High Yield Corporate Debt and Pension Schemes – an Update

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Abstract

This paper is an updated version of my 2002 paper to the Staple Inn Actuarial Society. The purpose of the paper is to investigate the role that high yield corporate debt may play in pension scheme investment. After describing the origins of the high yield corporate debt market, I compare the investment characteristics of high yield corporate debt with both equities and investment grade bonds. I concentrate on data from the US market. Not only is this the largest single-country debt market, with the longest history and the greatest amount of data, but concentrating on a single market also removes the need to allow for more than one currency and the differences in risk/return profiles that would occur if the country weights were different in each asset class.

There are several analyses that I carry out. The first is to compare the historical risk and return characteristics of US high yield corporate debt, investment grade corporate debt, treasury bonds and equities. Looking at the risk and reward characteristics in isolation offers inconclusive evidence as to the suitability of US high yield corporate debt. However, when the correlations between the asset classes are taken into account, the low correlation of the return on US high yield corporate debt with the other bond asset classes means that it is a good diversifying asset class when included in lower risk portfolios.

I also carry out analysis of US high yield corporate debt relative to a neutral portfolio. This produces some interesting results. Firstly, the neutral portfolio lies below the efficient frontier, because US investment grade and high yield corporate debt make up only a small proportion of the market portfolio but are strongly represented in the efficient frontier. The analysis also suggests that US bond asset classes are undervalued, although the degree of undervaluation is not statistically significant.

The efficient frontier analysis is extended to include liabilities. This indicates that the appropriate amount of high yield corporate debt depends on the funding level of the scheme.

Finally, I carry out cash flow analysis on both an asset-only and an asset-liability basis. These show that, for a post-1991 investor, a diversified portfolio of US high yield corporate debt is an attractive investment. A fund investing before 1991 would have suffered a sharp fall in income (and capital values) that would not have been recovered (although the level of income would still have remained largely above that of other US bond asset classes after 1991). However, if this early period in the development of the US high yield corporate debt market is avoided, then income going forward is reasonably high and stable.

All of this is based on US asset classes. The European high yield corporate debt market is much younger and still more concentrated (in telecoms), although the bursting of the tech bubble and the downgrading to sub-investment grade of a variety of other stocks has increased the size and diversification of the high yield corporate debt market.

1. The High Yield Corporate Debt Market

1.1 Introduction

The purpose of this paper is to investigate the role that high yield corporate debt may play in pension scheme investment. This asset class has been popular for some time in the retail market, although it has still yet to make inroads into institutional pension schemes. However, the increase in the supply of such debt, both from issuers and through pooled investment vehicles, means that the question of its place in pension scheme portfolios should be addressed.

More generally, the role of debt asset classes in pension schemes has also been brought into sharper focus with the introduction of Financial Reporting Standard (FRS) 17 [1]. Also, the application of financial economic theory is resulting in moves away from equities and towards bonds, as in the case of Boots [2]. This theory suggests that a pension scheme should be regarded as part of the sponsoring company rather than a stand-alone entity, and questions the "free-ride" supposedly available from equities. It is discussed in more detail by, among others, Smith [3], Jarvis et al [4] and Chapman et al [5].

High yield debt is a broad term that refers to non-investment grade debt, i.e. debt below Moody's rating Baa [6] or Standard & Poor's rating BBB [7]. Such debt may have been issued as high yield, or may have been downgraded from investment grade. There are two broad circumstances that might cause debt to be downgraded: voluntary and involuntary. A company may voluntarily downgrade if it wishes to significantly increase its debt (e.g. as a result of a leveraged buyout), whereas involuntary downgrades tend to occur when companies are in financial difficulty. Bonds downgraded to below investment grade are often known as "fallen angels".

High yield debt, as its name suggests, offers a higher interest yield than investment grade debt. The yield is higher because there is a significant chance that the interest and/or the capital outstanding will be deferred, reduced, or even remain unpaid. Even for the highest grade of high yield debt, the bonds "are judged to have speculative elements; their future cannot be considered as well-assured" [6].

For a pension scheme in a developed market, there are three true matching asset classes: fixed income government bonds, inflation-linked government bonds (both of which are risk free in a developed market) and cash (or at least fixed-term deposits or zero-coupon bonds). These are effectively the only classes that can exactly match fixed pension payments, inflation-linked pension payments and cash lump sums respectively (if mortality is ignored).

Other investment grade debt may be used in addition, as the low default rates can make it an attractive substitute for part of the government bond portfolio. However, it should be noted that although the default risk is low, valuation risk is still potentially present. If liabilities are valued using government bond yields, then an increase in the yield spreads of corporate over government bonds will adversely affect the ratio of assets to liabilities or "funding ratio". This risk is reduced, though, if liabilities are valued with reference to investment grade corporate bond yields, as is the case with US, UK and international accounting standards.

Is high yield corporate debt a matching asset class? Not strictly speaking, as the higher default rates take returns even further away from government bond returns than investment grade corporate bonds. However, it is not clear how good a match high yield corporate debt would be for liabilities in terms of comparing the income stream from a portfolio of high yield bonds with a group of pensions in payment.

High yield corporate debt can also be analysed as a risk asset class, i.e. it can be used to try and enhance the return of the non-matching portion of pension scheme assets.

1.2 Proposed Analyses

In this paper, I compare the investment characteristics of high yield corporate debt with both equities and investment grade bonds. With respect to investment grade bonds, the following categories are included in the analyses:

- investment grade treasury bonds – debt issued by central government, which can be taken to be free from the risk of default in developed markets; and
- investment grade corporate debt – high quality debt issued by companies;

I do not consider other categories such as collateralised debt or debt issued by supranational organisations.

I concentrate on data from the US market. Not only is this the largest single-country debt market, with the longest history and the greatest amount of data, but concentrating on a single market also removes the need to allow for more than one currency and the differences in risk/return profiles that would occur if the country weights were different in each asset class. However, in this chapter I do review the growth of the global market for high yield debt, so that the US market can be seen in a global context.

There are several analyses that I carry out to assess the suitability of high yield corporate debt for pension schemes. The first is to compare the historical risk and return characteristics of US high yield corporate debt, investment grade corporate debt, treasury bonds and equities. I also consider correlations between these asset classes.

The risk and return characteristics of a market or neutral portfolio[1] of the various US asset classes are then used to calculate the beta for US high yield corporate debt (relative to the market portfolio). This shows whether the asset has been undervalued relative to the market. I then extend the efficient frontier analysis to include liabilities.

Finally, I consider the cash flow properties of US high yield corporate debt, both on an asset only basis by looking at the income produced by a portfolio of such debt, and on a matching basis, by comparing this income with the benefits payable to a group of pensioners.

[1] I.e. where each asset class is weighted according to its market capitalisation

Analyses could also be carried out using projections to try to determine what role high yield corporate debt might have in pension schemes going forward. These could be both asset only and asset-liability projections. However, since stochastic asset models are generally calibrated from past data and the past data on high yield corporate debt is limited, I do not believe that such analyses would add any value.

At this stage, it is worth mentioning a weakness of the proposed approach. The analyses will be carried out using index data. However, it is difficult to match a high yield bond index. The reason for this is the price at which some stocks enter the index. If a stock is downgraded to high yield status from investment grade, then funds only allowed to hold investment grade stocks will need to sell the bond immediately, whatever the price. This leads to the price of the bond being artificially – and temporarily – depressed. The stock price will then revert to a more realistic price, but only after having been included in the high yield index. Because high yield corporate debt issues are generally small, it is impossible for the majority of managers to participate in the relative out-performance enjoyed by this bond, so it is difficult for many managers to even match the index.

1.3 Market Sizes

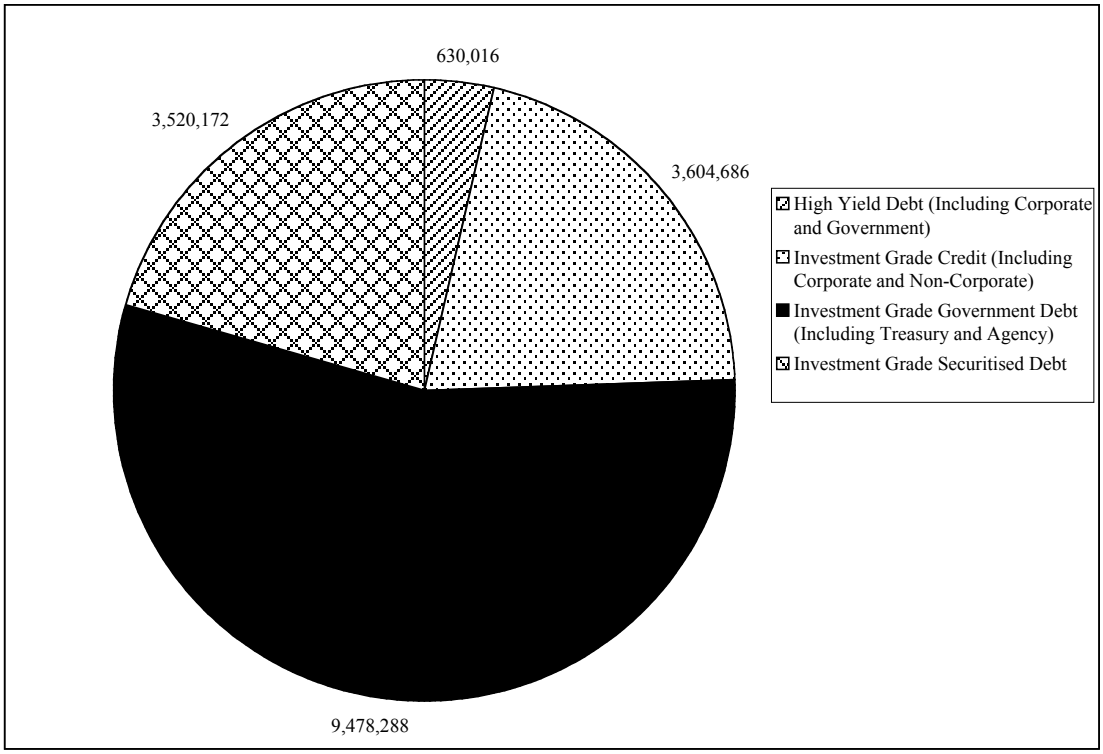
For this part of the analysis, I rely mainly on figures from Lehman Brothers [8] and CSFB [9]. The Lehman Brothers series offers coverage of investment grade and high yield debt, whereas the CSFB series concentrates solely on high yield debt. Both sets of indices have been running long enough to provide good historical data, especially for the US market. I also draw on the UBS Warburg series [10], which gives more detail on European bond markets.

The Lehman Brothers figures indicate that the total market value of bonds at December 2002 was $17,233 billion. However, the value of bonds outstanding is highly dependant on the series used and the eligibility criteria for the index. For example, the figures I use from Lehman Brothers include issues with a minimum size of $150m for US investment grade and high yield debt. However, the CSFB figures for US high yield debt include all issues larger than $75m and, because of the large number of issues between $75m and $150m, the value of bonds shown is doubled. On average, issues with lower ratings are smaller than those with higher ratings. However, using a different minimum issue size for each class would be highly subjective, so I use the Lehman Brothers numbers to compare the relative sizes of the two markets and it should be assumed that the relative size of the high yield debt market is underestimated here.

Whichever series is used, it can be seen that the high yield debt market is dwarfed by other bond markets, as shown in figure 1.

As shown in figure 2, this pattern still exists in the US, although as most of the world's high yield debt is from the US (as shown in figure 3), it is slightly less of a minority asset class. Figure 2 also includes the US equity market, which despite recent falls is still larger than all of the bond markets put together.

Figure 1: Composition of the global bond market ($m, December 2002)



Source: Lehman Brothers

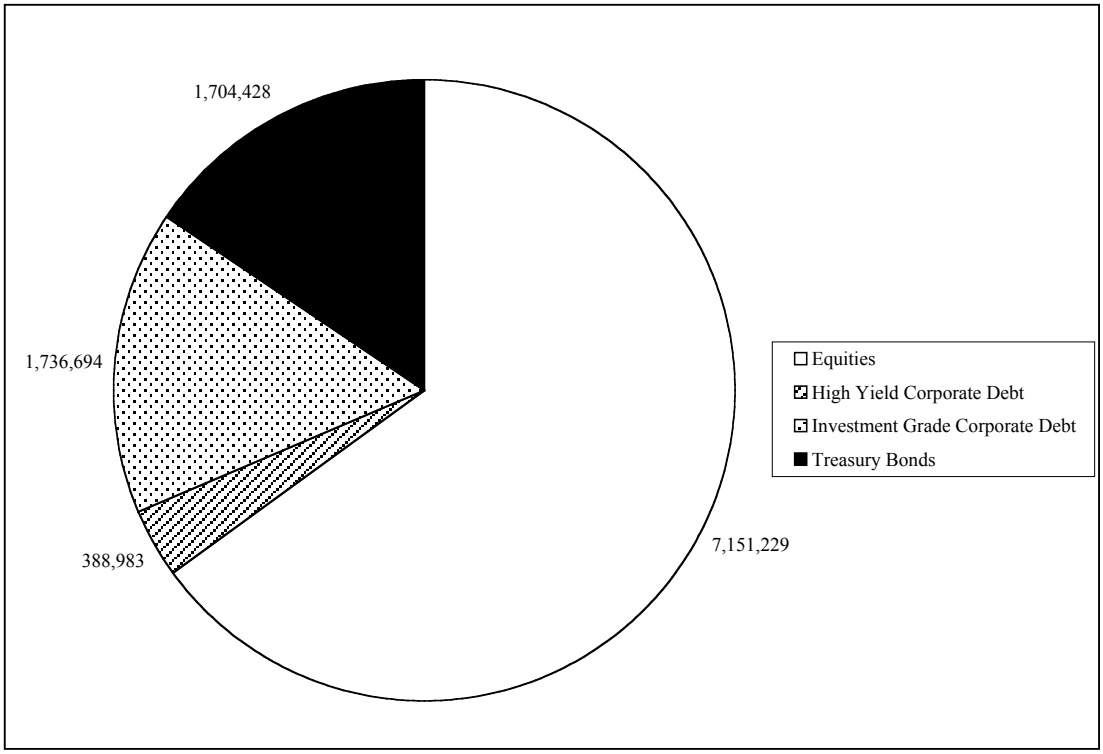
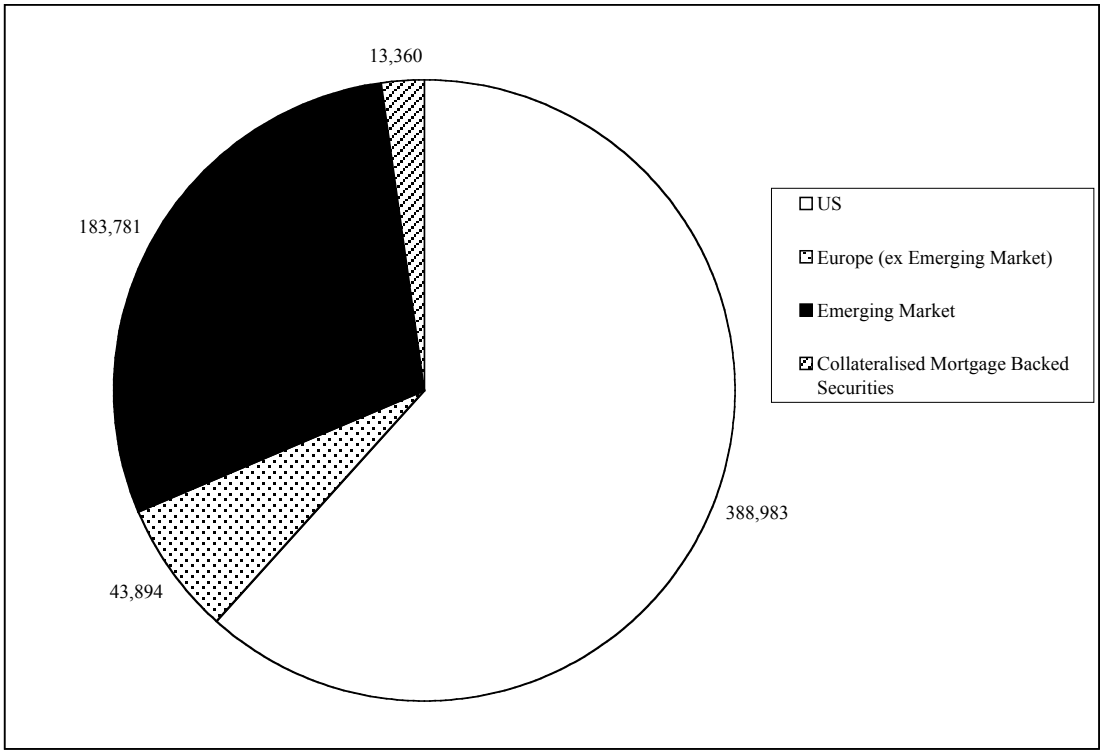


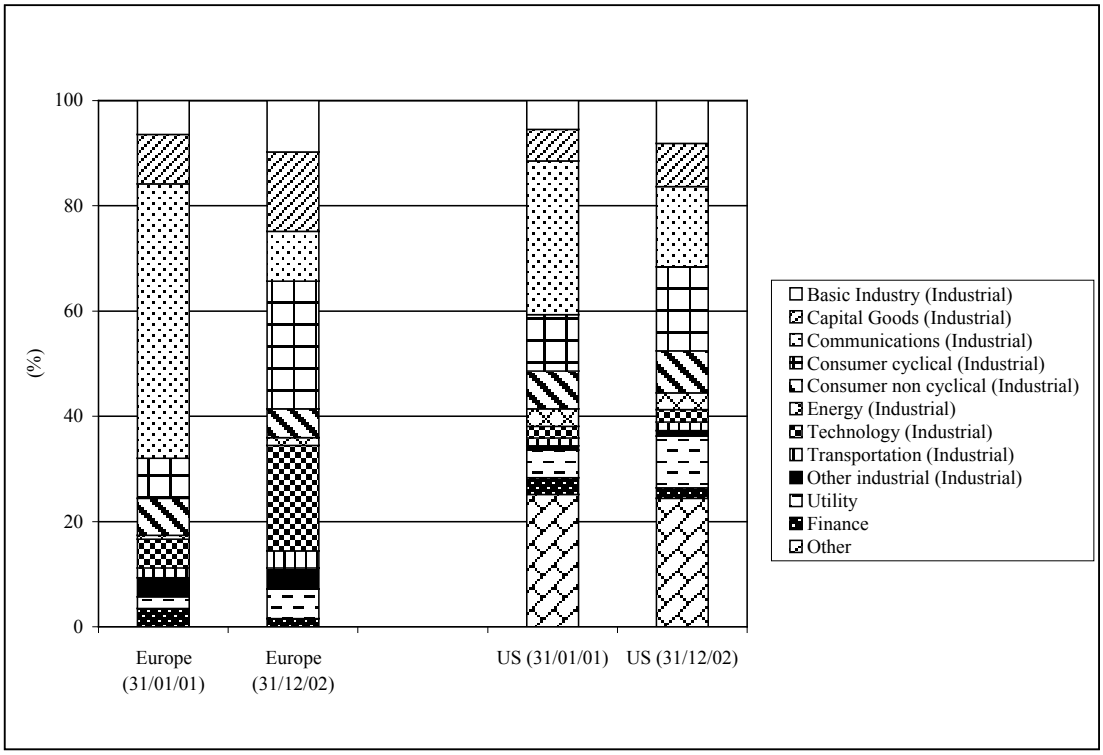
Figure 2: Composition of the US market ($m, December 2002)
Source: Lehman Brothers, MSCI

Figure 3: Composition of the global high yield corporate debt market



Source: Lehman Brothers

Figure 4: Sectoral composition of US and European high yield corporate debt markets



Source: Lehman Brothers

Figure 4 shows that the US high yield corporate debt market is not only larger than the market in Europe, but also more diversified. However, even over the twelve months to 31 December 2002, this became less true. There were two main reasons for

this. First, the concentration in Europe was largely down to the large proportion of telecom bonds. However, many of these companies have gone out of business, or their bonds have fallen significantly in value. The second reason for the increase in diversification is that bonds in a variety of industries have been downgraded recently. However, this might mean that the quality of the bonds has, on average, fallen.

1.4 Development of the High Yield Debt Market

1.4.1 High Yield Corporate Debt in the US

A large amount of information in this section is taken from Kricheff & Strenk's chapter in *High Yield Bonds – Market Structure, Portfolio Management & Credit Risk Modelling* [11].

The high yield corporate debt market began in its modern form in the US in the 1980s. Initially, it consisted of fallen angels, since most companies that wanted to issue debt but did not have an investment grade credit rating had to raise funds through private placements, generally involving restrictive covenants. This also meant that the secondary market for these securities was limited. However, by the mid 1980s, a growing number of issuers were accessing the public market through bonds issued at ratings below investment grade, the prime underwriter in this market being a firm called Drexel Burnham Lambert. These issuers fell into four categories:

- fallen angels requiring additional funds (the airline, energy and steel industries featured heavily in this category);
- issuers wishing to expand but unable to obtain financing from banks (e.g. gambling and cable television firms);
- miscellaneous "growth" companies that were too small and already carried too much debt to qualify for an investment rating; and
- companies raising funds for acquisitions either in the form of specific projects or for a "blind pool" for unknown future acquisitions (leveraged buyouts).

It was this final category that became a major feature of the high yield corporate debt market in the late 1980s.

As shown in figure 5, there was a marked increase in the general level of default rates[2] in the 1980s when compared to the 1970s. This is possibly because the inherent default risk in "old style" high yield corporate debt (such as fallen angels) was less than that of "new style" bonds. This is particularly likely to have been true if fallen

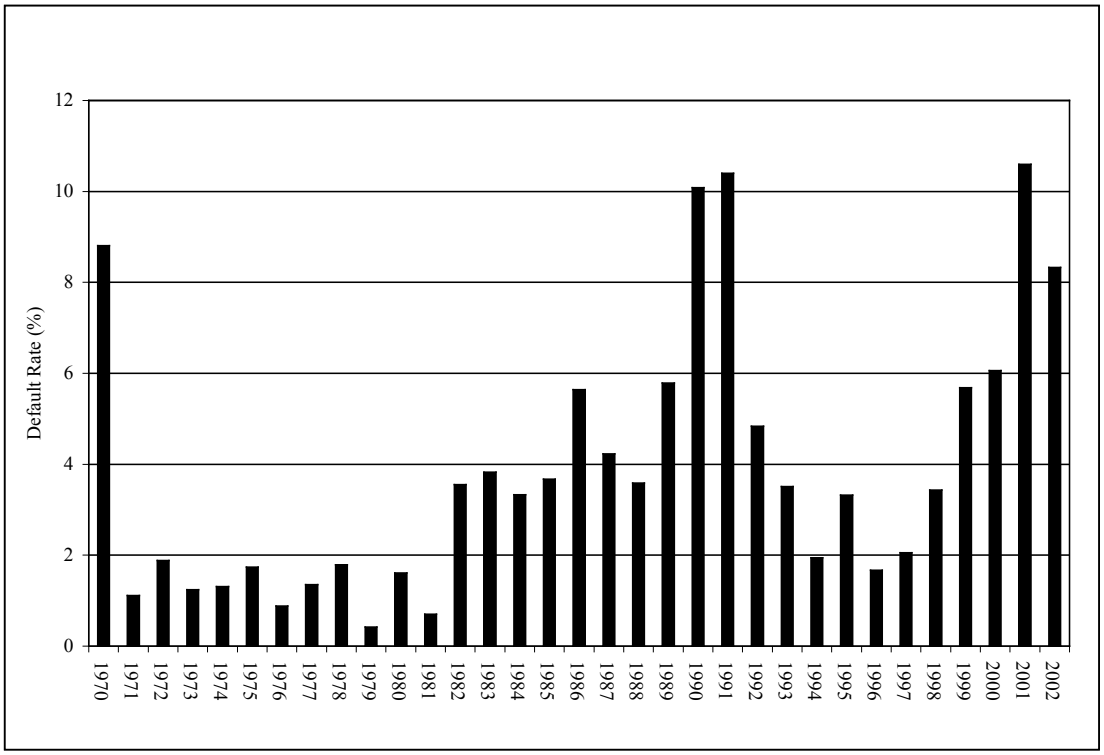
[2] Default is defined by Moody's [1] as covering three types of event: where there is a missed or delayed disbursement of interest and/or principal, including delayed payments made within a grace period; where an issuer files for bankruptcy (Chapter 11, or less frequently Chapter 7, in the US) or legal receivership occurs; or where a distressed exchange occurs where the issuer offers bondholders a new security or package of securities that amount to a diminished financial obligation (such as preferred or common stock, or debt with a lower coupon or par amount), or the exchange had the apparent purpose of helping the borrower avoid default.

The default rate for a particular period is defined as the number of issuers that defaulted in a period divided by the number of issuers that could have defaulted in the period.

angels were likely to be nearer the top of the rating spectrum (having at least previously had an investment grade rating), unlike leveraged buyout debt.

In the 1980s, hostile leveraged buyouts in particular became more prevalent. With the increased supply of high yield corporate debt, coupon rates for some new issues rose to more than 15% (compared with treasury yields of around 9% per annum). However, these rates required strong growth to maintain coupon payments and when this was not forthcoming, characterised by a few large defaults and unsuccessful restructurings, default rates soared in 1990, as can be seen in figure 5.

Figure 5: One-year default rates of US high yield corporate debt (%)



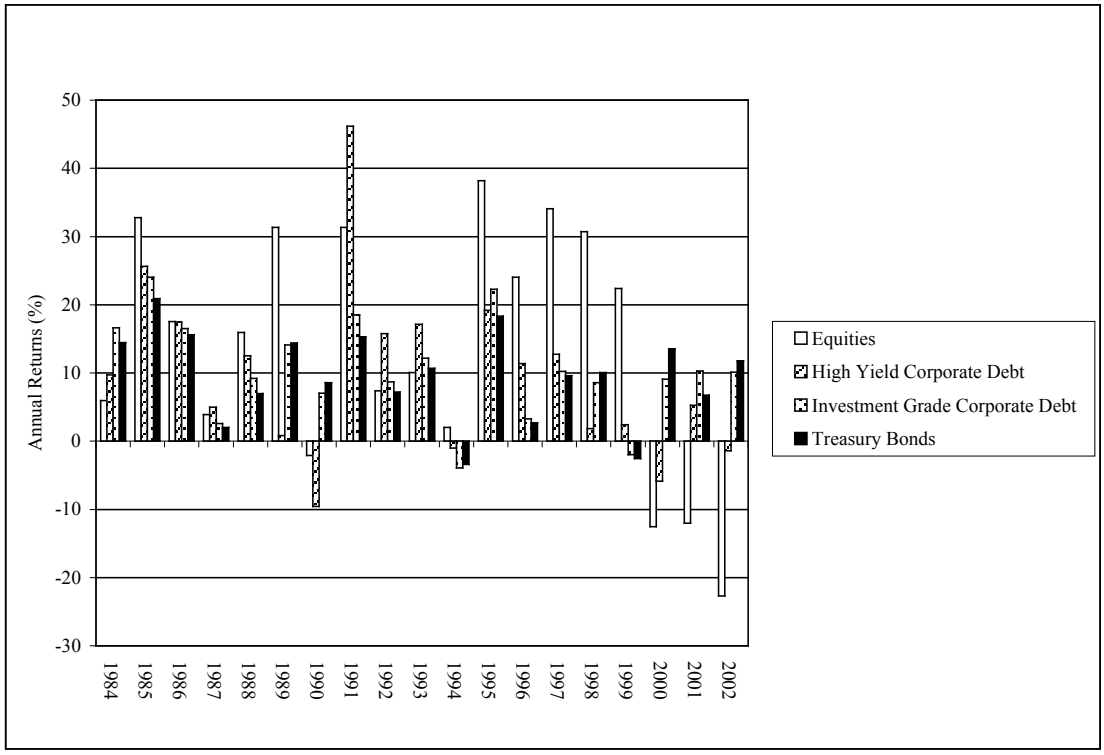
Source Moody's Investor Services

This came at the same time as the collapse of Drexel Burnham Lambert and the virtual disappearance of new high yield bond issuance, and resulted in a negative return in 1990 (shown in figure 6), at which time the very survival of the high yield corporate debt market was questioned [12]. The high level of defaults continued through 1991. However, this year also saw record positive performance. Four potential reasons for this have been suggested [12]:

- prices had fallen so much in 1990 that certain bonds represented good value;
- limited issuance caused excess demand for high yield corporate debt;
- treasury bond interest rates dropped significantly; and
- although default rates had been high, expected default and recovery rates implied a high break-even yield[3] at then-current prices, prompting price rises.

[3] "Break-even yield" on a high yield corporate bond is the yield-to-maturity required to compensate the investor for expected defaults. It is calculated by Altman as follows:

Figure 6: Annual rates of return on US asset classes



Source: Lehman Brothers, MSCI

The US high yield corporate debt market not only survived the problems of 1990, it positively thrived.

In the US, the issuance in the early 1990s was focussed around refinancing outstanding higher coupon debt. Leveraged buyout capital did return to the market, but the main increase from 1995 onwards was in the telecom sector. As a result of the deregulation of the telecom industry and the growth in technologies such as the internet, a number of developmental telecom companies have been set up, financed by high yield corporate debt. This has led to a sharp increase in the proportion of telecom bonds in the index, as shown in figure 7, although due to the recent problems in the telecoms industry and the increase in the volume of "fallen angel" debt in the indices, the proportion has fallen back sharply. This pattern was followed to a lesser extent in other media sectors, in particular with cable companies. In this case, changes in regulations meant that a single company could own a large number of smaller broadcasters. The consolidation that resulted needed financing and this came in the shape of high yield corporate debt.

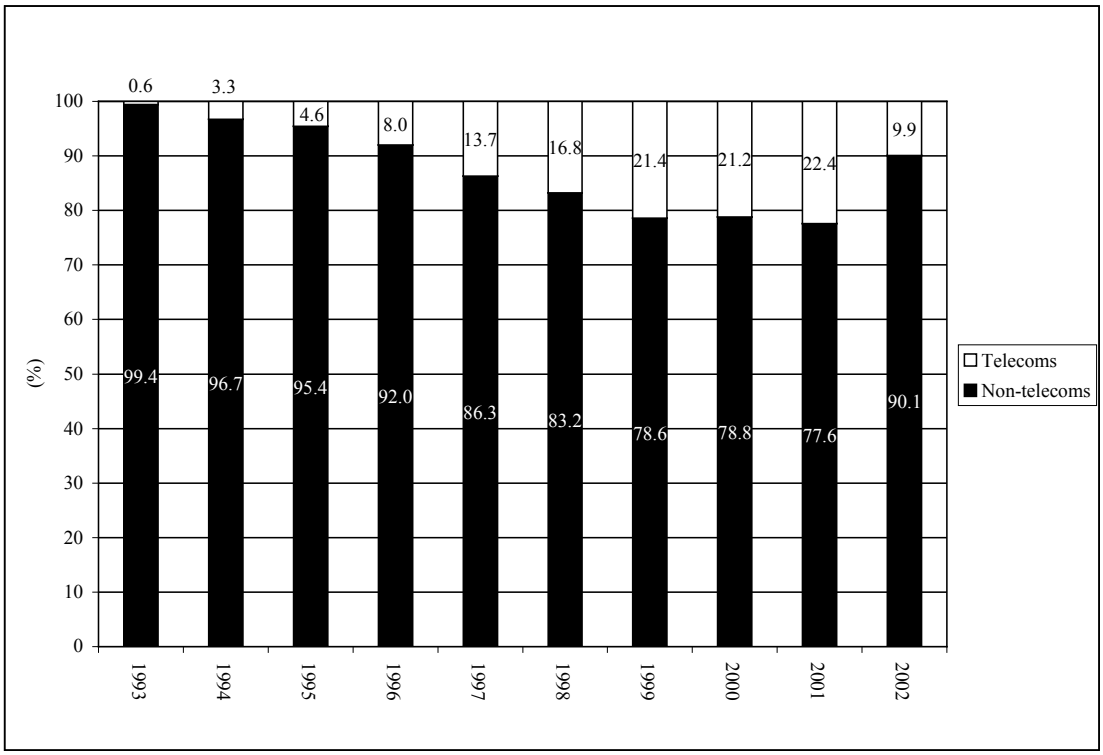
However, this concentration in telecom, media, and technology bonds contributed to the most recent downturn in the US high yield corporate debt market, when a rash of

BEY = (RF + DF(1 - Rec) + DF x *HYC/2))/(1-DF)*

where *BEY* = break-even yield-to-maturity on portfolio of high yield bonds; *RF* = risk free yield; *DF* = expected default rate on high yield bonds; *Rec* = expected recovery rate on high yield bond defaults; and *HYC* = high yield coupon rate.

profit warnings led to negative returns in 2000 and later. However, compared to the gains made over the previous decade, these poor returns are only a temporary setback.

Figure 7: Split of the US high yield corporate debt market between telecom and non telecom bonds



Source: Lehman Brothers

The US high yield corporate debt market now is a very different market to the one in 1980. Not only has it grown greatly in size, but it is also much more diversified than it was two decades ago – it is now an asset class in its own right.

1.4.2 High Yield Corporate Debt in Europe

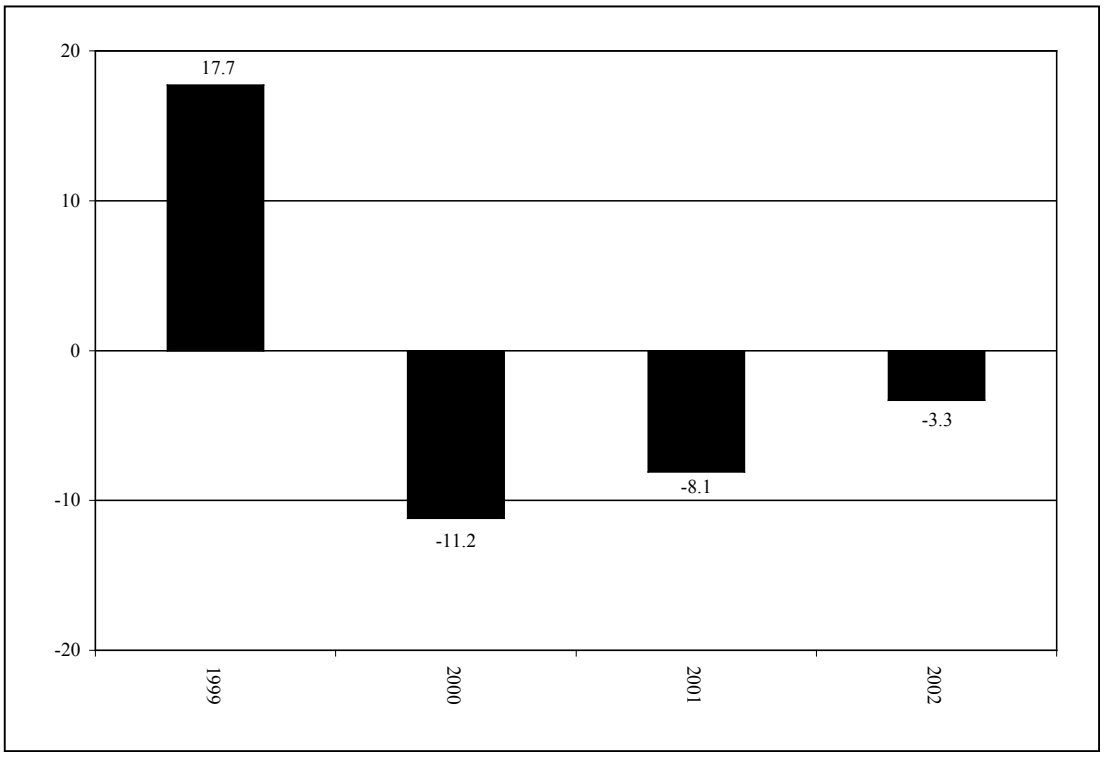
The European high yield corporate debt market is much smaller than its US counterpart and, as mentioned above, telecom stocks made up a much larger proportion of the market (around 50% until recently).

It started in its modern form in April 1997, with a DM157.5m issue by Swiss plumbing manufacturer Geberit Beteiligungs, the cash being raised to fund a leveraged buyout. Prior to that, European companies which were non-rated or below investment grade only had access to the mezzanine debt market and the private placement market in sterling. Some sterling high yield deals had been sold prior to this, but many people considered these to be quasi-private placements. Also, in the 1980s a high yield debt market emerged in Swiss francs, but quickly closed again after a series of corporate failures [13]. Almost all European high yield corporate debt issued before 1997 was issued in $US and was part of the US market.

Because the market is so small, European high yield corporate debt does not lend itself so well to diversified portfolios as US or global high yield corporate debt. The

concentration in telecoms meant that it was more exposed than the US to the telecom, media and telecom downturn, giving the poor recent performance shown in figure 8. However, the large amount of new issuance and downgrades from investment grade mean that the European market is still growing.

Figure 8: Annual rates of return on European high yield corporate debt (%)



Source: Lehman Brothers

The most important aspect of the European high yield corporate debt market is its potential to grow as quickly in the future as it has over the last few years.

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2. Asset-only Analysis

2.1 Introduction

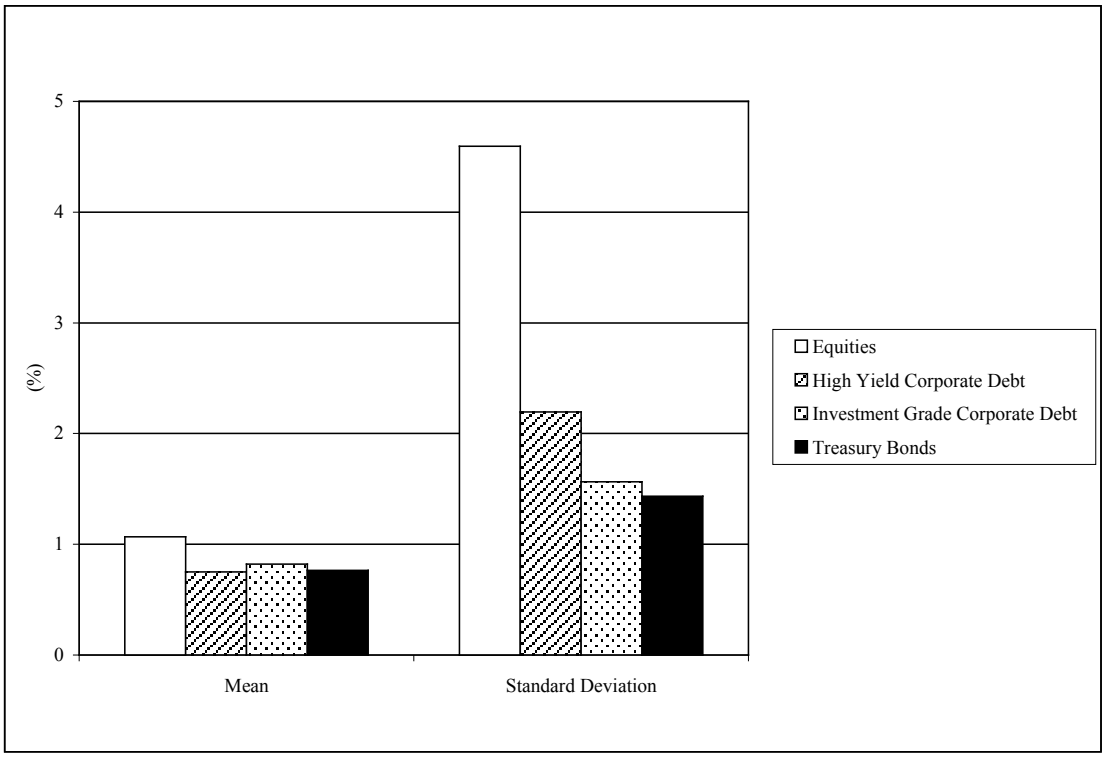
In-depth work on the efficiency of credit bonds was carried out by ABN Amro [1]. This work was largely based around mean-variance analysis (i.e. comparing the expected return and expected risk as measured by the variance of return) and included both historical and projected analysis. My analysis in this chapter builds on theirs, both in terms of scope and of data used.

2.2 Some Basic Risk and Return Measures

The data that I use covers the period 1984 to 2002, since this is the longest whole-year period for which returns on US high yield corporate debt (the asset class with the shortest history) are available. I generally use monthly data in my analysis (although I sometimes aggregate it to give annual figures).

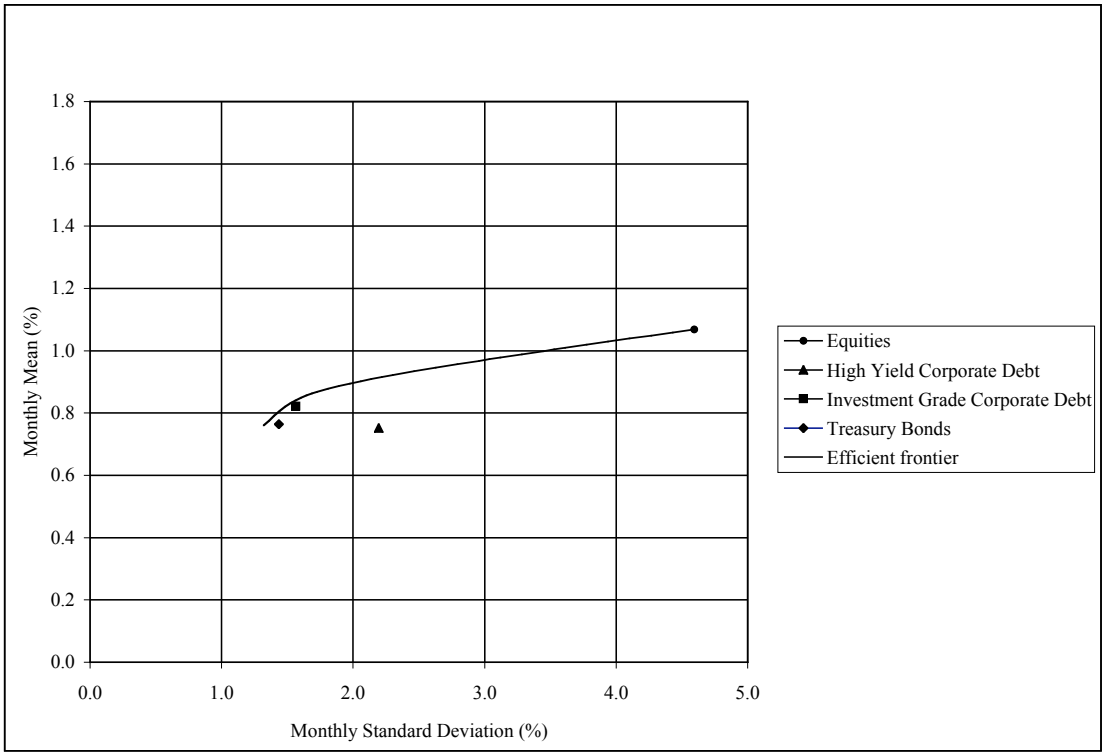
Annual returns are given earlier, but it is worth considering statistics calculated from the underlying monthly returns. Looking at the mean monthly returns and the standard deviations of monthly returns in figure 9, it is clear that equities have had the highest average returns, but with the greatest volatility. This pattern of higher return for higher risk also holds for investment grade corporate debt and treasury bonds, but for high yield corporate debt, the higher volatility was not similarly rewarded for the period. Looking at the annual returns, it can be seen that recent strong performance by investment grade corporate debt is as big a factor in this as poor performance by high yield corporate debt.

Figure 9: Mean and standard deviation of US asset classes, 1984-2002



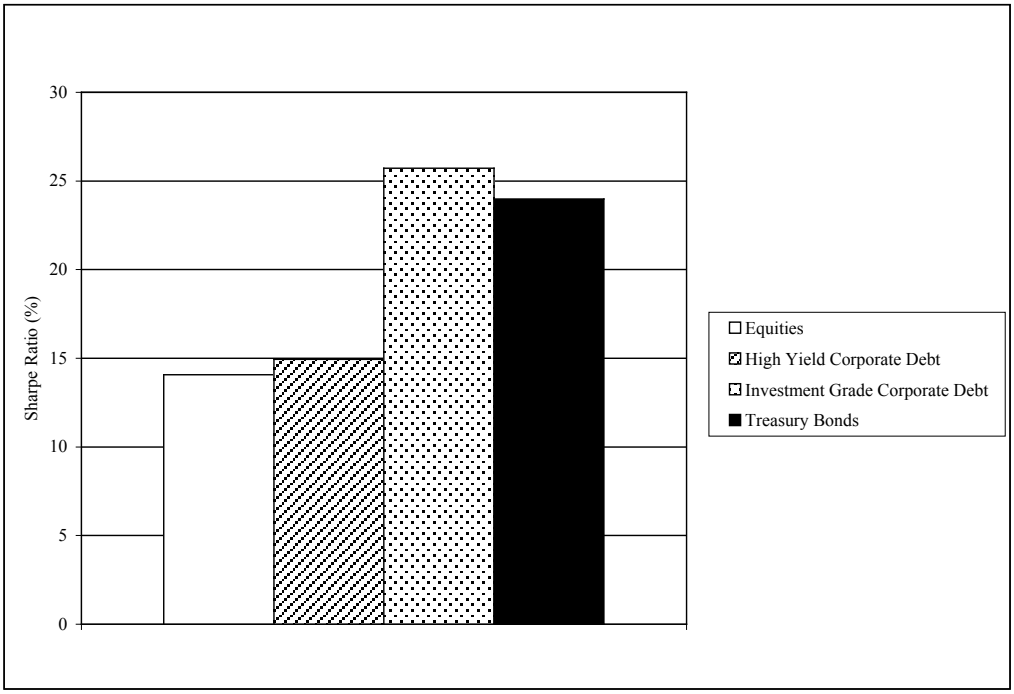
Source: Lehman Brothers, MSCI

Figure 10: Mean-variance analysis for US asset classes, 1984-2002



Source: Lehman Brothers, MSCI

Figure 11: Sharpe ratios, 1984-2002



Source: Lehman Brothers, MSCI

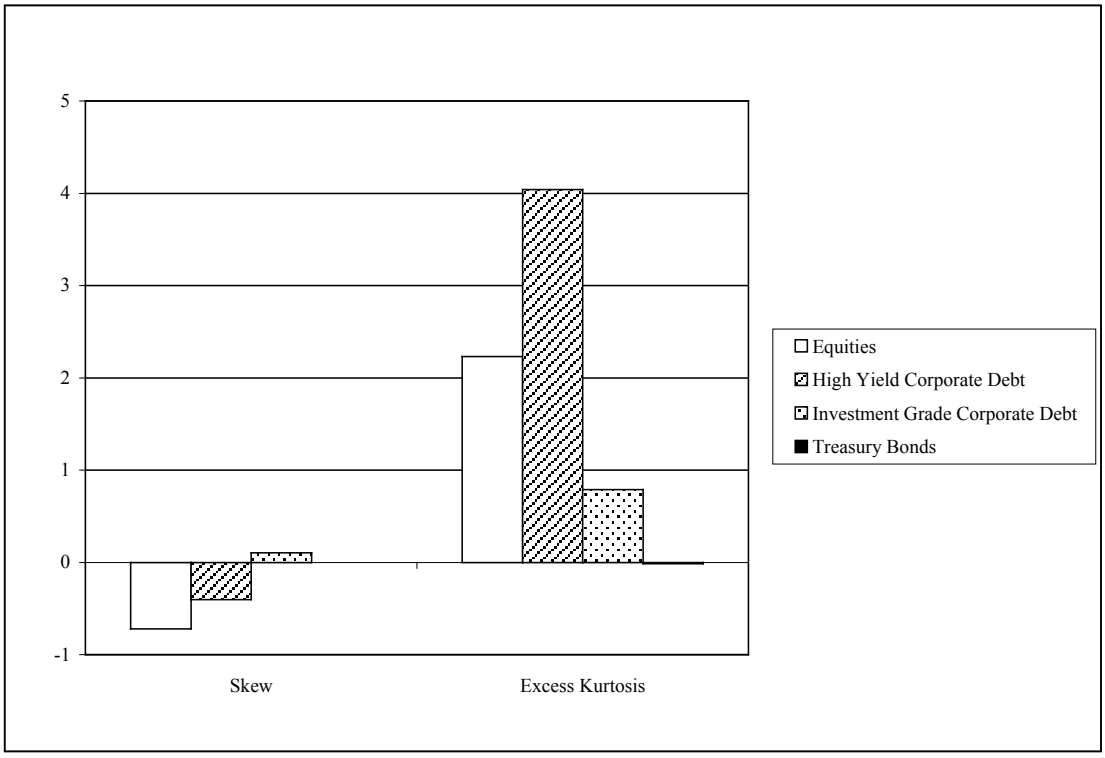
Figure 10 shows the mean variance analysis for the period. It shows that although the broad level of risk for high yield corporate debt is comparable to that of the other bond asset classes (albeit the highest of that group), it did provide the lowest returns over the period 1984-2002. Figure 10 also gives the efficient frontier, which I discuss in more detail later.

However, apart from high yield corporate debt, it is difficult to see which of the asset classes have relatively good or poor risk-adjusted returns. One way of demonstrating the risk-adjusted returns on the various asset classes is to look at the Sharpe ratio. This is calculated as the mean of the excess returns over the risk free asset divided by the standard deviation of the same excess returns. For the risk free asset class, I use US cash, so the risk free return is the US discount rate. The Sharpe ratios are given as figure 11. Looking at the results, the asset classes appear to fall into two distinct groups: treasury and investment grade corporate bonds in one, and high yield corporate debt and equities in the other, with the former group giving significantly better risk-adjusted returns from the latter.

2.3 Skew and Kurtosis

Although mean-variance analysis gives an indication of the risk-return trade off, it does not always give the whole picture. For example, investors interested in a one-sided measure of risk such as expected shortfall should consider the shape of the return distributions, i.e. skew and excess kurtosis as shown in figures 12.

Figure 12: Skew and excess kurtosis for US asset classes, 1984-2002



Source: Lehman Brothers, MSCI

The skew of a distribution measures how lop-sided the distribution is – positive skew indicates that the right tail of the distribution is longer than the left (and the mean is greater than the median, which is greater than the mode), whilst negative skew indicates the opposite. The normal distribution is symmetric, so the mean, median and mode are equal.

Excess kurtosis measures how fat the tails of the distribution are. The fatter the tails, the greater the chance of an extreme result relative to the probability implied by the

normal distribution. Excess kurtosis is calculated as the kurtosis less 3, since the standard normal distribution has a kurtosis of 3. I always refer to excess kurtosis. A distribution with fat tails (positive excess kurtosis) is said to be leptokurtic, whilst one with thin tails (negative excess kurtosis) is said to be platykurtic.

Looking at the skew and excess kurtosis for the full period marks out one asset class – high yield corporate debt – as apparently being less "normal" than the others, by virtue of its high excess kurtosis ("fat tails").

There are few statistical tests available to determine the statistical significance of skew or excess kurtosis. Excess kurtosis in particular is difficult to test since it is characterised by too many (or too few) observations in the tails of the distribution, so a large number of observations is needed to provide any certainty over the result. It is possible to determine whether the skew and kurtosis combined are statistically significant by carrying out a test for non-normality such as the χ^2 test or the Bera-Jarque [2] test.

The χ^2 test involves comparing the number of observed results in each range of returns with those that would be expected if the returns were normally distributed, using the sample mean and standard deviation. There was no significant non-normality at the 5% level for any asset class other than for high yield corporate debt.

The Bera-Jarque test, rather than being a general "goodness of fit" test is calculated from the skew and excess kurtosis. It is calculated as:

$$\frac{S^2}{6} + \frac{(K - 3)^2}{24}$$

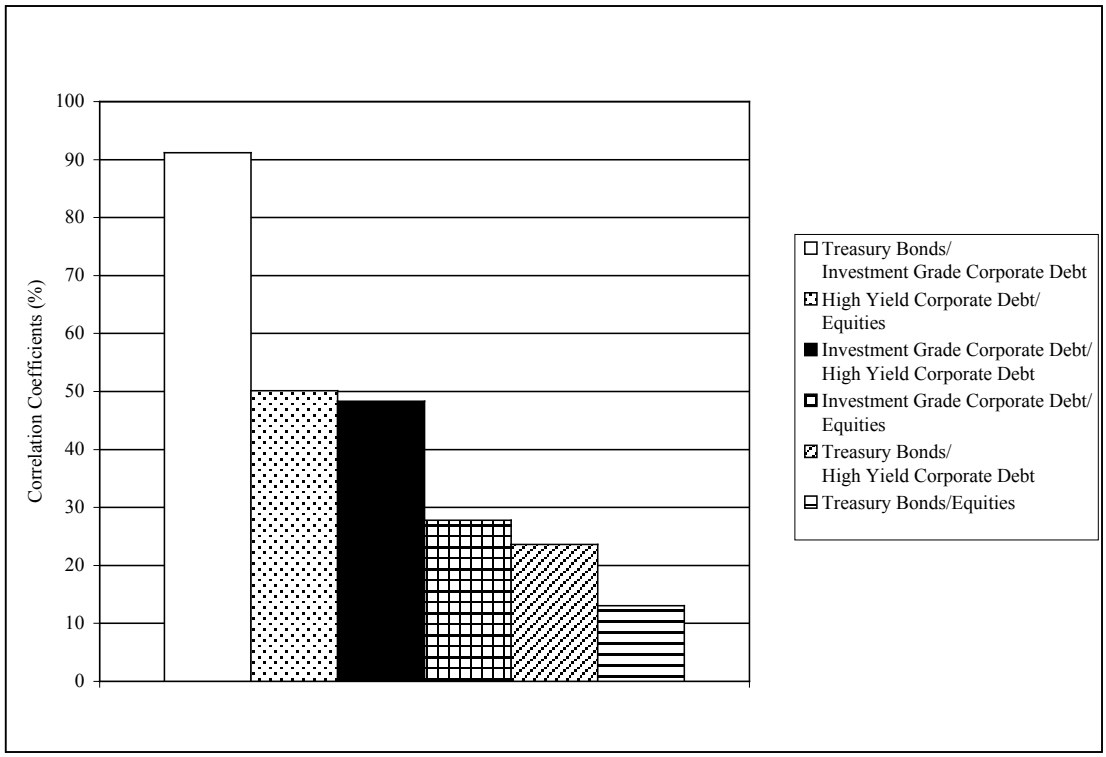
which is distributed χ^2_2, and where S is the sample coefficient of skew and K is the sample coefficient of kurtosis (excess kurtosis being kurtosis in excess of 3). Under this test, the "least normal" asset class appears to be high yield corporate debt. However, even in this instance, the Bera-Jarque statistic is not significant at even the 20% level.

2.4 Correlation and Efficient Frontiers

The information in the charts so far does not give a complete story. Treasury bonds always offer the lowest risk (and return) and the reverse is true of equities; investment grade corporate debt has slightly higher risk and return that treasury bonds; and high yield corporate debt has slightly higher risk than treasury and investment grade bonds and this risk has sometimes been rewarded with higher returns, although both risk and reward fall a long way short of equities.

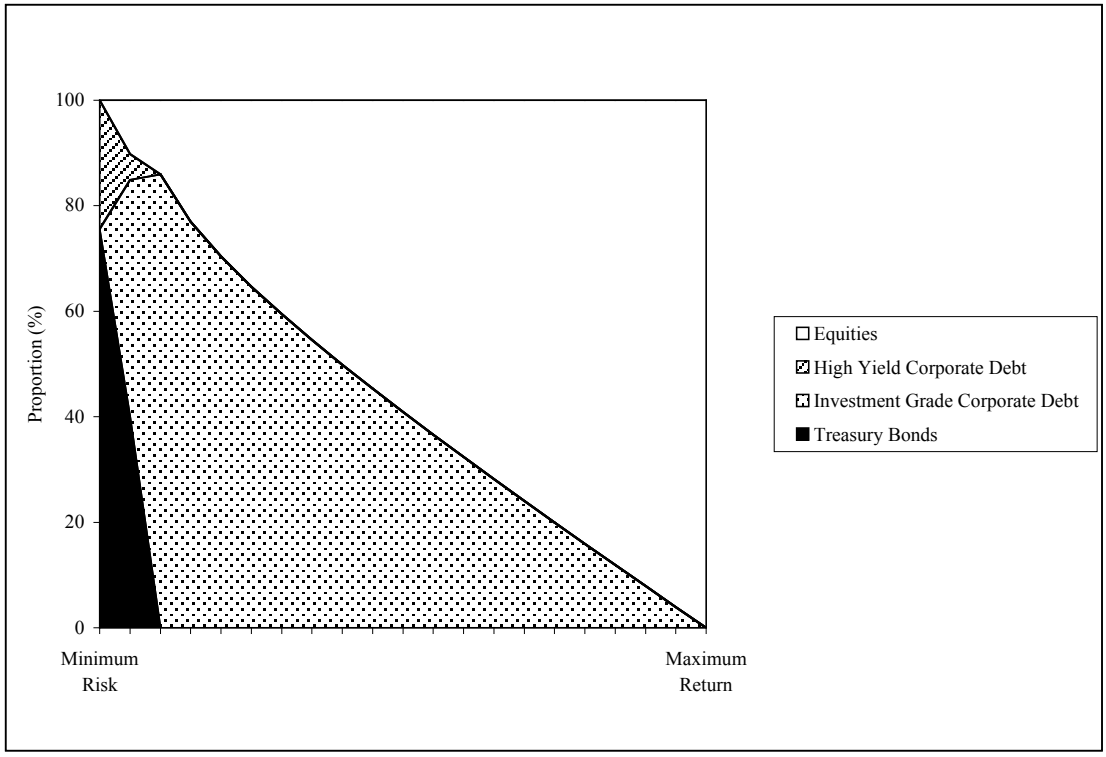
However, what none of these charts show is the diversifying effect of combining various asset classes. Figure 13 shows that apart from treasury bonds and investment grade corporate debt, the correlations between the various asset classes are not high. This chart indicates that high yield corporate debt has a potential role to play as a diversifier in low risk portfolios, and that equities come into play higher up the risk/return scale.

Figure 13: Correlation coefficients for US asset classes, 1984-2002



Source: Lehman Brothers, MSCI

Figure 14: Proportion of assets in the efficient frontier, 1984-2002



Source: Lehman Brothers, MSCI

A way of combining the expected risk and return characteristics of the various asset classes that takes into account the correlations between them is to use efficient frontier analysis. The charts of the efficient frontiers themselves are not that

interesting – all are upward sloping and end with the portfolio of 100% equities (which gives the maximum return). However, the chart showing the composition of the efficient frontier is more interesting. This is given as figure 14.

The minimum risk portfolio consists of around 80% treasury bonds and 20% high yield corporate debt and the maximum return is (unsurprisingly) provided by a portfolio of 100% equities (at least it has been historically – there is no guarantee that this will be the case going forward).

2.5 Capital Market Line Analysis

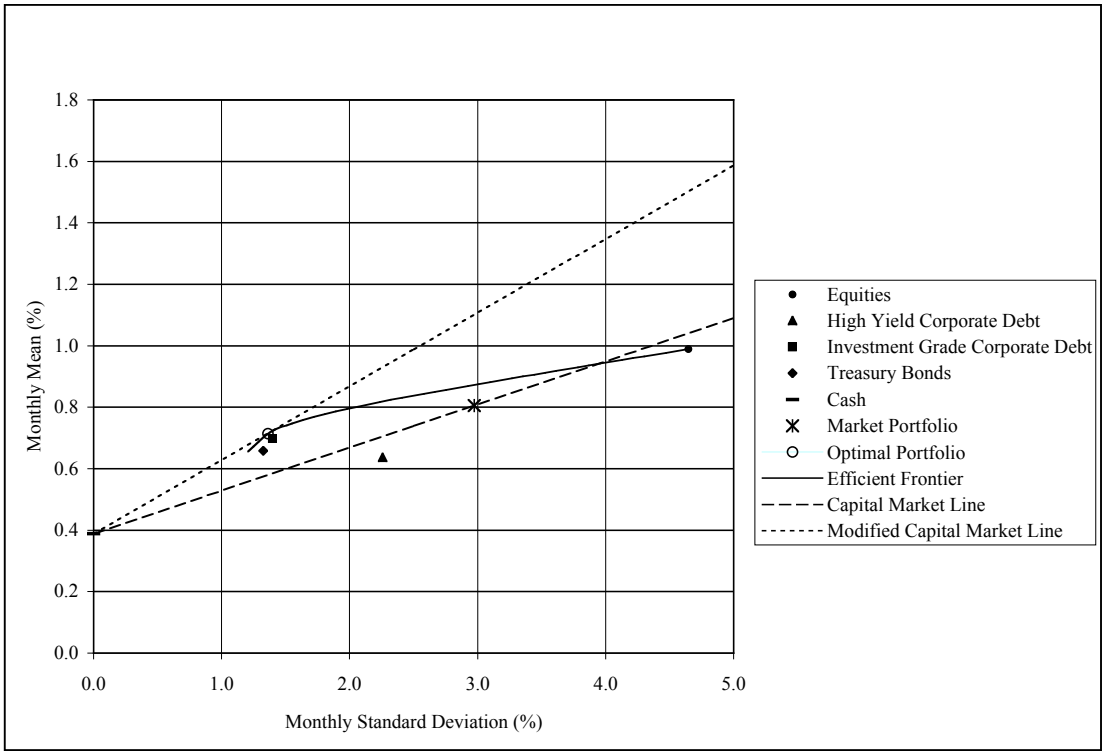
In this section, I look at the returns in excess of the risk free rate when calculating the standard deviation of returns. This analysis introduces the idea of a market portfolio, being the portfolio containing all assets in proportion to their market weights. These weights are the ones given by the various indices used. The market portfolio therefore consists of:

- US treasury bonds;
- US investment grade corporate debt;
- US high yield corporate debt; and
- US equities.

In order to calculate the monthly return on the market portfolio, I multiply the monthly return on each asset class by the average market value of that asset class over the month (calculated as the start-of-month figure plus the end-of-month figure divided by two), sum over all asset classes and divide the result by the average market value of all asset classes over the month (calculated as before). Because the market values of the indices are required, the period 1987-2002 is used since the market value of the US high yield corporate debt is unavailable prior to 1987. Because the dataset is smaller, I do not look at rolling periods, only the full sample period.

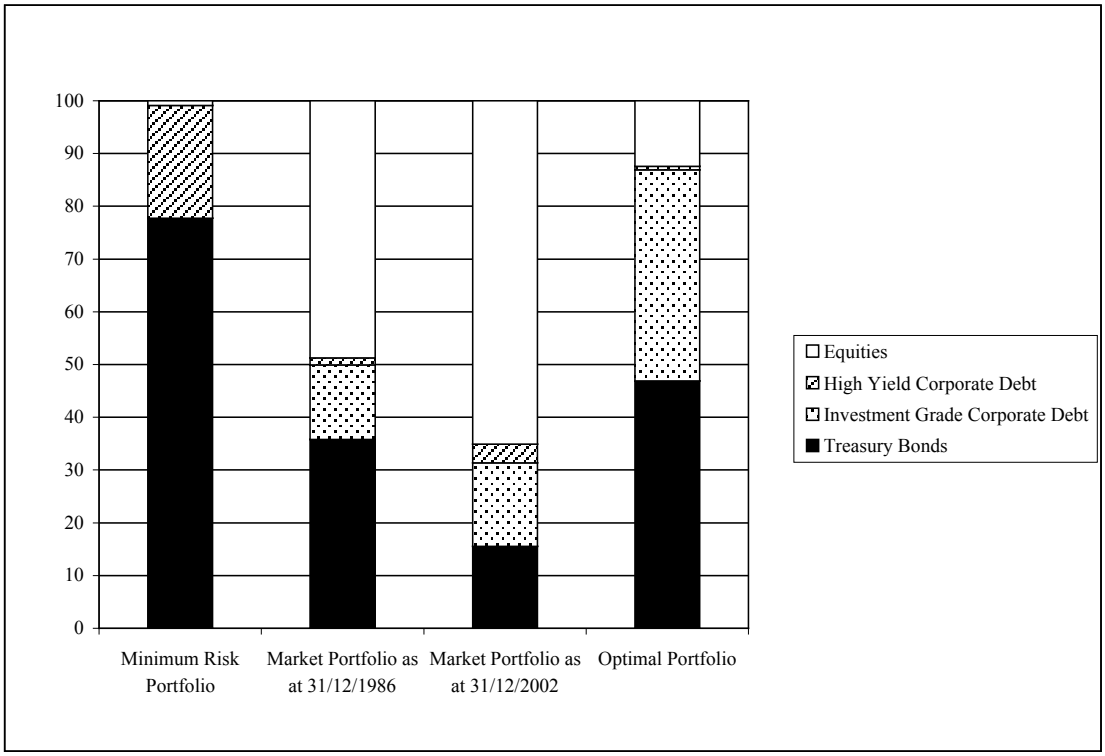
Since the risk free asset has zero standard deviation, all portfolios consisting of a combination of the market portfolio and the risk free asset fall on a linear risk/return line. If it is assumed that an investor can borrow at the risk free rate, then the risk/return line can be extended beyond the market portfolio to allow for gearing (leverage). This line is known as the capital market line. Each of the asset classes lies below the capital market line, as is shown in figure 15. However, figure 15 also shows that, relative to the efficient frontier, the market portfolio appears to be inefficient, being placed some way below the frontier. This implies that there is a more efficient portfolio that can be combined with the risk free asset. Such a portfolio would be the point on the efficient frontier at which a line drawn from the risk free asset on the vertical asset would be tangential. I call this line the modified capital market line and the portfolio the optimal portfolio.

Figure 15: Capital market line analysis, 1987-2002



Source: Lehman Brothers, MSCI, US Treasury

Figure 16: Minimum risk, market and optimal portfolio compositions, 1987-2002



Source: Lehman Brothers, MSCI, US Treasury

The asset mixes making up the optimal and market portfolios are shown in figure 16. Since the composition of the market portfolio changes over time, I show the market portfolio's composition at the start and the end of the sample period. What this shows

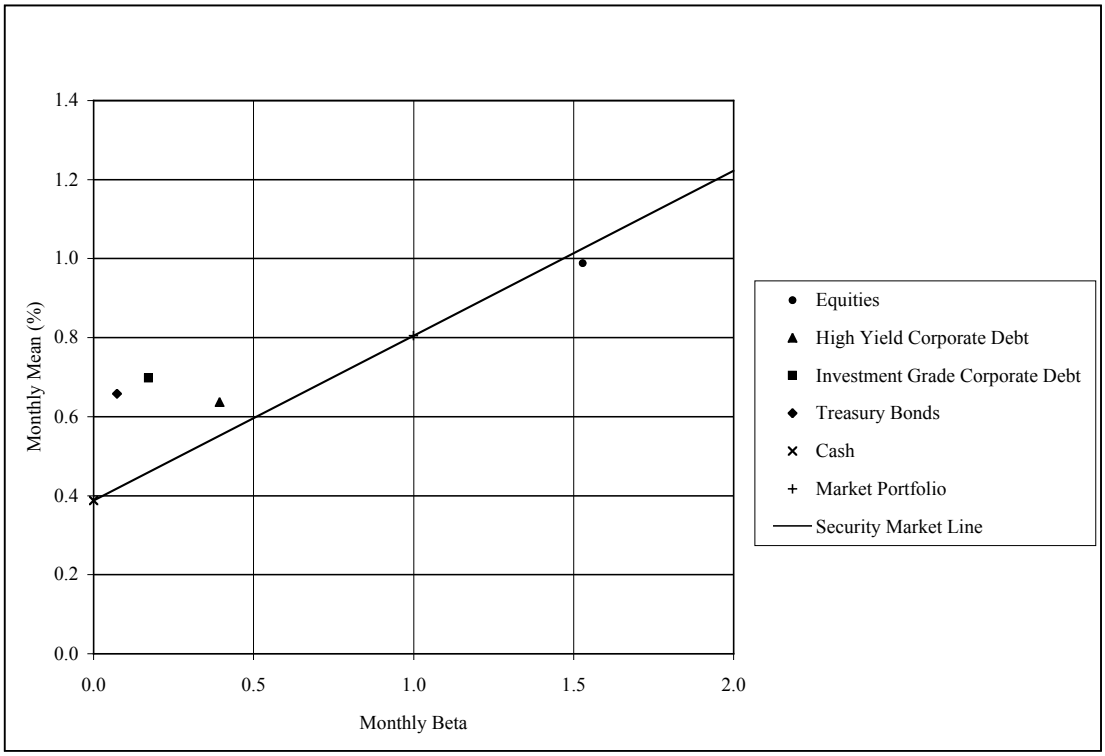
is that there are far higher proportions of both treasury bonds and investment grade corporate debt in the optimal portfolio than in the market portfolio, and a much lower proportion of equities. High yield corporate debt remains a minority asset class in all cases (apart from the minimum risk portfolio).

2.6 Beta Calculation

Beta is a measure of the efficiency of an asset class. The beta for each asset class is calculated as the covariance of the asset's monthly return with the market portfolio divided by the variance of the monthly returns on the market portfolio. The calculation can be done using either the actual returns or the returns in excess of the risk free asset.

According to the Capital Asset Pricing Model (CAPM) a security is undervalued if it falls above the security market line, a straight line plotting expected return against beta, starting with the risk free return on the vertical axis and passing through the market portfolio (which has a beta of one). As can be seen in figure 17, all bond asset classes appear to be undervalued (and equities slightly overvalued) according to this approach, if historical mean returns are taken to be a good indicator of the expected returns. If regressions are run of each bond asset class against the market portfolio (all net of the risk free rate of return), then t-statistics for the intercept term are given as 2.503, 2.499 and 0.596 for treasury bonds, investment grade corporate bonds and high yield corporate bonds respectively. In other words, the degree of undervaluation is significant at the 95% level of confidence for treasury bonds and investment grade corporate bonds, but not for high yield corporate debt.

Figure 17: Security market line analysis, 1987-2002



Source: Lehman Brothers, MSCI, US Treasury

Another interpretation of the apparent undervaluation of the bond asset classes is based on the CAPM estimation of expected return. This is given as:

$$ER_S = RF + \beta(ER_M - RF)$$

where ER_S is the expected return on the stock or asset class; RF is the return on the risk free asset; β is the beta of the stock or asset class relative to the market portfolio; and ER_M is the expected return of the market portfolio). The second interpretation is that the expected return of the bond asset classes is a better estimate than the historical mean return, and that bonds are not going to perform as well going forward as they did between 1987 and 2002 – an argument that is plausible given the fall in inflation and, likewise, interest rates in the 1990s.

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[1] ABN Amro: Credit Bonds as an Asset Class (ABN Amro Global Consulting Group, August 2000)
[2] Bera & Jarque: Efficient tests for normality, heteroskedasticity and serial independence of regression residuals: Monte Carlo evidence (Economic Letters, 1981)
[3] Markowitz: Portfolio Selection (Journal of Finance, March 1952)
[4] Microsoft Corporation: Excel X for Mac (1985-2001)
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3. Asset-Liability Value Analysis

3.1 Introduction

The mean-variance analysis above can be extended from an asset-only to an asset-liability basis. In this case, the return measure I use is the average (mean) increase in surplus (assets less liabilities). The risk measure I consider here is the volatility in the increase in surplus. I have not used any downside measures of risk. Since the statistical analysis above does not strongly suggest skew, the results would not add any insight to the analysis. This is not to say that downside risk measures should not be used in practice – they are the best way to allow for any non-normality in the return distributions produced by asset models.

There are a number of possible approaches that can be used in deriving an interest rate to value the liabilities. The theoretically correct approach to valuing the liabilities should involve some sort of option pricing that takes into account the degree to which the liabilities are securitised (i.e. the funding level) and the various options available to stakeholders in the pension scheme (e.g. the employer's option to default). An approximation to this value of liabilities is obtained by using the risk-free rate to value the securitised liabilities, and the company's cost of borrowing to value any liabilities not backed by assets (i.e. a deficit), the higher cost of borrowing taking into account the fact that the employer might not be able to cover the deficit.

Because the funding level changes in each time period, so does the effective interest rate that applies, at least when there is a deficit. I therefore use the risk free rate to value all liabilities. This gives more conservative results than the method outlined above, but only when there is a deficit present.

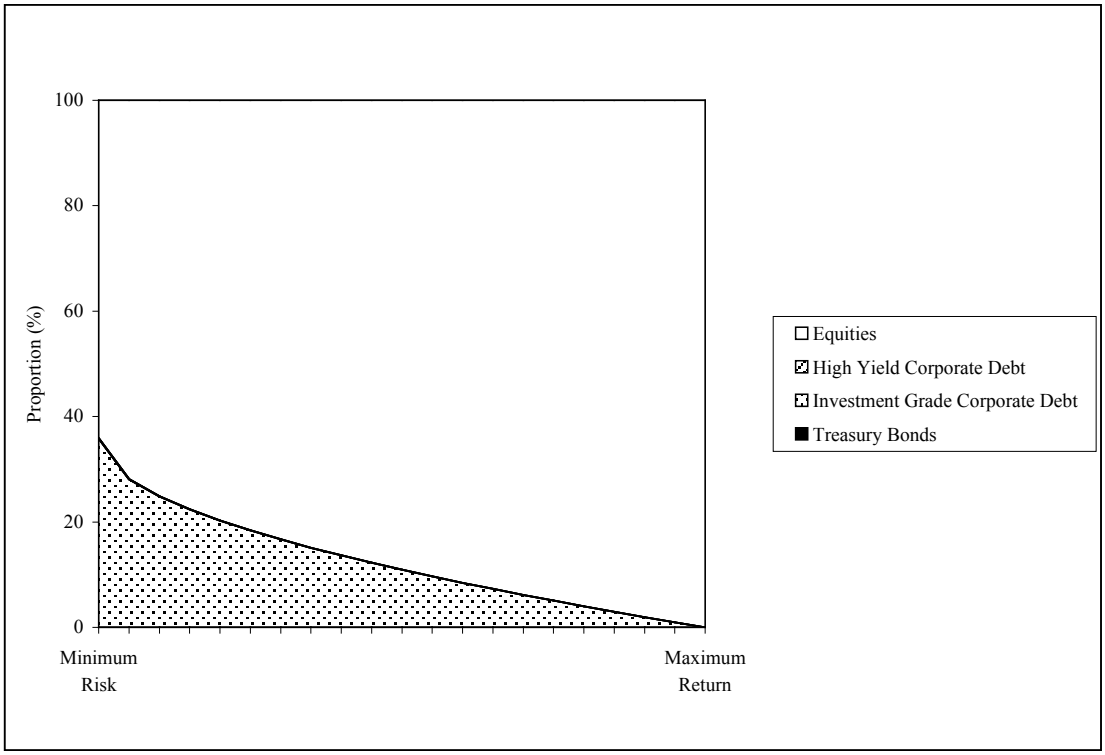
The risk free rate that I use in this context is the long-dated US treasury bond yield. Mortality is assumed to be in line with US mortality tables RP-2000.

I only look at closed pensioner portfolios in the analysis. Looking at a scheme with pre-retirement members, or a pensioner portfolio with new retirements, could give very different results.

3.2 Results

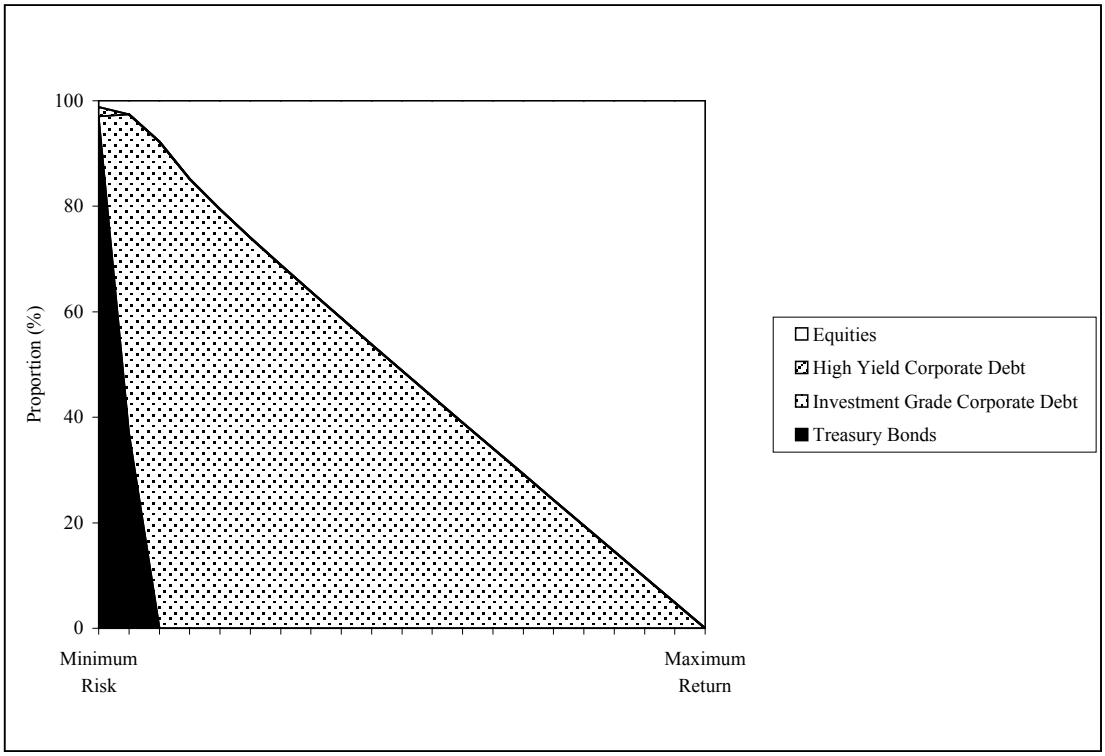
I show three results, being for for the 80%, 100% and 120% initial funding levels. The easiest chart to explain is figure 19, the chart for the fully funded scheme. Here, the best match for the liabilities is a portfolio of near to 100% treasury bonds, so this forms the minimum risk portfolio, with other asset classes appearing as risk (volatility) increases. For the over-funded scheme, the assets are required to be less volatile than the liabilities, since in a closed scheme the surplus will grow over time. Therefore the minimum risk portfolio is a combination of the fully funded and the asset-only minimum risk portfolios. For the under funded scenario, because the deficit will tend to grow in a closed scheme, much more volatility is needed, meaning that a combination of equities and investment grade debt gave the minimum portfolio. In other words, high yield corporate debt becomes useful as a risk reducer the larger the surplus.

Figure 18: Efficient frontier composition, 80% funded, 1984-2002



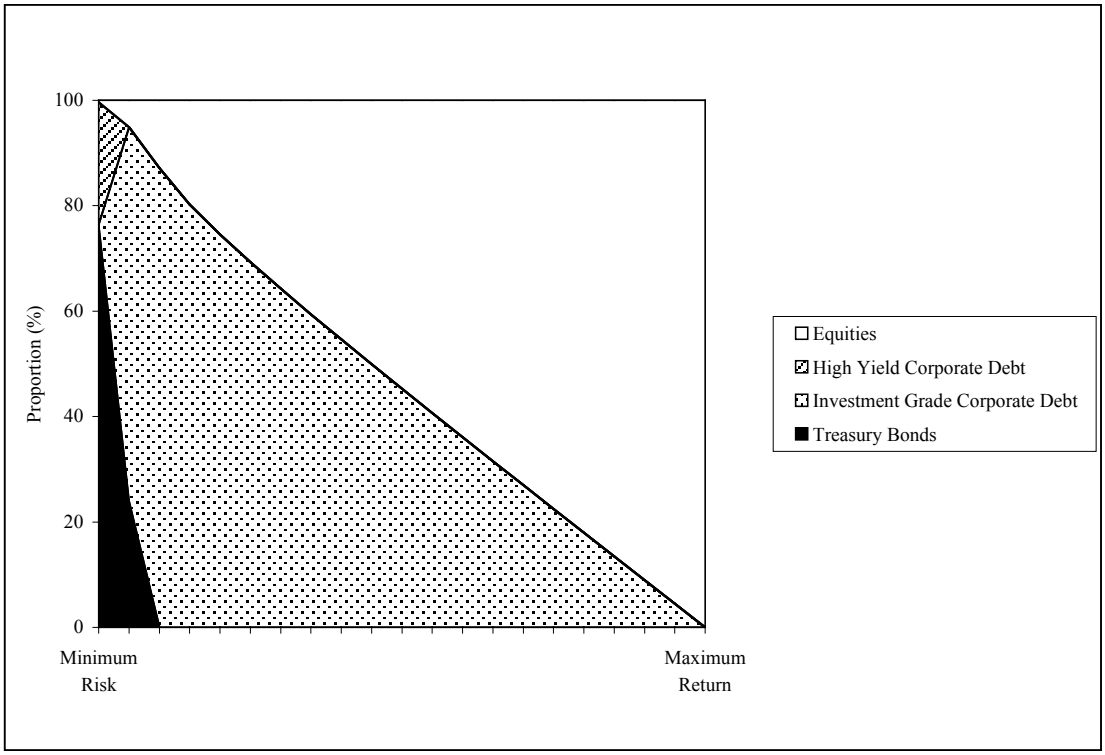
Source: Lehman Brothers, MSCI

Figure 19: Efficient frontier composition, 100% funded, 1984-2002



Source: Lehman Brothers, MSCI

Figure 20: Efficient frontier composition, 120% funded, 1984-2002



Source: Lehman Brothers, MSCI

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4. Income Analysis of High Yield Corporate Debt

4.1 Introduction

The preceding work concentrates on valuation measures. However, another indication of the usefulness of high yield corporate debt to pension schemes might be to consider the income that a portfolio of each would produce. There are two broad analyses that can be carried out here: the first is to look only at the income produced by the portfolio and to consider the level and stability of that income; the second is to consider the development of a portfolio of assets and liabilities over time.

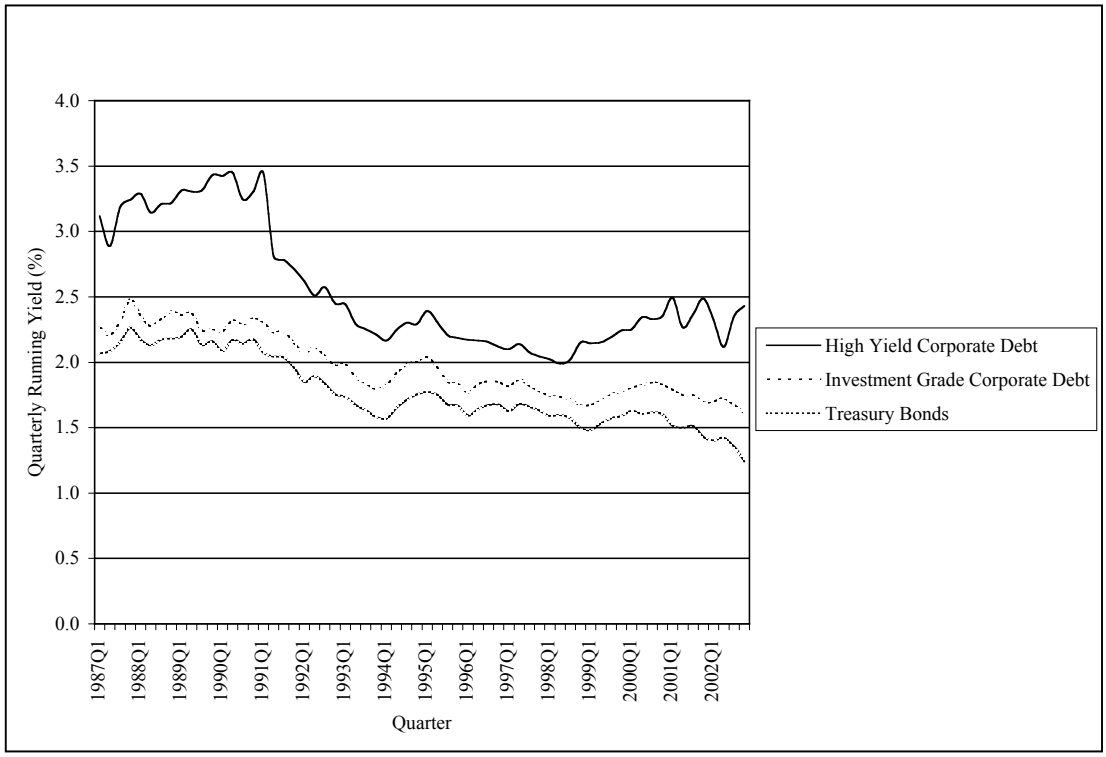
In these analyses, it would be preferable to look at the actual coupon income produced by assets. However, the Lehman Brothers indices only give accrued interest. This means that using monthly data would be misleading, particularly for treasury bonds, which tend to be issued in February, August and November. Treasury bond coupons are paid half-yearly so, with the issue months a quarter of a year apart, considering the income received quarterly would resolve much of the distortion. Also, a three-month period helps to remove any distortion existing in investment grade or high yield corporate debt coupon payments, although there should be less of an issue with these asset classes. I therefore use quarterly periods in my analyses. The income shown allows for defaults.

4.2 Long-term Results

There are two ways in which the income-producing potential of high yield corporate debt can be analysed. The first (and crudest) method is to consider the running yield of various bond asset classes. The quarterly running yields are constructed from monthly data in the Lehman Brothers series. The calculation method is straightforward. First, the index returns are split into price and coupon returns (both are given as data items in the Lehman Brothers' series). I then assume income to be paid out and not reinvested. Starting with an initial fund value of $100, the price of the fund at the end of each month is calculated as the price at the end of the previous month multiplied by the index price return. The income produced each month is calculated as the index coupon return multiplied by the fund price at the end of the previous month. The quarterly running yield is then calculated as the income received each quarter divided by the fund price at the end of the previous quarter.

It is important to note that this approach assumes that the index portfolio is sold at the end of each period and the proceeds are reinvested in the new index portfolio. In practice, this would be prohibitively expensive as bid-offer spreads on high yield corporate debt are high. The quarterly running yield is shown for different asset classes in figure 21. This data is only available for high yield corporate debt from 1 January 1987 so I use this as my start date for all bond asset classes. The chart shows that the running yield on high yield corporate debt is, unsurprisingly, the highest of the three. However, it also shows differences in running yields to be reasonably steady over time, particularly after around 1991.

Figure 21: Quarterly running yield of bond asset classes



Source: Lehman Brothers

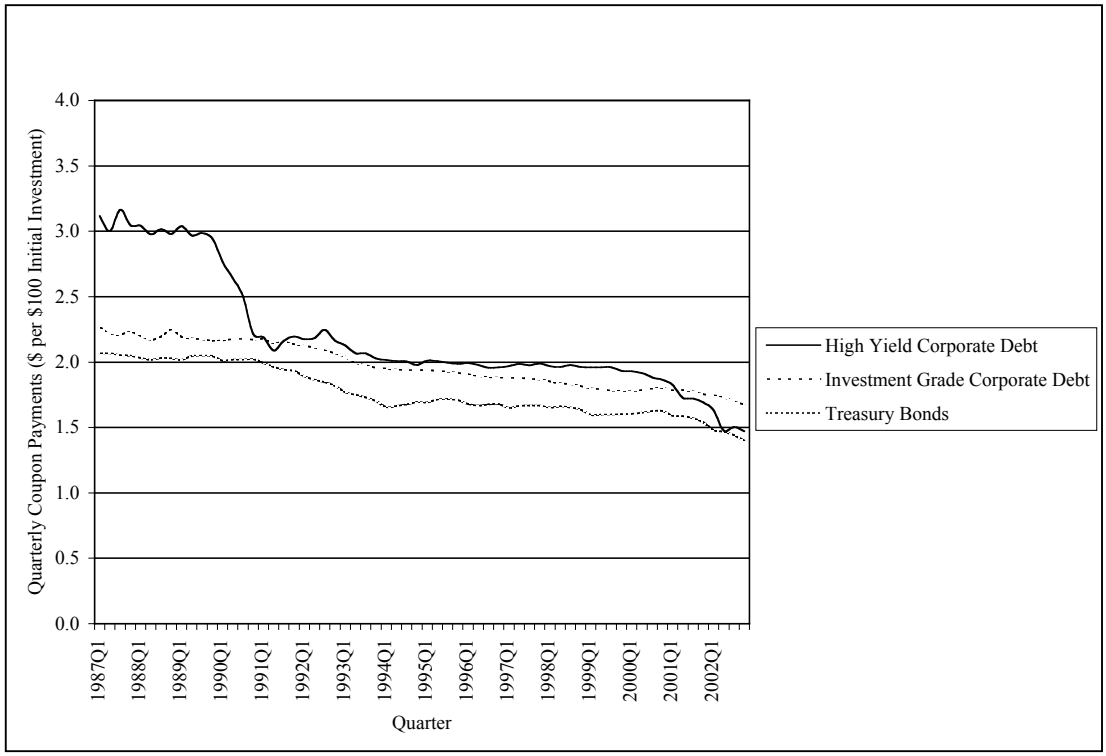


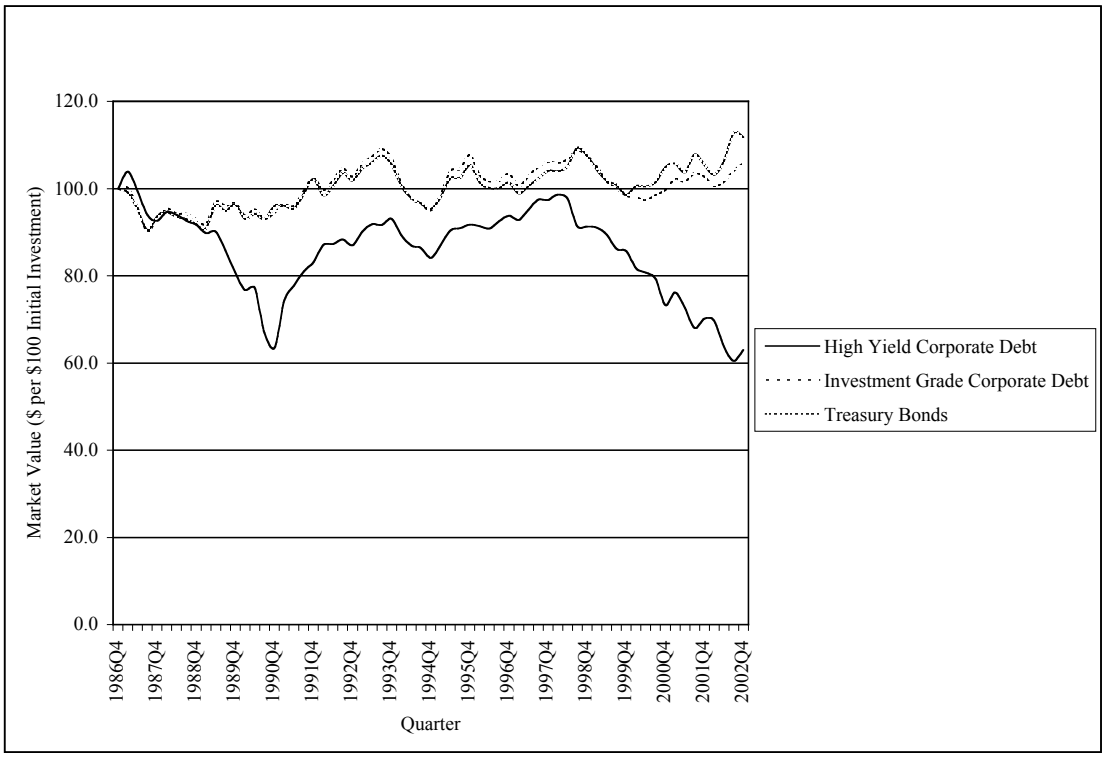
Figure 22: Quarterly coupon payments of bond asset classes
Source: Lehman Brothers

An alternative asset-only approach is to consider what income would be produced from a portfolio of each asset class. Here, the same calculations are carried out as above, but I take the quarterly income itself rather than dividing it by the previous

end-of-month fund value. The results are shown in figure 22. As can be seen, the income produced by the portfolio of high yield corporate debt is higher than that produced by either of the two asset classes apart from a short period in 1990/91 where it fell below the other asset classes, and also in 2001. It is also a relatively stable income after around 1990. Investment grade corporate debt, though, has maintained its income advantage over treasury bonds for the whole period.

Looking at the market value of these portfolios (still assuming that coupons are paid out rather than being reinvested) for the same period is also informative. Figure 23 shows that for someone investing in 1987, the loss in capital value for a high yield corporate debt portfolio between 1989 and 1991 relative to the other portfolios was never regained (although there was partial compensation in the form of higher income).

Figure 23: Market values of bond asset classes



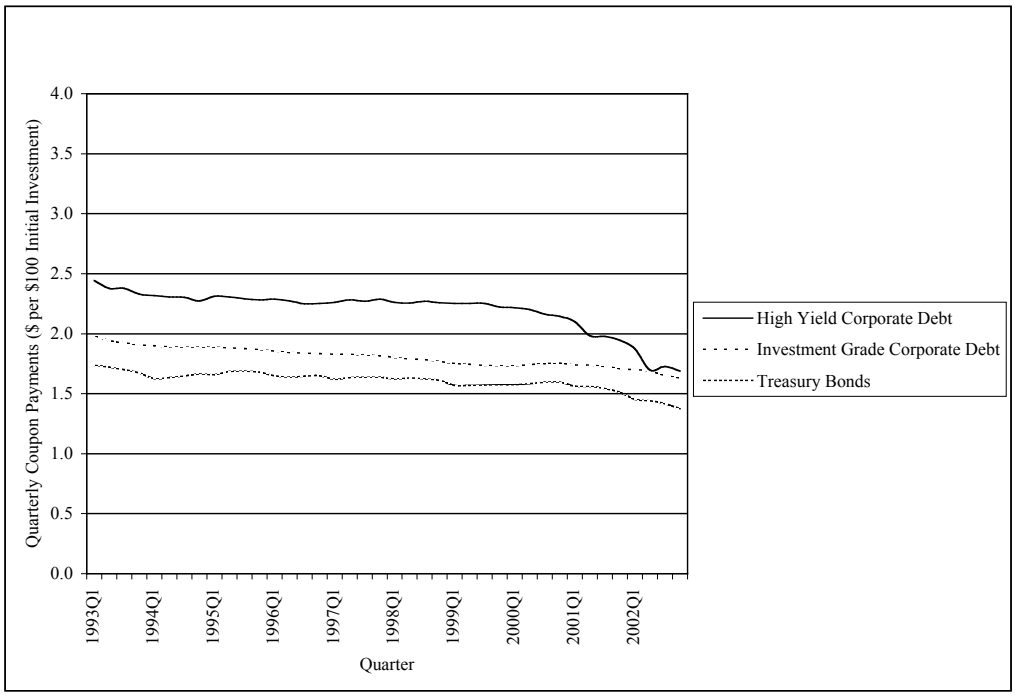
Source: Lehman Brothers

4.3 Short-term Results

What happens, then, if we consider a "modern" investor in high yield corporate debt who avoided the capital loss of the early 1990s? For this purpose I look at what would happen if an investor were to start with the three portfolios on the (admittedly arbitrary) date of 1 January 1993. The purpose of this is to exclude from the analysis a period during which it could be argued that, because the market was immature, the returns on high yield corporate debt might not be consistent with those after the period. The period excluded is after the crisis and subsequent recovery of the early 1990s, and the results are shown in figure 24. As can be seen above, high yield corporate debt provides a smooth – and high – level of income, although the level of income from a high yield corporate debt portfolio commencing in 1993 would now be

below that of an investment grade corporate debt portfolio commencing at the same time.

Figure 24: Quarterly coupon payments of bond asset classes, 1993-2002



Source: Lehman Brothers

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[1] Lehman Brothers: Lehman Brothers Global Family of Fixed Income Indices (Lehman Brothers, 2001)
[2] Society of Actuaries: The RP-2000 Mortality Tables (Society of Actuaries, 2000)

5. Asset-Liability Income Analysis

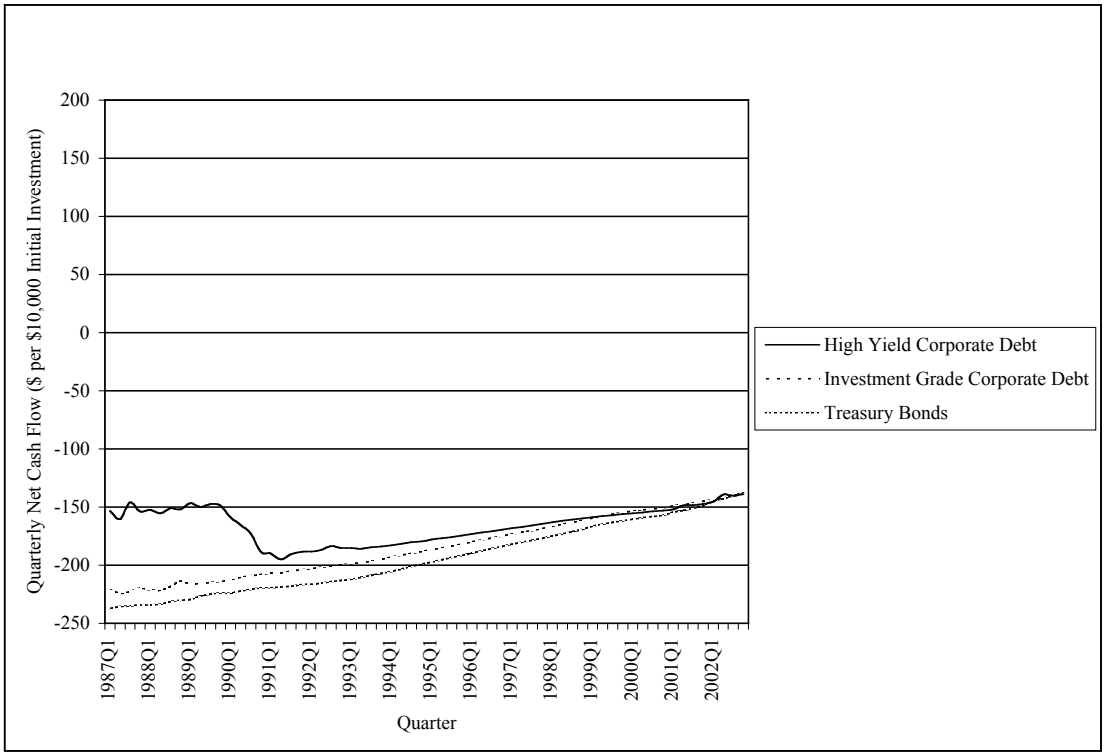
5.1 Introduction

Although relative to the other debt asset classes high yield corporate debt appears to be an attractive asset class in asset-only income analysis, treasury bonds and investment grade corporate debt fare better in the efficient frontier analysis when liabilities are taken into account. In this section, however, I look at the income produced by bond portfolios relative to the income required by pension schemes. Again, I only consider closed pensioner portfolios in the analysis.

5.2 Results

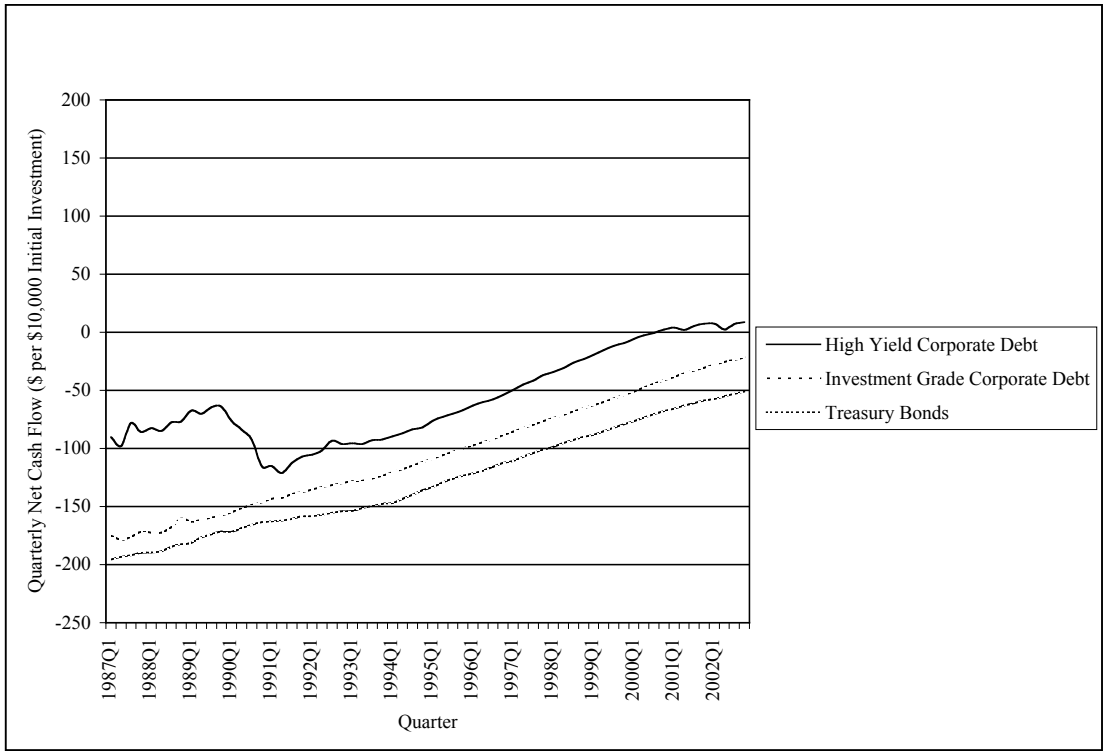
Initial liabilities are assumed to be equal $10,000 and initial assets are assumed to be either $8,000, £10,000 or $12,000 respectively. The pensions payable and income receivable are both calculated quarterly. Pensions are assumed to be payable quarterly in advance. If the coupon income exceeds the pension payments, then the excess is reinvested. However, if there is a shortfall, then it is assumed that the amount required is obtained by disinvestment. The net cash flow for each asset class is the quarterly income less the quarterly pension payment.

Figure 25: Net cash flows, 80% funding level



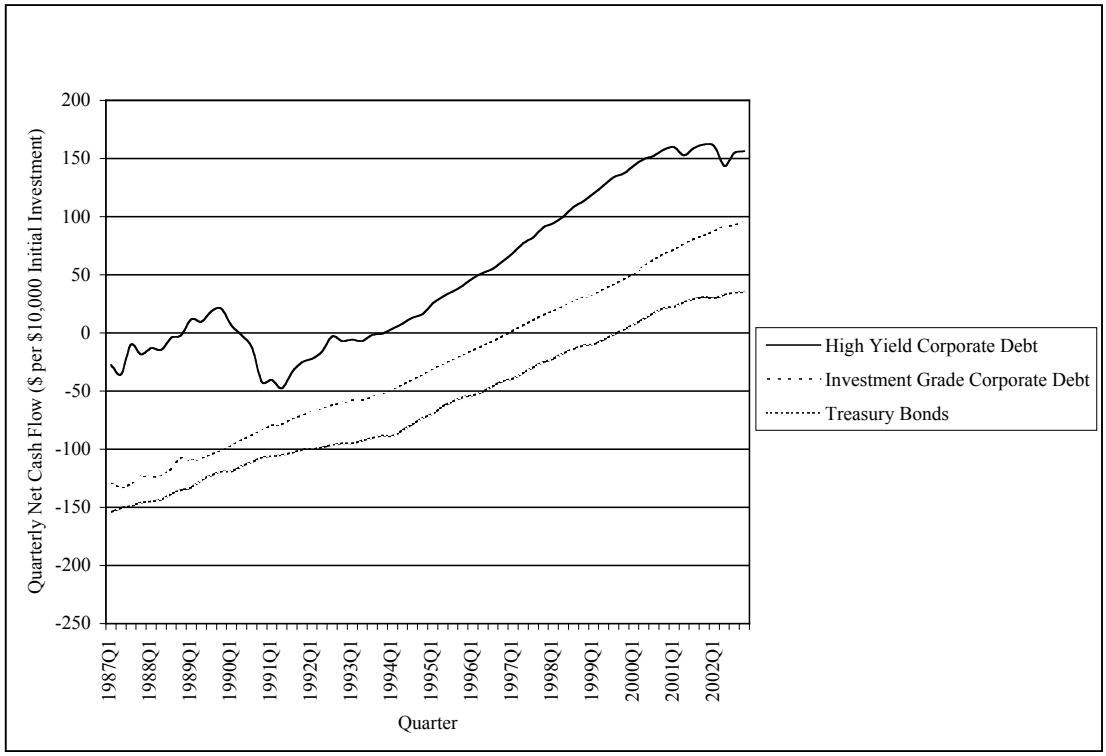
Source: Lehman Brothers

Figure 26: Net cash flows, 100% funding level



Source: Lehman Brothers

Figure 27: Net cash flows, 120% funding level



Source: Lehman Brothers

The net cash flows are smooth for all asset classes, including high yield corporate debt. Also, the initial funding level has a significant difference on the relative attractiveness of the different bond asset classes: the higher the initial funding level,

the more attractive high yield corporate debt becomes (although investment grade corporate debt is always more attractive than treasury bonds). Indeed, in the under-funded scenario, there is no advantage at all to holding high yield corporate debt, but there was a significant advantage in the other scenarios.

References for Chapter 5

[1] Lehman Brothers: Lehman Brothers Global Family of Fixed Income Indices (Lehman Brothers, 2001)
[2] Society of Actuaries: The RP-2000 Mortality Tables (Society of Actuaries, 2000)

6. Conclusion and Final Thoughts

I believe that this study shows that there is a role for high yield corporate debt in pension scheme investment on a number of levels. Looking at the risk and reward characteristics of the asset classes in isolation offers inconclusive evidence as to the suitability of high yield corporate debt. However, when the correlations between the asset classes are taken into account, the fact that the returns on US high yield corporate debt have a low correlation with the other US bond asset classes means that it is a good diversifying asset class when included in lower risk portfolios.

The correlations between returns on US high yield corporate debt and other US asset classes are low, and decomposition calculations leave most of the returns unexplained. One reason for this could be different compositions of the equity and high yield corporate debt indices. However, risk decomposition calculations within corresponding equity and high yield corporate debt sectors leave even less of the risk explained, suggesting that even the small proportion of the risk explained in the complete indices is spurious. This is unsurprising given the radically different properties of fixed income and equity-type securities – more fundamental analysis considering the drivers of the returns might offer greater insight.

The beta analysis produces some interesting results. Firstly, the market portfolio lies below the efficient frontier. This situation arises because investment grade and, especially, high yield corporate debt make up only a small proportion of the market portfolio but are strongly represented in the efficient frontier.

The analysis also shows that, if historical mean returns are taken as a good indicator of future returns, then bond asset classes are undervalued. However, the degree of undervaluation is not statistically significant for high yield corporate debt. If liabilities are taken into account, then high yield corporate debt only appears to be attractive for part of any surplus assets if a low-risk investment strategy is required, since treasury bonds are a better match – unsurprisingly, since the liabilities are valued here with reference to treasury bonds.

Finally, cashflow analysis on both an asset-only and an asset-liability basis shows that, for post-1991 investor, a diversified portfolio of high yield corporate debt is an attractive investment. A fund investing before 1991 would have suffered a sharp fall in income (and capital values) that would not have been recovered (although the level of income would still have remained above that of other bond asset classes after 1991). However, if this early period in the development of the high yield corporate debt market is avoided, then income going forward is high and stable.

All of this is based on US asset classes. What about European high yield corporate debt? Being a young market, will it exhibit the same volatility that the US market did a decade ago, or will globalisation cause returns to be linked to US returns, reducing the risk? There was a concern that the European high yield corporate debt market was too concentrated in telecoms. This problem could be mitigated by investing in a diversified global high yield corporate debt portfolio, although telecom bankruptcies and the variety of new fallen angels have led to a larger and more diversified (though arguably lower quality) market.

Additional analysis could be carried out. For example, asset models such as the Wilkie [1, 2] and TY [3] models could be adapted to incorporate high yield corporate debt. This type of analysis could allow analysis not only of the relative market values but also of the income produced.

One complication is that no category of high yield corporate debt has a particularly long history. However, there is an argument that an asset class should not be ignored simply because it does not have a long time series to enable quantitative modelling. As Paul Myners points out [4], if poorly-researched markets with limited data are likely offer the best opportunities for higher risk adjusted returns, it is precisely those asset classes that are not susceptible to quantitative modelling which may be most worth pursuing.

Another area that would benefit from analysis is the effect on the division of risk between different stakeholders such as pensioners and shareholders in a company/pension scheme environment. Comprehensive work has been carried out in this area by Chapman et al [5].

Finally, I have not considered the potential for tax arbitrage available from choosing bond over equity investment – there is a compelling argument for many firms that they should match their pension liabilities with bonds and get any equity exposure that they want through altering their capital structure rather than investing in equities in their pension schemes.

However, from this paper, three conclusions can be drawn:

- US high yield corporate debt would have improved the mean-variance efficiency of low-risk portfolios of US assets;
- although past returns of US high yield corporate debt appear to have more than compensated for the additional risk as defined by the estimated beta, the additional return is not statistically significant at the 5% level; and
- a portfolio of US high yield corporate debt would have produced a consistently higher income stream relative to other bond asset classes and could have been used successfully as a matching asset for pensions in payment.

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