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RISK-ADJUSTED PERFORMANCE OF SHORT VERSUS LONG DURATION CREDIT PORTFOLIOS

Introduction

An oft-heard notion in the fixed-income market is that short duration spread product has better risk-return attributes than long-duration spread product.[1] Such a view motivates many credit investment strategies. For example, some investors may direct the focus of their credit research to the short end of the curve. Other investors may leverage short duration credit assets to substitute for long duration assets. Nevertheless, what is the empirical evidence supporting this notion?

To study this issue, we examine risk-adjusted returns on short duration and long duration index "portfolios" from January 1990 through April 2001. Specifically, we partition the Lehman Credit Index into 18 sector-quality-duration portfolios according to sector (industrial, utility, and financial), quality grade (AAA/AA, A, and BBB), and duration range (0-3 years and 3+ years). We then calculate historical Sharpe ratios for each of these eighteen portfolios and compare the Sharpe ratio for each short duration portfolio with the Sharpe ratio for its corresponding long duration portfolio.

Historical Sharpe Ratios

The Sharpe ratio is a commonly used measure of risk-adjusted performance that shows the average excess return (over the risk-free return) per unit of volatility in excess returns.[2] The Sharpe ratio is defined as:

$$SR_i = \frac{\text{mean}(d_i)}{\text{standard deviation}(d_i)},$$

where d_i is defined as the monthly total return on bond (or portfolio) i minus the monthly risk free return for the same month. The mean and standard deviation of the excess returns are computed over many months. We use a risk-free return based on the one-month term repurchase rate backed by U.S. Treasuries.

Figure 1 presents Sharpe ratios for the eighteen index portfolios using monthly data from January 1990 through April 2001. Figure 1 also shows the difference between the short duration Sharpe ratio and the long duration Sharpe ratio for each sector-quality combination. A short-long difference greater than zero indicates that the short duration credit portfolio has historically offered better risk-adjusted returns than the long duration credit portfolio.

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[1] Other research has shown that the 1-2 year duration range of the U.S. Treasury curve generates the highest historical Sharpe ratio. See "Reserve Management of Central Banks: Recent Changes and Optimization Techniques," in *Global Relative Value,* February 2000.

[2] For information on the Sharpe ratio please refer to "Mutual Fund Performance," by William F. Sharpe, *Journal of Business,* January 1966.

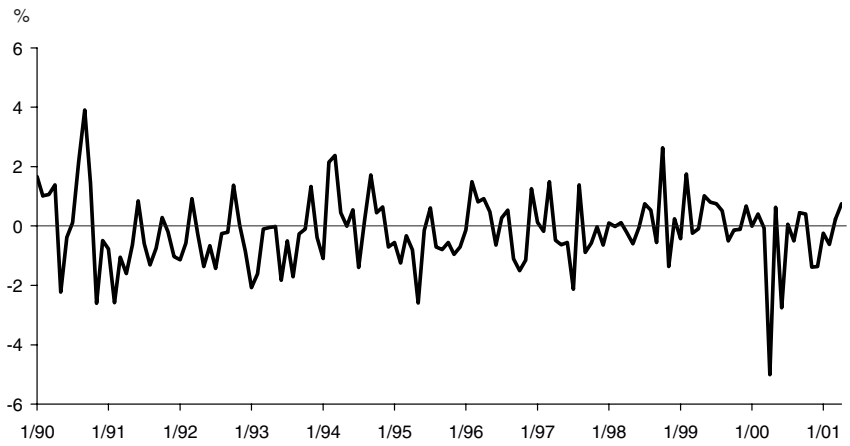
For the industrial sector, the Sharpe ratio for the short duration portfolio is greater than that for the long duration portfolio for all three quality grades. In particular, the Sharpe ratio for the AAA/AA-rated short duration industrial sector is 0.11 greater than the Sharpe ratio for the corresponding long duration portfolio. The results are similar for both the A-rated and BBB-rated industrial portfolios.

For the financial sector, the AAA/AA and A-rated short duration portfolios outperform their long duration counterparts by a difference of 0.20 and 0.14, respectively. However, the BBB-rated short duration financial sector has a Sharpe ratio 0.07 less than that for the BBB-rated long duration financial sector. This result is due to a single month, April 2000, when short duration financial paper performed particularly poorly. To indicate the magnitude of this outlying month, Figure 2 shows the difference in monthly returns for the BBB-rated short and long duration financial sectors since January 1990. While there were

Figure 1. **Sharpe Ratios,** January 1990-April 2001

	Duration		
	0-3 Years	3+ Years	Short-Long Difference
AAA/AA			
Industrial	0.27	0.16	0.11
Utility	0.13	0.17	-0.04
Financial	0.38	0.18	0.20
A			
Industrial	0.30	0.17	0.13
Utility	0.14	0.16	-0.02
Financial	0.32	0.18	0.14
BBB			
Industrial	0.22	0.16	0.06
Utility	0.35	0.18	0.17
Financial	0.09	0.16	-0.07

Figure 2. **Monthly Total Return Difference**
BBB 0-3 Duration - 3+ Duration Financials



large monthly returns differences in mid-1990, they largely offset each other. In April 2000, however, the large negative return difference was not subsequently offset.

If the April 2000 observation were dropped, the short-long difference for the BBB-rated financial sector would have been 0.07 (with Sharpe ratios equal to 0.26 and 0.19 for the short and long duration portfolios, respectively).[3]

For the utility sector, only the BBB-rated short duration portfolio outperforms the long duration portfolio, by an amount of 0.17. The AAA/AA and A-rated quality utility sectors both produce short-long differences less than zero. For the A-rated utility sector, the –0.01 short-long difference is driven by the poor performance of short duration paper in a single month, December 2000. If that month were dropped, the short-long difference for the A-rated utility sector would have been 0.06 (with Sharpe ratios equal to 0.22 and 0.16 for the short and long duration portfolios, respectively).

However, for the AAA/AA quality utility sector the –0.04 result above was not driven by a single outlying month. Unlike the BBB-rated financial and A-rated utility cases above, dropping an outlying month does not substantially alter the short-long difference for the AAA/AA-rated utility sector. In fact, dropping the worst three months (November 1994, December 1994, and September 1995) would produce a short-long difference of only 0.01. In general, the short-long difference for the AAA/AA-rated utility sector gradually declines for most of the entire data period as shown below in Figure 3d.

Overall, the results in Figure 1 tend to support the argument that short duration credit instruments produce better risk-adjusted returns. How stable are these results over time? Figures 3a-3i present short/long ratios for the nine sector-quality combinations using cumulative data windows. These figures are constructed as follows. Beginning in January 1990, we calculate for each sector-quality combination the Sharpe ratio for both the short and long duration portfolios. We then calculate the difference between the short duration portfolio's Sharpe ratio and the long duration portfolio's Sharpe ratio. As each new month of data becomes available, we recalculate the short-long difference. We continue doing this until April 2001. With the exception of the three cases discussed above, the graphs show that the short-long difference has been stable for many years, and at a value greater than zero. The graphs for BBB-rated financial and A-rated utilities would look very similar to the other graphs if their single month outliers were omitted.

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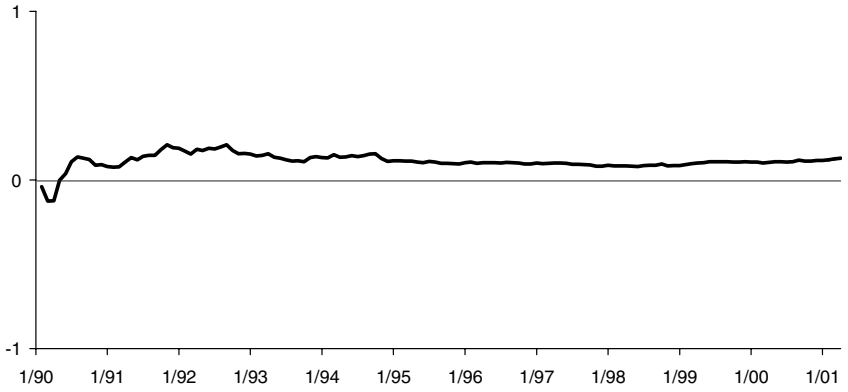
[3] Should this monthly observation be removed from the data series? Because some issues were removed from the index (due to downgrade below investment grade) the short-long difference will not benefit if the credits subsequently recover. Consequently, dropping the observation from the data set may be more relevant for investors who are not forced to sell bonds when they are downgraded below investment grade. For investors who must sell bonds, dropping the observation avoids the problem of determining when during the month the investor sold the bonds. The index holds the bonds for the entire month in which it is downgraded. The investor, on the other hand, may have sold the bonds earlier in the month at a much higher price. Consequently, dropping the observation may be more relevant for investors who sold earlier in the downgrade month. Despite these arguments for dropping the observation, we report results following index conventions. However, we will note results assuming the observation had been dropped from the data series.

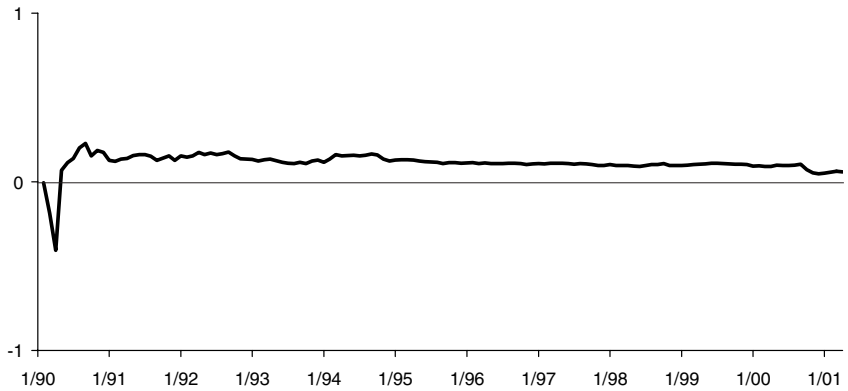
Figure 3. **Short-Long Difference in Sharpe Ratios**
Cumulative Window

a. **AAA/AA 0-3 vs. 3+ Industrial**

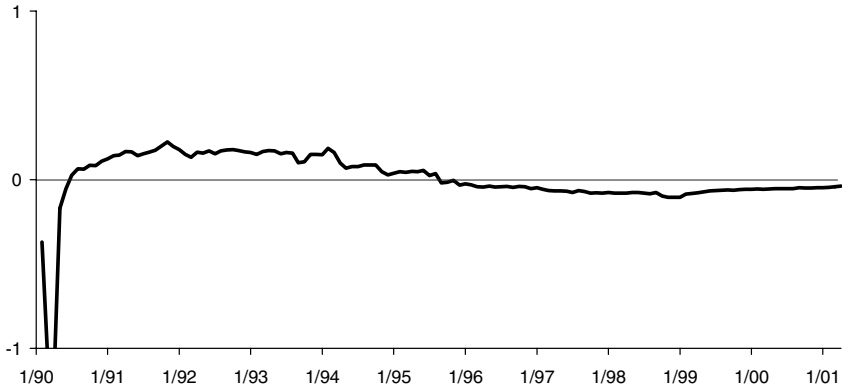
b. **A 0-3 vs. 3+ Industrial**



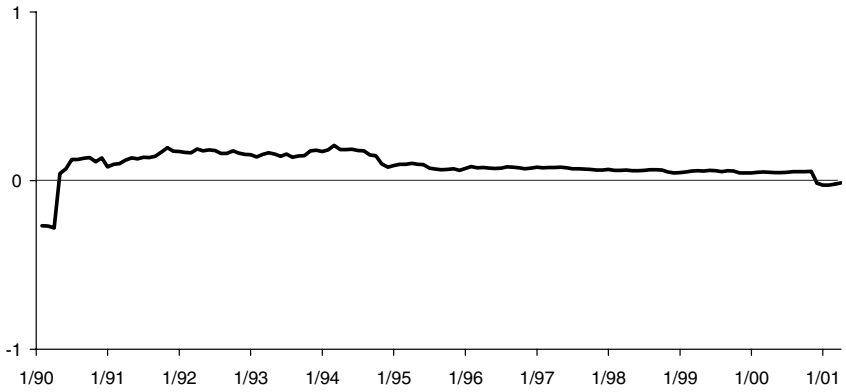
c. **BBB 0-3 vs. 3+ Industrial**



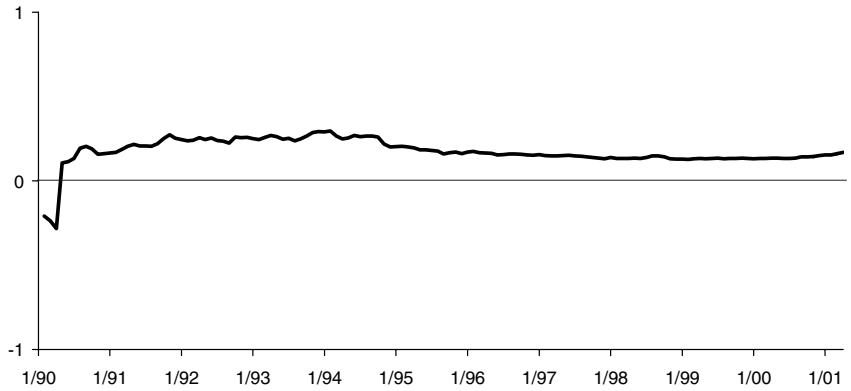
d. **AAA/AA 0-3 vs. 3+ Utility**



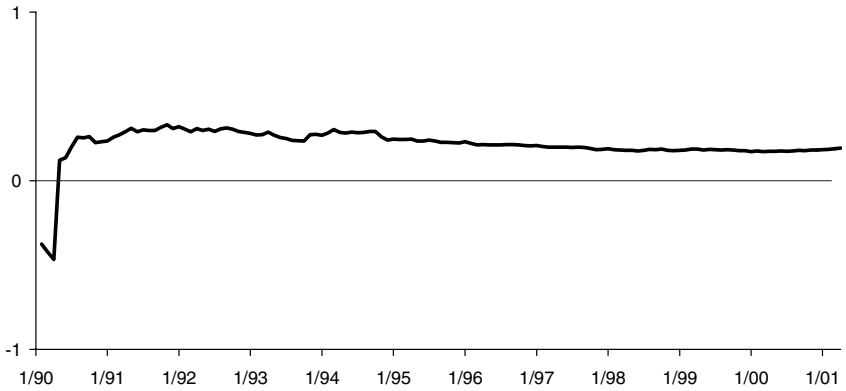
e. **A 0-3 vs. 3+ Utility**



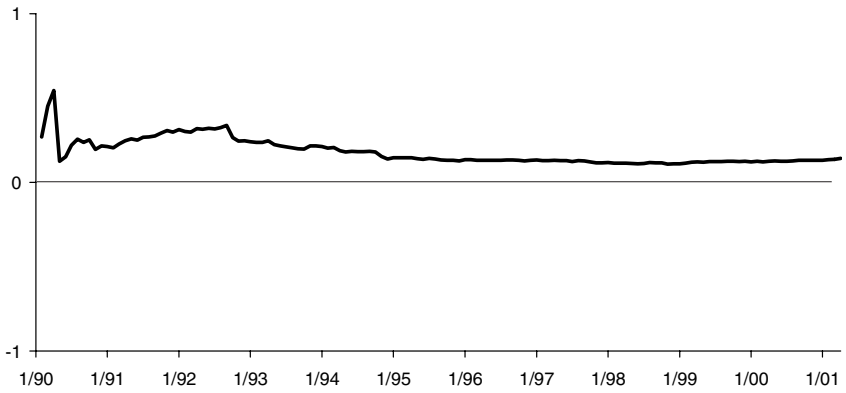
f. **BBB 0-3 vs. 3+ Utility**



g. **AAA/AA 0-3 vs. 3+ Financial**



h. **A 0-3 vs. 3+ Financial**



i. **BBB 0-3 vs. 3+ Financial**

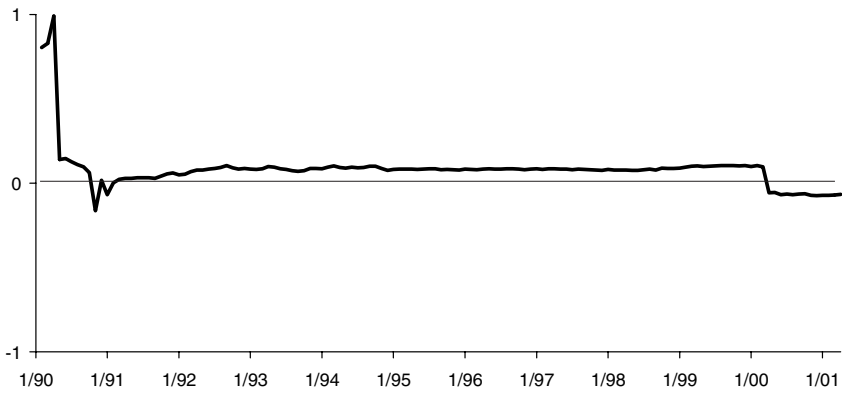
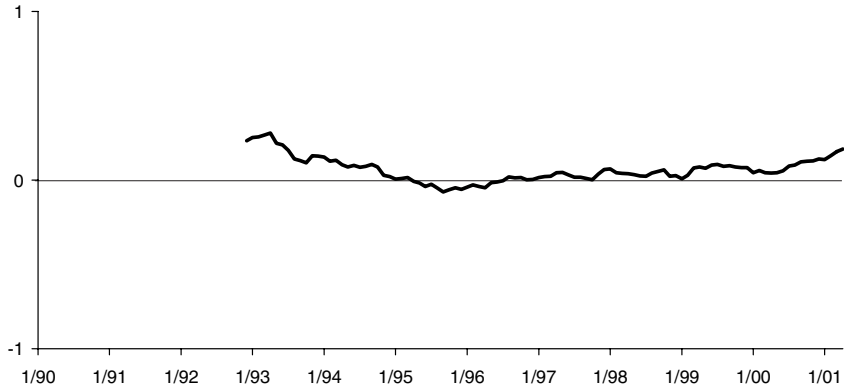
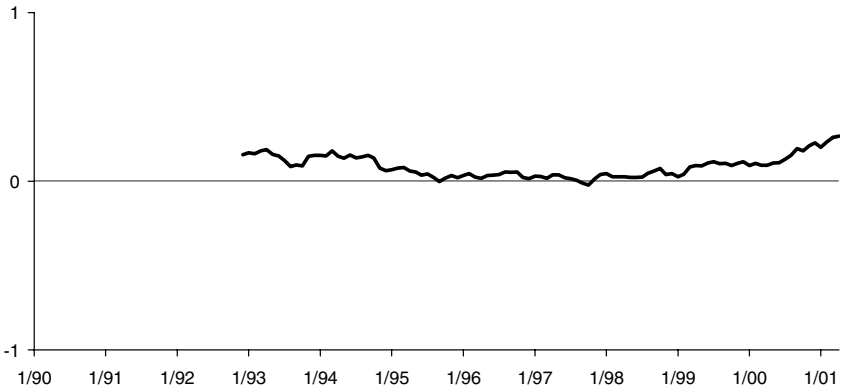


Figure 4. **Short-Long Difference in Sharpe Ratios**
3-Year Moving Window

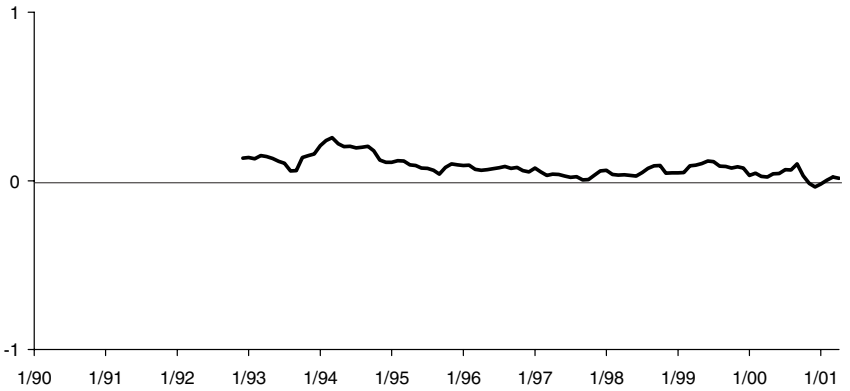
a. **AAA/AA 0-3 vs. 3+ Industrial**



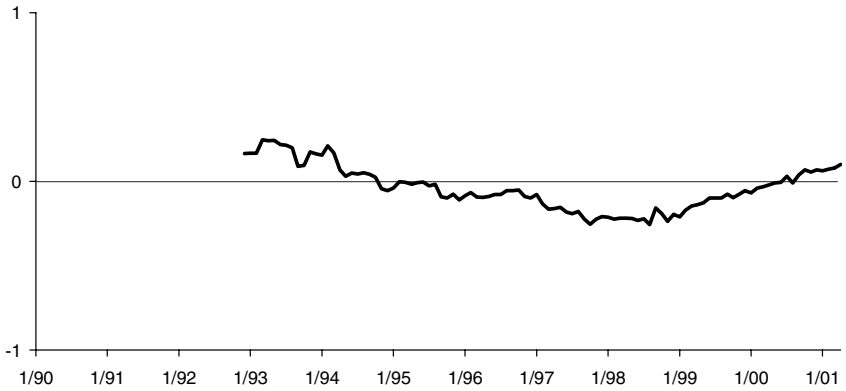
b. **A 0-3 vs. 3+ Industrial**



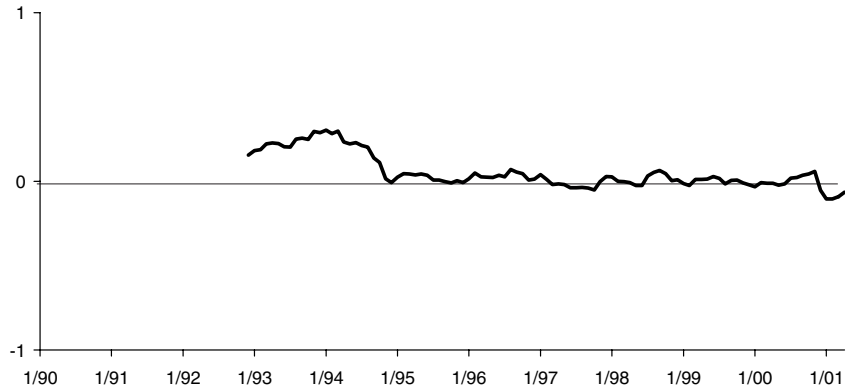
c. **BBB 0-3 vs. 3+ Industrial**



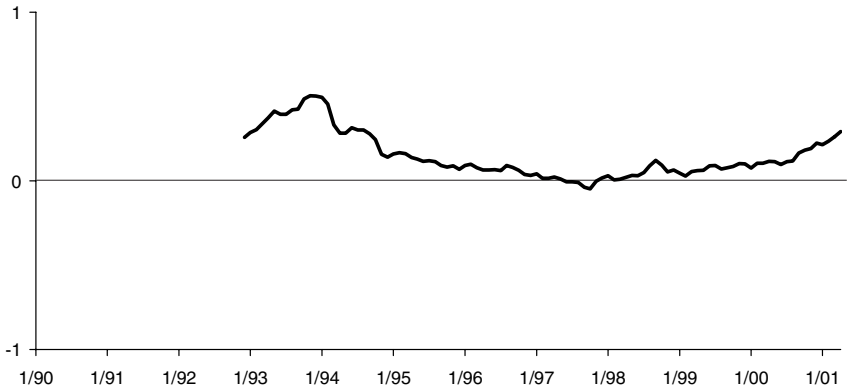
d. **AAA/AA 0-3 vs. 3+ Utility**



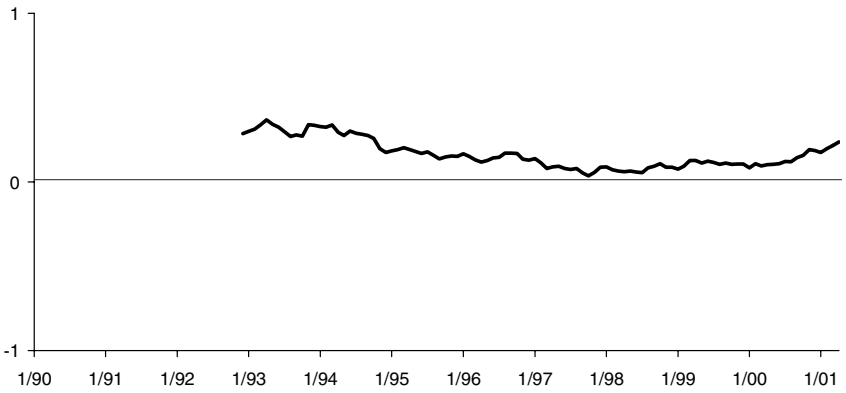
e. **A 0-3 vs. 3+ Utility**



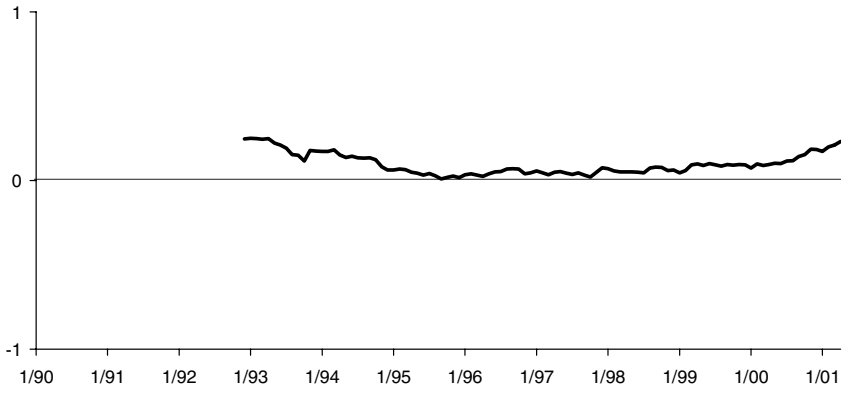
f. **BBB 0-3 vs. 3+ Utility**



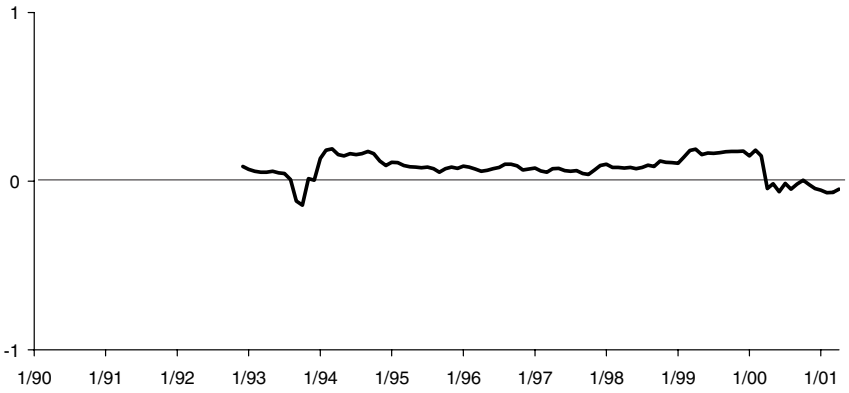
g. **AAA/AA 0-3 vs. 3+ Financial**



h. **A 0-3 vs. 3+ Financial**



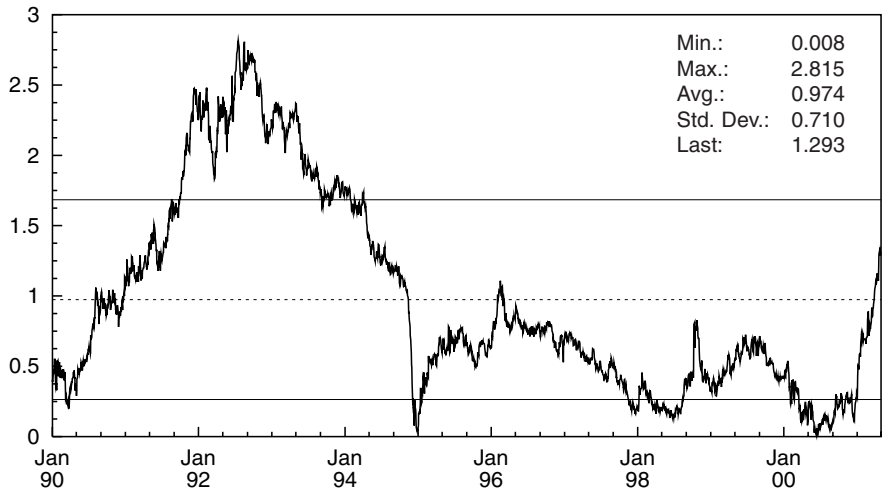
i. **BBB 0-3 vs. 3+ Financial**



To study the stability of the short-long difference it is helpful to examine 3-year moving windows that are presented in Figures 4a-4i. These figures are constructed as follows. Beginning in December 1992, we calculate for each sector-quality combination the Sharpe ratio using the prior three years of data for both the short and long duration portfolios. We then calculate the difference between the short duration portfolio's Sharpe ratio and the long duration portfolio's Sharpe ratio. As each new month of data becomes available we drop the oldest observation so we are always working with the past three years of data. We then recalculate the short-long difference. We continue doing this until April 2001. The advantage of using moving windows is that it may highlight time intervals when the short-long difference was particularly high or low.

For five of the six sector-quality combinations with positive short-long differences for most of the data period, Figures 4a-4i show that their 3-year moving window also generally remains greater than zero. (The exception was the AAA/AA-rated industrial sector that had a negative short-long difference from mid-1995 through mid-1996.) The short-long difference for all six sector-quality combinations also tended to decline from 1993 to 1998. This period coincides with a flattening of the swap yield curve as measured by the difference between 10-year and 2-year swap yields (Figure 5). However, despite a flattening of almost 300 bp, the short-long difference generally remained greater than zero. The recent improvement in the short-long difference also coincides with the recent (*i.e.,* since early 2000) steepening of the swap curve. While movements in the curve affect the short-long difference as might be expected, the difference displays a tendency to remain positive despite dramatic movements in the curve.

Figure 5. **10-Year – 2-Year Swap Yields**



Leveraged Portfolios

Some investors do not simply maximize Sharpe ratios. For example, a maximum Sharpe ratio may occur with very little risk, and very little excess return. In practice, however, some investors manage to a given level of risk (*e.g.,* the risk inherent in a particular benchmark) and then attempt to maximize their performance subject to this risk level.

To examine the relative value of short versus long duration credit strategies, we assume that the investor targets a level of risk equal to that of the long duration portfolio for each sector-quality combination. The investor then leverages up the short duration portfolio so that its risk is comparable to that of the long duration portfolio. Leveraging the short duration portfolio is accomplished by borrowing at a spread over LIBOR and then purchasing additional short duration assets so that the historical standard deviation of total returns of the (now) leveraged short duration portfolio equals that of the long duration portfolio.

The leverage factor is defined as the desired ratio of the market value of short duration assets to long duration assets. The leverage factor is calculated by taking the ratio of the standard deviation of monthly total returns for the long duration index portfolio of a given sector-quality combination and dividing it by the standard deviation of returns for the short portfolio of the same sector-quality combination. Standard deviations are calculated using data available up to the current month. Consequently, a new leverage factor is calculated each month. The effect of leveraging the short portfolio is to make the short and long portfolios for each sector-quality combination equally risky. We then calculate Sharpe ratios.

The Sharpe ratio is invariant to leverage if borrowing can be done at the risk-free rate. In our case, however, we assume that the investor borrows at a spread to LIBOR. Consequently, the Sharpe ratio will depend on both the level of the leverage factor and the difference between the borrowing rate and the risk-free rate.

The monthly total returns for the levered short duration credit portfolios are derived as follows. Let

$_{t}BR$	=	borrowing rate in period t, assumed equal to one month LIBOR in period t plus a constant spread;
$_{t-1}SD_{short,i}$	=	empirical standard deviation of monthly total returns, up to time t-1, for the short (long) duration portfolio for sector-quality combination i;
$_{t}MR_{short,i}$	=	monthly total return in period t for the short (long) duration portfolio for sector-quality combination i; and
$_{t}h_{i}$	=	$_{t-1}SD_{long,i}$ / $_{t-1}SD_{short,i}$ = leverage factor at time t for sector-quality combination i.

Then, the leveraged monthly total return for the short duration portfolio in sector-quality combination i for period t equals

$$ {}_tLMR_{short,\,i} = {}_th_i \times {}_tMR_{short,i} - ({}_th_i - 1) \times {}_tBR. $$

Figure 6 shows summary characteristics for the nine leveraged short duration and nine unleveraged long duration portfolios assuming a 20 bp borrowing spread over LIBOR. The first column presents the average leverage factor for the period from January 1990 through April 2001. For example, for the AAA/AA-rated, short duration industrial sector, the average leverage factor for the period was 3.1, which produced a mean leveraged portfolio monthly return of 85 bp with a standard deviation of 161 bp. The unleveraged AAA/AA-rated, long-duration industrial sector had an average monthly return of 71 bp with a standard deviation of 166 bp. Overall, in terms of risk, the leveraged short duration portfolios compare closely to the unleveraged long duration portfolios. The exceptions are the same three exceptions mentioned above (*i.e.,* BBB-rated financial, and AAA/AA and A-rated utilities).

Figure 6. **Comparable Risk Portfolios**
Average Leverage Factor and Empirical Statistics, bp
Borrowing Spread over LIBOR = 20 bp**,** January 1990-April 2001

	Avg. Leverage Factor	Mean Return	Std. Dev. Return
AAA/AA (Short)			
Industrial	3.1	85	161
Utility	2.9	69	202
Financial	3.1	92	148
AAA/AA (Long)			
Industrial		71	166
Utility		72	168
Financial		71	148
A (Short)			
Industrial	3.1	86	157
Utility	3.3	66	191
Financial	2.8	91	153
A (Long)			
Industrial		72	167
Utility		69	162
Financial		71	150
BBB (Short)			
Industrial	2.8	75	176
Utility	3.3	91	160
Financial	2.6	62	277
BBB (Long)			
Industrial		71	170
Utility		72	159
Financial		71	166

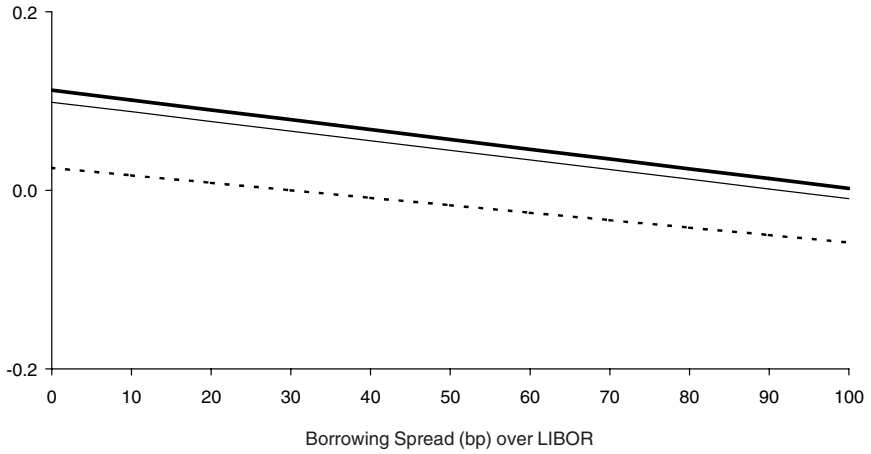
Figure 7 presents the Sharpe ratios for the eighteen portfolios as well as the short-long differences for each of the nine sector-quality combinations assuming a borrowing spread of 20 bp over LIBOR. The results in Figure 7 are comparable to those in Figure 1. Although the short-long differences are now lower, those that were greater than zero in the unleveraged scenario remain greater than zero with leverage. The short-long differences for the BBB-rated financial and A-rated utility sectors, without their outlying observation, would be 0.01 in both cases with leveraged short duration Sharpe ratios of 0.21 and 0.19 and unleveraged long duration Sharpe ratios of 0.21 and 0.18, respectively.

As noted earlier, the leveraged results in Figure 7 are sensitive to the borrowing spread assumption. Figure 8 presents the short-long differences for the three quality grades in the industrial sector for various borrowing spread levels, ranging from 0 bp to 100 bp. For the

Figure 7. **Sharpe Ratios,** Borrowing Spread over LIBOR = 20 bp
January 1990-April 2001

	Leveraged Short Duration	Unleveraged Long Duration	Short-Long Difference
AAA/AA			
Industrial	0.26	0.18	0.08
Utility	0.13	0.18	-0.05
Financial	0.33	0.20	0.13
A			
Industrial	0.27	0.18	0.09
Utility	0.12	0.17	-0.05
Financial	0.31	0.20	0.11
BBB			
Industrial	0.18	0.17	0.01
Utility	0.30	0.19	0.11
Financial	0.07	0.18	-0.11

Figure 8. **Short-Long Difference Industrial Sector**



AAA/AA and A-rated industrial sectors, for example, the short-long difference remains greater than zero until the borrowing spread reaches 100 bp.

The results in Figure 7 are a function of the leverage factors, which were determined by the ratio of the standard deviations of historical total returns of the short and long duration portfolios. Another way to derive the leverage factors is to take the ratio of the durations of the long and short duration portfolios. In other words,

$${}_t h_i = {}_t\text{Duration}_{\text{long},i} \,/\, {}_t\text{Duration}_{\text{short},i}$$ = leverage factor at time t for sector-quality combination i.

The results using these duration-based leverage factors, which assume a 20 bp borrowing spread over LIBOR, are presented in Figure 9. The results are similar to those in Figure 7. The short-long differences for the BBB-rated financial and A-rated utility sectors, without their outlying observation, would be 0.04 and 0.01, respectively, and with leveraged short duration Sharpe ratios of 0.23 and 0.17 and unleveraged long duration Sharpe ratios of 0.19 and 0.16, respectively.[4]

Discussion of Results

The data support the notion that short duration credit product has better risk-return characteristics than long duration credit product and that these better characteristics have persisted over time. This result is surprising for a couple of reasons. First, some have argued that short duration spread product has more of a liquidity premium than long duration spread product. If so, we would expect that short duration product would give

[4] We also calculated information ratios for the leveraged short duration portfolios using the corresponding long duration portfolio as the benchmark. Results are consistent with those shown above.

Figure 9. **Sharpe Ratios: Duration-Based Leverage Factors**
Borrowing Spread over LIBOR = 20 bp, January 1990-April 2001

	Leveraged Short Duration	Unleveraged Long Duration	Short-Long Difference
AAA/AA			
Industrial	0.21	0.16	0.05
Utility	0.08	0.17	-0.09
Financial	0.32	0.18	0.14
A			
Industrial	0.23	0.17	0.06
Utility	0.10	0.16	-0.06
Financial	0.28	0.18	0.10
BBB			
Industrial	0.19	0.16	0.03
Utility	0.29	0.18	0.11
Financial	0.09	0.16	-0.07

up some risk-adjusted return relative to long duration which would tend to push the short-long difference below zero. Secondly, other research at Lehman has shown that Sharpe ratios for various asset classes (e.g., Treasuries, agencies, corporates, mortgages, high yield, and EMG) tend to converge over long time periods. The results above, however, show little convergence of the Sharpe ratios for short and long duration credit assets.

Perhaps market segmentation provides an explanation. If excess demand for long duration assets is greater than that for short assets due, say, to strong asset/liability demands for long assets, then the short-long difference may persist at a level greater than zero. As a future project it may be of interest to find where the "break point" in risk-adjusted performance occurs in the 3+ duration category.

Conclusion

The data support the view that short duration credit product has better risk-return characteristics than long duration credit product. Six of the nine sector-quality combinations have short-long differences greater than zero, with the average equal to 0.13. In addition, these results hold if the short duration assets are leveraged to the same risk level as the long duration assets at a reasonable borrowing spread over LIBOR. Further work is required to provide an argument as to why the risk-adjusted performances of short and long credit assets have not converged.

These results may prove useful to new investors as they try to determine where to begin allocating their U.S. credit investment dollars and research efforts. In addition, investors who can use leverage may be able to make use of these results to improve total returns. Finally, issuers may use these results as they evaluate whether to issue short or long debt.

Publications—L. Pindyck, A. DiTizio, B. Davenport, W. Lee, D. Kramer, J. Threadgill, R. Madison, A. Acevedo, K. Kim, C. Rial, J. Batstone