to duration across the entire yield curve. The benefit of a risk framework is that we know that the long end of the curve on a yield basis is much less volatile than the short end of the curve, which means you can't just add up contributions to duration across the curve and have a good sense of your term-structure exposure. That type of behavior will be captured by a risk system, which is why a risk system is needed; otherwise, it is too easy to fall back on the simple assumption that all of those factors are perfectly correlated and that you will be taking parallel shift risks.

The same holds true in high yield. The high-yield market has a common factor, and a lot of different segments of the high-yield market have different degrees of exposure to that common factor. Unless you've isolated that type of behavior, your analysis becomes too bond-by-bond specific; you end up with correlated bets in your portfolio that lead to higher-than-expected risk levels.

Question: Would you elaborate on stress testing at Payden & Rygel?

Joshi: Our stress testing looks at various interest rate scenarios and spread risk scenarios. If a volatility or an optionality component is present, then we look at volatility and prepayment scenarios to create a framework that shows the tolerable levels of volatility and prepayments. This approach is not that different from what many managers do, but we include a more client-oriented, practical approach in the process than our peers. Although stress testing involves the science of quantitative modeling, it is also an art. For example, in sensitive portfolios, we may have many conversations with the portfolio managers who are the most familiar with the clients to better understand how the clients may react to a particular scenario, which may be based on an absolute return number, not necessarily on underperformance versus a specific benchmark.

Question: Is there a moral hazard in buy-side risk management, in the sense that the risks to the firm may not be the same as the

risks to the shareholders of individual funds?

Maloney: The firm and the fund shareholders clearly have different risk management issues. (I'll answer this question from the point of view of the equity management side because it is a little more straightforward.) In the short term, Putnam's revenues depend on what happens in the stock market. When the market acts as it did from July to October 2001, we have all kinds of conversations about how market events will affect our bottom line, because revenues are tied to asset levels. An absolute-risk sense of Putnam's own business success clearly exists and dominates our focus in the short term. But that's cyclical. Those concerns play themselves out over market cycles.

As a firm, our competitive success over time depends on our ability to add value for our clients wherever we are invested. We can manage our macro risk from a product-line standpoint, and we can manage our risk to shareholders specifically in the markets and sectors they've chosen by the funds they've chosen. And sophisticated clients have been asking for performance-based fees as a way to bridge that moral hazard gap in certain cases.

Question: Is there material risk associated with benchmarks not representing the universe they are supposed to capture?

Joshi: It is a challenge we all face because we can't run away from benchmarks. The problem with many benchmarks is price discovery, especially those with less-liquid issues. For instance, in extreme cases of illiquid securities, how do you measure a hedge fund or private equity return, or even a real estate portfolio return? In each of these examples, how does one go about setting a price on each investment on a daily basis? Who knows what the true price is? The problem is not as dramatic in the more traditional fixed-income benchmarks, but the price factor could result in a material impact, particularly in the short run. For example, say you are managing a portfolio against the Lehman Aggregate and your performance is being compared against other managers, in addition to the benchmark. What if your pricing is relatively conservative compared with that of your peers? Over time, this situation may correct itself, but during periods of market stress, it may not. Several issues in the benchmark may not trade frequently. Would the prices of those securities truly reflect what an investor is willing to pay for the securities? If those prices are inflated, is your underperformance compared with the benchmark's true underperformance? Vis-à-vis the client, the challenge is being able to communicate this phenomenon without sounding as though you are making excuses for poor performance.

Maloney: In our daily cycle at Putnam, we price every benchmark through a consistent hierarchy in which they all might have different prices. We'll put a consistent price for each security across all those benchmarks because we don't want our exposures and attribution systems to find "security-selection returns" that are just pricing service differences. You will never achieve a consistent exposure report, attribution system, or risk management framework unless you put a consistent pricing framework across those systems.

Question: Does that mean you restate the index return and report that return to your clients?

Maloney: We report the official return of the benchmark to our clients, which is based on their pricing. But our internal attribution systems use a single price for a given security to account for the occasional times when our portfolio pricing service prices a security differently on a given day than does the benchmark provider. We do everything on a consistent basis to prevent pricing differences from causing phantom return and exposure differences in our systems.

Question: To what extent do you find scenario analysis useful?

Maloney: Scenario analysis is absolutely complementary to parametric risk. If you generate a parametric risk number, it is a standard-deviation-type number. Once you've gone through the pain and effort of creating all those factors and the time series of those factors so you can calculate their volatilities and correlations, you have a rich set of data to use for stress tests. In addition, we may do a five-year simulation of today's exposures with historical factor returns to get a sense of the possible distribution of returns. We can find out how a current portfolio would have performed in the third quarter of 1998, for example, based on that simulation. Stress testing is helpful once the hard work of setting up the structure has been done.

Question: What percentage of Putnam's technology effort is complete, and what is your time line to complete it?

Maloney: I don't think we'll ever be done with our technology effort because it's always evolving. Our fixed-income risk model is deployed, but we are actively researching the factor structure on a regular basis and are trying to enhance it. As far as a seamless stitching of things together, on the equity side of Putnam, we have all the risk management frameworks in place and the distribution of

these tools to the portfolio managers is complete. The link to the trading system will be delivered soon, as will the link into compliance and the entire real-time framework.

On the fixed-income side, we're about a year behind where we are on the equity side. We have the reporting and risk engine part done, and we have a trading system and compliance system. Stitching all the parts together is costly.

The biggest challenge is the terminology and expertise gap. Portfolio managers have difficulty describing exactly what they want from a framework. They tend to show you the report they want. And if you have engineered a system to give them that report, the first thing they want is a modification of that report. As a result, you can't do a traditional system development framework because you will end up with an expensive, huge framework. You have to articulate a framework vision that goes further than what people want and then bring them to that vision.

The hardest part of the process is translating the finance terminology, because in our business, we have our own language. We have to translate that language into one that a software developer can understand on an ongoing basis, which works only when people sit down next to each other and work long term on issues. I've certainly spent many more years thinking about systems than I ever thought I would when I left academia to work in the private sector.

Applying Risk Management Tools to Fixed-Income Portfolio Management

Kevin Maloney
Director of Financial Engineering
Putnam Investments
Boston

Risk management is playing an increasingly prominent role in the investment process. Because fixed-income portfolio management is inherently a risk allocation business, choosing the right risk management system is critical. The challenge is incorporating appropriate tools into each step of the investment process rather than simply applying risk management in the form of post-investment-decision monitoring or crude risk limits on portfolio managers.

Risk management techniques are increasingly being added to the fixed-income investment process. My presentation describes this trend and then addresses the role of risk management within an investment firm, the evolution of fixed-income risk management over time, the development of fixed-income risk models (in general and specifically at Putnam Investments), and the application of these models to portfolio management.

Risk management should be neither an "after-the-fact" monitoring tool nor a set of handcuffs on the portfolio management team; rather, it should be a collection of tools that is used every day in the investment process to make the process more effective. The fixed-income risk factors I discuss are nothing new, but my hope is to add flavor to the pot by explaining how these risk management issues can be brought together in an effective way.

Role of Risk Management

In the fixed-income world, the ability to measure and manage risk is a critical component of every stage in the investment process. Fixed income can be viewed as a risk allocation game. The common factors that drive fixed-income returns (term structure, currency, spread movements, and so on) explain so much more of the variability in a fixed-income portfolio's return than the equity factors (industry, size, style) do for an equity portfolio's return. Thus, the management of fixed-income risk factors is how fixed-income portfolio managers effectively deploy their best ideas in a portfolio.

Our risk management platform at Putnam has been applied consistently for the various aspects of the investment process—from product design, portfolio construction, and individual security evaluation to performance analysis and management oversight. This system is used both at the corporate level and in all individual portfolio management processes.

In the evolutionary stages of many corporate risk management systems, the system primarily involves risk limits and monitoring. Later, these systems evolve into style-based or asset-class-based frameworks that are unique to the different desks and processes within a firm, but no across-the-board standard exists for all the systems. As more complicated products, such as core-plus or multiasset-class products, are introduced into a firm, the systems in place do not provide a consistent approach for all asset classes.

At Putnam, we have returned to the "ground floor" to seek a framework that can encompass all asset classes with each of their unique contributions to the management process and that can be applied uniformly, with a consistent terminology and set of analytics. If we can create such a system, then the corporate risk management system will be using exactly the same framework and will speak the same language as the portfolio risk management system. Our goal is to avoid having one system at the corporate level that indicates portfolio managers are taking too much risk and another system at the portfolio

Editor's note: The joint Question and Answer Session of Asha B. Joshi and Kevin Maloney follows this presentation.

management level that indicates portfolio managers are not taking enough risk. Our combined approach has successfully eliminated these types of conflicts.

At the firmwide level, one role of a risk management system is to advance the firm's risk culture and processes. Another role, which I have already mentioned, is the development and deployment of a unified risk management framework that can be used for a wide range of products: fixed income, high yield, global governments, emerging markets, balanced funds, value equity funds, growth equity funds, and so on. To create such a unified risk management framework, our goal at Putnam is to be as consistent as possible. For example, portfolio managers should not measure and manage currency risk on the equity side differently than on the fixed-income side. The final role of a risk management system (at the firm level) is to integrate risk monitoring, risk measurement, and risk management into the investment process. Once those steps are taken, the firm can monitor and measure a whole product line with this risk framework by deploying it to the desktops of all the portfolio management teams for use in the portfolio construction process.

At the portfolio management level, we are less concerned with managers taking too much risk and more concerned that managers are taking risks where they have the greatest insights. The purpose of portfolio construction is to ensure that risk contributions are consistent with return expectations and to highlight intentional and unintentional exposures. The role of risk management at the portfolio level is to confirm that risks are in line with client/management tolerances.

Evolution of Fixed-Income Risk Management

In the early 1990s, two levels of risk monitoring or risk limits existed in most firms: senior management oversight and portfolio management oversight. Senior management was most concerned about asset gathering. A great deal of attention went to whether money was flowing into individual portfolios and whether their mutual funds were being sold. Senior managers also looked at security concentrations and focused on post-trade regulatory compliance. Securities were reviewed on a market-value basis, and derivatives monitoring was based on the amount of notional exposure. In addition, senior managers performed basic performance monitoring.

Portfolio managers, on the other hand, looked at daily holdings reports and standard duration analytics; typically, the full suite of reports would be run once a week. Portfolio managers focused on the two broad dimensions of asset class and sector weightings. These asset class and sector exposures became the implicit tools of risk management. When portfolio managers did scenario analysis, the analysis was generally done on a security-by-security basis to justify a sale or trade. Benchmarks were typically used after the fact, for performance analysis only, and were not a focus of the process. Risk reporting was limited to historical analysis of *ex post* volatility numbers.

By the late 1990s, the market had catapulted through significant changes in volatilities and correlations across asset classes, and investment management firms started developing higher standards for risk management. The Asian crisis occurred in 1997, Russia defaulted and Long-Term Capital Management blew up in 1998, and interest grew in defining the downside volatility of certain asset classes and strategies. In response, at the senior management oversight level, firms tried to build or buy a risk management system. The goal was to implement a third-party system for corporate risk and to monitor counterparty exposures from derivatives. Senior managers began to consider liquidity and capacity monitoring more important and started scrutinizing performance versus benchmarks and peer groups. They also began to group their funds in a style-based framework.

The higher risk management standards also influenced portfolio managers to demand more-detailed and frequent reporting. Typically, they sought exposure reports in the two dimensions of asset class and key rate duration ranges. In global portfolios, portfolio managers wanted to see currency exposures, country exposures, and term-structure exposures, as well as integrated analytics, for bonds and derivatives. Furthermore, more firms were using either principal-component-type three-factor term-structure risk measures or key rate duration measures to capture yield-curve risks. Portfolio managers began to more explicitly compare their active exposures relative to those of their benchmarks. The compliance focus shifted to a pretrade basis from a post-trade basis.

Today, firms continue to build on the higher risk management standards of the late 1990s. Senior managers use a complete corporate risk system and have as many tools in their toolbox as portfolio managers do. When senior management evaluates performance, it cannot limit itself to achieving simple absolute performance and attaining high Lipper rankings; rather, it needs to think more holistically about the entire product line and ensure that the firm has appropriate style-based performance measures. Risk-adjusted returns deserve a greater focus than ever before, and risk ranges are now central to product definition. Finally, firms need to focus on their full product line, not just on an individual product after a blowup in that product line occurs.

Portfolio managers now seek ways to link exposure reports with risk analytics. A manager wants to be able to say, "I have this much tracking error. It comes from these exposures. These exposures are associated with the following securities. If I do the following trades, they will affect my portfolio in these various ways." Risk management has become an integrated process—from a very macro level to a very micro level—that requires detailed risk decomposition and marginal risk analysis. Managers also perform "what if" analyses by analyzing the market forces affecting their portfolios and using this information when modeling trades and constructing portfolios. They also carry out pretrade compliance and use optimization tools.

General Fixed-Income Risk Models

A risk model produces a forecast of the risk of a portfolio by combining

- information on the current holdings in the portfolio and benchmark,
- knowledge about the characteristics of each security in the portfolio and benchmark,
- exposure sensitivities for each security in the portfolio and benchmark, and
- statistical information about the variances and correlations of historical security returns.

To determine factor exposure sensitivities for securities and portfolios, a pricing model is needed that can calculate effective duration, convexity, spread duration, and volatility sensitivity. Most managers stop at the determination of these exposure sensitivities and with reports that aggregate information about portfolios and characterize each sector's contribution to the duration of the overall portfolio. This approach, however, needs to be taken a step further and combined with past patterns of historical returns, asset class levels, and individual securities as a framework for a state-of-the-art risk management system.

Most risk models attempt to identify common factors—factors that describe broad, shared patterns in security returns. The common factors capture the observed correlations of individual security returns. Security characteristics (e.g., asset type, country, currency, and industry) are used to identify the factors that affect the return on a security. Each security has an estimated exposure to each common factor. The exposure is usually the product of a model-based analytical measure (e.g., contribution to spread duration) and an empirically estimated sensitivity (e.g., spread beta) for each security based on its characteristics.

All risk models start by identifying the common factors. The risk not captured in the common factors is called residual, idiosyncratic, or security-specific risk, which is the return variability not explained by the common factors. Security-specific risk is assumed to be uncorrelated across issuers. In the equity market, more than 70 percent of the volatility of individual securities is unexplained by the common factors. In fixed income, depending on the asset class, that number can be as small as 1–3 percent or as big as 10 percent, but most of the variation in returns can be explained by the common factors. Given those common factors, a pricing model can be used to provide exposure sensitivities to each of those factors, and then those exposure sensitivities can be combined in a risk prediction framework.

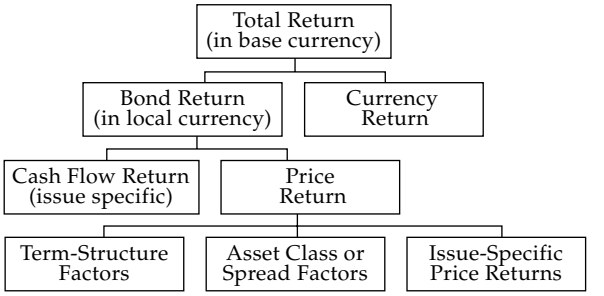
The Putnam Fixed-Income Risk Model

The Putnam risk system is a proprietary enhancement of the Barra TRAM (TotalRisk for Asset Management) system. TRAM is a framework that reaches across all asset classes—global equities and global fixed income—and provides significant detail at specific classification levels. We discovered, however, that at Putnam, we needed yet another level of detail, particularly on the fixed-income side.

We started with Barra's basic framework, including its calculation engine and setup programs, and then customized the detail for some of the risk-factor breakdowns. The common factor covariance matrix is updated monthly, and we run this risk system every day for all portfolios and their benchmarks. Every security in every Putnam portfolio, plus roughly 35 different benchmarks, gets sent through a pricing model every night. The model calculates factor exposure sensitivities and performs detailed risk calculations, risk-decomposition information, and exposure analytics using the volatilities and correlations of the factors. The model is used to produce detailed risk reports for all "lead accounts" every single day. The managers can access those reports from a Web-based interface and do trade modeling to get a sense of the macro aggregations of risk.

The simplest way to describe how our risk model works is to think about it as a hierarchy, as shown in **Figure 1**. The total return for a security is measured in the base currency of the portfolio, say, a euro-denominated German security in a U.S.-dollar-based portfolio. The total return can be broken into a bond return component in local currency and a currency return component. The bond return component has a cash flow element, which typically is the income, or coupon, plus any of the prepayment flows in a structured asset. So, the cash flow return is issue specific, but the price return component is affected by factors that are common in a variety of different assets. Broadly speaking, that price return can be attributed to common term-structure movements, asset class or spread factors, and issue-specific events.

Figure 1. Putnam Fixed-Income Risk Model



Putnam's fixed-income risk model includes 46 currency factors. We include the euro, but we also retain the legacy European currencies, which is the reason the number of currency factors is so high. We have three term-structure factors (shift, twist, and butterfly) for bonds denominated in 23 developed-market currencies.

We have customized the Barra system in the description of what drives returns across and within asset classes. We use 23 swap spread factors; 26 emerging market spread factors; 55 rating and industry spread factors for the corporate and high-yield markets (which will increase in the next generation of this model); 34 spread factors and 1 volatility factor for mortgages and structured assets; and 1 spread factor for agencies. These factors are used to explain fixed-income return patterns so that this model has approximately 250 common factors.

We are confident our risk model encompasses the drivers of our investment processes and the patterns of returns for each asset class, because early in the process, we asked our portfolio management teams to participate in the creation of the risk model. We are now satisfied that our risk management framework explains the sources of risk in the sectors of the fixed-income world and that it does so by using factors our portfolio managers are comfortable actively managing.

Application to Portfolio Management

Risk reports alone, as tools, are not sufficient. Portfolio managers need analytics that will allow them to manage and reallocate risk as their views and insights about the world evolve. To practically embed risk management techniques into the investment process requires having the ability to

- calculate total risk and active risk,
- decompose the risk and understand the contributions from common factors and specific risk,
- understand the risk contributions from each security to both common factor risk and specific risk,
- understand the marginal contribution to risk from each security and the potential impact of trades involving that security, and
- combine risk analytics with indicators of potential return in a portfolio construction process.

Typically, some form of risk decomposition is present in most risk models. The traditional approach to risk decomposition isolates individual common factors or groups of those common factors and calculates the risk that comes from those factors in isolation. Risk decomposition answers many questions: How much portfolio risk comes from term structure, currency, credit factors, or volatility? How much portfolio risk is security specific? For example, the standard risk-decomposition summary for Putnam's fixed-income risk model displays common factor and sector risk. Then, common factor risk is further decomposed into term-structure, asset class, and currency components. Finally, each of these common factor groups is decomposed into key factor groups.

Table 1 is an example of a typical risk decomposition for a moderate core-plus institutional portfolio in August 2001. It is benchmarked against the Salomon Brothers Broad Investment Grade (BIG) Index. Table 1 shows a decomposition of the portfolio's total volatility, the benchmark's total volatility, and the active risk or tracking error of that fund. The fund had 50 bps of predicted tracking error—30 bps was specific risk and about 12 bps was term-structure risk. The portfolio had little currency risk (1 bp) but a fair amount of corporate spread risk (23 bps).

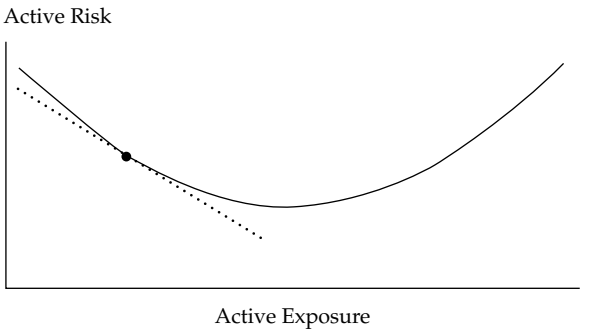
Knowing only portfolio volatility levels, however, may provide little help in the risk management process, unless that volatility can be put into context so that the portfolio manager can understand how to change or modify the volatility. Marginal risk analysis supplies this capability. Marginal risk analysis answers the question: "If I change my exposure to this security or factor, how will it affect the overall risk of my portfolio?" Marginal risk analysis can account for interactions in all asset classes and can calculate both total risk and active risk or tracking error. Marginal risk measures represent the first derivative of the risk measure with respect to the exposure in question.

Figure 2 is an example of marginal risk analysis. For every asset and factor, a graph can be drawn that plots how active risk changes as the active exposure to the security, factor, currency, and so forth changes. The slope of the tangent line at any point on the line, which is fairly easy to calculate, gives the marginal contribution to active risk (MCAR) for that exposure. This measure gives managers a quick sense of how their portfolio's risk profile will change based on the trades they undertake. This information can be the basis of trade-modeling exercises.

Table 1. Risk Decomposition for a Typical Core-Plus Fund Benchmarked against the Salomon Brothers BIG Index

Factor	Portfolio Risk	Benchmark Risk	Active Risk
Total risk	2.97%	2.98%	0.50%
Common factor risk	2.95	2.98	0.39
Term-structure risk	3.00	3.01	0.12
U.S. term structure	2.89	3.01	0.13
Shift: United States	2.85	2.97	0.12
Twist: United States	0.49	0.44	0.04
Butterfly: United States	0.03	0.02	0.01
Non-U.S. term structure	0.15	0.00	0.15
Spread risk	1.05	0.71	0.37
U.S. spread risk	1.05	0.73	0.35
AAA—structured	0.59	0.44	0.18
Interest only/principal only	0.04	0.00	0.04
Asset-backed securities/Collateralized Mortgage-Backed Securities	0.12	0.01	0.11
Pass throughs	0.45	0.38	0.08
Agency	0.04	0.10	0.06
Corporate	0.57	0.35	0.23
High yield	0.15	0.00	0.15
Investment grade	0.45	0.35	0.10
Non-U.S. spread risk	0.00	0.03	0.03
Emerging market spread	0.00	0.03	0.03
Developed spread	0.00	0.00	0.00
Currency risk	0.01	0.00	0.01
Emerging market	0.00	0.00	0.00
Developed	0.01	0.00	0.01
Volatility	0.00	0.00	0.00
Specific risk	0.30	0.04	0.30

Figure 2. Active Risk versus Active Exposure



Note: The marginal contribution to active risk is the slope of the tangent line.

Portfolio managers can go one step further by looking at the details of risk composition. Bob Litterman, who is at Goldman Sachs, has written some papers on this topic, and his approach has become known as "Litterman Risk Decomposition." His approach uses the mathematics of marginal risk analysis to isolate the contribution to a portfolio's risk that comes from each individual security. This approach can be used to decompose either total or active risk. The approach assigns to each individual security the variance contribution of that security plus half the security's covariance contribution. The formula is simple:

$$\text{Active risk} = \sum_i \left(w_i^P - w_i^B\right) \text{MCAR}_i$$
$$= \sum_i \text{CAR}_i,$$

where

w_i^P = the exposure weight of security i in the portfolio

w_i^B = the exposure weight of security i in the benchmark

MCAR_i = the marginal contribution to active risk for security i

CAR_i = contribution to active risk for security i

This equation quantifies that the product of the active exposure of each asset or factor in a portfolio and its marginal contribution to active risk constitute the contribution to active risk (CAR) from that asset. The sum of the CAR terms gives the active risk or tracking error of the portfolio. Consequently, managers can use this approach to isolate the largest contributors of risk within a portfolio. This ability is a great tool in the portfolio management process because it allows portfolio managers to see how much and where risk resides in the portfolio—term structure, structured assets, high yield, emerging market spread, and so on.

An even more efficient way to use risk-decomposition analytics is to highlight the biggest contributors (in terms of factors and specific risk) to the active risk of a portfolio. At Putnam, we distribute risk analytics reports to managers that are organized by factor class. For example, **Table 2** shows the top contributors to active risk in the same core-plus portfolio used in Table 1. This portfolio had the leeway to invest in emerging markets, developed country debt, and so on. The risk analytics report in **Table 3** indicates that most of the term-structure risk in the portfolio was attributable to U.S. market exposure. The next biggest contributor of term-structure risk in this portfolio is the position in Swedish debt that was outside the benchmark. Each of the following eight lines in the table indicates how much each of those factors contributes to the portfolio's total term-structure risk. **Table 4** ranks the 10 largest contributors to the total currency risk of the portfolio. The risk analytics reports at Putnam also rank the 10 highest contributors of portfolio risk in the areas of investment-grade credit factors, high-yield spread factors, and so forth. These reports can quickly give the manager an idea of where the bets are in a portfolio and how the bets are interacting.

Table 2. Contributions to Active Risk

Term structure	6.69%
AAA/structured assets	21.45
High yield	19.64
Investment grade	11.66
Emerging market spread	3.65
Developed spread	0.22
Specific	36.67

Table 5 shows the security-specific risks in the portfolio. A large percentage of the portfolio's mortgage position is in a single Fannie Mae 6 percent generic mortgage. So, 22 percent of the specific risk in this portfolio—that is, 22 percent of the 30 bps of specific risk in Table 1 equals 6 bps, which is a fairly small number—comes from the residual risk of that Fannie Mae mortgage. The large contribution to total portfolio risk arises because the holding in that particular issue is so large. Also notice that a 60 bp position in AOL Time Warner is the second greatest contribution to issue-specific risk in this portfolio. Corporate and high-yield portfolio positions often appear on this list because they tend to have large issue-specific risk volatility contributions. High-level risk decomposition is useful for understanding the macro sources of risk in a portfolio and also for understanding the sources of those factor risks to uncover whether the risk bets are concentrated.

To go from the high-level risk report to a more detailed risk assessment, we use the graphs shown in **Figure 3**, which show the risk contributions of each factor and the percentage of contribution of each factor within a factor group. We construct a separate graph for each of the market sectors represented in the portfolio because we have specialist teams, such as an investment-grade team and a high-yield team, that manage each of those areas. At the macro portfolio level, we can then get a visual image of where

Table 3. Top 10 Term-Structure Risk Factor Contributions

Rank	Risk Factor	Active Exposure	MCAR	CAR	Percentage of Active Risk	Active Risk
1	Shift: United States	–0.1738	–0.1822	0.0317	6.37	0.1231
2	Shift: Sweden	0.0498	0.1099	0.0055	1.10	0.0407
3	Shift: Italy	0.0263	0.1101	0.0029	0.58	0.0224
4	Butterfly: United States	–0.0732	0.0247	–0.0018	–0.36	0.0095
5	Shift: Canada	0.0358	–0.0425	–0.0015	–0.31	0.0294
6	Twist: United States	0.1735	0.0068	0.0012	0.24	0.0429
7	Shift: Germany	0.1156	–0.0080	–0.0009	–0.19	0.0660
8	Butterfly: Germany	–0.0623	0.0115	–0.0007	–0.14	0.0068
9	Twist: Sweden	0.0405	–0.0155	–0.0006	–0.13	0.0121
10	Butterfly: Canada	–0.0189	0.0316	–0.0006	–0.12	0.0029
Total Top 10				0.04	7.05	

Table 4. Top 10 Currency Risk Factor Contributions

Rank	Risk Factor	Active Exposure	MCAR	CAR	Percentage of Active Risk	Active Risk
1	Europe	–0.0006	–2.0393	0.0013	0.26	0.0060
2	Canada	–0.0005	0.6598	–0.0003	–0.07	0.0024
3	Sweden	0.0001	–1.9485	–0.0002	–0.05	0.0011
4	Denmark	–0.0001	–1.9995	0.0002	0.04	0.0009
5	United Kingdom	–0.0001	–1.1510	0.0002	0.03	0.0010
6	New Zealand	0.0000	0.0611	0.0000	0.00	0.0003
7	Austria	0.0000	0.3497	0.0000	0.00	0.0000
8	Australia	0.0000	–2.0393	0.0000	0.00	0.0000
9	Belgium	0.0000	–2.0393	0.0000	0.00	0.0000
10	Brazil	0.0000	0.0000	0.0000	0.00	0.0000
Total Top 10		0.00		0.00	0.22	

Table 5. Highlighting the Biggest Bets

Security Name	Exposure Weight	Benchmark Exposure Weight	Active Exposure Weight	Percentage of Active Specific Risk
Fannie Mae 30-year conventional	22.17%	0.36%	21.81%	20.94
AOL Time Warner 7.625% 04/15/31	0.60	0.03	0.56	1.25
GNR 1998-2 EA PO 0.00% 01	0.49	0.00	0.49	1.11
News American Holdings 7.7% 10/30/25	0.50	0.00	0.50	0.82
FHR 2028 SG IO 7.35%	0.22	0.00	0.22	0.59
Vesta Capital I 8.525% 01/15/27	0.08	0.00	0.08	0.53
Progress Energy 7.1% 03/01/11	0.62	0.02	0.60	0.53
Fannie Mae 7.25% 5/15/30	1.59	0.08	1.51	0.47
Superior Financial 8.65% 04/01/03	0.12	0.00	0.12	0.44
Union Pacific Company 7.375% 09/15/09	0.61	0.00	0.61	0.44

the portfolio may be overly concentrated in terms of risk. For example, when the pattern is fairly evenly distributed, as with investment-grade debt in Panel A of Figure 3, the risk contributions from that area are relatively well balanced. The goal at the macro portfolio level is to assess whether the portfolio bets, in effect, are concentrated in only a few themes.

If a spike pattern appears, as in Panel B of Figure 3, then all of the risk is coming from one or two bets within the sector. In this case, the core-plus portfolio had a very small high-yield position. The entire high-yield position was in BB rated bonds, and most of those BB bonds were industrial. Thus, most of the risk in high yield was coming from the position in BB rated industrial bonds. This graph provides a good way of telling whether a local specialist team is making one thematic bet or a broad set of bets in the portfolio.

Finally, we address how to build risk considerations into portfolio construction. In order to incorporate such considerations, we must identify how actions might alter the risk of the portfolio (best hedges, marginal contribution to risk, etc.), optimize the allocation of a tracking-error budget to investments with the highest return, and incorporate guidelines, product objectives, and downside risk constraints.

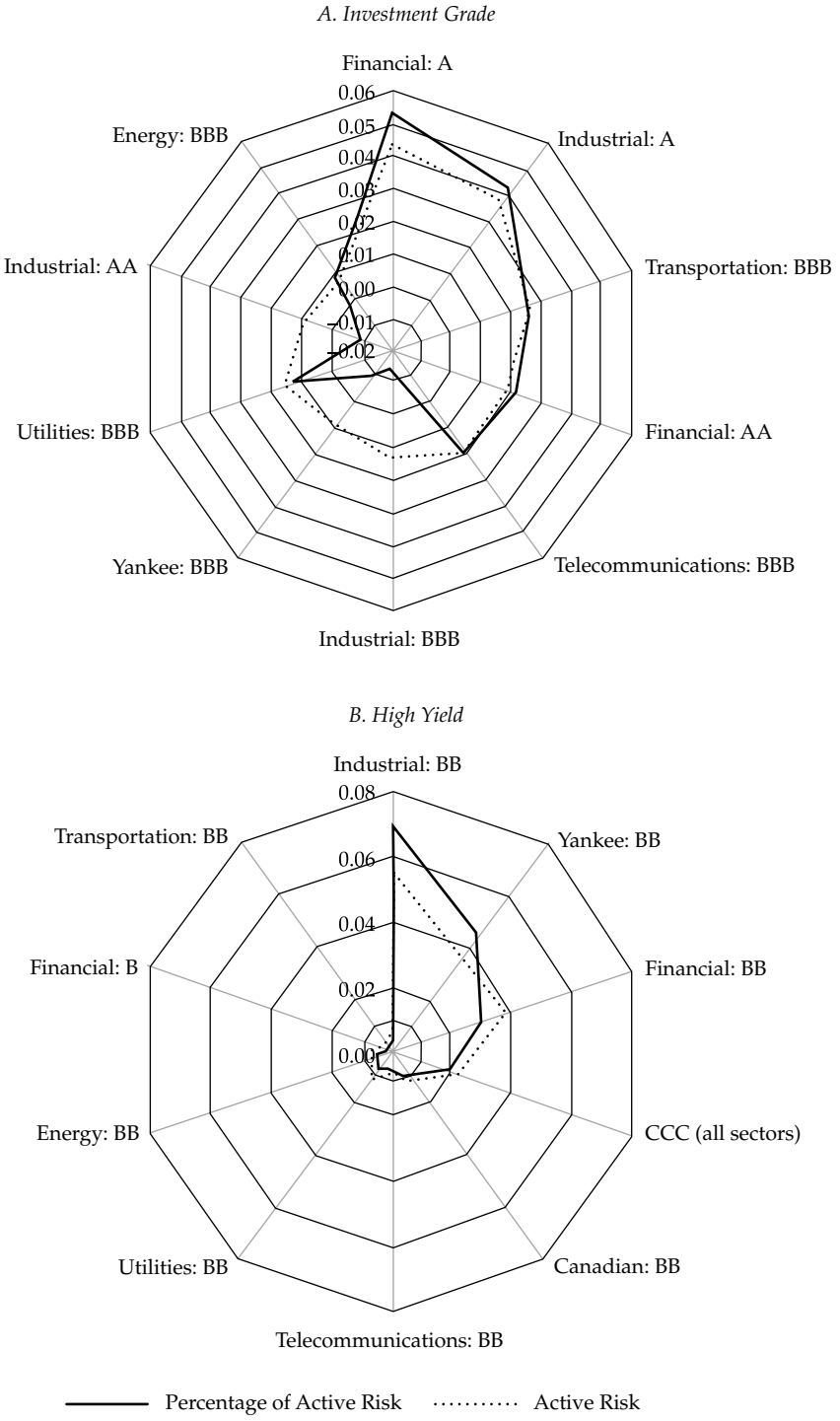
For both our equity and fixed-income management teams, Putnam is working toward a high-level systematic vision for incorporating risk into the portfolio construction process. Our idea is that all portfolio managers would have access to the information provided through what is called the portfolio construction tool, which can access various services or functions (such as a risk engine, a real-time price and market data server, a compliance and constraint engine, and an attribution engine). The goal would be to electronically move from the idea stage and the "How would a trade idea affect my portfolio?" stage to the "I like this trade idea, so clone it across the 50 accounts with the same mandate" stage. We are also working with the high-level system to generate a wide range of reports. Putnam is spending a fair amount of money on the technology to enable this functionality.

Conclusion

Fixed-income portfolio management is inherently a risk allocation business because of the complex nature of the assets and the complicated exposures that arise from fixed-income securities. At Putnam, we have chosen to make a big investment in pricing models to

produce duration sensitivities and key rate durations. We leverage that information to build a risk platform for more useful communication with our portfolio managers; in other words, we make sure the risk factors represent the managers' investment process. But a risk management system also provides a firm-wide monitoring capability and a portfolio-wide sense of how the risks coalesce; it shows where the biggest bets are and what issues should be focused on. This system helps us manage our product line in a more risk-aware way, and in the process of creating the risk system, we have developed a common language for communicating with portfolio managers.

Figure 3. Risk Concentration by Factor Group



Question and Answer Session

Asha B. Joshi, CFA
Kevin Maloney

Question: What steps did you take to get portfolio managers to buy into the risk management mind-set at Putnam?

Maloney: Portfolio managers focus on what is likely; risk managers focus on what is possible. Because portfolio managers have a different starting point for their analyses from that of risk managers, the most important step was to listen to the portfolio managers as they discussed what they pay attention to in their investment processes.

The factor structure within our model starts from a framework of how we look at our industry exposures—including credit exposures, mortgage portfolio exposures, and so on. We then determine whether that is a good robust basis for the factors in our risk model. If it is, we go forward; if it isn't, we examine the framework in more detail. We might discover that what we think of as an industry bet is really just a security-specific bet. That is, different securities might not exist in that area because not enough different patterns, other than what are unique company events, are present. We then go back and discuss these issues with the portfolio managers.

Thus, our approach to creating this risk system involves a combination of methodological rigor on my team's part and conversations with the portfolio management teams. If we just hand portfolio managers risk reports, they will not use them unless the reports align with their investment processes.

Question: How successful are credit risk models, such as those produced by KMV, in identifying and managing credit risk?

Maloney: The KMV system resembles an internal rating system. Public ratings provide a framework of differences among issuers, but they are after-the-fact determinations; they're late. KMV has a more generic framework that tries to use information on equity prices to predict future volatility. Based on a combination of traditional fundamental analysis and stock market information, it creates an internally generated rating scheme.

Most firms have some kind of internal scoring system that then gets translated into a single rating, such as a Moody's A rating. KMV is merely a third-party example of the same idea.

Question: What is your plus allocation in your core-plus portfolios?

Joshi: We're currently not too enamored of the higher-quality nondollar issues because the United States now holds better value than Europe. In the 1990s, we had a good ride with the convergence trade, as European yields converged while the EMU was being formed. Since then, we've been waiting for the nonsovereign debt market to take off, but in the meantime, we see better value in U.S. non-Treasury markets. Swap spreads, an indication of credit premiums, are still much tighter in Europe than in the United States. We do like nondollar agencies, such as German Pfandbriefe and Swedish mortgages, but their spreads are minimal. So, our allocation to nondollar agencies in core-plus portfolios is close to zero at this time. Relatively speaking, our allocation to high yield is quite high (15–20 percent). Historically, it's not a bad place to be. And after seeing the problems with Argentina, we have pared down emerging markets from 5 percent to 2 percent.

Maloney: We have many different core-plus, aggressive frameworks. Using the core-plus Lehman Aggregate institutional product as an example, we basically have a neutral allocation to emerging markets. We are slightly overweight with high yield, but we do have a high-quality bias in our portfolios. We are underweight traditional mortgage pass-throughs and hold other structured assets to make up for that underweighting, such as CMBS. We definitely have an overweight in ABS.

Question: How do you deal with high yield in Putnam's risk model?

Maloney: High yield is modeled in the same hierarchy or architecture as investment-grade securities. The factor sets for the two are similar but not identical. The industry groupings that we use for high-yield and investment-grade securities are different, which is partly a function of the concentration of industries in the different segments of credit financing.

The high-yield portfolio managers were the most skeptical about this type of framework. They think of high yield as an individual bond credit analysis story, and that's a huge part of the process. But you'd be surprised at how often high-yield managers end up with common themes in their

portfolios, as they do in all individual credit-type stories. A lot of high-yield managers were overweight telecommunications in 1999. A lot of them had correlated returns. Although high-yield managers will look at the correlation as a bunch of stories that blew up, a common element to that phenomenon was present.

We've done a few things in the model that are unique to high yield. We don't model the distressed area of the high-yield bond market as bonds or as contributions to duration and spreads. We model distressed debt as if it were equity. So, we use price return factors, not spread return factors. For higher-quality distressed debt, we use spread return factors, just as we do in the corporate bond market. Moreover, the returns of high yield and corporate credit in general are asymmetrical; simply relying on a standard deviation number isn't enough. We need to calculate a standard deviation to fit in the context of the overall risk framework, but using skewness measures, we also separately measure the asymmetry of the return pattern for high yield and corporate credits.

Question: How well do key rate durations capture mortgage price performance?

Joshi: Capturing mortgage price performance with key rate durations is a challenge, and prepayment obviously is the major factor with MBS. As a result, we do not look at key rate durations for mortgages as much as we do for the other sectors. Key rate duration analysis is helpful when comparing against mortgages in the benchmark. In that case, we can compare the contribution across the curve for a given prepayment assumption on an apples-to-apples basis. But in the final analysis, this tool is most reliable with bullet bonds. Looking at key rate durations on an overall portfolio basis is also more meaningful than for mortgages per se.

Question: What is the downside of having too many factors in a risk model?

Maloney: A great statistical and investment process debate has ensued about how many factors you need—10 factors, or 1 or 2 factors in a particular area. We think of our model as a hierarchy of groupings of factors. Some of the correlations between specific, precisely defined factors are time varying, and yet the factors in the broader aggregate asset class perform similarly.

If you want to get detailed risk decomposition into the hands of the portfolio managers who are thinking about very fine groups of securities, you have to go down to a level that matches their investment process. From a statistical standpoint, you must be careful about the way you aggregate those factors together in a risk calculation. Thus, through this hierarchical framework, we take the math out of the portfolio managers' realm so they don't have to worry about it.

Correlations and volatilities are dynamic; they change through time. But they do capture the patterns of industries becoming more or less similar. People spend a lot of time worrying about correlations being noisy, but the real benefit is a better understanding of basic trends and patterns. Take the term-structure factor, for example. Without a risk model, people usually add up contributions to duration across the entire yield curve. The benefit of a risk framework is that we know that the long end of the curve on a yield basis is much less volatile than the short end of the curve, which means you can't just add up contributions to duration across the curve and have a good sense of your term-structure exposure. That type of behavior will be captured by a risk system, which is why a risk system is needed; otherwise, it is too easy to fall back on the simple assumption that all of those factors are perfectly correlated and that you will be taking parallel shift risks.

The same holds true in high yield. The high-yield market has a common factor, and a lot of different segments of the high-yield market have different degrees of exposure to that common factor. Unless you've isolated that type of behavior, your analysis becomes too bond-by-bond specific; you end up with correlated bets in your portfolio that lead to higher-than-expected risk levels.

Question: Would you elaborate on stress testing at Payden & Rygel?

Joshi: Our stress testing looks at various interest rate scenarios and spread risk scenarios. If a volatility or an optionality component is present, then we look at volatility and prepayment scenarios to create a framework that shows the tolerable levels of volatility and prepayments. This approach is not that different from what many managers do, but we include a more client-oriented, practical approach in the process than our peers. Although stress testing involves the science of quantitative modeling, it is also an art. For example, in sensitive portfolios, we may have many conversations with the portfolio managers who are the most familiar with the clients to better understand how the clients may react to a particular scenario, which may be based on an absolute return number, not necessarily on underperformance versus a specific benchmark.

Question: Is there a moral hazard in buy-side risk management, in the sense that the risks to the firm may not be the same as the

risks to the shareholders of individual funds?

Maloney: The firm and the fund shareholders clearly have different risk management issues. (I'll answer this question from the point of view of the equity management side because it is a little more straightforward.) In the short term, Putnam's revenues depend on what happens in the stock market. When the market acts as it did from July to October 2001, we have all kinds of conversations about how market events will affect our bottom line, because revenues are tied to asset levels. An absolute-risk sense of Putnam's own business success clearly exists and dominates our focus in the short term. But that's cyclical. Those concerns play themselves out over market cycles.

As a firm, our competitive success over time depends on our ability to add value for our clients wherever we are invested. We can manage our macro risk from a product-line standpoint, and we can manage our risk to shareholders specifically in the markets and sectors they've chosen by the funds they've chosen. And sophisticated clients have been asking for performance-based fees as a way to bridge that moral hazard gap in certain cases.

Question: Is there material risk associated with benchmarks not representing the universe they are supposed to capture?

Joshi: It is a challenge we all face because we can't run away from benchmarks. The problem with many benchmarks is price discovery, especially those with less-liquid issues. For instance, in extreme cases of illiquid securities, how do you measure a hedge fund or private equity return, or even a real estate portfolio return? In each of these examples, how does one go about setting a price on each investment on a daily basis? Who knows what the true price is? The problem is not as dramatic in the more traditional fixed-income benchmarks, but the price factor could result in a material impact, particularly in the short run. For example, say you are managing a portfolio against the Lehman Aggregate and your performance is being compared against other managers, in addition to the benchmark. What if your pricing is relatively conservative compared with that of your peers? Over time, this situation may correct itself, but during periods of market stress, it may not. Several issues in the benchmark may not trade frequently. Would the prices of those securities truly reflect what an investor is willing to pay for the securities? If those prices are inflated, is your underperformance compared with the benchmark's true underperformance? Vis-à-vis the client, the challenge is being able to communicate this phenomenon without sounding as though you are making excuses for poor performance.

Maloney: In our daily cycle at Putnam, we price every benchmark through a consistent hierarchy in which they all might have different prices. We'll put a consistent price for each security across all those benchmarks because we don't want our exposures and attribution systems to find "security-selection returns" that are just pricing service differences. You will never achieve a consistent exposure report, attribution system, or risk management framework unless you put a consistent pricing framework across those systems.

Question: Does that mean you restate the index return and report that return to your clients?

Maloney: We report the official return of the benchmark to our clients, which is based on their pricing. But our internal attribution systems use a single price for a given security to account for the occasional times when our portfolio pricing service prices a security differently on a given day than does the benchmark provider. We do everything on a consistent basis to prevent pricing differences from causing phantom return and exposure differences in our systems.

Question: To what extent do you find scenario analysis useful?

Maloney: Scenario analysis is absolutely complementary to parametric risk. If you generate a parametric risk number, it is a standard-deviation-type number. Once you've gone through the pain and effort of creating all those factors and the time series of those factors so you can calculate their volatilities and correlations, you have a rich set of data to use for stress tests. In addition, we may do a five-year simulation of today's exposures with historical factor returns to get a sense of the possible distribution of returns. We can find out how a current portfolio would have performed in the third quarter of 1998, for example, based on that simulation. Stress testing is helpful once the hard work of setting up the structure has been done.

Question: What percentage of Putnam's technology effort is complete, and what is your time line to complete it?

Maloney: I don't think we'll ever be done with our technology effort because it's always evolving. Our fixed-income risk model is deployed, but we are actively researching the factor structure on a regular basis and are trying to enhance it. As far as a seamless stitching of things together, on the equity side of Putnam, we have all the risk management frameworks in place and the distribution of

these tools to the portfolio managers is complete. The link to the trading system will be delivered soon, as will the link into compliance and the entire real-time framework.

On the fixed-income side, we're about a year behind where we are on the equity side. We have the reporting and risk engine part done, and we have a trading system and compliance system. Stitching all the parts together is costly.

The biggest challenge is the terminology and expertise gap. Portfolio managers have difficulty describing exactly what they want from a framework. They tend to show you the report they want. And if you have engineered a system to give them that report, the first thing they want is a modification of that report. As a result, you can't do a traditional system development framework because you will end up with an expensive, huge framework. You have to articulate a framework vision that goes further than what people want and then bring them to that vision.

The hardest part of the process is translating the finance terminology, because in our business, we have our own language. We have to translate that language into one that a software developer can understand on an ongoing basis, which works only when people sit down next to each other and work long term on issues. I've certainly spent many more years thinking about systems than I ever thought I would when I left academia to work in the private sector.

Alpha Transfer in a Hedge Fund World

John M. Liew
Principal
AQR Capital Management, LLC
New York City

A portable alpha strategy can be readily applied to a fixed-income mandate—that is, if alpha can indeed be generated from more fertile areas. Although hedge funds are widely seen as a good potential source of uncorrelated alpha, research indicates that the broad universe of hedge funds may be more correlated with the market than many think. Investors must cautiously examine hedge funds' reported returns to identify potential defects in the data, particularly with regard to lags in mark-to-market valuations.

This presentation addresses two questions. First, how can portable alpha be used to enhance the return prospects of traditional portfolios? In theory, portable alpha is a good idea. There is no reason why an investor's choice of benchmark or asset class exposure needs to be tied to the source of alpha. For example, if I decide that I want X percent of my portfolio in fixed income, X percent of my alpha does not necessarily have to be generated from active fixed-income management. If alpha can be generated from more fertile areas, such as hedge funds, I should be allowed to take advantage of them. Given the existence of highly liquid and efficient derivatives markets, portable alpha strategies can be easily implemented—and in a reasonably cost-effective manner.

Second, if portable alpha is a concept that makes sense and is doable, are hedge funds a good place to look for alpha? Much recent research on hedge funds has shown them to be a great source of return that is not highly correlated to traditional portfolios. I will look at some hedge fund data and point out several potential pitfalls investors should be aware of when analyzing hedge fund returns.

Using Hedge Funds to Create Traditional Active Portfolios

Consider a simple decomposition. A traditional active portfolio can be viewed as two pieces—the return that comes from the benchmark and the return that comes from the alpha (or the excess return over the benchmark):

Traditional active = Benchmark + Alpha.

If I rewrite this formula by subtracting cash from one component and adding that cash to the other component, I can look at the equation in a different way:

Traditional active = (Benchmark – Cash)
+ (Alpha + Cash)

"Benchmark – Cash" represents the excess return to the benchmark over a risk-free or short-term instrument. This part of the equation usually can be replicated using derivative instruments. For example, we used to manage a global fixed-income portfolio that had the J.P. Morgan World Bond Index as its benchmark. To get the benchmark exposure with reasonably tight tracking error, we created a replicating basket of global bond futures. If tighter tracking error is needed or futures cannot be used, a dealer can write an OTC swap for most major indexes at a reasonable cost.

The second component, "Alpha + Cash," represents a hedge fund. At least in theory, a hedge fund's return is the risk-free rate of return plus the manager's skill. This simple decomposition can therefore be used to create a traditional portfolio in which the benchmark and alpha decisions are made independently.

Now, if all the cash is put in the hedge fund, or alpha component, the result will probably be a portfolio with more tracking error than the manager wants. Another consideration is that if all the cash is invested in the hedge fund, the manager will not have

Editor's note: For further information on this topic, see Clifford S. Asness, "Do Hedge Funds Add Value?" *Hedge Fund Management* (Charlottesville, VA: AIMR, forthcoming 2002).

The Joint Question and Answer Session of John M. Liew and Andrew W. Lo follows Mr. Lo's presentation.

any free cash for the margin and the mark-to-market on the futures. This problem, however, has a simple solution:

$$\begin{aligned}\text{Traditional active} = {} & (\text{Benchmark} - \text{Cash}) \\ & + X\%(\text{Alpha} + \text{Cash}) \\ & + (1 - X\%)\text{Cash}.\end{aligned}$$

In other words, do not put all of the cash in the hedge fund. The manager can control the amount of tracking error taken in the synthetic active portfolio by investing only a fraction of the assets in the hedge fund and the rest in cash.

Thus, a manager can create a synthetic actively managed portfolio through a combination of derivatives to get benchmark exposure, an investment in hedge funds, and an investment in cash. Note that this approach breaks the link between the choice of benchmark and the source of alpha.

Are Hedge Funds a Good Source of Uncorrelated Alpha?

Alpha should be positive, on average, and should have low or zero correlation with the benchmark. Have hedge funds produced positive, uncorrelated alpha? **Table 1** shows the monthly returns of hedge fund indexes from Credit Suisse First Boston (CSFB)/Tremont from January 1994 to September 2000. In general, hedge funds performed well during this period. The overall index beat cash by an average of 8 percent a year with 10 percent annual volatility, producing a Sharpe ratio of 0.8, which is not bad after fees.

All of the index subcategories have also been positive during this period, except for managed futures and dedicated short-bias funds. Several subcategories have done remarkably well. For example, the market-neutral equity portfolio has realized an impressive Sharpe ratio of 1.85. During this period, however, the market did well—the S&P 500 Index realized a Sharpe ratio greater than 1.0—and most hedge funds were strongly correlated with the S&P 500. So, from January 1994 to September 2000, hedge fund returns have generally been positive and correlated with at least one benchmark, the S&P 500.

Although many hedge fund investors claim to be unconcerned about correlation (as long as the hedge fund makes money), correlation is important for one critical reason—fees. Hedge funds charge very high fees, and if the only reason investors are making money is because they are long the market, then cheaper alternatives are available. For instance, they can invest in the Vanguard Group's funds. Therefore, at AQR Capital Management, we believe it is worthwhile to test whether hedge funds are really adding value above and beyond their market exposure.

A common method for testing whether hedge funds are adding value above and beyond their exposure to the market, particularly when the only source of data is the fund's return history, is to run a regression. In this case, the Y variable is the excess return to the hedge fund, and the X variable is the excess return to various benchmarks (In this presentation, for the sake of simplicity, the S&P 500 is the benchmark, but obviously, any number of different benchmarks can be used.):

$$\begin{aligned}&\text{Excess hedge fund return}_t = \\ &\quad \alpha + \beta(\text{Excess S\&P 500 return}_t) + \varepsilon_t.\end{aligned}$$

This regression examines the aggregate relationship between the hedge fund returns and the S&P 500 returns and, based on that average relation, estimates

Table 1. Summary Statistics for Hedge Fund Returns Based on Monthly Data from CSFB/Tremont, January 1994 to September 2000

Portfolio	Annualized Excess Return	Annualized Standard Deviation	Annualized Sharpe Ratio	Correlation with S&P 500
Aggregate hedge fund index	8.0%	10.0%	0.80	0.52
Convertible arbitrage	5.4	5.1	1.07	0.13
Dedicated short bias	–7.1	18.6	–0.38	–0.76
Emerging markets	2.3	20.8	0.11	0.50
Equity market neutral	6.4	3.5	1.85	0.48
Event driven	7.0	6.7	1.05	0.60
Fixed-income arbitrage	1.6	4.4	0.36	0.08
Global macro	7.7	14.4	0.54	0.36
Long–short equity	11.8	12.6	0.94	0.62
Managed futures	–1.2	11.1	–0.10	0.01
S&P 500 Index	14.6	14.2	1.03	1.00

the beta, which also can be interpreted as a hedge ratio. I like to look at the regression in the following way:

$$\text{Excess hedge fund return}_t - \beta\,(\text{Excess S\&P 500 return}_t) = \alpha + \varepsilon_t.$$

If the market term, β (Excess S&P 500 return$_t$), moves to the left side of the equation, the left side then represents the return on a "hedged" hedge fund, which is composed of the investment in the hedge fund, represented by Excess hedge fund return$_t$, and a short position in S&P futures, β (Excess S&P 500 return$_t$), in which the magnitude of the short position is structured so that the hedged hedge fund has zero market exposure. Thus, the alpha in the regression can be interpreted as the average return to the hedged hedge fund.

Table 2 shows the results of monthly regressions of excess hedge fund returns on S&P 500 excess returns for the period from January 1994 to September 2000. The betas, given in the second column, are generally positive. The *t*-statistics (in parentheses) show that the beta on the overall hedge fund index is positive and statistically significant, and the betas for the different portfolios tend to be positive, except for the dedicated short-bias portfolio (for which a negative beta is expected).

The regression results for the portfolio alphas also look good. The alpha for the market is an annualized 2.6 percent a year. Although hedge funds, in aggregate, have a significant amount of market exposure, they appear to be adding value beyond this exposure. The alpha does not have great statistical significance, but it is certainly positive. At this level of analysis, the data suggest that hedge funds are doing what they claim.

Problems with Hedge Fund Data

Although recent research has concluded that hedge funds earn excess return, this research has been primarily in the form of simple analysis similar to what I just described using monthly hedge fund return data. Obviously, the conclusions from the regression analysis depend on the accuracy of the regression inputs. One potential problem with monthly hedge fund returns is that, to varying degrees, many hedge funds hold illiquid securities. Because illiquid securities trade irregularly, month-end pricing of the portfolio can often be a challenge. To the extent that monthly hedge fund returns are unreliable, regression results that are based on them are likewise unreliable.

The presence of illiquid securities in hedge funds can bias the type of simple regression analysis in Table 2. **Table 3** compares a stylized time series of

Table 2. Monthly Regressions of Excess Hedge Fund Returns on S&P 500 Excess Returns, January 1994 to September 2000

	Monthly Regressions		
Portfolio	Alpha (annualized %)	Beta vs. S&P 500	Adjusted R^2
Aggregate hedge fund index	2.63	0.37	26.5%
	(0.76)	(5.46)	
Convertible arbitrage	4.78	0.04	0.3
	(2.35)	(1.12)	
Dedicated short bias	7.34	–0.99	57.0
	(1.50)	(–10.34)	
Equity market neutral	4.69	0.12	22.2
	(3.84)	(4.89)	
Emerging markets	–8.38	0.74	24.2
	(–1.15)	(5.15)	
Event driven	2.93	0.28	34.9
	(1.35)	(6.62)	
Fixed-income arbitrage	1.24	0.02	–0.6
	(0.70)	(0.71)	
Global macro	2.41	0.37	11.8
	(0.44)	(3.43)	
Long–short equity	3.82	0.55	37.4
	(0.95)	(6.98)	
Managed futures	–1.30	0.01	–1.2
	(–0.29)	(0.12)	

Table 3. Problems with Hedge Fund Data

	Month			
	T – 3	T – 2	T – 1	T
S&P 500	–20%	0%	0%	0%
Liquid security	–10	0	0	0
Illiquid security	0	0	0	–10
Smoothed security	–1	–2	–3	–4

returns from different securities with the returns of the S&P 500. In the first month (T – 3), the S&P 500 drops 20 percent and is flat for the next three months. In the same month that the S&P 500 falls 20 percent, a liquid security with a beta of 0.5 will drop 10 percent and then remain flat for the subsequent three months.

Suppose, however, that the portfolio consists of an illiquid security and that the portfolio is marked for valuation purposes according to the last available traded price of that security. Moreover, suppose that when the S&P 500 drops, the illiquid security's price does not move because it does not trade. Three months later, however, when it finally does trade, it trades down 10 percent. Because a simple regression looks only at the contemporaneous co-movements of a security with the market, if illiquidity is a problem, the regression will miss the actual correlation between the portfolio and the market.

Another problem with illiquid securities is that they often are not exchange traded. Moreover, because they are not exchange traded, no publicly available record of traded prices exists and managers thus can have substantial discretion in terms of pricing. A cynic might argue that managers, being aware of the importance of monthly returns in computing Sharpe ratios and in regression analysis, will smooth monthly returns, to the extent that some wiggle room exists in the pricing of illiquid securities. Smoothed returns lower portfolio volatility and correlations to market indexes. Exploiting the opportunity to price illiquid securities can help a manager's performance appear less volatile and more attractive when measured by a battery of standard statistical tests.

Resolving Mark-to-Market Problems

The bottom line is that to the extent that hedge funds are trading in illiquid securities and traditional analytical tests are used as the measurement tool, hedge funds may appear less correlated to the S&P 500 and other benchmarks. Thus, traditional tests will produce betas that are lower than true betas. A simple approach to test for stale or smoothed prices is to run a multiple regression of the hedge fund's return not only on the contemporaneous market return but also on the lags in the market:

$$Ri,t = \alpha_i + \beta_{0i}R_{m,t} + \beta_{1i}R_{m,t-1} + \beta_{2i}R_{m,t-2} + \beta_{3i}R_{m,t-3} + \ldots + \varepsilon_{i,t},$$

where Ri,t represents the excess return to hedge fund i over month t and $R_{m,t-j}$ represents the excess return to the S&P 500 over month $t-j$.

This technique is relatively standard and was initially proposed by Scholes and Williams as well as Dimson, who were concerned with estimating betas of small stocks, which also suffer from an illiquidity problem.[1] As I stated earlier, a simple linear regression looks only at contemporaneous co-movements. If a fund holds illiquid securities that are being priced at a lag to market movements, the price changes will not be reflected as contemporaneous, thus skewing the results of the regression. If market lags are incorporated in the regression, these lags will capture the lags in hedge fund pricing. Thus, an alternate way to better measure hedge fund betas is to look at the sum of the contemporaneous regression betas with the lagged betas.

The Real Hedge Fund Beta. **Figure 1** shows betas for the different hedge fund indexes. For each index, the gray bar shows the simple beta generated by a standard regression of hedge funds on the S&P 500 and the white bar shows the summed beta from a multiple regression that incorporates current and lagged excess returns. The results are dramatic. Betas for almost every single index rise significantly when the regression accounts for this lagged pricing problem. If hedge fund betas are a lot bigger than simple estimates might suggest, what happens to hedge fund alphas when these bigger betas are taken into account?

The cumulative excess returns of three versions of the hedged CSFB/Tremont Aggregate Hedge Fund Index are shown in **Figure 2** for the period from December 1993 to September 2000. The "unhedged" line is the cumulative excess return of the unhedged index (Excess hedge fund return$_t$) over a cash index. The simple beta hedged return (Excess hedge fund return$_t$ – β[Excess S&P 500 return$_t$]) is calculated by a standard regression. This line compares unfavorably with the unhedged line because the market's contribution (which was positive) to the index's performance is removed, although some value is still added. The summed beta hedged return accounting for possible lags in valuation compares unfavorably with both the unhedged and simple beta hedged lines. Suddenly, the performance of the aggregate

[1] Myron S. Scholes and Joseph T. Williams, "Estimating Betas from Nonsynchronous Data," *Journal of Financial Economics* (December 1977):309–327; Elroy Dimson, "Risk Measurement When Shares Are Subject to Infrequent Trading," *Journal of Financial Economics* (June 1979):197–226.

Figure 1. Regressions of Excess Hedge Fund Returns on Current and Lagged S&P 500 Excess Returns, January 1994 to September 2000

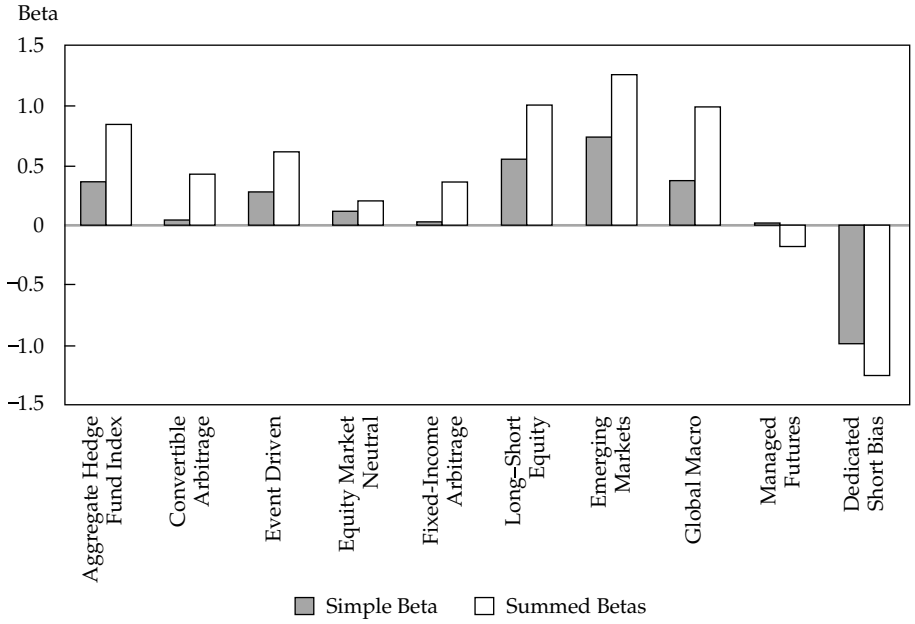
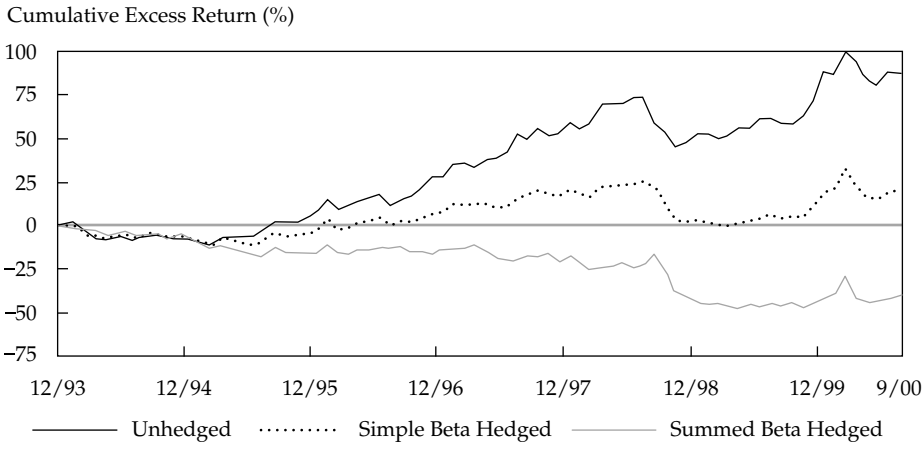


Figure 2. Hedged CSFB/Tremont Aggregate Hedge Fund Index, December 1993 to September 2000



hedge fund index does not look so good; hedge fund managers are subtracting rather than adding value.

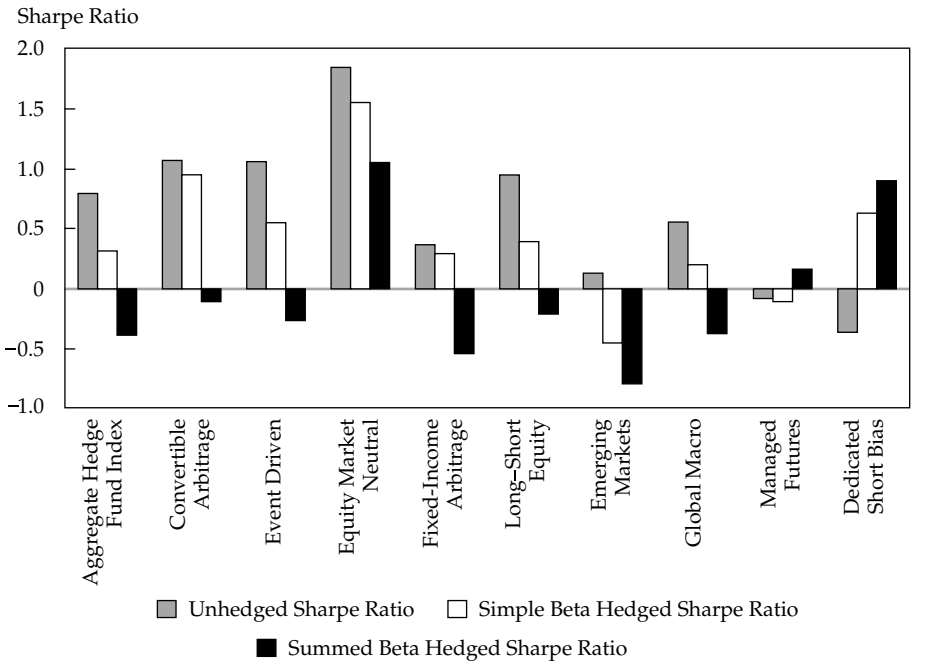
A slightly different way of looking at the issue is presented in **Figure 3**. This figure shows the Sharpe ratios for the same array of hedge fund indexes shown in Figure 1. For all but the equity market-neutral and dedicated short-bias funds, moving from unhedged to simple hedged to summed beta hedged, the Sharpe ratios go negative, which is bad news for hedge funds.

Conclusion

Portable alpha makes a lot of sense, and given the structure of the marketplace today, a portable alpha strategy can be readily applied to a fixed-income mandate. At AQR, we have implemented these strategies in our own portfolios. Before alpha can be ported, however, it must be found, which raises several interesting points:

- Hedge funds are a natural place to look for uncorrelated alpha.
- In the search for alpha, investors must cautiously examine hedge funds' reported returns, because the broad universe of hedge funds may be more correlated with the market than many think.
- Our analysis shows definite lags (whether accidental or intentional) in the mark-to-market valuations of hedge funds, and once these lags are accounted for, hedge fund betas rise significantly.

Figure 3. Annual Sharpe Ratios of Unhedged and Hedged Hedge Fund Returns, January 1994 to September 2000



- If these higher betas are taken into account, at least at the index level, hedge funds do not appear to add a lot of value.

In light of these conclusions, the following caveats are in order. In general, the available hedge fund data are not great. In fact, the data have a lot of problems, primarily survivorship bias. Survivorship bias, however, would be expected to bias the alphas up rather than down. Thus, this bias would not change the direction of the findings. In this study, we used the CSFB/Tremont Hedge Fund indexes, which are asset weighted. Accordingly, the big hedge funds are heavily weighted in the indexes, and the index returns are sensitive to a limited subset of funds in the dataset. We have performed the same kind of analysis using other hedge fund indexes—in particular, the Hedge Fund Research and Evaluation Associates indexes—and the results are similar.

Another caveat that bears mentioning is that our regression analysis is not able to give credit to hedge funds if they were making a conscious tactical bet that the market would perform well during the 1994–2000 period. If a hedge fund made this bet, it should get credit for being right, and obviously, our type of analysis cannot account for this.

Also, the regression analysis looked at the static behavior of hedge funds for a six-year period. Over the last year or so, hedge funds appear to have done better. For the short time period from 2000 through year-to-date 2001, hedge funds have generally outperformed what we would expect, given their summed betas. This improvement could be attributable to funds choosing to hedge more, or it could be the result of statistical randomness.

Finally, and I want to stress this point, this analysis does not comment on any particular hedge fund. It looks only at broad indexes. Certainly, some hedge funds generate alpha. The results reported here are not saying that hedge funds do not add value. Hedge funds can be an excellent source of alpha, although a strategy of passively investing in all the funds in the hedge fund universe is probably not as attractive as many investors claim. But why should the entire universe be attractive? Are hedge funds an asset class, or do hedge funds represent managers' skill? If the answer is skill, blanket–buying of all funds in the universe will not be a successful strategy. Some managers are good, some are bad, and the net result of investing the entire fund universe will probably be a lot of fees to pay and no alpha.

Basically, our research does not intend to make any statements about whether hedge funds in general are good or bad, but when investors look to hedge funds as a source of portable alpha, they should be careful when interpreting the return data. In particular, investors should be mindful of the illiquidity problem for securities held in hedge funds; this issue is not trivial.

Question and Answer Session

John M. Liew
Andrew W. Lo

Question: Because many hedge funds allow client flows in or out based only on month-end net asset values (NAVs), isn't the month-end data all that matters economically, even if there is smoothing or illiquidity?

Liew: Our study examines the amount of correlation between hedge funds and the underlying index. The fact that the investor is buying and selling at the NAV doesn't change the results of the study. A potentially serious problem exists, however, with the combination of smoothing and the investor buying and selling at the NAV. Picture a world in which the market experiences a big drop, and because the manager is smoothing, the portfolio is not marked down appropriately. Investors buying into that fund at the NAV are not buying at a fair market price; they're buying at a price that's probably higher than what they should be paying, which results in an unaccounted for transfer from one investor to another. We've actually talked to some investors that have thought about this kind of smoothing as a potential strategy for generating alpha—actively trading hedge funds to strategically take advantage of this phenomenon.

Lo: Performance smoothing is a very serious matter and may very well affect month-end NAVs, which is why this is such a serious problem. In fact, in some recent research that my students and I have been conducting, we've found that even mild amounts of performance smoothing can generate rather significant serial correlation in monthly returns, and this could lead to real economic effects for investors.

Question: The issue raised about the strategy of portfolio insurance (selling puts) is not limited to hedge funds but is probably embedded in a lot of traditional fixed-income portfolios. What kind of analytics can consultants or others use to discover the implicit or explicit selling of puts, and would something like William Sharpe's style analysis be of any use in a hedge fund context?

Lo: First, style analysis is definitely useful but probably not directly related to the issue of selling puts. In the example of CDP, I developed a relatively simple analytic, which is to use a volatility measure as a factor in a risk model. Instead of focusing on the traditional factors of the S&P 500, sector returns, and other such indicators, using a volatility measure may reveal whether any kind of option-related strategy is being applied. This type of analysis will indicate either a long- or short-volatility exposure. Other more complex analytics require nonlinear estimators that go beyond the standard linear factor models. I am currently developing such nonlinear models to try to capture some of these more complex and dynamic trading strategies.

Question: Sometimes equity hedge funds are accused of being the cause of market crises, but in markets where they aren't allowed, financial crises also occur. How do you view this phenomenon?

Lo: Just because you don't observe prices doesn't mean a crisis isn't occurring. I have a problem with people saying that real estate prices, for example, are not as volatile as other prices. How do you know they're not as volatile? They don't trade. During the four-day gap after September 11th when the markets were closed, was there no volatility? From a statistical perspective, yes, the volatility was zero. But I would argue that a lot of volatility was present but not observed because there wasn't a trade. Just because you can't observe the daily fluctuations, it doesn't mean they're not present.

Liew: In the past few years, equity long–short hedge funds have become more involved in private equity, and private equity is probably one of the most extreme cases of an illiquid security. Many equity long–short funds have the combination of decently liquid exchange-traded stocks and some very illiquid private equity securities. Marking to market on private equity can be the ultimate in terms of manager smoothing. Many stories exist about private equity funds going through a terrible year, down 20 percent from their highs. But if you look at the secondary market in which people sell their investments in private equity, they're selling at 40 cents on the dollar. Something is not right there.

Alpha Transfer in a Hedge Fund World: Fact or Fantasy

Andrew W. Lo
Harris & Harris Group Professor, Massachusetts Institute of Technology
Chief Scientific Officer, AlphaSimplex Group, LLC
Cambridge, Massachusetts

Because of the implicit assumptions involved in attempting to transfer alpha from hedge funds to fixed-income portfolios, investors must be aware that risks get transferred along with returns. The kind of alpha at play is a random variable, not a number that can be extrapolated based on historical patterns. Three important areas for future development are identified: new risk models for hedge fund investments (particularly the ability to measure liquidity risk), the relative efficiency of alpha transfer mechanisms, and the ability to model investment cycles.

A theme throughout this presentation is that it is fairly important to understand the technology you are using, especially newer technologies, such as alpha transfer in the hedge fund world. Alpha transfer, like many technologies, is a two-sided coin. There is no doubt that there is a lot of alpha and many attractive investment opportunities in this part of the financial services industry, but at the same time, there are some equally significant concerns. It is important to weigh the costs against the benefits of alpha transfer using hedge fund vehicles. So, this presentation is intended to give a little bit of a flavor for both—a bit about the benefits and a bit about some of the costs and potential problems.

I take a somewhat broader view of this subject than some of the other authors and highlight the general issues and illustrate them with a couple of examples. Most of the examples in this presentation are taken from an article I published recently on risk management for hedge funds, and in the context of alpha transfer using hedge fund vehicles, the examples are even more compelling.[2]

The author wishes to thank Peter Chan and June Zhang for research assistance and many stimulating discussions and Stephanie Hogue for many helpful comments and suggestions. Research support from AlphaSimplex Group is gratefully acknowledged.

Editor's note: The joint Question and Answer Session of John M. Liew and Andrew W. Lo follows this presentation.

What Is Alpha Transfer?

Let me start with what I call the "legend of alpha transfer." In an ideal world, what is alpha transfer all about? Suppose you have a fixed-income mandate for an enhanced index product and the index is something like the Lehman Aggregate Bond Index, but as chief investment officer of your fund, you feel that fixed-income opportunities are currently rather limited. Then, the natural thing to do is to consider the following strategy: Index 90 percent of your portfolio to the Lehman index, or whichever benchmark you are getting measured by, and put the remaining 10 percent in an emerging market equities hedge fund. Say the hedge fund yields 30 percent and the benchmark yields 12 percent for the year—lo and behold, your fund outperforms by 180 bps!

[2] Andrew Lo, "Risk Management For Hedge Funds: Introduction and Overview," *Financial Analysts Journal* (November/December 2001):16–33. See also Andrew Lo, "The Three P's of Total Risk Management," *Financial Analysts Journal* (January/February 1999):13–26, and "The Statistics of Sharpe Ratios," *Financial Analysts Journal* (forthcoming).

You have added value for your investor, and this is a great year for your fund.

There are many other such opportunities for adding performance in creative ways, especially in light of the plethora of complex financial securities that are now available—swaps, options, futures, and other derivative securities. This is an example of financial engineering at its best.

Implicit Assumptions

To do this kind of alpha transfer effectively, five implicit assumptions must hold. The first is that the alpha transfer process is nearly frictionless, so that as you transfer the alpha, you are not "spilling" any of it.

The second is that "investment-opportunity timing" is possible. In other words, the fact that some of you may feel that there are not a lot of opportunities out there in the fixed-income world presumably means that you think the opportunities are elsewhere. So, you must think you can determine where the opportunities are at a given point in time, at least to some degree. If fixed-income markets do not have opportunities today, well, maybe emerging market equities do or maybe the opportunity is in convertible bond arbitrage. You have to have some faith that you can time those kinds of investment opportunity cycles.

Third, you have to assume the capacity is not an issue, particularly if you are an institutional investor such as a pension fund, where you are managing several hundred million dollars or more. In that case, a hedge fund currently managing $50 million is not a particularly relevant opportunity for you and does not even justify the time required for you to evaluate it.

The fourth implicit assumption is that liquidity is not an issue. John Liew discussed some of these liquidity issues and the implications for the standard performance statistics.[3] Anyone who thinks that liquidity is irrelevant should talk to someone who has just lost his job, has to move his family to another city, and is looking to sell his house within six weeks without the benefit of a corporate relocation package. Liquidity takes on an entirely different sense of urgency in that case! Even after the summer of 1998, liquidity is still underappreciated by investors and managers, and financial economists are still struggling to develop a deeper quantitative understanding of this elusive concept.

And finally, the last implicit assumption in any kind of alpha transfer program is that the risks of the alpha transfer vehicle are consistent with the original mandate of the overall portfolio. In particular, by putting 10 percent of your portfolio in a high-yield vehicle, will you be giving your clients high blood pressure? In fact, I will argue shortly that for certain types of alternative investments, developing an understanding of the kinds of risk exposures they represent is not a simple task, and value at risk (VAR), the standard measure many investors and regulators use today, certainly does not provide a complete picture of what those risk exposures might be.

So, I want to focus on two issues: First, do these assumptions hold? Second, what kind of "risk transfer" accompanies alpha transfer? The fact is that any time you engage in any kind of alpha transfer, whether you like it or not, you are also engaging in risk transfer. With hedge funds, it is not even clear in certain contexts what those risks are because unlike more traditional investments, for which the asset classes are actually classes (that is, groups of securities that have relatively homogeneous legal, institutional, and statistical properties), alternative investments, as far as I can tell, are not really an asset class, at least not yet, and several concerns arise out of this observation.

Why Hedge Funds?

There are at least five reasons for investors to consider investing in hedge funds:

- Obviously, the primary motivation is alpha. Hedge funds seem to have alpha.
- The second motivation is that hedge funds are generally subject to fewer regulatory restrictions, allowing them to engage in investment strategies that other "prudent investors" might not, which leads to alpha.
- Third, hedge funds are typically able to exploit market opportunities much more quickly than traditional managers, which leads to alpha.
- Fourth, hedge fund incentive fees are very rich, and this tends to attract the best and the brightest—a great talent pool that leads to alpha.
- Finally, hedge funds are exciting; they are sexy, happening, and stimulating—and that is, of course, because of their alpha.

Apparently, alpha seems to be the *only* motivation for alternative investments!

But I want to argue that there is a significant gap between the way hedge fund managers think—namely, in terms of the alpha—versus the way institutional investors think in terms of the investment process.

Let me give you a very simplified caricature of these two groups of people—the hedge fund managers and institutional investors.

Typical Hedge Fund Manager. The typical hedge fund manager will hold the following views:

[3] See John Liew's presentation in this proceedings.

The hedge fund manager knows best, so sit back, shut up, and enjoy the ride. "It's my fund, not yours. You have no clue what I'm doing, nor do you understand investments as well as I do, so leave the investing to me." Hedge fund managers provide very little in the way of transparency, and they have extraordinarily broad discretion because, after all, the hedge fund managers are supposed to be the best and the brightest.

Second, trading strategies are highly proprietary. There is absolutely no transparency. This view is, of course, a caricature. Certainly, some hedge funds do provide some transparency, but by and large, hedge funds feel that their value added is a particular strategy and that giving you positions and telling you what they are doing, particularly when they are dealing with illiquid securities, as in fixed-income and emerging market funds, is tantamount to giving away the goose that lays the golden eggs.

Third, return is the ultimate, and often the only, objective. As I said earlier, hedge funds are about alpha. In particular, risk management is not important. It is a necessary evil: We may need to have some risk management now in the wake of the summer of 1998; we need to talk about VAR; we need to talk about stress testing and scenario analysis; and we need to hire a risk manager with a fancy degree; and then we are done. The bottom line is still alpha.

Fourth, regulatory constraints should be avoided at all costs. The whole point of having a hedge fund—as opposed to a regulated entity, such as a registered investment advisory firm—is to avoid U.S. SEC and Commodity Futures Trading Commission (CFTC) regulations, which are often considered a drag on performance.

Finally, there is very little intellectual property in most hedge funds. That is, the typical hedge fund manager is building a portfolio, not a business. If the hedge fund manager decides to leave the business, the fund shuts down. Very few hedge funds have ever sold for a multiple of earnings the way institutional asset management companies do, and one of the reasons is the lack of intellectual property.

Typical Institutional Investor. The following is a caricature of a typical institutional investor:

The first characteristic is that as fiduciaries, institutional investors have to understand the investment process. They have to report to a board of trustees or directors, and they have to understand the risks and expected returns of the manager's investment process.

Second, a manager's investment policies may have to be constrained by an institutional investor's mandate, some of which are dictated by laws such as ERISA. These kinds of restrictions are part and parcel of the typical institutional investor's job.

Third, performance is multifaceted. Alpha is great, but there is also a thing called risk. Many institutional investors these days are focused on a risk-budgeting approach to portfolio construction, so they have to be able to understand how the risks of a hedge fund interact with their other investments. Issues such as tracking error, downside risk, correlation with various benchmarks, and correlation with the existing portfolio are relevant to an institutional investor; hence, risk management and risk transparency are essential, not mere afterthoughts.

Finally, institutions are highly regulated. In addition to focusing on risk, they have to focus on a number of other restrictions. It simply is not possible for the institutional investor to be free of all regulatory constraints. As a result, what institutional investors look for is "process." Personnel are certainly important, but an institutional investor must be assured that the investment process does not hinge on a single individual. This desire for an institutionalized investment process, which amounts to intellectual capital and franchise value, is diametrically opposed to the character of the typical hedge fund manager.

Bridging the Gap. I hope these caricatures provide a clearer understanding of the nature of the gap between hedge fund managers and institutional investors today. Despite these differences, however, hedge fund managers and institutional investors clearly have much to gain from a better understanding of each other's perspectives, and they do share the common goal of generating superior investment performance for their clients. There are five specific issues concerning hedge fund investments that provide significant opportunities to bridge this gap.

The first involves data issues and survivorship bias. John Liew mentioned these issues in his presentation, and I am sure many of you who have ever worked with hedge fund data understand the nature of the problems I am referring to. Most fixed-income managers are spoiled rotten in the sense that you deal with extraordinarily clean data! And not only do you deal with clean data, but the kinds of models you use—even your most basic vanilla-flavored term-structure model—have an explanatory power, or R^2, of about 95 percent. In other words, a simple one-factor term-structure model can explain 95 percent of the variability in yield curves. So, all of your efforts are focused on the remaining 5 percent, which may be very challenging, but the fact is that there is a lot of explanatory power in typical fixed-income models. On the other hand, if you consider equities or foreign exchange, I can tell you right now that the R^2s are roughly one minus your R^2s. These markets are where all the uncertainty in the economy lies. As a result, a number of issues come into play with hedge

fund investments that typical fixed-income managers will not see: really dirty data, selection bias, and some of the issues that John Liew talked about earlier in his presentation.

The second issue is dynamic risk management. For many fixed-income portfolios, particularly the larger ones, the kinds of risk management protocols that are implemented—some presentations in this proceedings discuss some fairly sophisticated approaches to risk management—are almost always *static* methods. They focus on risk at a single point in time. But hedge fund investments are highly dynamic and change in response to market conditions, and that fact calls for a completely different set of risk analytics. (I am going to give you an example of such a set later in this presentation.)

Third, correlation and risk adjustments matter a great deal, again, as described in Liew's presentation.

Fourth, because of the first three points, new risk and performance attribution metrics are needed for evaluating hedge fund investments.

Finally (and this subject is something that academics do not talk about in polite company, but it is particularly important for hedge fund investments), the psychology of risk preferences plays a critical role in determining the behavior of hedge fund managers and investors. Hedge fund investments are what someone once referred to as "high-octane" investing, which calls for a certain psychological makeup on the part of the manager and the investor. All sorts of issues surround individual and institutional risk preferences, and the issues become particularly complex when you are making investment decisions in a group (for example, as with a board of trustees). Unfortunately, a detailed exposition of risk preferences is beyond the scope of this article.[4]

Why Risk Management?

The first example I want to present will provide some motivation for risk management for hedge funds. Why is risk management important if all we are interested in is alpha? The answer is closely related to my earlier point that alpha transfer always involves some form of risk transfer. So, I am going to give you an example in which alpha and risk are opposite sides of the same coin.

Suppose that you have a risk management procedure that, when all is said and done, provides a guarantee that your portfolio will not yield less than –10 percent over the coming year. Now, –10 percent is nothing to write home about, and I suspect that few investors would consider this an especially comforting guarantee. But consider what happens when such a risk management protocol is layered on top of a mediocre portfolio. In particular, suppose that in the absence of this guaranteed floor, the portfolio's annual expected return is 5 percent, with an annual standard deviation of 75 percent. Now, this investment opportunity is one that most of you would rather forgo, and most hedge fund managers would be embarrassed to market such a fund. But, if you overlay the –10 percent floor on top of this portfolio and then calculate the expected return of the combination, you get an expected value of 22.7 percent, as shown in **Table 1**. We are now in the hedge fund

[4] Please see Footnote 2 for references.

Table 1. Example of How Risk Control Can Be a Source of Alpha

	$E(R)$					
$SD(R)$	–5%	0%	5%	10%	15%	20%
5%	–4.6%	0.0%	5.0%	10.0%	15.0%	20.0%
	4.4	4.9	5.0	5.0	5.0	5.0
10%	–3.1	0.7	5.2	10.0	15.0	20.0
	7.8	8.9	9.6	9.9	10.0	10.0
25%	2.2	5.1	8.5	12.3	16.4	20.8
	18.3	19.8	21.1	22.2	23.1	23.8
50%	10.7	13.2	15.9	18.9	22.2	25.7
	38.7	39.9	41.0	42.2	43.3	44.4
75%	17.7	20.2	22.7	25.5	28.4	31.5
	61.5	62.3	63.2	64.1	65.0	66.0
100%	23.5	25.9	28.5	31.2	34.0	37.0
	85.7	86.2	86.8	87.5	88.2	88.9

Note: Expected values $E(R^*)$ and standard deviations $SD(R^*)$ of $R^* \equiv \text{Max}(R - 10\%)$ for lognormally distributed return R with expectation $E(R)$ and standard deviation $SD(R)$.

Source: Based on data from AlphaSimplex Group, LLC.

neighborhood of expected returns. Remarkably, this increase in alpha—an increase of 17.7 percentage points or, in the units of the industry, 1,770 bps of excess return—comes from the fact that you have cut off the left tail of the return distribution at –10 percent. How hard could that be? You probably suspect that it could not be that easy, given its extraordinary impact on the expected return of the portfolio. In fact, you can put a price on this guarantee because you can think of it as a put option on the portfolio with a strike price of –10 percent return, which can be priced as a function of the assets under management and under the assumption of lognormality and the other assumptions of the Black–Scholes option-pricing model. If you do the analysis, you will come to a fee for the guarantee that approaches something like 20 percent of the assets covered by the guarantee.[5] The point is that risk management is a source of alpha—one of the best ways to make money is not to lose any. This observation should provide fairly compelling motivation for hedge fund managers and investors interested in alpha transfer to also think seriously about risk management.

Current Risk Management Practices

Now, what tools do investors have at their disposal for managing the risks of hedge fund investments? The problem is that most of the existing tools for risk management were developed by the derivatives industry to capture the risks of OTC derivatives books, not all of the myriad types of investment strategies that constitute the hedge fund industry. For this reason, the typical risk management protocol—identify risk exposures, evaluate your portfolio's VAR, target the risks to hedge, select your hedging vehicles, and evaluate your post-hedge VAR—is not necessarily ideal or sufficient for managing the risks of hedge fund investments. There are a number of reasons for this limitation, and I will not belabor the point here.[6]

The fact is that different hedge funds have different risks, so attempting to use one tool to assess all of those risks is simply not possible. To make the point more explicitly, I thought I would give you a quick comparison between the most obvious risk factors for an equity hedge fund and for a fixed-income hedge fund.

Equity Hedge Fund. For an equity hedge fund, you have to think about investment style; for example, are you a value manager, a growth manager? Are you quantitative, and if you are quantitative, do you have inadvertent exposures to value or growth? You have to think about your factor exposures, whether or not you are using a factor model for constructing your alphas. Are you long or short the S&P 500 Index? Are you long or short liquidity? What kind of betas do you have with respect to other factors? You have to think about how to construct your portfolio, how to optimize it. You need to estimate the covariance matrix. You may need a risk model. You need to think about changes in parameters over time. If you are a long–short market-neutral hedge fund, you have to worry about stock loan considerations, hard-to-borrow securities, and getting caught in short squeezes. You have to worry about the gap between the short rebate and your financing costs if you use leverage. You have to think about execution costs and implementation issues, and finally, you have to think about performance attribution and whether you will be graded based on whatever kinds of benchmarks equity managers get graded on.

Fixed-Income Hedge Fund. Now, if you are a fixed-income hedge fund manager, what do you have to contend with? The first thing you have to have is a good yield-curve model. You need to decide how many factors should be included, estimate the model and update it periodically, and deal with various statistical issues related to the estimation process (e.g., parameter instability, nonstationarities, overfitting, and data mining.) If you are a mortgage-backed securities fund, you have to develop and implement a prepayment model. If there is any kind of optionality in the instruments that you deal with, you have to break out those features, price them separately, and then aggregate the results. Credit risk, inflationary pressures, macroeconomic factors, central banking activity—all of these are concerns for a fixed-income manager. Many fixed-income managers, I am sure, are focusing on these very issues right now.

Remarkably, there is virtually no overlap in the two sets of issues, and this contrast is really quite striking. Therefore, if you are thinking about transportable alpha, you also have to think about how the risks are transported and how to assess the different kinds of risks as you venture into new investment opportunities.

Dynamic Risk Management

To give you a sense of these new kinds of risks, try a simple thought experiment having to do with the notion of dynamic risk management. As I mentioned, hedge funds are highly dynamic. In addition to the typical categories of investors—passive versus active—there should be a third category called "hyperactive" for the hedge fund investors. Of course, in a way, hyperactivity is what hedge fund

[5] See Lo 2001 for details.

[6] See Footnote 2 for further details.

investors pay for. They are paying for active management, and although active management does not necessarily mean that you are trading all the time, in most cases, the two seem to be very highly correlated. As an example of the concerns that might arise, consider a little thought experiment about engaging in this alpha transfer process and shopping around for managers who might add alpha. Pretend you are interviewing me—I am going to pretend to be a manager of a hedge fund, a long–short equity hedge fund. Now, I presume that most of you do not spend as much time focusing on equity funds as you do on fixed-income funds. After all, the point of alpha transfer is to look for alpha in areas other than those you are familiar with. Ask yourself what your reactions are as you listen to my performance numbers and my pitch, and ask whether you would, as a fixed-income manager, be interested in considering an alpha transfer program using my hedge fund as the vehicle.

The name of my fund is "Capital Decimation Partners" (CDP), which should give you a little hint about where this example is going. It is a market-neutral equity hedge fund that I established in 1992, starting with $10 million, and I have an eight-year track record that I am going to share with you.

Table 2 summarizes the monthly performance statistics of CDP, with corresponding statistics for the S&P 500 for purposes of comparison. The average monthly return for the S&P 500 during this eight-year period was 1.4 percent a month. My performance was 3.7 percent a month on average, nearly triple the performance of the S&P. Of course, you do not get something for nothing, so my monthly standard deviation is a bit higher: 5.8 percent per month for me versus 3.6 percent per month for the S&P 500. The worst month for the S&P 500 was a –9 percent monthly return; my worst month was –18 percent. So, yes, I am higher risk, but this is why you are engaged in alpha transfer: higher risk, higher return.

Table 2. CDP Performance Summary, January 1992 to December 1999

Statistic	S&P 500	CDP
Monthly mean	1.4%	3.7%
Monthly standard deviation	3.6%	5.8%
Minimum month	–8.9%	–18.3%
Maximum month	14.0%	27.0%
Annual Sharpe ratio	0.98	1.94
Number of negative months	36/96	6/96
Correlation	100.0%	59.9%
Total return	367.1%	2,721.3%

The best month for the S&P 500 was 14 percent; my best month, on the other hand, was 27 percent. During this period, the S&P 500 had an annual Sharpe ratio of about 1.00; my Sharpe ratio was roughly double that, 1.94. Finally—and this is the statistic I want you to dwell on—for the eight-year period, or 96 months, the S&P 500 had negative returns in 36 out of 96 months, roughly one-third of the time, whereas my fund had only *six* negative months. CDP had positive returns in 90 out of 96 months. Now, I do have correlation with the S&P 500, and while the correlation is significant, it is by no means perfect. Moreover, I can make a variety of statistical arguments to say that this correlation is an overestimate. I am not telling you that such an argument is true. I am merely saying that I can make this argument in much the same way that I can argue for being of one religion or another.

Now look at the bottom line. What is the total return? If you put $1 in the S&P 500 at the beginning of the eight-year period, you would have gotten $367 at the end. On the other hand, if you put $1 into my fund at the beginning of the period, you would have gotten $2,721 at the end. Thus, my total return is an order of magnitude larger than the S&P 500's total return, and my fund did it with only 60 percent correlation to the S&P 500 and only six negative months.

You must be thinking that some of those six negative months must have been extreme losers. You are absolutely right. The worst month was –18 percent, as I said earlier.

Now consider the details. You are going to do some more due diligence on me. Take a look at my monthly track record, as shown in **Table 3**. For the first year of my fund, I returned 46.9 percent to my investors; the S&P 500 returned 14 percent. The second year, I returned 23.7 percent; the S&P 500 returned 5.7 percent. The third year, I returned 33.6 percent; the S&P 500 was down by –1.6 percent for the year.

Look at my worst months. I told you I had a –18 percent drawdown, and not surprisingly, it happened in September of 1998. It was those LTCM folks; they did that to me. On the other hand, that year was one of my best years because after that shakeout, I was up 27 percent in October, and my return in November was 22.8 percent. That year was fantastic for me because there was a lot of market overreaction, and as a quantitative market-neutral equity hedge fund, I look for exactly those kinds of opportunities.

I could show you some more graphs and pictures, but you get the idea. How many people would invest with me after seeing that performance?

Now let me tell you where the bodies are buried and then argue that without the proper analytics, you

Table 3. CDP: Monthly Performance History

	1992		1993		1994		1995		1996		1997		1998		1999	
Month	S&P	CDP	S&P	CDP	S&P	CDP	S&P	CDP	S&P	CDP	S&P	CDP	S&P	CDP	S&P	CDP
January	8.2%	8.1%	–1.2%	1.8%	1.8%	2.3%	1.3%	3.7%	–0.7%	1.0%	3.6%	4.4%	1.6%	15.3%	5.5%	10.1%
February	–1.8	9.3	–0.4	1.0	–1.5	0.7	3.9	0.7	5.9	1.2	3.3	6.0	7.6	11.7	–0.3	16.6
March	0.0	4.9	3.7	3.6	0.7	2.2	2.7	1.9	–1.0	0.6	–2.2	3.0	6.3	6.7	4.8	10.0
April	1.2	3.2	–0.3	1.6	–5.3	–0.1	2.6	2.4	0.6	3.0	–2.3	2.8	2.1	3.5	1.5	7.2
May	–1.4	1.3	–0.7	1.3	2.0	5.5	2.1	1.6	3.7	4.0	8.3	5.7	–1.2	5.8	0.9	7.2
June	–1.6	0.6	–0.5	1.7	0.8	1.5	5.0	1.8	–0.3	2.0	8.3	4.9	–0.7	3.9	0.9	8.6
July	3.0	1.9	0.5	1.9	–0.9	0.4	1.5	1.6	–4.2	0.3	1.8	5.5	7.8	7.5	5.7	6.1
August	–0.2	1.7	2.3	1.4	2.1	2.9	1.0	1.2	4.1	3.2	–1.6	2.6	–8.9	–18.3	–5.8	–3.1
September	1.9	2.0	0.6	0.8	1.6	0.8	4.3	1.3	3.3	3.4	5.5	11.5	–5.7	–16.2	–0.1	8.3
October	–2.6	–2.8	2.3	3.0	–1.3	0.9	0.3	1.1	3.5	2.2	–0.7	5.6	3.6	27.0	–6.6	–10.7
November	3.6	8.5	–1.5	0.6	–0.7	2.7	2.6	1.4	3.8	3.0	2.0	4.6	10.1	22.8	14.0	14.5
December	3.4	1.2	0.8	2.9	–0.6	10.0	2.7	1.5	1.5	2.0	–1.7	6.7	1.3	4.3	–0.1	2.4
Year	14.0	46.9	5.7	23.7	–1.6	33.6	34.3	22.1	21.5	28.9	26.4	84.8	24.5	87.3	20.6	105.7

would never be able to find them. The strategy is very simple: I simulated a strategy that shorts put options on the S&P 500 that are 7 percent out-of-the-money for the nearest maturity month and used the $10 million initial capital as margin to support these short positions. What I am doing is essentially selling portfolio insurance, earning premiums most of the time but losing big every once in a while. Every so often, when the market goes down, this strategy suffers extreme losses. And what I did *not* tell you, and what some hedge fund managers may not tell you, is that if I were to try to implement this strategy, as soon as I hit a drawdown of –18 percent, my broker would have called me to close out my positions and eliminate any credit lines previously extended to me. So, unless I had deep pockets during August and September 1998, that would have been the end of my fund.

On the other hand, I hope you will agree that prior to that time, this fund had a pretty impressive track record. A five-year track record—never mind eight years—is already considered quite substantial in an industry in which most funds go out of business in the first two years.

This example is a cautionary tale. It is not meant to suggest that many unscrupulous hedge fund managers are using this approach (although, in fact, some probably are). There are certainly many honest hedge fund managers working hard to do well by their investors. The point is that this kind of dynamic risk exposure, shorting puts on the S&P 500, is extremely difficult to detect, and the track records generated by such strategies are quite tempting.

You might conclude that such problems are not much of a concern if you can obtain position transparency from your managers. Certainly, such is the case for CDP—looking into the portfolio would reveal the simple strategy immediately. Thanks to the miracle of financial engineering, however, I can craft a so-called "delta-hedging strategy" using the underlying securities and synthetically replicate short put positions on each of them. That is, I could trade each of the 500 securities in the S&P 500 using dynamic hedging to synthetically replicate short put positions on each security, and you would never be able to tell. If you looked at my positions for any single security, as shown in **Table 4**, you would conclude that I am a contrarian—when the stock price goes down, I buy, and when the stock price goes up, I sell. The lesson here is that this particular kind of risk exposure is not something you will ever glean from VAR analysis, stress testing, scenario analysis, risk budgeting, or any of the other traditional risk management tools. You need a new set of analytics for addressing these issues.

Conclusions

The whole alpha transfer process is definitely a valuable and potentially useful approach to creating value for your clients. The basic principles are sound, but the process involves a number of implicit assumptions, and you need to be aware of these assumptions. You need to understand what you are engaged in and why. You have to understand what you are doing, even if you are looking for opportunities in markets other than the main markets you focus on. The fact is that risk is an important part of the equation. Alpha transfer is wonderful, but you have to keep in mind that the kind of alpha I am talking about is a random variable, not a number. You do not know for a fact that my hedge fund is going to give you an alpha of 30 percent this year—what you know is that over the past eight years, I returned something on the order of 30 percent to my investors, but this year could be

extremely different from that average. Because alpha is random and the risks associated with the alpha also get transferred to you, you have to figure out what the risk-transfer implications are.

Table 4. Example of a Delta Hedging Strategy

Week (t)	P_t ($)	Position (shares)	Value ($)	Financing ($)
0	40.000	7,057	282,281	–296,974
1	39.875	7,240	288,712	–304,585
2	40.250	5,850	235,456	–248,918
3	36.500	33,013	1,204,981	–1,240,629
4	36.875	27,128	1,000,356	–1,024,865
5	36.500	31,510	1,150,101	–1,185,809
6	37.000	24,320	899,841	–920,981
7	39.875	5,843	232,970	–185,111
8	39.875	5,621	224,153	–176,479
9	40.125	4,762	191,062	–142,159
10	39.500	6,280	248,065	–202,280
11	41.250	2,441	100,711	–44,138
12	40.625	3,230	131,205	–76,202
13	39.875	4,572	182,300	–129,796
14	39.875	5,690	224,035	–173,947
15	39.625	4,774	189,170	–137,834
16	39.750	4,267	169,609	–117,814
17	39.250	5,333	209,312	–159,768
18	39.500	4,447	175,657	–124,940
19	39.750	3,692	146,777	–95,073
20	39.750	3,510	139,526	–87,917
21	39.875	3,106	123,832	–71,872
22	39.625	3,392	134,408	–83,296
23	39.875	2,783	110,986	–59,109
24	40.000	2,445	97,782	–45,617
25	40.125	2,140	85,870	–33,445

In ongoing research, I am working on three areas that I think are important for addressing some of these issues. Obviously, one of them is developing new risk models for hedge fund investments, of which one innovation is the ability to measure liquidity risk. Liquidity exposure is extraordinarily important and subtle and has ways of interacting with other kinds of risk that are totally unexpected; we academics have learned an enormous amount since 1998 about the whole notion of liquidity. It is certainly not "overrated."

Second, the relative efficiency of alpha transfer mechanisms is important. When you are transferring alpha, you want to make sure you do not spill too much of it.

Third, it is important to be able to model investment cycles, one of the implicit assumptions of alpha transfer. I believe that it is possible to see these cycles—when real estate is hot or convertible bonds are not. For whatever reasons, these cycles exist, but it is important to understand why they are there, how strong they are, and how they wax and wane.

Of course, all of this research leads to a lot more complexity for the investment process. I understand that this presents some new challenges to the investment community, but I will close with a quote from Albert Einstein who, when chided for the complexity of some of his physical theories, said in response, "A theory should be made as simple as possible but not simpler." The same should be said for hedge fund investments. It should be made as simple as possible but not simpler.

Question and Answer Session

John M. Liew
Andrew W. Lo

Question: Because many hedge funds allow client flows in or out based only on month-end net asset values (NAVs), isn't the month-end data all that matters economically, even if there is smoothing or illiquidity?

Liew: Our study examines the amount of correlation between hedge funds and the underlying index. The fact that the investor is buying and selling at the NAV doesn't change the results of the study. A potentially serious problem exists, however, with the combination of smoothing and the investor buying and selling at the NAV. Picture a world in which the market experiences a big drop, and because the manager is smoothing, the portfolio is not marked down appropriately. Investors buying into that fund at the NAV are not buying at a fair market price; they're buying at a price that's probably higher than what they should be paying, which results in an unaccounted for transfer from one investor to another. We've actually talked to some investors that have thought about this kind of smoothing as a potential strategy for generating alpha—actively trading hedge funds to strategically take advantage of this phenomenon.

Lo: Performance smoothing is a very serious matter and may very well affect month-end NAVs, which is why this is such a serious problem. In fact, in some recent research that my students and I have been conducting, we've found that even mild amounts of performance smoothing can generate rather significant serial correlation in monthly returns, and this could lead to real economic effects for investors.

Question: The issue raised about the strategy of portfolio insurance (selling puts) is not limited to hedge funds but is probably embedded in a lot of traditional fixed-income portfolios. What kind of analytics can consultants or others use to discover the implicit or explicit selling of puts, and would something like William Sharpe's style analysis be of any use in a hedge fund context?

Lo: First, style analysis is definitely useful but probably not directly related to the issue of selling puts. In the example of CDP, I developed a relatively simple analytic, which is to use a volatility measure as a factor in a risk model. Instead of focusing on the traditional factors of the S&P 500, sector returns, and other such indicators, using a volatility measure may reveal whether any kind of option-related strategy is being applied. This type of analysis will indicate either a long- or short-volatility exposure. Other more complex analytics require nonlinear estimators that go beyond the standard linear factor models. I am currently developing such nonlinear models to try to capture some of these more complex and dynamic trading strategies.

Question: Sometimes equity hedge funds are accused of being the cause of market crises, but in markets where they aren't allowed, financial crises also occur. How do you view this phenomenon?

Lo: Just because you don't observe prices doesn't mean a crisis isn't occurring. I have a problem with people saying that real estate prices, for example, are not as volatile as other prices. How do you know they're not as volatile? They don't trade. During the four-day gap after September 11th when the markets were closed, was there no volatility? From a statistical perspective, yes, the volatility was zero. But I would argue that a lot of volatility was present but not observed because there wasn't a trade. Just because you can't observe the daily fluctuations, it doesn't mean they're not present.

Liew: In the past few years, equity long–short hedge funds have become more involved in private equity, and private equity is probably one of the most extreme cases of an illiquid security. Many equity long–short funds have the combination of decently liquid exchange-traded stocks and some very illiquid private equity securities. Marking to market on private equity can be the ultimate in terms of manager smoothing. Many stories exist about private equity funds going through a terrible year, down 20 percent from their highs. But if you look at the secondary market in which people sell their investments in private equity, they're selling at 40 cents on the dollar. Something is not right there.

Credit Analysis: A Battle-Scarred Veteran's View

Martin S. Fridson, CFA
Chief High-Yield Strategist
Merrill Lynch & Company, Inc.
New York

Credit analysts can never be too cautious, especially given the current environment in which financial reporting abuses have become more prevalent. Recognizing the disparity between a company's reported earnings and its true economic profits requires a healthy dose of skepticism, a broad perspective, and a familiarity with the techniques of ratio analysis, which serves best to uncover financial reporting problems.

I remember years ago reading about a newspaper that had written an article about a war veteran, and as a result of a typographical error, the paper described him as a "bottle-scarred veteran." The veteran demanded a correction, so the newspaper printed the following: "We apologize for referring to this gentleman as a 'bottle-scarred veteran.' We should have said 'battle-scared veteran.'" Ever since, I have liked the phrase "battle-scarred veteran." What this incident tells me is that although you can hope to get what you are doing right the first time, if you do not, that is what being a veteran is all about. This lesson applies to credit analysis. To be successful, we must learn from our own mistakes as well as the mistakes of others. I want to emphasize the importance of being skeptical and of looking at the big picture when undertaking credit analysis. It is not a paranoid delusion; the issuers of financial statements really are out to get you! But with diligence and persistence, you can beat them at their own game.

Be Skeptical

Fernando Alvarez said, "The purpose of financial reporting is to obtain cheap capital." For those who do not know Professor Alvarez, he is currently at New York University's Stern School of Business, where he teaches courses on financial reporting and entrepreneurship. He was able to summarize a book I wrote on financial statement analysis in one sentence—the one I just quoted. I was so impressed by his succinctness that we are now collaborating on a new edition.[1]

Note that Alvarez's advice is in stark contrast to that almost invariably found in accounting textbooks, which states that the purpose of financial reporting is to present a company's financial results and financial condition accurately. What is missing from the textbook definition is from whose standpoint the accurate reporting is done. All of us who are users of financial statements applaud the textbook's sentiment and would like statements to be prepared with that idea in mind, but we do not prepare financial statements—corporations do. And a corporation's purpose has nothing to do with financial accounting theory or being nice by providing good information that allows for thorough analysis. A corporation's stated objective, which is in line with Milton Friedman's theories, is to maximize shareholder wealth. If putting out honest financial statements advances that objective, then that is what the corporation ought to do. If tricky financial reporting achieves the result more effectively, however, then that might be what the corporation is likely to do.

The question is: How do corporations choose to report financial events? I hear this subject discussed frequently. A common position taken is that investors can comfortably assume that a corporation will act in its own enlightened self-interest by putting out good,

Editor's note: The joint Question and Answer Session of Martin S. Fridson and Christopher L. Gootkind follows Mr. Gootkind's presentation.

[1]Martin S. Fridson and Fernando Alvarez, *Financial Statement Analysis: A Practitioner's Guide*, 3rd ed. (John Wiley & Sons, Inc.: forthcoming 2002).

honest reporting that paints an accurate picture of the corporation's financial health; doing otherwise would be self-defeating. The empirical results indicate that putting out good, honest financial statements is not, in fact, what corporations invariably do, and in some cases at least, they put out dishonest statements. There are many notorious instances of corporations being less than forthcoming in financial reporting, such as the infamous story of Sunbeam Corporation and "Chainsaw Al" Dunlap. Along with all the other questionable practices at Sunbeam, under the guidance of Dunlap, Sunbeam shipped out barbeque grills in huge volumes to distributors in order to pump up earnings in the short run. The irony is that before getting to Sunbeam, Dunlap was discovered doing the same kind of thing at another company. It had made the press and was in the legal record. But surprisingly, these episodes were not mentioned during the hiring process at Sunbeam or when Sunbeam proudly stated it had hired one of the greatest managers in corporate America. None of Dunlap's prior history came to light until much later when a reporter bothered to check the record, and then the news hit the front page of the *New York Times*.

A lot of financial reporting trickery occurs, and I will discuss several specific examples. Unfortunately, financial reporting abuses have become more frequent. One would think people would get wise to this reporting trickery and crack down on the abuses, but an important change has occurred. Corporations have increasingly emphasized the concept of aligning management and shareholder interests. Aligning these interests has been applauded as a wonderful development and, on the surface, sounds great. Managers should not be self-serving and try to line their own pockets at the expense of the shareholders, but this new approach to compensation has a downside that has not been adequately recognized.

In the old days, managers were rewarded solely based on earnings. These earnings were not necessarily real economic profits but rather a fictional accounting number that resulted from the Financial Accounting Standards Board's (FASB's) rules. These rules were (and are) established through a political process, and the companies, which are bound by the rules, had (and have) substantial input into this process. In short, an accounting number called earnings lay at the end of the reporting tunnel. When earnings per share increased, so did the bonuses of the managers.

This state of affairs was not too bad for investors. If a manager, for example, decided to extend the depreciation schedule on the corporation's assets by one year so that earnings per share and thus the manager's bonus would rise commensurately, such an accounting change was fairly transparent. An astute financial analyst reviewing this corporation's financial statements could see that change, understand its effect, and adjust for it. Such a change had no affect on cash flow but simply changed the reported earnings.

The reporting environment changes, however, when compensation is based on share price rather than earnings. In such an environment, a manager is encouraged to resort to financial reporting trickery that fools the market. This type of reporting alteration is much more insidious than the changes that happened when the focus was on earnings, and it reflects the previously mentioned downside of aligning management and shareholder interests. Quantifying how much more trickery is going on now as opposed to how much more is being apprehended is difficult, but this change in climate has had an adverse effect on the quality of financial reporting.

EBITDA Is Not Cash Flow

I want to underscore Christopher Gootkind's comments about the pitfalls of EBITDA (earnings before interest, taxes, depreciation, and amortization).[2] My colleague Richard Bernstein, who is in quantitative equity research at Merrill Lynch & Company, made an insightful observation about how companies seek to move the user of financial reports up the income statement. The higher the user goes, the less volatile the earnings—and the less volatile the earnings, the higher the value attributed to them by the user. Ultimately, corporations do not want users of their financial statements to look at net income; they want them to look at net income before taxes, which is generally less volatile. Or better yet, corporations want them to look at the operating earnings, which are even less volatile. And even better, corporations want users to look at the numbers to which they have added back depreciation and amortization, both of which are fairly stable numbers, so that volatility is further reduced. Some companies have even gone to the extreme of reporting earnings before expenses, which, of course, is revenue.

My favorite example from the past couple of years on the financial reporting front is probably the quarter when Yahoo missed its revenue estimate by 25 percent. Think about that; it is not easy to do. Companies may miss their earnings estimates by a penny a share from time to time, but to miss a revenue projection by 25 percent is astounding. The problem was that Yahoo had recorded as revenue the proceeds of other companies' initial public offerings (IPOs), which were then used to buy advertising on Yahoo. Many people could see that when those IPOs dried up, the revenues of Yahoo would be severely

[2] See Mr. Gootkind's presentation in this proceedings.

reduced. A columnist for *Barron's*, Mark Veverka, pointed out about a year before the sudden, drastic drop in Yahoo's revenues the exact problem that eventually materialized. It was a foreseeable weakness in Yahoo's revenues.

Figure 1 dramatically illustrates an example of what can happen if an analyst focuses too strongly on EBITDA.[3] From 1995 to 1999, EBITDA for Silverleaf Resorts progressed steadily higher, while the company's cash flow fell lower and lower. If that trend continues, the result for bondholders and ultimately the shareholders is predictable; nothing will be left for either type of investor after the company has exhausted all the cash.

The divergence between cash flow and EBITDA at Silverleaf Resorts has occurred for several reasons. The company markets time-shares in resorts. When the company sells a time-share, it receives 10 percent of the purchase price up front, but at the same time, it also has to pay out 100 percent of the development and sales costs. Furthermore, the company finances the customer's purchase for seven years, which represents another major cash use. Revenue is recognized up front, but has the company performed a sufficient portion of the service to justify this accounting treatment? Probably not; auditors are hired by the companies they audit and know which side their bread is buttered on. In this instance, revenue and earnings are recorded that have nothing to do with cash coming in the door. And the cash outflow, which Silverleaf Resorts accounts for as an investing activity, is high. Therefore, a huge gap exists between cash inflow and cash outflow.

[3] For further information on this example, see Pamela M. Stumpp, Tom Marshella, Mike Rowan, Rob McCreary, and Monica Coppola, "Putting EBITDA in Perspective," Special comment (Moody's Investors Service, May 31, 2001).

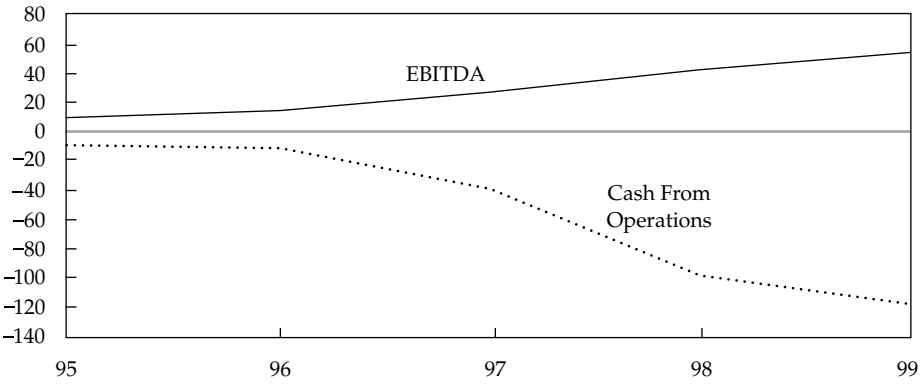
EBITDA–Cash Flow Disparity

Disparities between EBITDA and real cash flow can arise from a number of factors, one of which is a buildup in accounts receivable. Often such a buildup is a sign that the company is generating a large amount of receivables that will ultimately be uncollectable, so the earnings recorded based on these receivables will likely be wiped out at a later date. Another cause for a disparity between EBITDA and true cash flow is a reduction in accounts payable and accrued liabilities. Yet another source of disparities is a capital spending requirement that is not directly linked to the accounting depreciation. Accounting depreciation merely offsets what the company has spent in previous years, but the actual spending requirements may be higher. The property, plant, and equipment (PPE) in place may be becoming obsolete more quickly than it is being written off, or it may have to be replaced with more expensive equipment in the future. In short, many pitfalls await analysts who rely on EBITDA as a measure of cash flow.

Reported Earnings Are Not Economic Profits

Just as EBITDA can diverge from true cash flow, reported earnings can diverge from true economic profits. An economic profit is a genuine increase in wealth. In contrast, reported earnings is an accounting number that is recorded only after passing through a filter of various assumptions and accounting practices.

Figure 1. EBITDA and Cash from Operations for Silverleaf Resorts, 1995–99



Note: Cash from operations is adjusted for growth in notes receivable.

Source: Based on data from Moody's Investors Service.

A variety of dubious accounting assumptions and practices have distorted reported earnings in recent years. Some of the most widespread and abusive of these practices fall into the category of aggressive revenue recognition. One example is the practice of loading a corporation's distribution channels. Suppose a corporate manager wants higher earnings in the current quarter and gives customers a 10 percent discount to encourage them to place orders now instead of next month. If the orders are placed in the last days before the end of the quarter, the revenues can be recognized immediately rather than in the following quarter. Obviously, that manager has not increased the sales of the company but has merely accelerated them to the current period.

Accelerated revenue recognition is routinely used for smoothing earnings, but companies sometimes resort to other aggressive recognition techniques to create the illusion of greater earnings. One of the techniques that companies use to bring about these illusory earnings, which seems to be an innovation in this business cycle, is to create other companies to do business with them. That is, if Company A lends Company B the money necessary to get started and if it is not a true arm's length transaction because Company B could not borrow under the same terms from another source, then Company A is putting Company B into business. Company B then does business with Company A, and Company A recognizes revenue from Company B.

One of the most interesting variants on this strategy of aggressive revenue recognition is for Company X to create Company Y to do the R&D to develop a product. When the product has been developed, Company X purchases Company Y. Company X now owns the product that is the result of the R&D, but instead of spending, say, $50 million that would have been recorded as an expense, it has received $50 million of revenue—a much better treatment for Company X's bottom line. One certainly has to give a lot of credit to corporate managers for their creativity.

Another reason reported earnings do not equal economic profits is that corporations can make liberal assumptions about credit losses. To say that the entire subprime mortgage industry that has been created in the United States in the past 10 years is based on this one simple idea is probably not an overstatement. If a company has the good fortune to be in a line of business without a long history, its auditors will have to accept the company's assumptions until the house of cards collapses. By understating anticipated credit losses and growing its loan portfolio rapidly, a company can show large profits and buy time to benefit from a liberal accounting treatment.

To illustrate, suppose a mortgage company makes $100 million in loans during its first year. Because the company's customers have just received the proceeds of their loans, they have enough money to pay the interest for a while. These customers will not default right away, the company's loan losses will be low in the first year. In the second year, the mortgage company makes $1 billion in loans. Even if 10 percent of those first-year loans default, relative to the total loan portfolio, the company's default rate is still low. This setup is essentially a Ponzi scheme; the lag in defaults produces a low default rate on the total portfolio only as long as the portfolio continues to grow at a geometric rate. The scheme will blow up eventually, but for a few years, the company can show great profits. And if management compensation is based on profits, the managers receive a tremendous bonus. The company can also get a great stock price evaluation because if the company can get an auditor to call its "profits" earnings, Wall Street will put a multiple on them. And if the company's "earnings" increase rapidly, Wall Street will put a high multiple on them. This strategy has been used aggressively in rather creative ways in recent years.

Burying obsolete inventory is another way reported earnings can be manipulated. Auditors only sample. They do not look in every storage bin and at every product on the shelves. They do not have the resources to verify every single piece of inventory and are forthright in stating that auditing is based on sampling techniques. Consequently, ample opportunity exists for companies to bury and hide obsolete inventory, which will eventually be written off and thus will wipe out all profits currently being recorded.

Underspending on the maintenance of PPE and on franchises was a big problem in the leveraged buyout (LBO) era. When companies are strapped for cash, underspending tends to occur. And because underspending is not easily visible, it can be difficult to detect and is usually accompanied by references to alleged "previous management overspending and putting money into worthless projects." The high failure rate of overleveraged buyouts of the 1980s demonstrates that analysts must be alert to the possibility that high reported profit margins mask underspending on items essential to maintaining the company's franchise, such as advertising.

The final reason reported earnings do not equal economic profits is outright falsification in reported earnings. Falsification usually is not the first stage of earnings manipulation. I doubt that many managers begin with an outright fraudulent scheme as a business plan. But they start down the wayward path by smoothing earnings, perhaps by borrowing from the future period through discounts offered to accelerate

sales to the present period, with the belief they will be able to make up the difference later. These managers then find themselves in a period of still slower business, unable to make up the difference. Instead, they have to double up by borrowing even more from the subsequent period, and eventually, they slide into outright fraudulent practices because they cannot maintain the original stance of just playing around the edges of unethical or illegal practices. Take the software business. It has been rife in recent years with so-called sales in which the software companies have made side agreements; no documentation exists, but the customers contend they were promised the ability to return the product if they could not use it. That arrangement is not a sale. If the risk has not been transferred, no revenue exists. This criterion is crystal clear in the accounting rules. Yet many cases have been documented of companies recording revenues based on transactions that are not final sales.

Adding Value through Credit Research

To add value through credit research, analysts should spend proportionately less time on surface measures of credit risk (such as earnings before interest and taxes/interest, EBITDA/interest, total debt/total capital, and total debt/ EBITDA) and proportionately more time on underlying indicators of potential problems (namely, cost of sales/average inventory, sales/average accounts receivable, and depreciation/PPE). These underlying indicators are basic, but few analysts apply them. These techniques of ratio analysis do an amazingly good job of capturing financial reporting problems.

By observing the cost of sales/average inventory over a period of time, analysts can identify companies for which the ratio is falling. These companies generally have some story ready to explain why the ratio is falling. But chances are, if inventory has not been sold after a lengthy period, it will not be sold; it will be written off, which is why the average inventory is rising and the ratio is falling. Analysts can spot problems by comparing the company's cost of sales/average inventory trend with the trend of its industry peer companies. Admittedly, if a company lacks a lot of direct comparables in the industry, the analysis is tougher, but analysts can draw inferences from the company's own trend and take into account normal seasonality. If the ratios show an adverse trend, the better policy is to assume a problem exists, regardless of the company's explanation. Occasionally, in erring on the side of caution, analysts make a mistake because an innocent and legitimate explanation exists for the change in the trend, but more often than not, assuming the worst-case scenario pays off.

Similarly, if ratio analysis shows that accounts receivable are building relative to sales, then either the company has a lot of uncollectable receivables or managers are propping up sales by being more liberal in their credit terms (e.g., by extending the time for payment). Usually, the company will not do what it ought to do, which is to raise the allowance for bad accounts. As a result, when customers do not make good on the accounts receivable, the earnings reported already, based on the assumption that the receivables will be collected, will be wiped out.

Depreciation is another valuable indicator of potential problems. If the level of depreciation in relation to a company's PPE is lower than that of similar companies in the industry, then the company is probably underdepreciating or making excessively liberal assumptions about the useful life of the equipment. Earnings of companies that engage in underdepreciating their assets will be overstated relative to comparable companies.

In summary, the preceding ratios provide fairly basic analytical tools that the market often seems to ignore. Fundamental financial measures provide blatant warning signals, but only if analysts take the time to notice. Three warning signals that analysts should be aware of are (1) divergence of a financial ratio from the historical ratio for the company and the industry, (2) surges or sudden drops in a ratio that lack a plausible explanation, and (3) inexplicably superior performance for a ratio compared with the industry norm. Treating all of these warning signs with respect can highlight potential pitfalls.

Cracks in the Contingent Claims Model

The contingent claims model, also referred to as the Merton model, is one of the cornerstones of finance. Its significance to credit analysis lies in its implication that a company's stock price provides information about the company's default risk. The Merton model provides a useful way to analyze hedging. With the recent sell-off in the high-yield market, interest in the model as a hedging tool has increased.

I have been involved in many discussions about shorting stocks as a hedge for long investments in the high-yield sector, which is not a new idea. Bookstaber and Jacob published an article on this topic in 1986.[4] This strategy is not extensively used because it carries

[4] Richard Bookstaber and David P. Jacob, "The Composite Hedge: Controlling the Credit Risk of High-Yield Bonds," *Financial Analysts Journal* (March/April 1986):25–36.

a lot of basis risk; sometimes it works, sometimes it does not. The potential exists to lose on both sides of the trade. Although buying a very out-of-the-money put is an interesting strategy to contemplate, it cannot be depended on in practice to act in a precise manner—as the Merton model suggests it will. This is not to knock the Merton model. Whether discussing the Merton model, the Modigliani–Miller model, or another model, to make progress in establishing a theory, the theory has to start with a few non-real-world assumptions, and then researchers test those assumptions by varying them to match real-world conditions. The problem arises when investors stop at the non-real-world version of the model and try to apply it to the real world.

When the contingent claims model is applied to credit analysis, the basic idea is that both the stock and bonds of a company derive their value from the same set of cash flows. Therefore, if expected future cash flows decline or their volatility declines, the value of the stock and the bond are both expected to fall. By extension, the stock price and its volatility should give a clear indication of changes in the company's credit quality. This indicator, in theory, should be more effective than financial ratios because it relies on the truths of an efficient market.

In practice, however, the contingent claims model has a few cracks. A good example of one of these cracks was seen in 1993, when Steven Bollenbach split Marriott into two companies (Marriott International and Host Marriott), thereby segregating the strong assets in one company for the equity investors and the weak assets in a second company dedicated to the debt holders. On this news, not surprisingly, the stock soared and the bonds plummeted. This result, however, cannot happen in a contingent claims world. It is an impossibility. The effect happened not only in 1993, but on the day of the announcement that Bollenbach was coming to Hilton Hotels Corporation as CEO, Hilton's stock price rose and the price of its bonds fell. The market, as it turned out, had correctly anticipated that Bollenbach would repeat the same strategy. (At Hilton, however, the strategy was not executed in quite so radical a fashion.) So, the Bollenbach story is one anomaly in a contingent claims world. My point is that the contingent claims model simply does not capture all the possible market conditions.

Another case that illustrates a crack in the model was the November 1994 referendums in a number of states on legalizing casino gambling. In the majority of states, the proposals were rejected. Over the next year, the stocks of the casino companies underperformed the casino subindex of the S&P 500 Index. The casino operators' bonds, however, outperformed the high-yield index. This situation cannot possibly happen if contingent claims theory captures all the elements of valuation. Yet the reaction was logical. From the shareholders' standpoint, the negative vote reduced the opportunities to expand into new markets and increase earnings, whereas from the bondholders' standpoint, the credit risk for the time being was reduced substantially by the outcome of the referendums. By limiting competition from the expansion of legalized gambling, the outcome of the referendums made the revenue stream to service the debt more secure. This casino company example is another case of stock and bond prices moving in opposite directions.

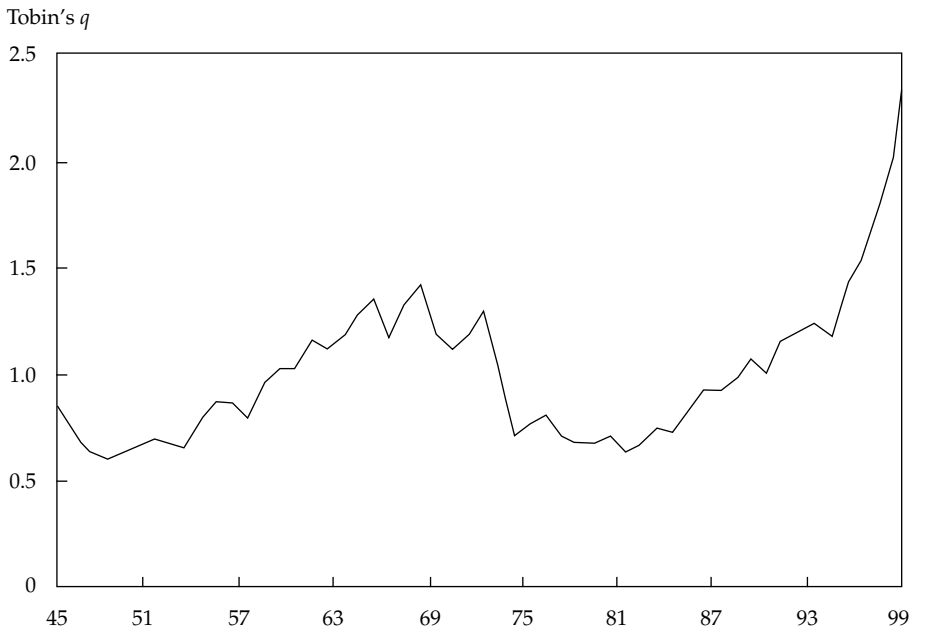
I need to stress that in his model, Merton makes a non-real-world assumption about uniform conditions in the stock and bond markets. The model does not allow for the difference in liquidity conditions that is experienced from time to time in the stock and bond markets. From time to time, the bond market suffers a severe loss of liquidity, resulting in what is called "roach motel risk": You can get in, but you cannot get out. Investors would be happy to own bonds at a spread of 500 bps over Treasuries if they were confident that the bonds could be sold when they started to see the credit head south. On the other hand, if investors know they will own the bonds until the credit goes bankrupt, they will demand a bigger risk premium than they would otherwise. So, if less liquidity is anticipated in a credit, investors will demand a bigger risk premium. Therefore, bond prices can be depressed without having any effect on the company's stock prices.

The Big Picture

In the mid- to late 1990s, there was talk of LBOs making a major comeback. For selected companies, an LBO might have made sense, but basic analysis suggested that organizing LBOs on a mass scale was not a great idea. **Figure 2** plots Tobin's q, the replacement cost of companies versus the market value of those companies, for the 1945–99 period. At the beginning of the 1980s, the Tobin's q was close to an all-time low. Investors could buy a company for 70 percent of the cost to reconstruct all of its physical assets. So, even if a substantial premium over a company's stock price was paid, the company's assets were being purchased cheaply. By the late 1990s, the same could not be said.

In the 1980s, LBO specialists could demonstrate on the back of an envelope whether a particular LBO would work. The transaction was simple: Borrow the money, buy the assets, break up the company, sell the pieces of the company, pay off the debt, and walk away with $1 billion in profit. But partly because of the awareness these transactions brought to the arbitrage

Figure 2. Aggregate Equity Market Valuations as a Percentage of Replacement Cost of Assets (Tobin's *q*), 1945–99



Source: Based on data from the Federal Reserve Board.

opportunities available, the market started to push up stock prices, and by the end of the 1980s, these arbitrage opportunities no longer existed. Of course, Wall Street continued to generate LBO transactions because of their past success. The Tobin's *q* rose to more than 200 percent during the 1990s, so the idea of LBOs making a dramatic comeback did not make a lot of sense. With the current sell-off in stocks, LBOs may start to look interesting again for companies in certain segments of the market. Investors, however, must look at the big picture to determine whether these transactions make sense in the first place.

Another development that is not good from the standpoint of investors is the creation of companies that have no rationale for existing. One of the more popular gimmicks is a variation on the theme of recycling stock market proceeds into revenues. Consider the situation of a company ostensibly in the restaurant business. The company is not actually in the restaurant business but rather the restaurant franchising business, which is a big distinction. The parent company sells stock to investors based on the investors' belief in the restaurant concept that the franchising company is selling. But the company does not operate any restaurants, because it acts only as the franchiser. The franchiser's only revenues consist of fees paid to it by the franchise operators for the company's services in creating the advertising, training the restaurant's employees, developing the menu, and so on. The restaurants turn out not to be profitable, but this fact is hidden because their operations are not included in the financial reports of the parent company. If the restaurants are not profitable, how are they able to pay the fees to the parent company? The parent company sends the proceeds of the stock sale to the franchise operators as a "loan," and the franchise operators use the loan to pay the franchise fees. When the parent company records the receipts from the franchised restaurants, it is called "fee revenue." Thus, cash from the initial stock sale is transformed into revenue.

If I give you a dollar and you hand it right back to me, has either one of us increased our wealth? Obviously not. But according to FASB, the result of this transaction is considered profit. If a company takes a dollar from an investor, gives it to a franchise operator, and gets it right back from the franchise operator, this transaction represents income under generally accepted accounting principles. The parent company can therefore record these profits and keep stockholders happy. Then comes a second round of financing in which the parent company raises more money and creates more franchises.

This scenario, a pyramid scheme, will eventually collapse. It shows that investors should not worry so much about EBITDA coverage ratios; instead, they should take a step back, scrutinize the business of the company in which they want to invest, and ask how

the business generates its alleged earnings. In many cases, that is the extent of the analysis investors have to do. I am amazed at the debates over EBITDA interest coverage of 1.32 versus 1.27. If both companies are going broke, why does it matter? In fundamental analysis, substantial value is gained merely by stepping back and looking at the economic basis of the reported earnings.

Conclusion

The three main points in this presentation are:

- Be skeptical.
- Look at the big picture.
- It is not a paranoid delusion; the issuers of financial statements really are out to get you!

Remember, financial reporting is a mechanism for inducing investors to part with their capital too cheaply. A chief financial officer (CFO) has done a good job if he or she has borrowed money at a lower cost of capital than the company deserves. Borrowing at cheap rates maximizes shareholder wealth, and maximizing shareholder wealth is what the CFO is supposed to be doing. If the CFO has obtained funds fraudulently, a more serious question is raised about whether it is the right thing to do. But more often than not, the company is able to raise cheap funds by taking advantage of loose ends in the accounting rules. In this case, the prevailing logic seems to be that this is what CFOs are supposed to do. And they do it.

Always look at the big picture. Watch out for those companies with no rationale for existing. Do not feel secure simply because you have calculated all the numbers; calculating all the numbers is not even necessary or productive when the company should not exist in the first place. In 1999, by my estimation, the cost of capital in the United States was less than zero, which is why dot-coms were created in such large numbers. Legitimate companies appeared, but venture capitalists were throwing money around and selecting companies for investment, for example, by finding the winners of MIT's business model contest and taking them public. The venture capitalists were not interested in whether a company had any revenues or a product ready for the market. They did not care because the hurdle rates for new investments were so low. To avoid disaster, be sure to examine not only the reported numbers but also the substance of a company and its premise for being.

And finally, bear in mind that as Henry Kissinger said, "Even a paranoid has some real enemies." If you are a bond investor, without a doubt, some clever companies that issue debt are out to get you—out to get your money anyway, and at a lower price than they ought to be paying you.

Question and Answer Session

Martin S. Fridson, CFA
Christopher L. Gootkind, CFA

Question: Do rating agencies examine covenants when assigning ratings to bond issues, and are the covenants' absence or presence adequately reflected in the ratings?

Gootkind: One of the challenges of covenants being adequately reflected in the ratings of bond issues is that the rating agencies are trying to combine two different concepts—default probability and loss severity—into one rating. The rating agencies are beginning to realize that this approach is not working well, which is why Moody's is creating a credit risk model. What makes combining the two risk assessments into one rating so difficult is that covenants are meant to protect bondholders, but at the same time, they limit what management can do. But until management acts, it is hard for the rating agencies to penalize the company. So, if Unilever has a AAA rating because it has a 10 percent debt-to-capital ratio and an awesome amount of cash flow, the rating agencies have to give it a AAA rating. If Unilever borrows $25 billion to buy Bestfoods the day after Unilever receives this AAA rating, Unilever does not deserve a AAA rating anymore. Separating those two considerations is difficult. But as investors, we need to be aware of both default probability and loss severity when making investment decisions about a particular issuer.

Question: How do we collectively voice our desire for covenants if we cannot vote with our feet (i.e., not invest)? Why can't large holders of debt organize and form a creditors' group that can negotiate with some bargaining power?

Gootkind: Individually voicing our displeasure as investors about inadequate bond covenants is almost futile. As a fragmented universe of buyers, we need to find a way to band together to effect change. Perhaps we could create a large creditors' committee to talk to underwriters about our concerns. But it is not in the investment bankers' interest for us to do that because the issuers, who pay the underwriters, do not want to have managements' strategy and flexibility hamstrung by bond covenants. If enough investors band together, we might be able to make a good attempt at effecting change. Doing so could be like the pond into which someone drops a stone; although the ripple starts out small, it gradually spreads wider and wider. The bond covenant issue is a big challenge.

Fridson: The fragmentation of investors has historically been the stumbling block to getting stronger bond covenants. I was actively involved with an effort about 15 years ago to try to organize investors to demand stronger bond covenants in new deals, but the effort wasn't successful because of the fragmentation among buyers. The effort has been somewhat more successful in the high-yield sector because it has a smaller universe of buyers. For some of the lesser credits in particular, a fairly small universe of buyers exists. Those deals are done almost as private placements, so a group of about a half dozen buyers can pretty much structure the deal with the terms they want.

In most public, high-grade deals, if an investor asks to discuss the terms, the salesperson is on to the next call. The salesperson will not get anywhere with the investment bankers in terms of adjusting the covenants, so it isn't worth his or her time to even discuss the changes the buyer wants. Sometimes, though, if the deal is slow, a buyer might get some concessions.

A big part of the problem is that companies do not perceive that a penalty exists for them if they exploit the weakness in a covenant to profit at the expense of bondholders. This perception is reinforced when the companies come back to market with another deal and investors do not punish them for their past covenant-related transgressions. Investors still buy their bonds. Don't criticize the investors though. When a buyer has a lot of money to put to work and there is only one issuer with a deal in the market, it is difficult for that buyer to say, "We are going to punish you for what you did a couple of years ago," and not buy the current deal.

The other issue, which is probably a greater factor in the high-yield market than in the investment-grade world, is that at some point, the issuers say to the buyers, "The whole benefit of issuing in a public market is having less-strict covenants. If you insist on covenants as tight as a private deal, we can save two weeks of touring the country in a road show to sell a public deal and instead do a private deal." Realistically, a limit exists on how far investors can push issuers on bond covenants.

Gootkind: In Europe, and particularly in deals out of London, the covenants are a lot stronger than the ones in the United States. And if investors are willing to forgo a covenant on a particular deal once,

getting the issuers to include that covenant in future deals is difficult.

Question: Are the rating agencies ill-equipped to deal with complicated structured financings, such as collateralized debt obligations (CDOs), where good ratings can slip quickly and reporting issues verge on misrepresentation?

Fridson: New structures are always coming along, and they tend to be tricky to evaluate in the early stages. The agencies can have a reasonable amount of confidence in rating a credit when they have a record going back many years. In the case of Moody's, the history on corporate credits dates back to 1909. Some analysts in the rating committees at Moody's and S&P have been in the business for decades and have accumulated a wealth of experience. They do a good job on the structures and credits they've seen again and again. Accounting fraud can elude them if it is well concealed, but they are wise to the trickery of financial reporting.

A lot of criticism in recent years has been directed at sovereign ratings. Sovereign credits have less history than traditional corporate credits and are thus more difficult to evaluate as a statistical proposition. Figuring out what the correct variables are is also trickier in the case of sovereigns.

As for CDOs, a problem arises because the manager has to meet a ratings standard in a portfolio by having only so many BB and B rated bonds and so forth. Creating a CDO portfolio is not purely a statistical proposition; the manager has the potential to add or subtract value through the selection process. In order to offer the most competitive yield, the manager may deliberately gravitate toward the highest-yielding issues in each of those rating categories. In general, those are the ones that are probably about to be downgraded. So, there is an adverse selection process that increases the risk of downgrade on the CDO. One way for buyers of CDOs to limit this risk of adverse selection is to make covenants take into account whether the bond is already on the rating agency's watch list for downgrading.

Both the market and the rating agencies continue to learn from experience and refine the analytical methods as they go along. But it is fair to say that they do not figure everything out the first time around. The evidence suggests that when the large volume of LBOs first came out in the market in the 1980s, some systematic overrating of those deals occurred. This statement is not horribly damning of the rating agencies. It is understandable that the first time a new phenomenon appears, the rating agencies do not get it exactly right.

Gootkind: The economy has become much more volatile and competitive on a global basis, and as a result, a company's financial position changes much faster and more dramatically than it used to. The rating agencies used to talk about rating through a cycle, but I don't know whether they still do. Distinguishing between a cyclical and a secular change is difficult. Auto companies are a good example. How much of the problem in the auto sector has occurred because of its place in the business cycle and how much has been caused by secular change? In 1981, General Motors had a 50 percent market share in the United States; now, it has about a 28 percent market share. Such a change is secular. Analysts need to think about cyclical versus secular changes, but unfortunately, the difference is not always clear until after the fact.

Question: How do you assess the level of market efficiency or, basically, the pricing of the corporate market?

Fridson: Judging the accuracy of pricing is difficult because we cannot observe an issue's true, intrinsic value. Investors cannot tell whether a particular bond is underpriced or overpriced relative to some objective standard, although in the market, these fine points of value are discussed all day long. After the fact, analysts may point out that a bond they considered to be undervalued did indeed outperform the market. But conditions may have improved at the issuer, so the outperformance does not necessarily mean the bond was mispriced at an earlier point.

The only real test for market efficiency is to look at the first-level financial ratios I spoke about earlier, such as EBITDA/interest and total debt/capital gain, and select issues based on that analysis. If bonds selected by that analysis generate a better than market risk-adjusted return, then one can argue that the market is inefficient. I do not think such an experiment would succeed, however. Enough analysts look at those basic financial ratios that generating excess returns through such a naive model is pretty tough. And once the analysis and selection process go beyond this naive model to more-sophisticated ratios, such as cost of sales/average inventory, the analyst has to rely on judgment. Whether the security was efficiently priced therefore becomes difficult to determine.

Gootkind: The other factor to look at is how much public debt a company has outstanding. You can think of "how much" in two ways: the total dollar amount outstanding and the number of bond issues. If a company has a lot of bond issues outstanding, then the pricing efficiency should be good because more analysts are looking at the credit and more people are trading and investing in the name.

Improving Credit Risk Analysis

Christopher L. Gootkind, CFA
Director of Credit Research
Wellington Management Company, LLP
Boston

Many opportunities currently exist to improve credit-risk analysis and add value to fixed-income portfolios. Because the credit markets have grown markedly in recent years and volatility has increased as well, the need for adequate bond covenants has grown commensurately. Credit analysts also must look beyond credit ratings to measure credit risk. The author discusses three ways to measure default probability and explores the use of capital structure convergence as a new tool in credit analysis.

Some of the biggest innovations in the capital markets are occurring in the credit area, specifically with regard to credit risk models, credit derivatives, default swaps, collateralized debt obligations, and collateralized bond obligations. Opportunities exist to improve credit risk analysis and credit investing that can add significant value in fixed-income portfolios.

Market Changes

The United States has been running a surplus for the past few years, which has dampened the pace of growth in investment-grade sovereign debt. **Figure 1** shows that the growth of "risky" credit and investment-grade credit increased dramatically from 1996 to 2000 while investment-grade sovereign debt, or government debt, remained relatively flat. The increase in the high-yield and investment-grade credit markets will likely continue on a global basis, but not without some bumps and pauses along the way.

The gradual decline in credit quality (again, for the investment-grade market) from a predominance of Aaa and Aa ratings to a high proportion of A and Baa ratings during the past 18 years virtually guarantees full employment for credit analysts. As shown in **Figure 2**, in 1973, 58 percent of the market was in Aaa and Aa rated securities, compared with roughly 25 percent today. Incredibly, A rated securities have gone from 32 percent to about 42 percent of the market while Baa rated securities have risen from 10 percent to nearly 32 percent. When I entered this business in 1981, believe it or not, General Motors Corporation was Aaa rated, not to mention the Coca-Cola Company, Procter & Gamble Company, Unilever, and most Japanese and U.S. banks. I interpret this shift as meaning that many companies do not need the highest credit ratings to readily access the public debt markets.

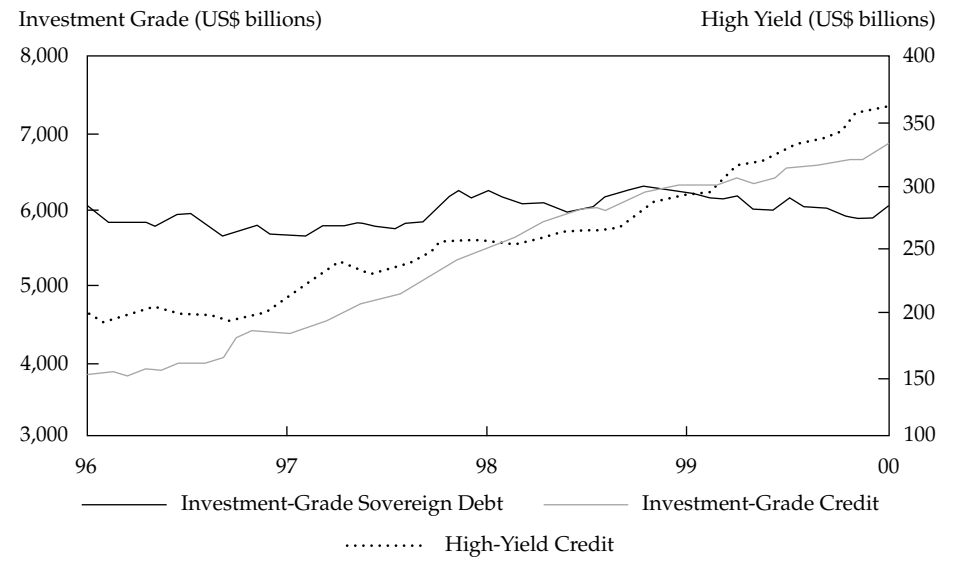
Another way of evaluating the market in terms of credit is by looking at the volatility in ratings changes. **Figure 3** shows the number of downgrades and upgrades made by Moody's Investors Service (Moody's) from 1987 through the first quarter of 2001. Since 1987, the number of both downgrades and upgrades has been high. The increase in both areas points not only to deterioration in overall credit quality but also to an overall increase in credit volatility. Credit deterioration clearly occurred in the late 1980s and early 1990s, when the United States was in the midst of a recession and leveraged buyouts were in full swing. A relatively calm period followed as the economy recovered and companies repaired their balance sheets, but since the mid-1990s, credit deterioration has again been evident.

EBITDA

EBITDA (earnings before interest, taxes, depreciation, and amortization), commonly used by analysts, can be a dangerous measure if used incorrectly. EBITDA is not cash flow. EBITDA started out as a measure to evaluate high-yield companies close to bankruptcy but has become an analytical tool

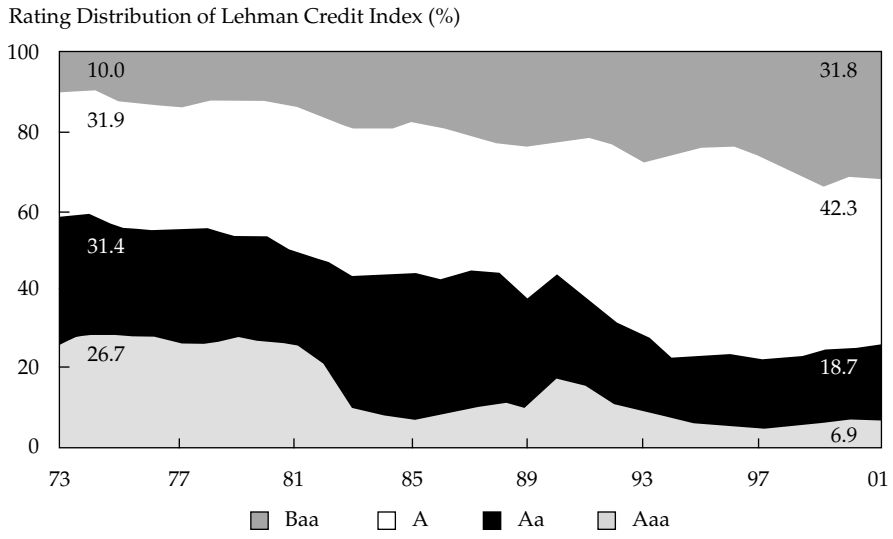
Editor's note: The joint Question and Answer Session of Martin S. Fridson and Christopher L. Gootkind follows this presentation.

Figure 1. Credit Growth, 1996–2000



Source: Based on data from Merrill Lynch & Company.

Figure 2. Credit Migration: Decline in Quality, 1973–2001



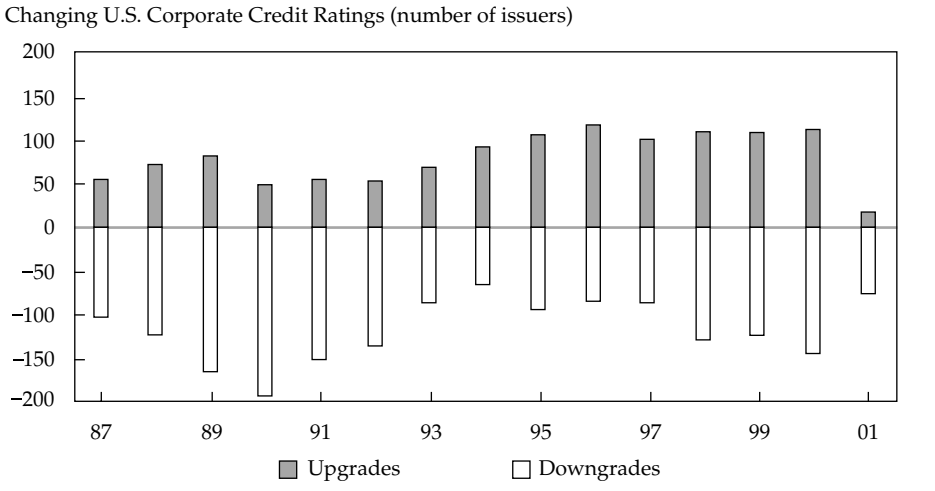
Source: Based on data from Lehman Brothers, Inc.

applied by banks and equity analysts to all, not only near-bankrupt, companies.

EBITDA ignores working capital. Companies can get into trouble when their growth slows and working capital soars, whether the cause is inventory levels or accounts receivable. This type of deteriorating credit situation would not be captured by looking at EBITDA alone. EBITDA also disregards capital expenditures for both maintenance and discretionary purposes. Capital expenditures are an important use of cash. In fact, many charges are excluded from EBITDA. Companies that are retrenching take big charges against their earnings, which often include a large cash component. Severance pay, a major use of cash, is an example of this type of charge. Off-balance-sheet items—stock buybacks, dividends, and mergers and acquisitions—also require cash payments. None of these uses of cash are included in EBITDA.[1]

Instead of EBITDA, credit analysts should focus on operating cash flow and free cash flow. Operating

Figure 3. Credit Volatility: Rating Agency Actions, January 1987–April 2001



Note: 2001 data through first quarter.

Source: Based on data from Moody's Investors Service.

cash flow would be cash available after working capital expenditures, and free cash flow would be cash available for debt service after all other payments, such as capital expenditures and payments to stockholders (dividends) and the government (taxes), have been made.

Covenants

Bond covenants are a hot-button issue for me. Bondholders have been burned by the lack of adequate debt covenants during the past 10 or 15 years, yet we seem to keep coming back for more. Bond buyers make credit judgments based on the way the company presents itself when it issues debt, but without strong covenants, that credit situation can change abruptly.

Several prominent examples of companies' bad faith to bondholders stand out in my mind. One instance is Unilever, an Aaa rated company until it borrowed 25 billion dollars to buy Bestfoods in 2000. Another example is the Walt Disney Company, which was a AA– rated company until Steven Bollenbach showed up in April 1995 as the new CFO. With the proceeds of debt issued at the end of September 2001, Disney bought back $750 million worth of stock that the Bass brothers of Texas needed to unload. Of course, this action alone was not good for the company's credit ratings, but then it borrowed another several billion dollars to buy the Fox Family network from News Corporation and Haim Saban. Many bondholders also painfully remember the R.J. Reynolds Tobacco Holdings (RJR) leveraged buyout in the late 1980s. And many probably still have scars from the Marriott International debacle in 1993, when the company split into a management company and a debt-laden hotel property business. Getting the fundamental analysis right is hard enough, but when bondholders give management too much latitude and discretion with the money we lent them, then bondholders are the losers.

Peter Finch's line in the movie "Network"—"I'm mad as hell and I'm not going to take it anymore!"—can be our rallying call for change. Strength lies in numbers. The bond market is so big and fragmented that a few corporate bond buyers will not be able to effect the needed change alone. If large bond buyers join together, however, we can establish parameters for protecting our investments despite the market fragmentation.

The following covenant "wish list" is not comprehensive but includes some covenants that are already available, as well as new ones that bondholders should be demanding:

Negative Pledge. The first item on the list is negative pledge. That is, if other lenders obtain some type of security or other special treatment, then bondholders will get the same deal. Consider the example of Federal-Mogul Corporation, a big auto parts supplier, which filed for bankruptcy in September 2001. Three or four years earlier, Federal-Mogul had issued unsecured debt rated Ba2/BB. The banks with outstanding loans to the company did not get security, although they did have some covenant protection.

[1] For additional information about the myths surrounding EBITDA, see Pamela M. Stumpp, Tom Marshella, Mike Rowan, Rob McCreavy, and Monica Coppola, "Putting EBITDA in Perspective," Special comment (Moody's Investors Service, May 31, 2001).

So, the bondholders were *pari passu* with the banks. When Federal-Mogul got into serious trouble last year, the company violated some of the covenants the banks had in place. The banks agreed to give Federal-Mogul a covenant waiver in exchange for security. In the absence of negative pledge, bondholders were no longer *pari passu* with the banks. After the company's downturn, the bank debt traded in the 50s or 60s and the bonds traded at about 8 cents on the dollar. With a negative pledge covenant, the bondholders would have been in the same position as the banks and would not have suffered such a huge drop in the price of their bonds. Negative pledge cannot prevent companies from going bankrupt, but if they do go bankdrupt, bondholders would be in much better shape with that covenant.

Coupon Step-Ups. Coupon step-ups have been used extensively in Europe, mainly by large telecommunication companies, which tend to be debt-heavy and in need of inducements to encourage bond investors to purchase new issues. A coupon step-up is triggered when a company is downgraded. A one-step rating change (for example, from A to Baa) typically translates into an increase of about 25 bps in coupon; the greater the downgrade, the larger the coupon. The additional compensation from step-ups is certainly better than nothing. Generally, most investment guidelines have limitations or prohibitions on owning lower-rated issues, so the downgraded bonds may be sold regardless of the larger coupon.

Change-of-Control Put. In the high-yield market, many issuers allow a change-of-control put on their debt. The investment-grade market also would benefit from this type of put. A change-of-control put means that if a company is acquired, the bondholders can put their bonds back to the issuer at par or at a slight premium.

Minimum Net Worth. A minimum-net-worth covenant would be very valuable to bondholders. This type of covenant would protect against leveraged buyouts and other highly leveraged recapitalizations.

Maximum Leverage Test. A covenant that includes a maximum leverage test would also provide protection for bondholders against companies engaging in large debt-financed acquisitions.

Asset Sale Limitations. An asset-sale-limitation covenant stipulates how the debt-issuer must use the proceeds from a large asset sale. Of course, bondholders would prefer that companies pay down outstanding debt. Once a company sells a major asset, depending on where those proceeds go—perhaps into a new venture or line of business—that company can have certain characteristics that differ after the sale or even be a totally different company from the one the investor bought.

Senior versus Subordinated. Senior versus subordinated claims on a company's assets can strongly influence the overall position of the bondholder. A subordinated bondholder is in a much weaker position than a senior bondholder. If a subordinated bondholder does not limit the amount of debt that has a senior claim to assets, the value of the subordinated bonds can plummet if the bond issuer gets into trouble. Therefore, whenever possible, the subordinated bondholder should attempt to secure covenants that limit the amount of debt issuance that would be senior to the subordinated bonds.

Credit Rating and Credit Risk

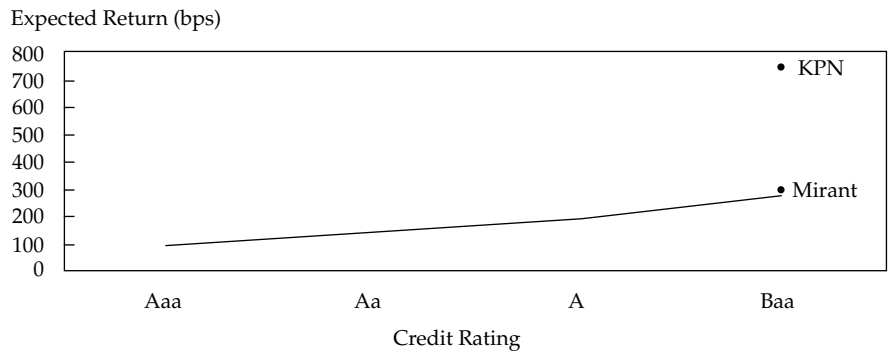
Does credit rating equal credit risk? Typically, credit ratings are equated primarily with the probability of default. Although the probability of default is an important part of the rating, another crucial aspect, loss severity, is often ignored by many investors, plan sponsors, and consultants. Investors and other market participants should consider both loss severity and the probability of default as being captured in a company's rating.

Every investment has two components: risk and expected return. The goal of credit analysis is to calibrate risk. The rating agencies issue "single point" ratings (e.g., A, Baa–, B+) and try to capture, with only limited success, the two components of credit risk—default probability and loss severity—in that one rating. The product of those two risks is equal to the expected loss from the investment, which is the ultimate goal in assessing credit risk.

Figure 4, which charts two companies (Royal KPN and Mirant Corporation) with almost identically rated bonds, illustrates how credit ratings do not equal credit risk. KPN, a Dutch telephone company, is rated Baa3 by Moody's and BBB+ by Standard and Poor's (S&P), and Mirant, an energy-generation company and a former utility, has a Baa3 rating from Moody's and a BBB– rating from S&P. The market values corporate credits by their relative basis point spreads over Treasuries. On September 18, 2001, the KPN 8.0% of 10/1/10 was yielding 735 bps over the 10-year Treasury, trading at a price of $78.00, and the Mirant 8.3% of 5/1/11 was yielding 290 bps over the same Treasury, trading at a price of $104.70—almost a 27 point difference in dollar terms.

Clearly, the market has priced these two nearly identically rated bonds quite differently. What does the market see that the ratings are not capturing? Figure 4 shows risk (measured by rating) on the *x*-axis

Figure 4. Credit Rating Does Not Equal Credit Risk



Note: As of September 18, 2001.

and expected return—in this case, the spread over Treasuries—on the *y*-axis. The line in Figure 4 should plot the "normal" spread of corporate bonds versus Treasuries for the range of investment-grade credit ratings of Aaa and lower. Thus, bonds with similar ratings should not deviate much from that straight line in terms of pricing; Aaa and Aa rated bonds should trade in a pretty narrow band. And yet within the investment-grade Baa rated bond universe, massive price and yield discrepancies that reflect credit risk discrepancies exist. Obviously, credit ratings do not equal credit risk.

Table 1 offers another example of my point that credit ratings do not equal credit risk. EchoStar Communications Corporation, rated B1/B+, is trading at a yield spread of roughly 1,400 bps and a price spread on the bid side of 46 points greater than Global Crossing, rated Ba2/BB (albeit with a negative outlook), even though Global Crossing has the higher rating. Is this discrepancy attributable to the probability of default or loss severity or both?

Consider the other example in Table 1. Hayes Lemmerz International is a high-yield auto supplier with two debt issues outstanding, one senior and one subordinated. The company recently announced some accounting "irregularities" in addition to troubles arising from the downturn in the business cycle. Although the subordinated bonds are rated only one notch below the senior bonds (Caa1 and Caa2) by Moody's—and are identically rated by S&P—a 44 point price differential exists on the bid side. By definition, these two bonds of the same company have identical default probability. The price difference is because of the market's perception of loss severity. Focusing only on the probability of default in determining a bond's value and on subsequent trading behavior can lead to investors getting badly burned.

A Plan for Change

Having established that credit ratings do not equal credit risk, what steps can be taken to improve credit risk analysis? First, investors need to stop equating ratings with the probability of default and instead think in terms of expected loss, which combines default probability and loss severity. Also, investors should disaggregate default probability from loss severity. Investors should be wary of bonds of issuers that have a low probability of default but potentially high loss severity. If the probability of default rises for that credit, these bonds will drop like a stone because investors will begin focusing more on loss

Table 1. Credit Rating and Credit Risk

Issue	Rating	Price/Yield	
Global Crossing, 8.7% '09	Ba2/BB (neg.)	\$52–54/23.5%	
Echostar, 9 3/8% '09	B1/B+	\$98–99/9.6%	
	Seniority	Rating	Price
Hayes Lemmerz, 11 7/8% '06	Senior	Caa1/B–	\$65–67
Hayes Lemmerz, 11% '06	Subordinated	Caa2/B–	\$21–24

Note: As of September 18, 2001.

severity. The trading behavior of senior and subordinated debt of the same company can exemplify this type of problem. In the Hayes Lemmerz example, the senior and subordinated bonds traded more closely in value when the company was doing well, and then the spread widened markedly when the company's prospects deteriorated. For a company such as IBM, senior debt and subordinated debt probably trade within 10 bps of each other because the company's probability of default is so low. But if that probability should rise for whatever reason, the price of IBM's subordinated debt will fall sharply.

Second, when doing credit analysis, consider a borrower's asset coverage, particularly by focusing on tangible assets and the company's brands. Be wary of companies with a lot of goodwill on their balance sheets. Federal-Mogul, for example, had high amounts of goodwill from several big acquisitions it made in 1997 and 1998. As a result, when things turned down for the company, the bonds simply did not have a lot of hard asset coverage and the price of the bonds plummeted.

Investors should expect higher loss severity in the future. In the past 10 or 20 years, the U.S. economy has moved more toward becoming a service economy, and service companies, which have good cash flow, generally do not have a lot of hard assets to support debt service should cash flow erode. Consider the Interpublic Group of Companies, a large advertising agency. Its assets are its employees, who disappear every night when the day's work is done. People, as assets, cannot be liquidated to provide cash, if needed, to pay interest and principal on a company's debt. Many companies that have outsourced manufacturing to lower costs and focus on providing services have borrowed money in the debt markets over the past several years. These companies have had strong cash flow, and as long as the cash keeps flowing, bondholders will be fine, but if the cash flow disappears, assets will be insufficient to support these companies' outstanding debt.

A good example of this concern is Sabre, an online reservation company that came to market in the summer of 2001 and had stable cash flow until September 11, 2001. The company does not have much hard asset coverage, however, and when the market started worrying about Sabre's business viability as travelers drastically cut back on flying, the price of Sabre's bonds plummeted. The market was no longer focusing only on the default probability for Sabre, which had definitely increased, but also on loss severity, which would be expected to be high because of the company's lack of hard assets to support debt service in the midst of a weakened outlook for the travel industry.

How to Assess or Measure Default Probability

If default probability is disaggregated from loss severity, then investors could benefit from a tool that can measure the probability of default. In this regard, several credit risk models have become available in the past few years. For example, KMV's products have been used in the banking community for about 10 years, and KMV, now a prominent name as a provider of credit risk models, is targeting other types of institutional investors. KMV uses a Merton model of default probability (which is described by Peter Knez).[2] Another available tool is RiskCalc, developed by Moody's Risk Management Services. RiskCalc assesses default probabilities by incorporating balance sheet and income statement information as well. In addition, some sell-side firms have created their own credit risk models, but these models measure only default probability.

Equity market capitalization and volatility are other gauges to consider in attempting to measure default probability. The closer the equity value of a company gets to zero, the closer the company is to bankruptcy, which is a relatively straightforward way of looking at the probability of default. The volatility of a company's equity will be a function not only of how much outstanding debt a company has but also of the riskiness and the uncertainty of the company's cash flow. If a stock's volatility increases dramatically vis-à-vis the overall market, it might be an early indicator of deteriorating credit quality.

Finally, another guide to measuring default probability is following bank loan and credit derivatives pricing, both of which are relatively recent innovations in the market. Bank loans have been around for a while, but the secondary trading market for bank loans has not. And the banks may have better information about a company's credit worthiness than public bond investors.

Capital Structure Convergence

Capital structure convergence is occurring because many different aspects of capital structure are now being publicly traded in today's marketplace. Bond investors stand to benefit from this trend. For example, the public bank loan market did not exist 10 years ago. Investors with nonpublic information and those with only public information both trade bank loans, but some of the nonpublic information seeps into the market to the benefit of all investors. Falling bank loan prices are most likely an early indicator that a particular credit's quality is deteriorating. Carefully

[2] See Mr. Knez's presentation in this proceedings.

note the price quotes that Wall Street firms are making on these credits. The same goes for credit derivatives. Credit derivatives or bank loans can be used as tools in credit analysis even by those who are not investing in them.

Equity prices and stock volatility are other aspects of capital structure convergence that can be simple, straightforward tools for credit risk analysis. Unlike bond prices, equity prices are readily available through the stock exchanges. Interestingly, the equity market is starting to look more closely at the debt market for clues about credit quality. Equity analysts often talk to fixed-income analysts when a company's credit quality appears to be deteriorating to try to get a handle on the company's liquidity situation. Motorola, for example, did not have a huge amount of long-term debt, but the company did have a lot of short-term debt that was threatening the company's liquidity position. Such information would have been well known to fixed-income analysts.

Liquidity is not the only information that the fixed-income market can pass on to equity investors. Whether a company will violate a bank or bond covenant and how coupon step-ups might affect a company's earnings per share are important pieces of information for equity investors. If companies are forced to pay higher interest rates, these higher debt service costs will adversely affect the company's equity valuation.

Capital structure convergence will continue. Potential arbitrage opportunities, between bank debt and public debt or debt with security and debt without, will be more obvious. The trend toward greater convergence in the capital markets will lead to better information flow, which fixed-income investors can use to their advantage.

Conclusion

The need for good credit risk analysis will increase in importance as the credit markets continue to grow and remain volatile. Better measures than EBITDA need to be devised to assess both the probability of default and loss severity, which together equal the expected loss from a security. We must demand covenants to protect ourselves as bondholders or we will continue to get burned badly as managements proceed to put their own agenda ahead of the bondholders' best interests. Using market-based tools such as the pricing and volatility of credit derivatives and secondary bank loans, as well as exploring the new credit risk models that are now available, can work to add value in portfolios by improving credit risk analysis.

Question and Answer Session

Martin S. Fridson, CFA
Christopher L. Gootkind, CFA

Question: Do rating agencies examine covenants when assigning ratings to bond issues, and are the covenants' absence or presence adequately reflected in the ratings?

Gootkind: One of the challenges of covenants being adequately reflected in the ratings of bond issues is that the rating agencies are trying to combine two different concepts—default probability and loss severity—into one rating. The rating agencies are beginning to realize that this approach is not working well, which is why Moody's is creating a credit risk model. What makes combining the two risk assessments into one rating so difficult is that covenants are meant to protect bondholders, but at the same time, they limit what management can do. But until management acts, it is hard for the rating agencies to penalize the company. So, if Unilever has a AAA rating because it has a 10 percent debt-to-capital ratio and an awesome amount of cash flow, the rating agencies have to give it a AAA rating. If Unilever borrows $25 billion to buy Bestfoods the day after Unilever receives this AAA rating, Unilever does not deserve a AAA rating anymore. Separating those two considerations is difficult. But as investors, we need to be aware of both default probability and loss severity when making investment decisions about a particular issuer.

Question: How do we collectively voice our desire for covenants if we cannot vote with our feet (i.e., not invest)? Why can't large holders of debt organize and form a creditors' group that can negotiate with some bargaining power?

Gootkind: Individually voicing our displeasure as investors about inadequate bond covenants is almost futile. As a fragmented universe of buyers, we need to find a way to band together to effect change. Perhaps we could create a large creditors' committee to talk to underwriters about our concerns. But it is not in the investment bankers' interest for us to do that because the issuers, who pay the underwriters, do not want to have managements' strategy and flexibility hamstrung by bond covenants. If enough investors band together, we might be able to make a good attempt at effecting change. Doing so could be like the pond into which someone drops a stone; although the ripple starts out small, it gradually spreads wider and wider. The bond covenant issue is a big challenge.

Fridson: The fragmentation of investors has historically been the stumbling block to getting stronger bond covenants. I was actively involved with an effort about 15 years ago to try to organize investors to demand stronger bond covenants in new deals, but the effort wasn't successful because of the fragmentation among buyers. The effort has been somewhat more successful in the high-yield sector because it has a smaller universe of buyers. For some of the lesser credits in particular, a fairly small universe of buyers exists. Those deals are done almost as private placements, so a group of about a half dozen buyers can pretty much structure the deal with the terms they want.

In most public, high-grade deals, if an investor asks to discuss the terms, the salesperson is on to the next call. The salesperson will not get anywhere with the investment bankers in terms of adjusting the covenants, so it isn't worth his or her time to even discuss the changes the buyer wants. Sometimes, though, if the deal is slow, a buyer might get some concessions.

A big part of the problem is that companies do not perceive that a penalty exists for them if they exploit the weakness in a covenant to profit at the expense of bondholders. This perception is reinforced when the companies come back to market with another deal and investors do not punish them for their past covenant-related transgressions. Investors still buy their bonds. Don't criticize the investors though. When a buyer has a lot of money to put to work and there is only one issuer with a deal in the market, it is difficult for that buyer to say, "We are going to punish you for what you did a couple of years ago," and not buy the current deal.

The other issue, which is probably a greater factor in the high-yield market than in the investment-grade world, is that at some point, the issuers say to the buyers, "The whole benefit of issuing in a public market is having less-strict covenants. If you insist on covenants as tight as a private deal, we can save two weeks of touring the country in a road show to sell a public deal and instead do a private deal." Realistically, a limit exists on how far investors can push issuers on bond covenants.

Gootkind: In Europe, and particularly in deals out of London, the covenants are a lot stronger than the ones in the United States. And if investors are willing to forgo a covenant on a particular deal once,

getting the issuers to include that covenant in future deals is difficult.

Question: Are the rating agencies ill-equipped to deal with complicated structured financings, such as collateralized debt obligations (CDOs), where good ratings can slip quickly and reporting issues verge on misrepresentation?

Fridson: New structures are always coming along, and they tend to be tricky to evaluate in the early stages. The agencies can have a reasonable amount of confidence in rating a credit when they have a record going back many years. In the case of Moody's, the history on corporate credits dates back to 1909. Some analysts in the rating committees at Moody's and S&P have been in the business for decades and have accumulated a wealth of experience. They do a good job on the structures and credits they've seen again and again. Accounting fraud can elude them if it is well concealed, but they are wise to the trickery of financial reporting.

A lot of criticism in recent years has been directed at sovereign ratings. Sovereign credits have less history than traditional corporate credits and are thus more difficult to evaluate as a statistical proposition. Figuring out what the correct variables are is also trickier in the case of sovereigns.

As for CDOs, a problem arises because the manager has to meet a ratings standard in a portfolio by having only so many BB and B rated bonds and so forth. Creating a CDO portfolio is not purely a statistical proposition; the manager has the potential to add or subtract value through the selection process. In order to offer the most competitive yield, the manager may deliberately gravitate toward the highest-yielding issues in each of those rating categories. In general, those are the ones that are probably about to be downgraded. So, there is an adverse selection process that increases the risk of downgrade on the CDO. One way for buyers of CDOs to limit this risk of adverse selection is to make covenants take into account whether the bond is already on the rating agency's watch list for downgrading.

Both the market and the rating agencies continue to learn from experience and refine the analytical methods as they go along. But it is fair to say that they do not figure everything out the first time around. The evidence suggests that when the large volume of LBOs first came out in the market in the 1980s, some systematic overrating of those deals occurred. This statement is not horribly damning of the rating agencies. It is understandable that the first time a new phenomenon appears, the rating agencies do not get it exactly right.

Gootkind: The economy has become much more volatile and competitive on a global basis, and as a result, a company's financial position changes much faster and more dramatically than it used to. The rating agencies used to talk about rating through a cycle, but I don't know whether they still do. Distinguishing between a cyclical and a secular change is difficult. Auto companies are a good example. How much of the problem in the auto sector has occurred because of its place in the business cycle and how much has been caused by secular change? In 1981, General Motors had a 50 percent market share in the United States; now, it has about a 28 percent market share. Such a change is secular. Analysts need to think about cyclical versus secular changes, but unfortunately, the difference is not always clear until after the fact.

Question: How do you assess the level of market efficiency or, basically, the pricing of the corporate market?

Fridson: Judging the accuracy of pricing is difficult because we cannot observe an issue's true, intrinsic value. Investors cannot tell whether a particular bond is underpriced or overpriced relative to some objective standard, although in the market, these fine points of value are discussed all day long. After the fact, analysts may point out that a bond they considered to be undervalued did indeed outperform the market. But conditions may have improved at the issuer, so the outperformance does not necessarily mean the bond was mispriced at an earlier point.

The only real test for market efficiency is to look at the first-level financial ratios I spoke about earlier, such as EBITDA/interest and total debt/capital gain, and select issues based on that analysis. If bonds selected by that analysis generate a better than market risk-adjusted return, then one can argue that the market is inefficient. I do not think such an experiment would succeed, however. Enough analysts look at those basic financial ratios that generating excess returns through such a naive model is pretty tough. And once the analysis and selection process go beyond this naive model to more-sophisticated ratios, such as cost of sales/average inventory, the analyst has to rely on judgment. Whether the security was efficiently priced therefore becomes difficult to determine.

Gootkind: The other factor to look at is how much public debt a company has outstanding. You can think of "how much" in two ways: the total dollar amount outstanding and the number of bond issues. If a company has a lot of bond issues outstanding, then the pricing efficiency should be good because more analysts are looking at the credit and more people are trading and investing in the name.

The Evolution of E-Trading in Fixed-Income Markets

Dwight D. Churchill, CFA
Head of the Fixed-Income Division
Fidelity Management & Research Company
Merrimack, New Hampshire

Bond trading has evolved from a purely "voice trading" (telephone-based) system through a spectrum of electronic trading mechanisms (from single-dealer systems to multidealer hubs to single-log-in multidealer trading platforms) to its current state—on the verge of another evolution to a fully automated exchange. And although the drivers of e-trading growth are pushing the market toward that end, significant dampers on progress exist. Regardless of the future form that e-trading assumes, market structure will continue to change. Adopting new approaches for inventory management, protocol development, and straight-through processing will be necessary. Perhaps the most important factor affecting the future viability of e-trading is the attitude of market participants, particularly on the buy side.

Bond trading has come a long way. Bonds were once pedaled door-to-door and then moved to telephone-based systems or "voice trading," which greatly improved the efficiency and timeliness of trading. Now electronic trading is providing the potential for significant gains in efficiency. Ultimately, with the acceptance of e-trading, bond trading may move away from the traditional OTC approach to an exchange approach, but regardless of the final state, continued change and improvement can be expected. Therefore, it is worthwhile to review the evolution of bond trading to show how far it has come and then speculate on how the current models might unfold in the years ahead.

To that end, this presentation begins with a review of the evolution of bond trading. I then discuss several e-trading approaches and models (both those that currently exist and those that have disappeared), describe the drivers behind the e-trading initiative, and look at what might be in store for fixed-income market participants in the future.

Evolution of Bond Trading

Voice trading, the standard communication mechanism in the bond market, is incredibly flexible, and it works well in dealing with the nuances of the market. Telephone conversation can be as customized as necessary and is a generally comfortable process for everyone. Nonetheless, voice trading is recognized as an inefficient form of communicating transactions in these markets, given the changing environment and the increased number and speed of transactions. It also comes with incredible "overhead"—the discussion of the kids, the weekend, the compensation program, or whatever happens to be the topic of the day. This overhead applies to both the buy side and the sell side.

Computers are arguably much less flexible than humans in the trading process, but an automated process can be made efficient if it is correctly applied. Single-dealer trading and research systems constituted the first step in the evolution toward electronic platforms, and they proved to be a significant advance over voice trading for certain types of standardized transactions. Such systems helped the bond traders at dealer firms think about how to parse, filter, and prioritize information—everything they had learned to do on the telephone in the past 10, 20, or 30 years. These functions had to be taken into account in order to deliver the same information via an electronic platform. Traders also had to be satisfied that this new way of displaying information and trading would not systematically work to their

disadvantage. Achieving such a result is not easy because, in trading, any information can and will be used by counterparties to gain an advantage, or such is the perception and expectation.

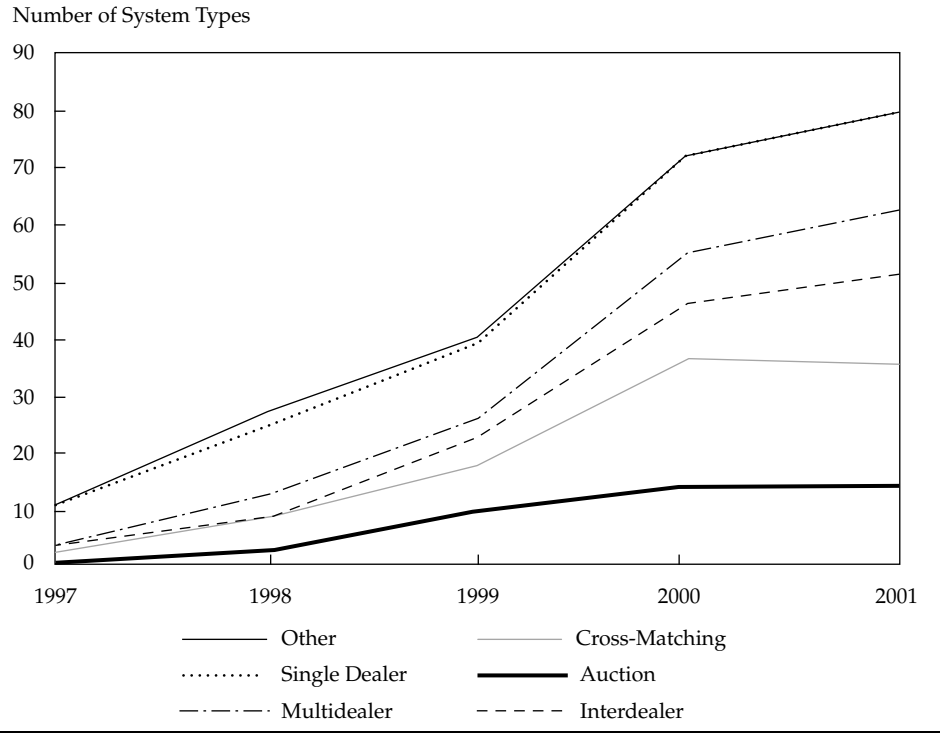
After several firms and their customers experimented with the single dealer systems, the multidealer information hubs came along as an attempt to consolidate the myriad of offerings. A multidealer hub is a huge advantage for the buy side of the business because information can be more easily accessed and dealer offerings can be more easily compared. Also, one of the more interesting ideas and discussions that resulted from the advent of the multidealer hubs is the consideration that research can now be separated from the capital commitment in trading. These hubs helped create a new way of thinking about dealer relationships and pricing. The traditional model is that dealers generally package services and present a packaged price. But if research can be delivered separately, and a multidealer hub is certainly an enabler for separate delivery, why should research be embedded in a security's bid–offer spread? If an investor wants to purchase a dealer's research, then the investor should be able to simply purchase the research, and if an investor wants a commitment of capital for a trade, the investor should be able to take the price charged for the capital without mixing in the cost of research. Although multidealer platforms are not a prerequisite for rethinking packaged pricing, they have acted as a catalyst for weighing potential changes in the current model.

Another advantage of multidealer information hubs, compared with the myriad single-dealer systems, is that they lower the requirement for repeated individual log-ins. Although seemingly minor, multiple log-ins, a problem with having many single-dealer systems, is a huge deterrent to maintaining a large number of system relationships.

The next step in the e-trading evolution was the rapid rise in the development and use of single-log-in multidealer trading platforms that offered reasonable coverage in standardized market trading. The clear advantage of these systems is broad price discovery, a feature far superior to anything available by telephone or in the earlier versions of computerized trading systems. These platforms are the current pinnacle of e-trading in the evolution of the traditional model of an OTC market, but they fall short of providing the shift to an exchange, which would be truly revolutionary. Nonetheless, they offer great improvements to bond trading as we know it.

To put all of this in perspective, **Figure 1** shows the growth patterns of various types of trading systems during the past five years. From 1999 through

Figure 1. Growth of Electronic Bond-Trading Systems, 1997–2001



Source: Based on data from the Bond Market Association.

2000, a new trading system or platform seemed to appear every week.

Auction systems have become popular with issuers who can avoid underwriting fees by going directly to the end investor. Other new types of systems include cross-matching and interdealer systems (i.e., the broker/broker market). This interdealer market, as it used to be defined, seems to be a stale concept in the current world of e-trading. As a result, we should expect to see e-trading platforms continue to gain popularity. There are also single-dealer systems and multidealer systems, as shown in Figure 1. **Exhibit 1** shows the players in the market segments as of mid-2001, but several of them may have already disappeared.

E-trading in the fixed-income markets is clearly a better, or at least more natural, concept when applied to the more liquid, higher-volume markets. I do not mean to suggest that e-trading cannot work for lower-volume, less liquid markets, but it certainly is more complex and less transparent. The telephone dialogue and a less visible transaction may represent a better solution in this less liquid space, at least for some time into the future. **Figure 2** plots the liquidity of various bond markets against their relative trading volumes. In the highly liquid, high-volume markets (Area 1), all types of e-trading systems are suitable. In general, reasonable price transparency already exists in these markets and e-trading simply facilitates greater efficiencies and lower transaction costs. In contrast, the illiquid markets of collateralized bond obligations (CBOs), collateralized loan obligations (CLOs), and emerging market corporate debt (shaded space of Area 3) are not well suited for any of the e-trading platforms, at least not currently. These markets are highly customized, and without significant sacrifices on both the buy and sell side, current trading systems are unable to deal with the subtleties of transacting in these markets.

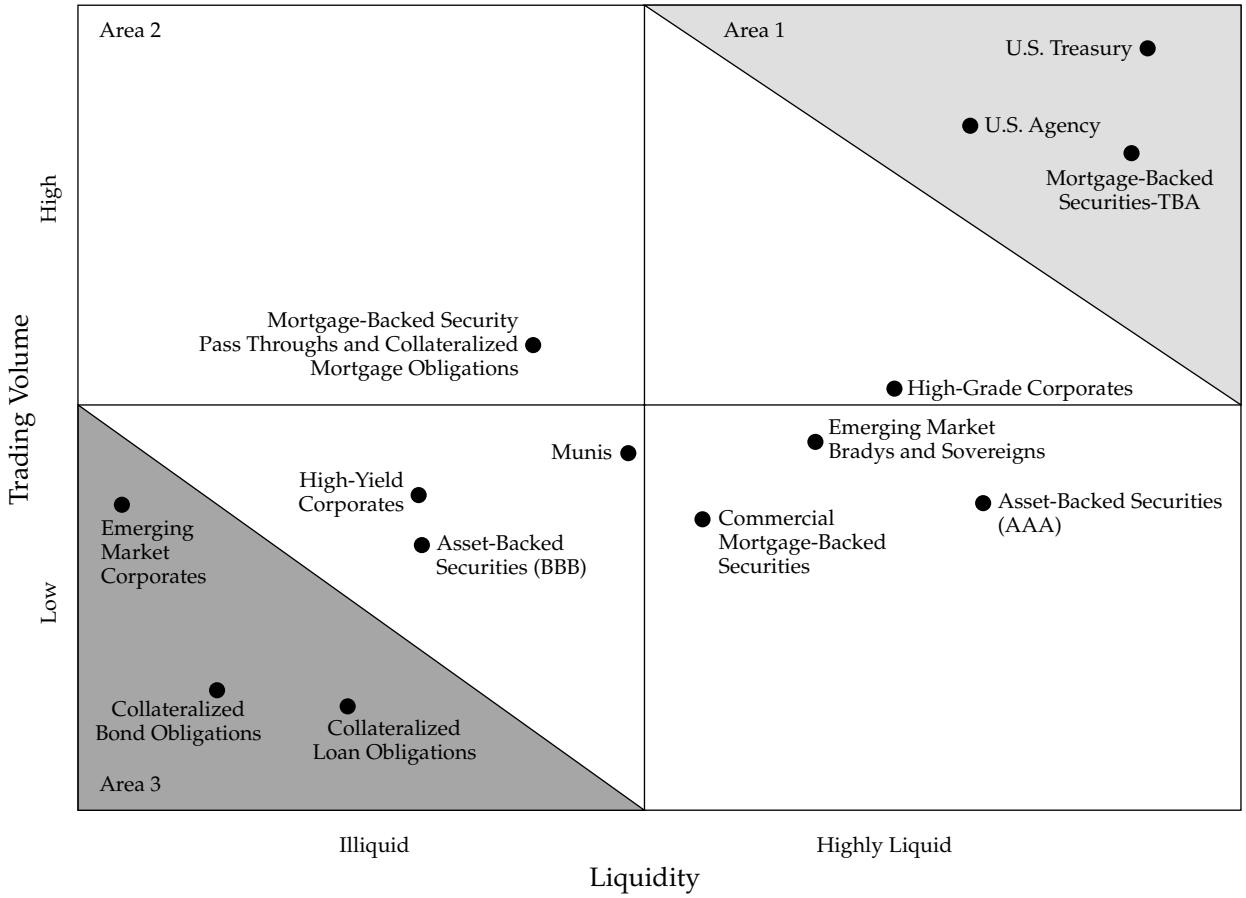
So, where does bond trading go from here? The markets shown in Figure 2 that have reasonable liquidity and volume provide some interesting opportunities for the future of e-trading. For these types of instruments, auction and cross-matching systems appear to promise the greatest potential gains.

Will the efficiency of the OTC market be increased by e-trading moving into the markets where it does not exist currently or rather by expansively moving to more revolutionary electronic exchanges with platforms that allow for order crossing and anonymous execution? Such exchanges would arguably offer optimal price discovery and standardized settlement in any of the markets currently served by e-trading platforms. If electronic exchanges develop, will capital be drawn into the bond markets? Will these potential electronic exchanges provide an improved trading environment relative to the dealer-to-customer environment currently in place? Will the buy-side firms find ways to participate that allow capital to be added to the system? Will electronic exchanges in fixed income become just another fad? The answers to these questions will unfold over time.

Exhibit 1. Examples of Electronic Bond-Trading Systems

Auction	Cross-Matching	Interdealer	Single Dealer	Multidealer
BondConnect	BondDesk.com	BrokerTec Global	Credit Suisse First Boston	BondBook
cpmarket.com	BondGlobe	COREDEAL	eBondTrade	BondNexus
DealComposer	BondHub.com	eSpeed	Fixed Income Securities	BondsOnline
eBondUSA.com	BondLink	EuroMTS Limited	Fuji Securities	Dalcomp
The Equavant Group	BondMart	Garbon-Intercapital	Goldman Sachs	EuroMOT
Ford Motor Credit Company	BondNet	GFInet.com	G.X. Clarke & Company	Market Axess
InterVest	BuySideDirect	Instinet Fixed Income	J.P. Morgan eXpress	TradeWeb
MBSAuction	Cantor Muni	LibertyDirect	Lehman Live	
Muni Auction	Creditex	The MuniCenter	Merrill Lynch	
PARITY	IBX	Xerta	Morgan Stanley	
Treasury Direct	LIMITrader Securities		Odd-Lot Machine/ GovRate	
ValuBond	MuniBEX.com		Ragen MacKenzie	
	Muniversal		RetLots Caboto	
	Pedestal		Spear, Leeds & Kellogg	
	Visible Markets		Tradebonds.com	
	Xbond		Winstar Securities	

Figure 2. Suitability of E-Trading Systems for Various Segments of the Market, by Trading Volume and Liquidity



Note: TBA = to be announced.

Source: Based on data from Bondbook.

The Growth of E-Trading

After a slow beginning, enormous growth occurred in e-trading in 1999 and 2000. Either sell side or third party supported, these vendors were showing up everywhere. I expect that every major buy-side firm met with the vendors listed in Exhibit 1 more than once, but they probably have not heard much from them lately. The intellectual momentum that drove the growth in this business in recent years has been lost for a variety of reasons, capped by world events in the latter half of 2001. It may be some time before we are in a position to regain the 1999–2000 pace of development and change. So, although we have recently not seen much follow through in the drive behind e-trading, the exponential growth in 1999 and 2000 was the result of a confluence of a number of important factors.

Drivers of E-Trading Growth. The critical factor, but not the only factor, in the growth of e-trading products in recent years was the relatively easy access to venture capital. Venture capital also facilitated the entrance of third parties in this area as legitimate competitors to the established dealer models and their e-trading platforms. Dealers also faced a number of financial challenges that led to their interest in e-trading, including a reduced return on capital, margin pressures, and distribution cost pressures. In addition, customer-based business pressures were occurring at a level that dealers had not seen before.

The reasons for the buy-side pressures are addressed later in this presentation, but regardless of the specific issue, with more assets accumulating in the hands of fewer buy-side firms, dealers are being driven to increase their attention to e-trading. Other

contributing factors are the promise of the cost savings of straight-through processing (STP) and the threat of price transparency by various regulatory agencies. In fact, the issue of price transparency has been, in my opinion, an important catalyst in the interest that dealers have shown in e-trading. Many dealers may have felt that as the price transparency initiative gained a foothold, they would be losing a critical information advantage. Therefore, dealers were willing to take a look at new ways to reduce their costs in the face of this changing market model.

It is also worth taking some time to consider the factors that specifically contributed to an interest in e-trading on the buy side. In my opinion, the critical event that caused the buy side to pay attention to e-trading and to put pressure on the dealers to change the way they approach this market was the 1998 "liquidity event." In the fall of 1998, dealers suffered from a number of market events that led to much reduced involvement and liquidity. This liquidity event was highly emotional for many buy-side participants because traditional market makers simply stepped away from the market. The fact that the dealers stepped away in such a visible way and at such a critical time spurred a wave of thinking that technology might prevent a recurrence and improve the likelihood that liquidity would be available when needed. The asset-concentration issue mentioned earlier is also an important driver behind e-trading. The buy side has changed dramatically over the years, with more assets accumulating in fewer hands. Not only do these firms have more clout, but some argue that buy-side firms have outgrown the dealers' ability or willingness to provide capital to service the trading needs generated by those assets. Without some way to improve that situation, such as an e-trading system, liquidity will continue to erode. Further, the buy side is similar to the sell side in that most everyone sees the infrastructure advantages as well as the promise of cost containment from the STP possibilities associated with e-trading.

Dampers on E-Trading Growth. Given all of those factors, one would expect that there would be no stopping this trend toward e-trading, but such has not been the case. The dampers on the growth of e-trading relate to identifiable changes in the markets that have occurred over the past year or so. One clear change is that venture capital has dried up. Not only are third-party entries continuing to have difficulty raising needed capital; the sell-side firms have clearly started rethinking their investments. Merely losing the threat from third-party disintermediation would have dramatically slowed the dealers' push into the e-trading area. Now, with capital drying up and the disintermediation threat reduced, the momentum is gone. But that is not all. Another damper on growth is that liquidity is no longer perceived to be a crisis issue among buy-side participants. Either these buy-side traders have found liquidity to be better, which I doubt, or more likely, they have grown accustomed to the generally reduced level of liquidity now available in the market. This change considerably lowers the buy-side pressure on the dealers.

Although not directly responsible for dampening e-trading growth, the rethinking of the financial viability of e-trading models has been an influential factor. There has been an increasing realization that e-trading systems are not revenue-creating but cost-saving models. The price one is willing to pay for a revenue-creating entity potentially differs greatly from the price one is willing to pay for a cost-saving process. Market participants are certainly willing to pay a fair price for cost savings but are not as willing to pay as high a price as they might if revenues were being raised. As a result, the financials of e-trading are now viewed quite differently than they were when e-trading first took off, thus reducing some of the market's interest in these systems.

Last but not least in terms of slowing the progress in e-trading is market participant behavior, which has been much slower to change than first anticipated. We have all underestimated behavioral inertia. On the buy side, for example, people have grown accustomed to phone calls and traditional voice trading. Maybe the sell-side practice of telling us on the buy side that we are geniuses 10 or 20 times a day is what we are most reluctant to give up. I doubt it, but behavior changes slowly.

In short, the third-party threat has all but disappeared, the buy side has become less emotional, and the financials of e-trading have come to be viewed as less compelling—and these developments have been combined with slow-moving changes in behavior. Not surprisingly, growth in e-trading has lost speed. But slowing the winds of change may not be all bad. It will give us time to pause, think through the issues, and focus attention on models that make sense for a wide audience. And perhaps in time, behavioral changes will catch up with technology.

Evolution or Revolution?

Once again, the move toward e-trading can take the evolutionary path toward more-efficient platforms that improve on current practices, or it can take the more aggressive revolutionary path to electronic exchanges. The jury is still out.

Evolutionary Systems. Multidealer inquiry systems, such as TradeWeb, represent the evolutionary path toward improving current practices. The

TradeWeb system is a reverse-auction platform that allows for matching dealer quotes to buyers' queries. Multidealer inquiry systems represent a scaleable, efficient platform for standardized liquid, high-volume products and arguably may work for other less standardized products as well. The price transparency available through multidealer inquiry systems, although not necessarily optimal, has improved dramatically from what was available to many buy-side firms in the past.

Although multidealer inquiry systems are the pinnacle of trading platforms in the current OTC market, they fall short of establishing an exchange. This platform does not change the relationship between dealers and buyers. Liquidity is solely in the hands of the dealers and the capital they make available. In this model, the market remains fragmented, with many islands of participants, but that may be as good as it gets, at least for the foreseeable future.

Revolutionary Systems. Multidealer exchanges, such as BondBook, represent a revolutionary e-trading path. BondBook is attempting to operate an exchange that handles live bids and offers and arguably provides optimal price discovery. Such a system creates a transparent market by providing real-time market information to the participants. This kind of market information is not available in a dealer-to-customer model. The system also offers an open, anonymous marketplace that can level the playing field and may encourage broad market participation.

With an exchange system, all participants can be liquidity providers as well as liquidity seekers. This point is important because in the past, the buy side was not particularly interested in becoming a liquidity provider to the market. Although I doubt major changes in this attitude will occur soon, having such an exchange system would mean that we (the buy side) would have to begin rethinking the way we trade securities. Buy-side firms cannot expect liquidity to improve in the marketplace without their active intervention. Buy-side assets are growing, putting pressure on the ratio of accumulated (and leveraged) assets to available capital. And the dealers will probably not be able to generate capital to match the growth in buy-side assets. Therefore, if we hope to see the situation improve, we will need to either increase the price paid for the available capital and liquidity or find new ways to provide more liquidity to the market. BondBook is an example of a platform attempting to provide the means for such a change.

Whether the buy side is willing to act as a liquidity provider is yet to be seen; alternatives that have not yet been explored may exist. One or two firms will not make the decision on how all of this unfolds; rather, the marketplace will make it. Behavioral changes associated with a model such as TradeWeb are simple, but behavioral changes associated with an exchange model such as BondBook are complex. Behavioral change may be a more powerful force than the economics of the issue and thus may be the critical factor in determining the future of e-trading. We also have the advantage of being able to observe the equity market and its alternative trading mechanisms, particularly in e-trading. Although the bond and equity markets are certainly different, much can be learned from the equity markets in areas where they have moved well ahead of the fixed-income markets.

Looking Forward

Whether the market evolves into an optimized OTC model, such as TradeWeb, or an exchange, such as BondBook, we will always be facing some sort of change in market structure. I would like to explore several changes I have observed and share my thoughts for how we might take a different approach in the areas of inventory management, protocol development, and STP.

Inventory Management. Over the years, dealers have become skilled at filtering their inventories—that is, figuring out who gets to see which inventory list and at what time. As the market moves toward an electronic framework, dealers' long-standing inventory management tools continue to work quite well. Dealers can deliver inventory through the different electronic systems and decide what they show and when they show it.

It is my experience that buy-side firms have not been as good at parsing or filtering inventory as the dealers have been. As a result, buy-side firms will be able to gain an advantage in an electronic environment when they improve their inventory and order-management processes. Automated information management is a critical component of e-trading, and buy-side firms will have to modify their own behaviors and systems to become experts in the ability to filter inventory and order-management information. As I have already noted, it is not an easy task. This process is currently done manually or over the telephone, particularly by smaller firms. A buyer can talk to a dealer directly and explain the trade he or she wants to do and which securities are available for sale. In an electronic environment, to maintain effectiveness, such information has to be transmitted in an automated format.

I recommend that buy-side firms think about both inventory and trade management in the new world of e-trading. With luck, there will not be dozens

of trading systems used in the future, but such a scenario is a possibility. Even if buy-side participants use just two trading systems to provide information to dealers, they still have to be able to use the technology of those two systems effectively to match the right security with the right trading system at the right time. The market moves fairly quickly, and decisions need to be made without delay. Dependence on a manual system for transmitting inventory or trading information flow will clearly be suboptimal.

Protocol Development. Protocol development, such as the FIX (financial information exchange) protocol or alternatives, has been slow in the fixed-income markets. It may be that participants are still exploring the different protocols. Do firms gain a competitive advantage with a protocol, or are they better served by flexible systems that allow all information to come and go in its native form? Will operating with a protocol benefit or hurt operational processes? It is always going to be a trade-off of standardization versus flexibility. Having established protocols provides the benefit of less administrative front-office work, which helps the smallest player but not necessarily the largest player. The ability to target resources better, improved back-office (and front-office) STP, and access to vendor-developed software might benefit everyone.

Notice that I said protocols, not protocol. My guess is that fixed-income markets will develop and use protocols, but we will not agree on a single protocol, at least not in the next couple of years. Therefore, as firms develop both front-office and back-office systems, my advice is to set up these systems to handle more than one protocol.

As I stated, there is always a trade-off. One drawback of established protocols is the loss of creativity that occurs when standards are developed and implemented. When we accept these standards or protocols, we will be giving up some creativity and associated flexibility. I recommend that you get involved in the industry discussions that are developing and weigh in to ensure protocols that capture your best thinking. Clearly, this train is out of the station, and the market is likely to see an increased use of protocols very soon, but it will never be too late to get involved.

STP. Most firms have spent a fair amount of time improving back-office STP—squeezing costs, reducing fails, and making sure that human intervention is not necessary for trades to move from a trading system to the bank for settlement. Therefore, instead of focusing on the back office, I prefer to draw attention to the front-office end of STP. This area offers huge untapped potential for greater efficiencies. Unfortunately, buy-side firms have not been concerned with applying STP in front-office functions, but all of them should.

Connecting a firm's trading systems to alternative e-trading interfaces can create an advantage, as can connecting the compliance system to the trading system. As the market gets better at moving securities through electronic mechanisms, the speed of transactions will pick up. Thus, a firm may not only have the option but the need to engage in, for example, real-time compliance. Firms that are not set up for real-time compliance or other trading features may have to run separate checks before trades can be done, creating a timing disadvantage. I mention the importance of front-end STP because I can envision a time when a security will need to be entered into three separate systems before that security can be traded and moved downstream. Such a scenario would understandably create difficulties in a competitive market.

To avoid such a problem, firms need to ensure that their internal trading systems connect to the key electronic market platforms. Firms will also require customizable interfaces to allow connections to new platforms. Further, firms will certainly want the capability to trade a single security on multiple platforms to ensure optimal execution, with the avoidance of manual steps as the primary consideration.

I have one final note on front-end STP. Firms should start thinking about risk management in an electronic environment. For a trader or portfolio manager, there is no better use of time than walking across a trading room, ticket in hand, only to observe that the numbers in the price have been reversed on the ticket. In the electronic world, this "double-check" time does not exist. And with a human interface, someone would invariably ask, "How could you trade 100 million bonds when our firm's largest holding is only 10 million?" if, for example, an error of this type was noticed on a trade ticket. That kind of question may not be raised in the electronic world because the review mechanism is not necessarily available. Therefore, if firms fail to program their best thinking on risk management into these systems, the problems related to technology shortcomings will come back and bite them.

Predicting Survival

Which e-trading systems will survive in the fixed-income markets is anybody's guess. But one thing is clear: Too many systems exist relative to the demand in the market. **Table 1** shows that most of the growth in e-trading systems has been in taxable bonds. So much attention has been paid to the taxable-bond sector that the possibilities for more and better

Table 1. Growth in E-trading Systems by Market Segment, 1997–2001

	1997	1998	1999	2000	2001
Taxable bonds					
Treasury	9	20	27	34	35
Agency	5	8	17	31	31
Corporate	2	9	14	30	32
Asset-backed	0	1	2	6	7
Mortgage-backed	2	3	5	14	14
European	NA	NA	NA	16	22
Taxable money markets					
General purpose	3	5	13	13	13
Repo	4	4	4	4	4
Municipal/Other					
Municipal	3	10	18	31	32
Other	0	0	0	11	11

NA = not available.

systems may nearly be exhausted, at least in the short term. Rather than pinning our hopes on the design of another new system, we should direct more creativity toward how participants will need to change their behavior and allow the current systems to survive and prosper.

Although the possibility exists that the best trading system has not yet been developed for the taxable-bond sector, some work needs to be done now to rationalize and unwind some of what has already occurred. Therefore, participants will inevitably see some of these systems merged, acquired, or simply closed. Beyond the taxable-bond sector, other market sectors may show better potential for interesting developments in the design of new systems. In particular, some improvements in the taxable or municipal money markets may occur.

Both sell-side and buy-side firms need to focus on the profit versus cost savings of these models when considering viability. The economics of all platforms has taken center stage and will probably remain at center stage for some time.

Conclusion

E-trading platforms are clearly not a panacea for creating liquidity or solving all of the problems associated with the current OTC markets for fixed-income securities, but they are worth pursuing and will improve efficiency. Although the real gain lies in evolving toward an exchange environment in which market participants may find greater liquidity, I am equally committed to improving our current state of trading with incremental steps. To realize the potential of e-trading, however, the buy side will have to make behavioral changes, and so far, I have not seen much willingness among buy-side firms to make such changes. Maybe it will just take more time; after all, this wave of change has come quickly.

If firms have not yet prompted a change of behavior within their organizations—for example, if they have not encouraged technology development to deal with alternative interfaces—they need to do so. I am convinced that e-trading systems will continue to evolve and will not disappear. Persuading people to adopt a new approach—a system with new ways of displaying information as well as automated features, such as built-in hedging—takes time to be adopted and to become useful. E-trading was developed on the sell side over a period of years, and an equal amount of time, or maybe even more, will be needed for it to gain wide acceptance on the buy side. My observation, however, is that buy-side firms have not been proactive in trying to change behavior in a more favorable direction. As a result, we are extending the time it will take to implement meaningful change.

As the familiarity with technology-based trading platforms rises, ideally, market participants (both buy side and sell side) will view e-trading more as an opportunity than a threat. For me, the continued evolution of e-trading, whether in the widespread creation and use of exchanges or simply through better inquiry systems, is inevitable. The telephone is still a powerful medium, but after more efficient trading mediums are accepted for handling generic transactions, the telephone will eventually be relegated to the appropriate position of handling customized transactions.

Question and Answer Session

Dwight D. Churchill, CFA

Question: Would you clarify what you meant by inventory management?

Churchill: I mentioned the information advantage that exists on the Street. Part of that advantage is how the information is handled. My experience on the buy side with several firms is that we generally just dump information on the dealers. For example, I believe many buy-side firms will send inventories of securities to the dealers in one way or another. They send all of it to everybody, or at least a select list, but little time or technology is spent on how to filter the inventory. Also, considering which dealer should see different parts of that inventory may make sense. And although all of this seems logical, the mechanism is not in place to figure out how to coordinate it. To date, inventory filtering seems to be a manual process.

As we move into an electronic framework, that manual process will become a problem. Inventory management is moving from a manual or Excel spreadsheet-based process to an approach integrated into your trading system. Ultimately, it will need to allow for parsing the data appropriately for the evolving e-trading marketplace.

Question: As a large player in the market, do I end up a loser as smaller players gain because of the new e-trading market?

Churchill: E-trading is one of the ways to level the playing field. In fact, one could argue that trading systems (which are anonymous in many cases, at least the exchanges) can provide a great advantage to smaller players. If small firms don't participate, that is, if they don't invest in technology to take advantage of the leveled playing field, they will be giving up this potential gain. As smaller firms set up their technology budgets in the next couple of years, I expect to see their investment in the e-trading area rise, as one of the potential ways of maintaining a competitive position. That said, return to my point that assets are accumulating in larger amounts and in fewer hands, so these larger firms will continue to gain clout and "volume discounts" when trading. I would not be surprised to see firms develop creative ways to reflect relationship pricing in the e-trading environment.