The Role of High Yield Corporate Debt in Pension Schemes

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Abstract

The purpose of this 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.

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 US equity and high yield corporate debt indices. I investigate this by carrying out decomposition calculations within US equity and high yield corporate debt sectors, but even less of the returns are explained in this case.

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.

Finally, I carry out cashflow 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 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 high and stable.

All of this is based on US asset classes. The European high yield corporate debt market is much younger and much more concentrated (in telecoms). Investing in a diversified global high yield corporate debt portfolio could mitigate this problem.

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 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].

It is also worth spending some time discussing emerging market debt. Emerging market debt is, put simply, debt originating from emerging market countries. It consists of both investment grade and high yield debt, although high yield debt dominates.

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.

I then carry out risk decomposition calculations to determine the degree to which returns on US equities and treasury bonds explain returns on US high yield corporate debt.

I then repeat this within corporate sectors for US high yield corporate debt and equities (for example, comparing capital goods high yield debt and equity) to see whether there are any biases arising from differing sectoral distributions within the 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.

Finally, I consider the cashflow 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.

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, I believe that it is important to construct an asset model that is sufficiently sophisticated to capture returns on treasury bonds, investment grade corporate debt, high yield corporate debt and equity. This is not a small project and I propose to carry out this work in a future study.

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

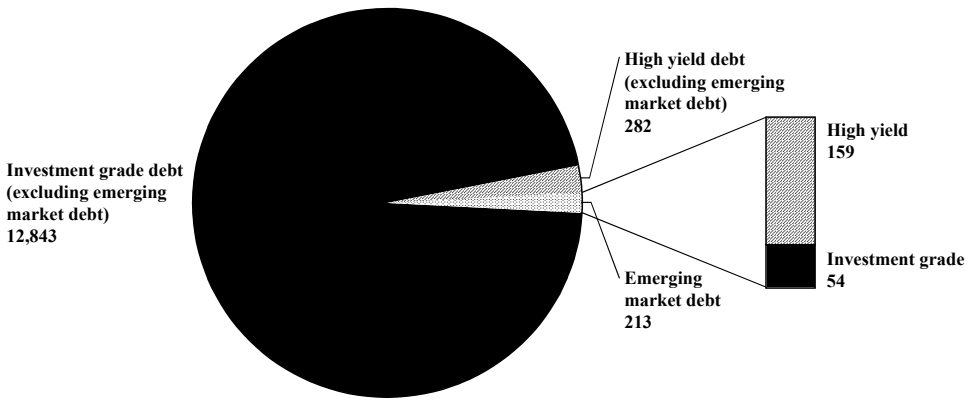
For this part of the analysis, I rely mainly on figures from Lehman Brothers [8] and CSFB [9]. The Lehman Brothers series offers coverage of investment grade and high yield debt, whereas the CSFB series concentrates solely on high yield debt. Both sets of indices have been running long enough to provide good historical data, especially for the US market. They are also broken down by corporate sector, which is essential for some of the analysis that I carry out. Finally, Lehman Brothers provide excess return figures for non-government bonds, these figures being the index return less the return on a set of duration-equivalent US treasury bonds. I also draw on the UBS Warburg series [10], which gives more detail on European bond markets.

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

The Lehman Brothers figures indicate that the total outstanding value of bonds at December 2000 was $13,347 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. I do, though, use the CSFB figures to illustrate the growth of the size of the high yield debt market because it has a longer history.

Whichever series is used, it can be seen that the markets for developed market high yield debt and emerging market debt are still tiny compared with the market for developed market investment grade debt, as shown in figure 1, even though the former have grown over the last few years. It is also interesting to note that high yield emerging market debt would make up more than one-third of the high yield debt market if it were included.

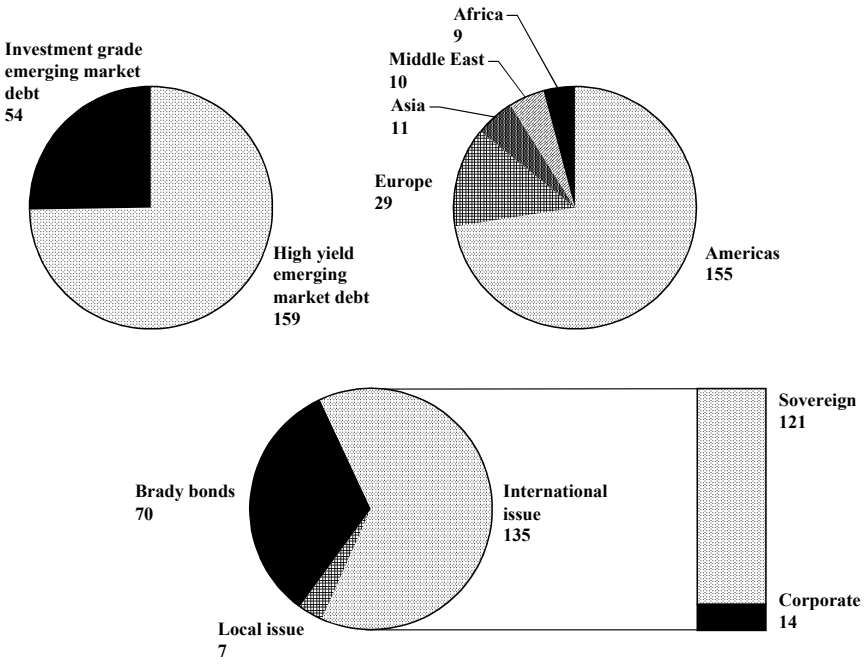
Figure 1: Composition of the global bond market by category ($bn, December 2000)



Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"

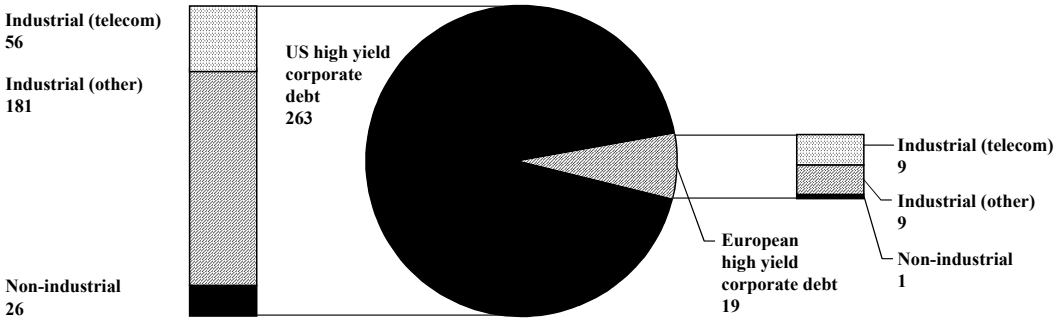
Let us now look in more detail at the market for emerging market debt. As noted above, it is dominated by high yield debt (75%). Indeed, according to the Lehman indices, it was entirely a high yield market in 1997. However, it can be divided several further ways (figure 2). Regionally, it is dominated by Latin America. This is unsurprising, as it is where the modern emerging market debt market originated. Brady bonds, fundamental to the expansion of this market, are a major sub-category. Also, interestingly, the vast majority of internationally issued emerging market debt is sovereign debt – in other words, very little high yield emerging market debt is corporate.

Figure 2: Composition of the market for emerging market debt by credit rating, region and type ($bn, December 2000)



Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"

Figure 3: Composition of the global high yield corporate debt market by region ($bn, December 2000)



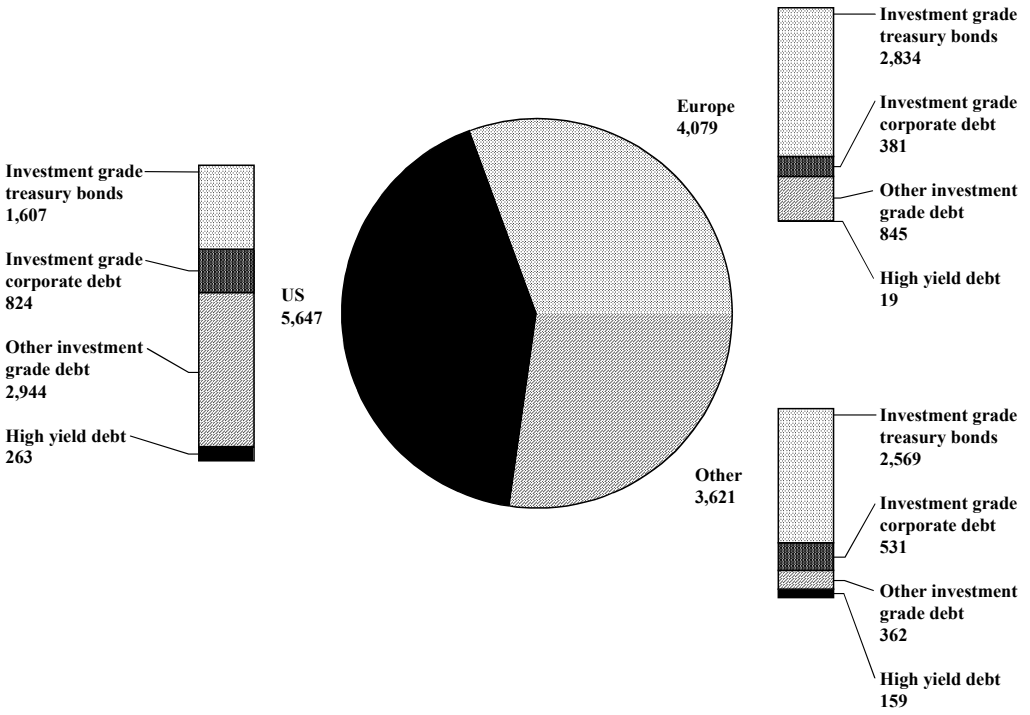
Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; UBS Warburg Bond Indices

Turning to high yield debt, there are several important features of this market. Ignoring emerging market debt ($213bn) and collateralised mortgage-backed high yield debt (only $9bn of the remaining $291bn), we can see that the high yield debt market is far larger in the US than in Europe (figure 3). It is also better developed and more diversified. In the Lehman Brothers US series, telecoms form a sub-group of the communications sub-sector, which itself falls within the industrials sector. However, they still make up more than 20% of the index. In UBS Warburg's European series, telecoms are a sub-sector of the corporate sector (equivalent to the industrial sector in the Lehman Brothers indices) and they make up nearly 50% of the index.

This is symptomatic of the fact that the increase in issuance of telecom bonds came at the same time as the creation of the European high yield debt market, whereas in the US they simply added to a pre-existing asset class.

Comparing the relative importance of different debt asset classes in the various regional markets is also informative. As can be seen in figure 4, the differences in composition of the various bond markets are significant. I divide the world into three regions – (US, Europe and "other") and each region into 4 categories (investment grade treasury bonds, investment grade corporate debt, other investment grade debt and high yield debt). Because of data limitations, emerging market debt could not be separated from the other categories in this instance. Other investment grade debt is mainly of importance in the US, due to the high level of collateralised debt. For high yield debt, developed market (i.e. corporate) debt makes up the all of the US and the majority of the European figures, and emerging market (i.e. mainly sovereign) debt makes up the remainder of the European and all of the "other" figures.

Figure 4: Composition of the global bond market by region ($bn, December 2000)



Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"

Investment grade treasury bonds make up the largest asset class in all regions outside the US (the largest part of the "other" region being Japanese government debt). However, this is more than offset by the size of the non-government debt market in the US, which is many times the size of that in other regions.

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.

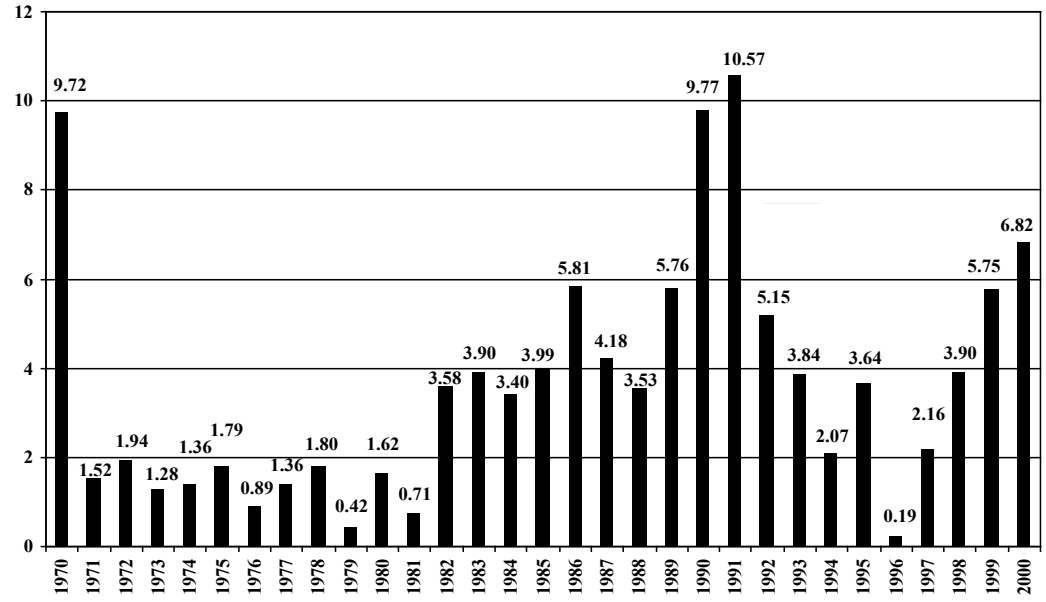
As shown in figure 5, there was a marked increase in the general level of default rates[2] in the 1980s when compared to the 1970s. This is possibly because the inherent default risk in "old style" high yield corporate debt (such as fallen angels) was less than that of "new style" bonds. This is particularly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

[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.

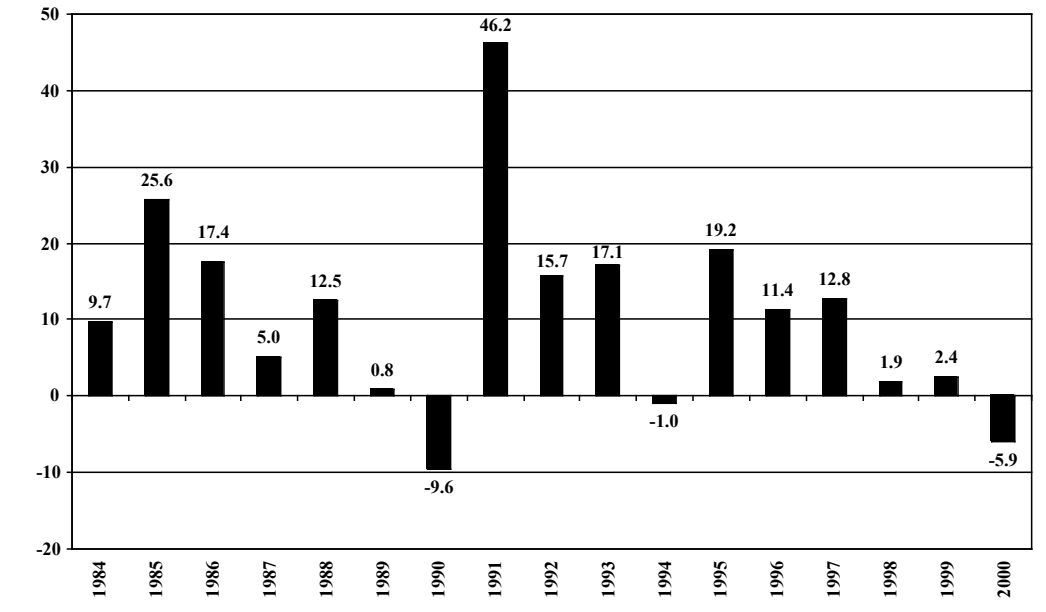
In the 1980s, hostile leveraged buyouts in particular became more prevalent. With the increased supply of high yield corporate debt, coupon rates for some new issues rose to more than 15% (compared with treasury yields of around 9% per annum). However, these rates required strong growth to maintain coupon 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, "Default and Recovery Rates of Corporate Bond Issuers: 2000"

Figure 6: Annual rates of return on US high yield corporate debt (%)



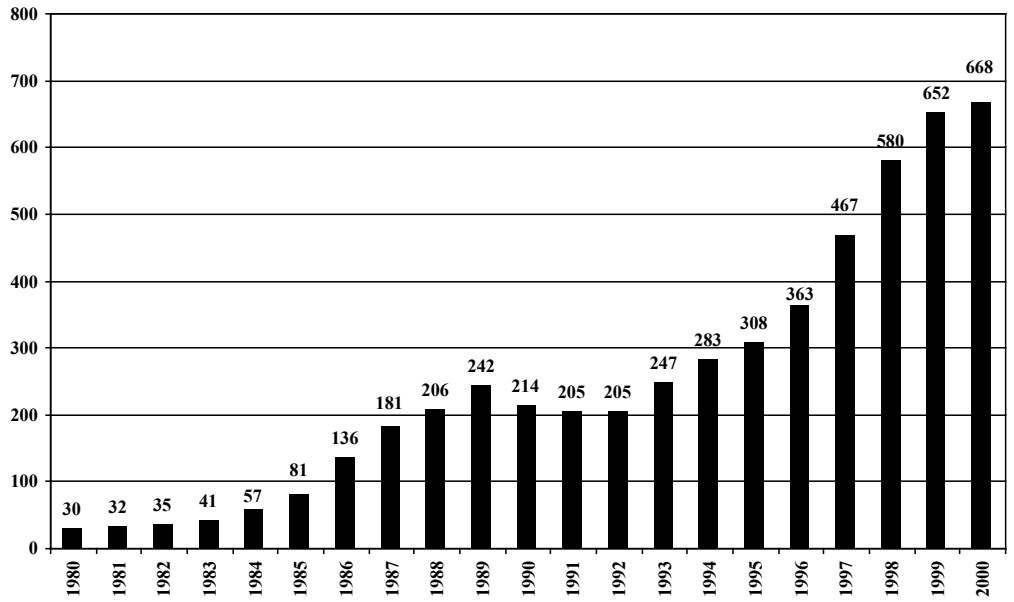
Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"

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.

The US high yield corporate debt market not only survived the problems of 1990, it positively thrived. As shown in figure 7, its market value grew at a consistently high rate throughout the 1990s.

Figure 7: Size of the US high yield corporate debt market ($bn)



Source: CSFB Global Leveraged Finance, "2001 Annual Review"

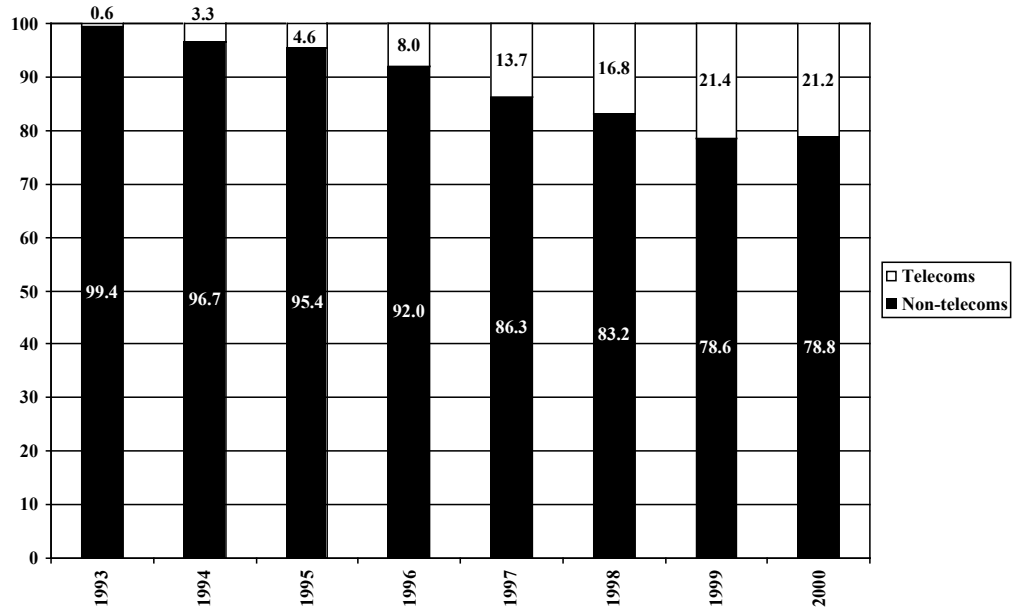
[3] "Break-even yield" on a high yield corporate bond is the yield-to-maturity required to compensate the investor for expected defaults. It is calculated by Altman as follows:

$BEY = (RF + DF(1 - Rec) + DF \times HYC/2))/(1-DF)$

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.

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 8. 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.

Figure 8: Split of the US high yield corporate debt market between telecom and non-telecom bonds (%)



Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"

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

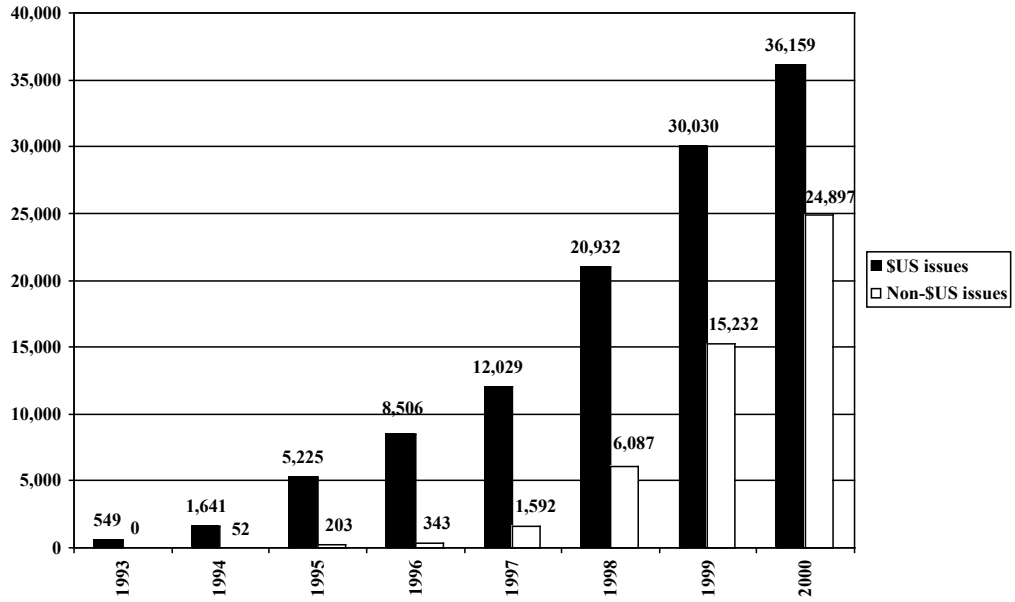
The US high yield corporate debt market now is a very different market to the one in 1980. Not only has it grown greatly in size, but it is also much more diversified than it was two decades ago – it is now an asset class in its own right.

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 make up a much larger proportion of the market (around 50%).

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]. As can be seen in figure 9, almost all European high yield corporate debt issued before 1997 was issued in $US and was part of the US market.

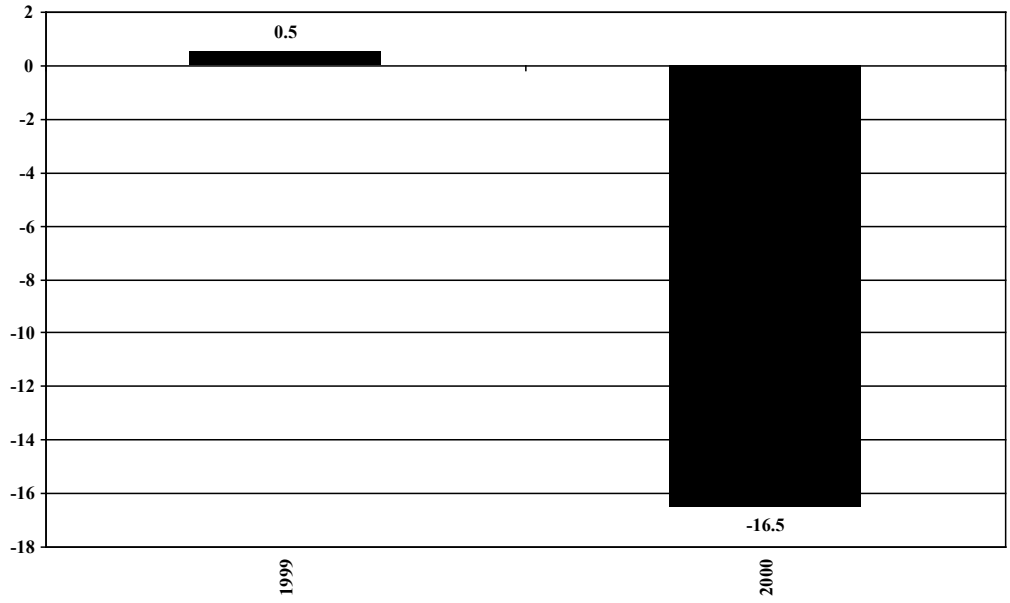
Figure 9: Size of the European high yield corporate debt market (€m)



Source: CSFB Global Leveraged Finance, "2001 Annual Review"

Because the market is so small and (currently) concentrated in telecom bonds (as shown in figure 3), European high yield corporate debt does not lend itself so well to diversified portfolios as US or global high yield corporate debt. This concentration also meant that it was more exposed than the US to the telecom, media and telecom downturn, giving the poor recent performance shown in figure 10. However, the large amount of new issuance meant that unlike the US high yield corporate debt market, the European market was still larger at the end of the year than at the start.

Figure 10: Annual rates of return on European high yield corporate debt (%)



Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"

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.

1.4.3 Emerging Market Debt

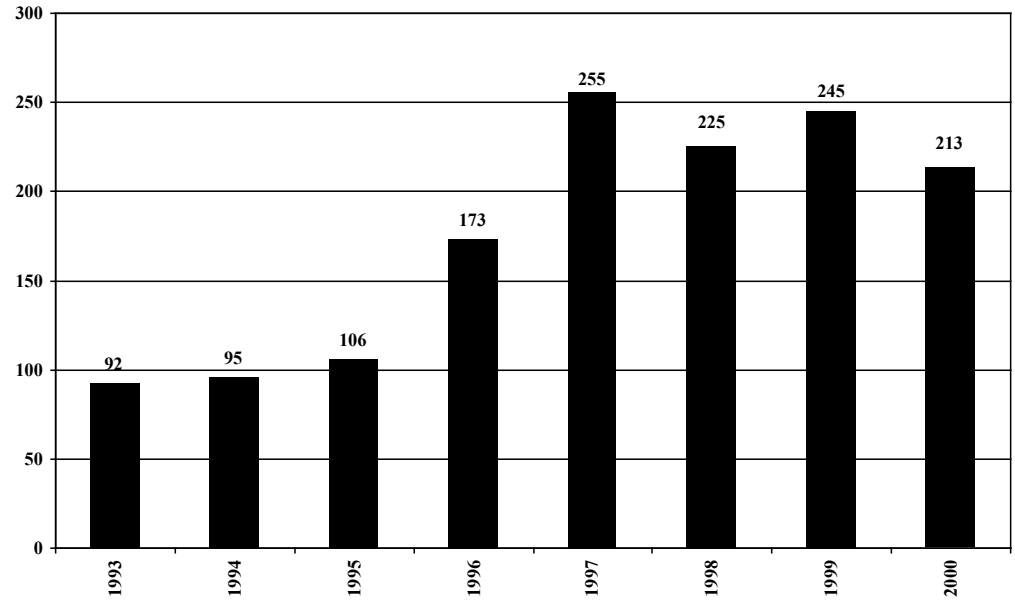
Much of the information in this section is taken from Buckley's *Emerging Markets Debt – An Analysis of the Secondary Market* [14]. At around the same time as the modern US high yield corporate debt market was forming, the foundations for the emerging market debt market were being laid. The event that drove this was the debt crisis of 1982 – prior to this, a market only existed inasmuch as some banks managed their emerging market debt portfolios through operations such as debt-debt swaps, assignments or sub-participations.

The crisis started in August 1982 when Mexico announced the suspension of principal payments on its foreign debt. By October 1983, 27 countries had begun or completed the process of rescheduling their debt to banks. For the next few years, rescheduling was the approach taken in response to the crisis, although even then it was only seen as a way of buying time rather than a permanent solution. However, the rescheduling process did lead to the amalgamation of debt into a smaller number of loan instruments, simplifying the documentation of the swaps and other loan transactions.

Another building block of the new market came in 1983 with the founding of the first specialist emerging market debt brokerages, Eurinam (in February) and Giadefi (in July). Despite this, transactions were still individually assembled with deals arranged over the telephone rather than through a central exchange. This also meant that there were no formal trading rules. In other words, it was still more of an informal network of banks than a true market.

The embryonic market carried on through various ups and downs until, in 1990, the first Brady bonds were issued by Mexico. The Brady Plan was a proposal for the conversion of commercial bank debt into standardised bonds. This conversion of bank loans into bonds set the scene for the new market until the mid 1990s, initially in Latin America but later more widely. As shown earlier in figure 2, Brady bonds are still a major part of the emerging market debt universe. However, although the market has grown greatly since Brady bonds came onto the scene (as shown in figure 11), it has not been an easy ride.

Figure 11: Size of the market for emerging market debt ($bn)

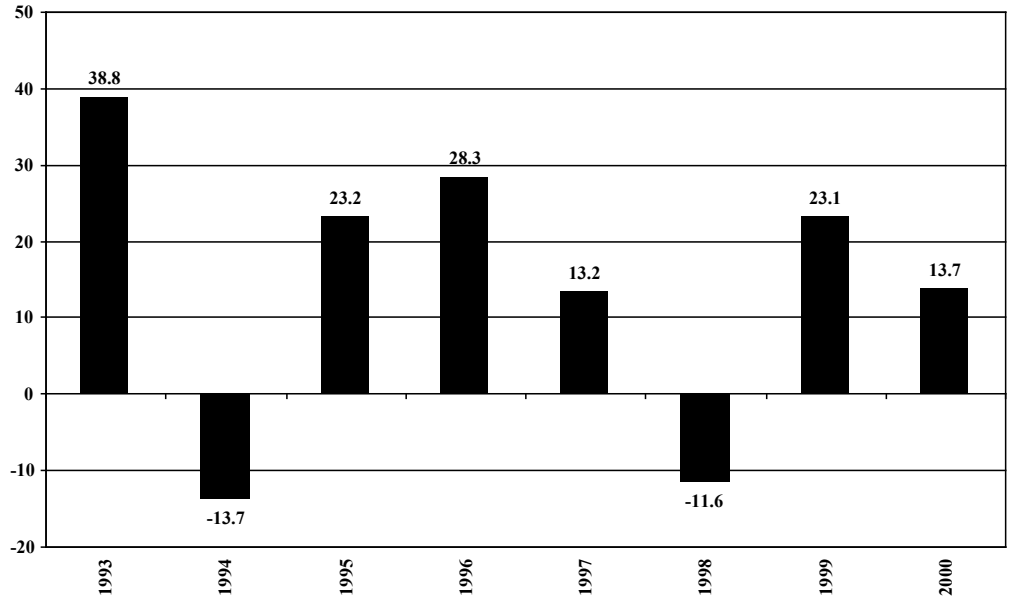


Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"

The first shock was the Brazilian collapse of 1991. This was caused by worries over the economy and the delay of a major privatisation, both events denting confidence. The effects were felt in almost all emerging market debt markets – the only exceptions were those nations that had adopted Brady style restructurings (i.e. issued collateralised bonds in exchange for debt relief).

Next, in 1994, a combination of US interest rate rises and political unrest in Latin America led to sharp falls in the value of emerging market debt, particularly in Mexico, as shown in figure 12.

Figure 12: Annual rates of return on emerging market debt (%)



Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"

The subsequent devaluation of the Mexican peso caused the fall to continue through into early 1995. The problems in Mexico were subsequently transmitted to other emerging markets, not just in Latin America but as far away as Europe and Asia (the "Tequila Effect").

The market did recover from these two shocks and in the second half of the 1990s could be said to have grown to become a mainstream rather than a niche market. However, the volatile returns continued and the next major problem arose in 1997, starting in Thailand. Its current account deficit coupled with a failed attempt to support its currency ended with the Thai baht losing 50% of its value in six months. As with the Mexican crisis in 1994 and 1995, the effect spread around the world (the "Asian Contagion"), with October 1997 seeing particularly sharp losses.

The markets were still reeling from the effects of this crisis when, in August 1998, Russia placed a three month moratorium on debt payments. The rouble fell by 50% in two weeks and, in August, the Lehman Brothers Emerging Market Debt Index fell by 25%. This fall was not so much a result of Russia's importance to the world economy but more to do with the lack of confidence sparked by two negative surprises occurring so closely together. In other words, although the market for emerging market debt is now much more mature than even a decade ago, the volatility it exhibits shows that it has some way to go.

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2. Previous Studies

2.1 Introduction

I next consider two previous studies that include discussions of the merits of high yield corporate bonds relative to other assets. These studies are:

- ABN Amro [1]
- UBS Warburg [2]

2.2 The ABN Amro Study

The purpose of this study was to compare the risk and reward of various credit bond asset classes (emerging market debt, investment grade corporate debt and high yield corporate debt), against treasury bonds and equities. One of the primary objectives was to investigate whether the yield spreads are sufficient to justify the additional risk of credit bonds over government bonds. The study considered $US and € investors, although only US data was used due to the paucity of non-US corporate bond data.

The study used two broad approaches to test the usefulness of credit bonds:

- historical analysis; and
- Monte Carlo simulations.

2.2.1 Historical Analysis

In the historical analysis, the means and standard deviations over several periods were compared for:

- US treasury bonds;
- US investment grade corporate debt;
- US high yield corporate debt;
- $US-denominated emerging market debt;
- global government bonds (unhedged and hedged into $US);
- US equities;
- developed market global equities (unhedged); and
- emerging market equities (unhedged).

The periods analysed were largely driven by the availability of data, but several other considerations were taken into account. Data from the period running from 1973 to 1987 were largely ignored, the reason being given that the late 1970s to the early 1980s was a period of high inflation that distorted returns. 1987 to 1999 was used as it contained a good balance of different economic regimes. However, the emerging market debt index used by ABN Amro (J P Morgan's Emerging Market Bond Index for Brady Bonds) does not stretch back that far, so the period 1991 to 1999 was also used to support strategic conclusions. The data for the other bond asset classes was Lehman Brothers' data, whereas the equity data was MSCI total return data for the appropriate region.

The bond indices, after having been split by credit rating, were then re-analysed after having been adjusted to make their durations match those of US treasury bonds. Without this adjustment, differences in returns could be attributable not only to credit quality differences, but also to duration differences. However, the analysis showed that this adjustment was only relevant for investment grade corporate debt, the difference in results being only marginal for high yield corporate debt and emerging market debt. The explanation given for this was that these categories of debt were much less sensitive than investment grade corporate debt to changes in interest rates. Since my analysis is centred around high yield corporate debt, I do not duration-adjust my data.

Some aspects of the historical risk-return analysis used by ABN Amro were designed to be easily understandable rather than theoretically correct. Therefore, whilst risk was measured in terms of annualised monthly standard deviations, return was measured in terms of geometric annual return rather than mean monthly return.

ABN Amro drew eight conclusions from the historical US data:

- in total return terms, credit bonds offer positive long-run credit risk premia which increase with their risk and are inversely related to rating quality;
- credit premia can vary enormously through time: recessionary periods and/or periods with great financial unrest tend to produce negative relative returns, particularly in the case of high yield corporate debt and emerging market debt;
- in total return terms there are 3 distinct groups:
  - US treasury bonds, US investment grade corporate debt and hedged global government bonds;
  - unhedged global bonds and US high yield corporate debt; and
  - US equities, global (including emerging market) equities and emerging market debt;
- the low risk of investment grade corporate debt relative to treasury bonds is a result of the negative correlation between treasury returns and investment grade excess returns;
- in terms of risk-adjusted returns, credit bonds, in particular investment grade corporate debt and high yield corporate debt, look attractive in comparison with other assets;

- risk decompositions show that investment grade corporate debt can be regarded as a bond asset class, while high yield corporate debt and emerging market debt need to be treated as separate animals as they have hardly any interest rate exposure, a limited (high yield corporate debt) to high (emerging market debt) correlation with equities and significant risks of their own (although it is worth mentioning that this risk decomposition, being based purely on a comparison of returns, might not be a robust way of measuring the relationship between different asset classes);
- pricing of corporate bond asset classes is remarkably consistent, with monthly residual rewards between 15 and 23 basis points per unit of residual risk. The emerging bonds asset class had a much lower reward of only 3 basis points; and
- due to non-normality and/or autocorrelation, the traditionally calculated standard deviation may underestimate the true risk of credit bonds. This is of particular relevance to high yield corporate debt and emerging market debt.

This part of the ABN Amro study was, therefore, positive on the use of high yield corporate debt in portfolios, based on historical data.

2.2.2 Monte Carlo Simulations

Next, the study considered a series of Monte Carlo simulations. The first considered a series of two-asset portfolios (optimisation techniques thus being avoided), the asset classes used being:

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

Historical data were used to calculate the standard deviations and correlations between the asset classes. The returns on investment grade and high yield corporate debt were modelled as functions of the returns on government bonds and equities plus a residual term. For high yield corporate debt, an additional term was added to capture the long-term effect of autocorrelation.

Long run returns of 7.00% were assumed for US treasury bonds with additional risk premia of 100 b.p. for US investment grade corporate debt, 200 b.p. for US high yield corporate debt and 400 b.p. for US equities. All returns were assumed to be normally distributed.

A similar study was carried out for European data using the same standard deviation and correlation figures as in the US study, except for European government bonds and equities, where local data was used. Also, a slightly lower risk premium was used for European investment grade corporate debt (60 b.p. rather than 100 b.p.) to reflect the lower bond spreads at the time of the study.

Initially, fixed income-only investors were considered. Efficient frontier analysis, where the variables were annualised geometric mean return and annualised standard deviation, showed that adding investment grade corporate debt to a government bond portfolio both increased return and reduced risk for all combinations in the case of the US simulation and up to around 70% investment grade corporate debt (after which risk increased slightly) for the European simulation. In other words, the efficient frontier for the US was a single point (100% investment grade corporate debt) and for Europe was from 70% to 100% investment grade corporate debt. This difference is unsurprising, given that the risk premium for investment grade corporate debt was higher in the US simulation than in the European one. The combinations of high yield corporate debt with investment grade corporate debt and government debt a showed more conventional picture where, for the most part, additional risk was compensated for by additional return.

For balanced (i.e. equity and fixed interest) investors, incrementally replacing government debt with investment grade or high yield corporate debt in a mixed portfolio of equity and bonds meant that greater return was achieved for a given level of risk. This was true for both the US and the European projections.

Although these projections are interesting, they are not too surprising. By giving credit bonds a higher expected return than government bonds and less than perfect correlations with all asset classes, it is almost inevitable that they will improve the efficiency of portfolios in projections. There is, perhaps, scope to increase the sophistication of the projection models.

Further projections extended the simulations to allow for global equities, global government bonds, emerging market equities and emerging market debt. An allowance was also made for two separate economic regimes, "bad times" and "normal/good times". Three periods of bad times were identified:

- 1989/90 when the US went into recession and corporate bond spreads widened;
- 1994 when the policy of the US Federal Reserve changed radically and the Mexican debt crisis loomed, both denting consumer confidence; and
- 1998 when the Asian and Russian debt crises caused credit spreads to widen sharply.

The ABN Amro study used an inspection of US industrial production graphs, yield to maturity indices and return figures to partition the data. The two-regime approach appeared to show that:

- historical mean returns are much lower in bad times than in normal/good times;
- standard deviations of returns are higher in bad times than in normal/good times; and
- credit bonds become less interest rate sensitive and more equity sensitive in bad times and vice versa in normal/good times.

The two-regime approach was incorporated in the modelling by attaching conditional probabilities to the occurrence of a particular regime given the previous regime. The probability of a particular regime continuing into time period t was higher if that regime had existed in time period t-1. This led to clustering in the occurrence of particular regimes.

The reason for this two-regime approach was to improve the modelling of non-normality and kurtosis displayed in the returns for some of the asset classes, in particular high yield corporate debt and emerging market debt, although over a three-year projection horizon, cumulative returns tended towards normality (as predicted by the central limit theorem).

The unconditional long-term risk premia for the additional asset classes were 400 b.p. for emerging market debt, 400 b.p. for global equities (both the same as for US equities) and 800 b.p. for emerging market equities.

These simulations showed that under ABN Amro's assumptions, investment grade and high yield corporate debt would improve the efficiency of a balanced portfolio at every level except the very lowest and very highest risk. Emerging market debt was more useful in higher risk portfolios. However, in bad-time scenarios, holding emerging market debt or high yield corporate debt in a portfolio was shown to be very damaging to portfolio returns.

2.3 The UBS Warburg Study

The UBS Warburg study focussed solely on European high yield corporate debt. UBS Warburg noted that many analyses of high yield corporate debt had gone no further than comparing the risk and return properties of a given high yield index with those of equity, government bond and investment grade bond indices. Three problems with this approach were highlighted:

- data bias;
- sector bias; and
- leverage bias.

Data bias refers to the fact that if you are trying to model European high yield corporate debt (which they were), then the indices are few in number, short in history and light on stocks. There was no solution to this problem in the case of the UBS Warburg study, but it is a difficulty that I hope to avoid by using US data.

Sector bias can arise because the sector composition of an index for high yield corporate debt is unlikely to be the same as that of the associated investment grade corporate debt or equity markets. As mentioned in Chapter 1, both the US and European high yield corporate debt markets have strong technology biases. I propose to tackle this issue by analysing the relationships between individual high yield corporate debt and equity sectors. UBS Warburg used a different approach, as discussed later.

The final bias highlighted was leverage (gearing) bias. UBS Warburg contended that a company issuing a bond with a lower investment grading is likely to have a higher debt/equity ratio than a company issuing a more highly rated bond. This is important, they said, because the risk and reward characteristics for the equity of each type of company will differ. However, there is evidence of a positive correlation between the degree of leverage and the sector to which a stock belongs [3], meaning that if the sector bias can be dealt with, then the effect of any residual leverage bias will be mitigated. For this reason, I do not propose to deal explicitly with this issue.

UBS Warburg did attempt to tackle all three biases. The way they did this was to look at five European companies that issued both equities and high yield corporate debt, and to compare the returns since issue on a company-by-company basis. The results of this analysis were that the equities gave a much higher return but at the expense of a much higher risk. Dividing the mean returns by standard deviation of returns (as an approximation to risk adjusted returns) gave a higher figure for equities in three cases and for high yield corporate debt in two, but such a small sample cannot be expected to produce a conclusive answer.

However, the returns for one company, Colt Telecom, indicated one important point: that whilst the maximum return on high yield corporate debt is finite (return to the call price for a callable bond or the yield if the bond is not called), there is no theoretical maximum return for an equity - between issuance (December 1996) and the end of the sample period for the UBS Warburg Study (June 2000), the annualised return on Colt Telecom's equity was 1,577.5%.

Further interesting information provided in the study was that the return on equity in a downturn was much worse than for high yield corporate debt, although the supporting sample consisted entirely of telecom stocks and the fall could well be attributed to the deflation of a bubble that gave rise to unrealistically high equity prices in the first place. If this was the case, then debt rated below investment grade could never be expected to give such high returns as equity whilst the bubble formed – in addition to the theoretical maximum return mentioned earlier, there is a practical limit to how far yield spreads on high yield corporate debt relative to treasuries can realistically reduce.

References for Chapter 2

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3. Expanding the ABN Amro Study

3.1 Introduction

The purpose of this chapter is to expand on the work carried out by the ABN Amro team in their paper [1]. As I noted in the previous chapter, there are several weaknesses in the ABN Amro methodology, some of which are more important than others. Also, an additional year's data is available since the conclusion of the study, so I update the ABN Amro results to take this into account.

3.2 Geometric versus Arithmetic Mean Returns

The ABN Amro study used geometric rather than arithmetic means in the mean-variance analysis. I use the arithmetic mean, since it is the more appropriate measure for mean-variance analysis. Considering the data for 1987 to 1999, the period favoured by ABN Amro, the differences between arithmetic and geometric means (shown in table 1) are quite small and do not alter the conclusions drawn from the data. Another point worth noting is that the ABN Amro figures are calculated using monthly data but quoted as annual amounts. In my analysis, I quote monthly figures.

Table 1: **Annual return statistics for US asset classes (1987-1999)**

Asset Class	Sample standard deviation (%)	Geometric mean (%)	Arithmetic mean (%)
Treasury bonds	4.57	7.49	7.35
Investment grade corporate debt	4.99	8.28	8.11
High yield corporate debt	6.99	9.61	9.45
Equities	14.92	18.43	18.17

Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Morgan Stanley Capital International

3.3 Extending the Sample Period

As mentioned above, ABN Amro favoured the period 1987-1999 for its study. However, since an additional year of data is available for my study, I recalculate the standard deviations and means to see how much of a difference the addition of data from 2000 has. I also consider the period 1984-2000, 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. The results are shown in table 2 and figure 13.

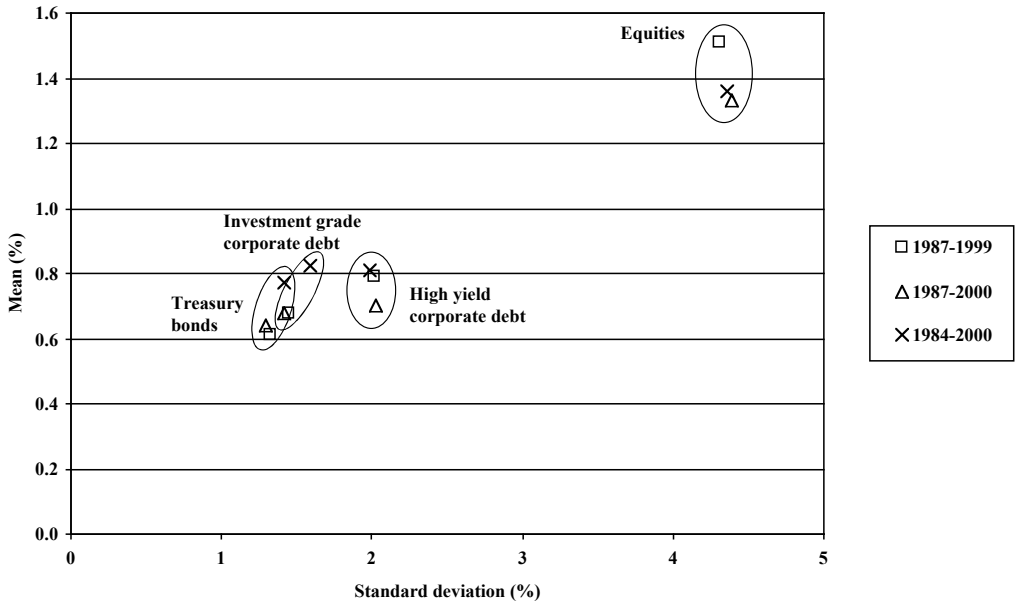
As can be seen, the near-linear relationship between risk and reward only exists for 1987-1999 – the return advantage of US high yield corporate debt over US treasury bonds is greatly reduced for the other two data sets due to the poor relative performance of US high yield corporate debt relative to US treasury bonds in 2000. Indeed, for 1984-2000, the mean return on US high yield corporate debt was exceeded by that on US investment grade corporate debt.

Table 2: **Monthly return statistics for US asset classes**

Asset Class	Sample standard deviation			Mean		
	1987-1999 (%)	1987-2000 (%)	1984-2000 (%)	1987-1999 (%)	1987-2000 (%)	1984-2000 (%)
Treasury bonds	1.32	1.29	1.42	0.61	0.64	0.77
Investment grade corporate debt	1.44	1.41	1.59	0.68	0.68	0.82
High yield corporate debt	2.02	2.03	1.99	0.79	0.70	0.81
Equities	4.31	4.39	4.36	1.51	1.33	1.36

Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Morgan Stanley Capital International

Figure 13: Monthly return statistics for US asset classes



Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Morgan Stanley Capital International

What this chart does not show is that the correlation of US treasury bonds with US high yield corporate debt is far lower than their correlation with US investment grade corporate debt, meaning that high yield corporate debt is a good diversifying asset at the lower risk end of the efficient frontier. Correlations are given in tables 3 to 5.

Table 3: **Correlation coefficients for US asset classes (1987-1999)**

	Treasury bonds	Investment grade corporate debt	High yield corporate debt	Equities
Treasury bonds	1.000			
Investment grade corporate debt	0.954	1.000		
High yield corporate debt	0.272	0.456	1.000	
Equities	0.231	0.346	0.499	1.000

Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Morgan Stanley Capital International

Table 4: **Correlation coefficients for US asset classes (1987-2000)**

	Treasury bonds	Investment grade corporate debt	High yield corporate debt	Equities
Treasury bonds	1.000			
Investment grade corporate debt	0.946	1.000		
High yield corporate debt	0.240	0.445	1.000	
Equities	0.223	0.339	0.491	1.000

Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Morgan Stanley Capital International

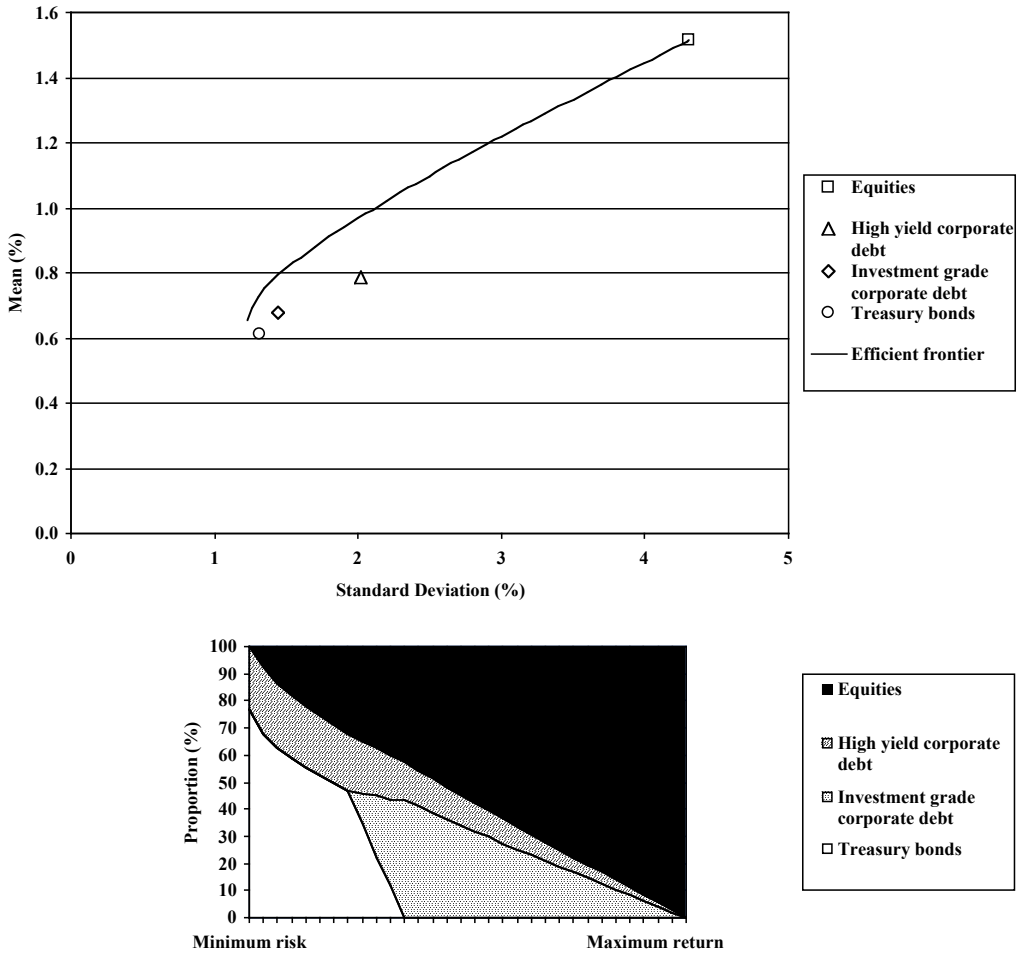
Table 5: **Correlation coefficients for US asset classes (1984-2000)**

	Treasury bonds	Investment grade corporate debt	High yield corporate debt	Equities
Treasury bonds	1.000			
Investment grade corporate debt	0.939	1.000		
High yield corporate debt	0.339	0.513	1.000	
Equities	0.275	0.355	0.497	1.000

Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Morgan Stanley Capital International

Efficient frontiers [2], calculated using the solver in Microsoft Excel [3] and charts showing the proportions of assets in them are given in figures 14 to 16. These charts differ slightly, but there are several important similarities. Firstly, the US fixed income asset classes are grouped at one end of the efficient frontier with US equities at the other. Also, the charts of the composition of the efficient frontier are dominated by US treasury bonds at the minimum risk end of the scale with the maximum return (and maximum risk) end of the scale being 100% US equities in all three cases. However, the interesting asset classes are US high yield and investment grade corporate debt.

Figure 14: Efficient frontier analysis and composition using monthly return statistics for US asset classes (1987-1999)

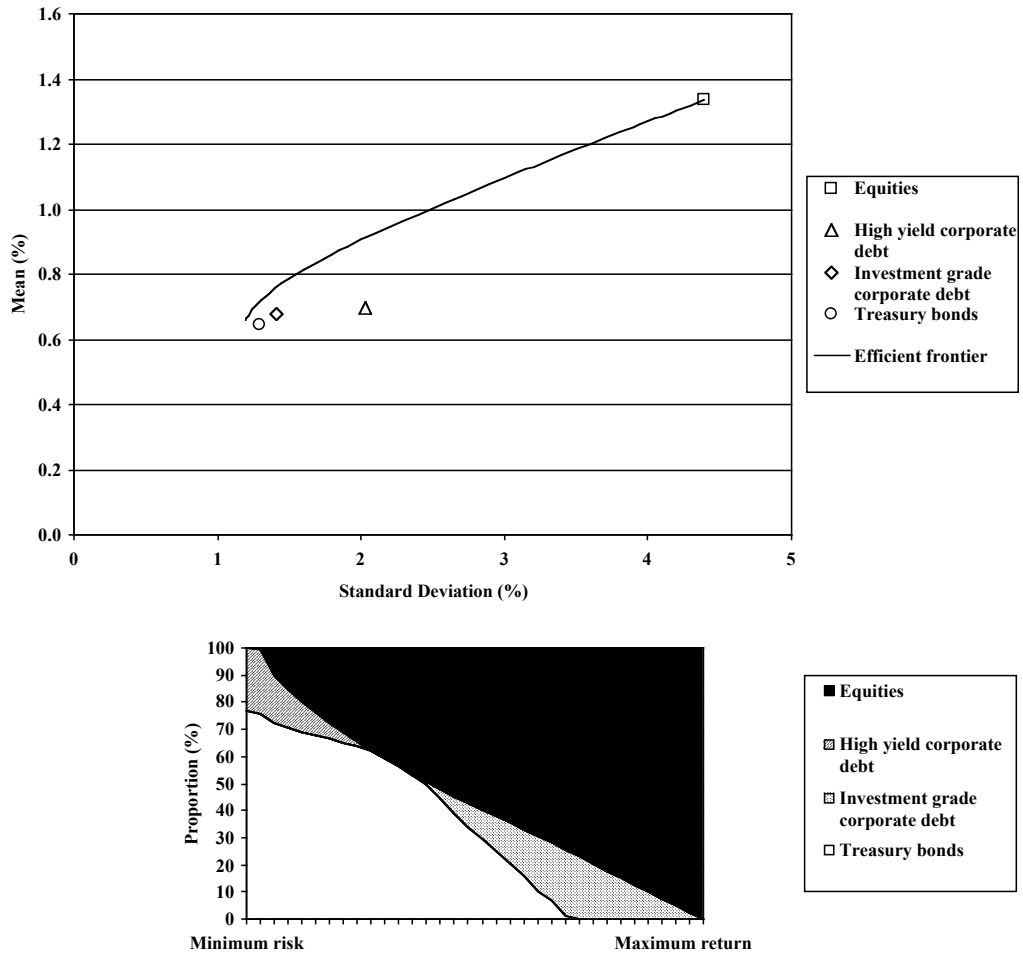


Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Morgan Stanley Capital International

US high yield corporate debt is a significant proportion of the minimum risk portfolio in all three cases – the exact proportions are shown in table 6. US investment grade corporate debt does not appear in any minimum risk portfolios. This is because the additional return offered by US investment grade corporate debt over US treasury bonds is not as attractive as the reduction in risk available from mixing US high yield corporate debt and US treasury bonds.

The return advantage of US investment grade corporate debt, and its lack of correlation with US equities, means that it is this asset class that can be found with US equities in the higher risk and return portfolios. The "middle ground" depends on the risk and return characteristics of the various asset classes in each sample. As can be seen, this middle ground is quite variable. In figure 14, US high yield corporate debt plays an important part in many portfolios, including those fairly high up the risk scale.

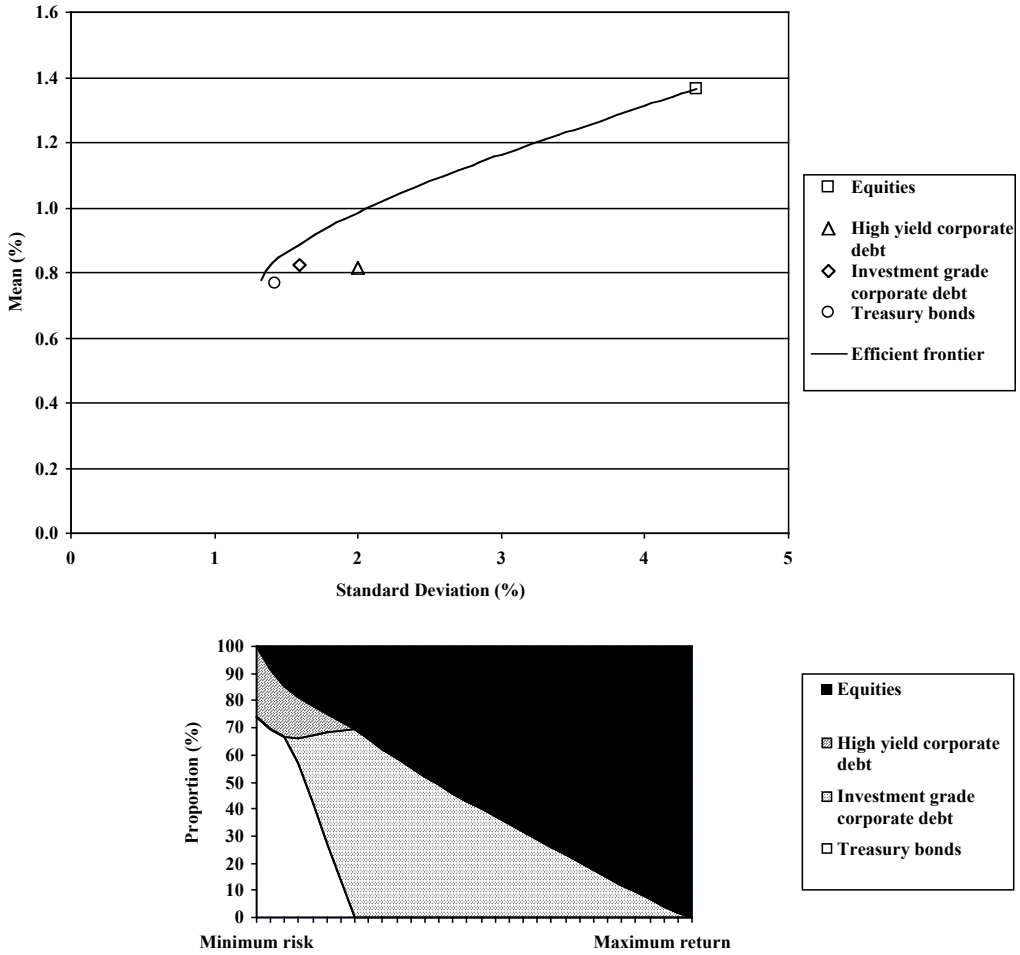
Figure 15:Efficient frontier analysis and composition using monthly return statistics for US asset classes (1987-2000)



Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Morgan Stanley Capital International

However, the poor relative performance of US high yield corporate debt relative to other asset classes in 2000 means that it falls out of the higher risk portfolios. In figure 15, the medium risk portfolios are dominated by US investment grade corporate debt. For the longest time period, shown in figure 16, both credit bond asset classes are squeezed to the margins as portfolios are dominated by US treasury bonds and US equities.

Figure 16: Efficient frontier analysis and composition using monthly return statistics for US asset classes (1984-2000)



Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Morgan Stanley Capital International

Table 6: Composition of the minimum risk portfolio for US asset classes

Asset Class	Sample period		
	1987-1999 (%)	1987-2000 (%)	1984-2000 (%)
Treasury bonds	76.7	77.0	74.0
High yield corporate debt	23.3	23.0	26.0

Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Morgan Stanley Capital International

3.4 Risk Decomposition – the ABN Amro Approach

As mentioned in chapter 2, the approach adopted by ABN Amro[4] may not be the best way of investigating the relationship between the various asset classes. However, it is an approach I adopt for some work in this paper, partly so that I can see how an additional year's data affects the results, but also for some additional analysis.

There is one change I make to the ABN Amro approach, and that is to restrict the regression so that there is no constant. This is because in all of the regression calculations bar one (the utilities sector later on) the t-statistics suggest that the constant term is not significant at the 5% level of significance.

Strictly speaking, if either US treasury bonds or US equities do not appear to have any explanatory power (according to the t-statistics), then they should be excluded from that particular risk decomposition. However, I choose not to omit either of these variables whatever the level of significance and to let the low explanatory power be reflected in the small proportion of returns explained in the risk decomposition. Also, the number of borderline cases would make exclusion a more arbitrary decision.

As mentioned earlier, ABN Amro favoured the period 1987-1999 for its study. However, since an additional year of data is available, I re-run the regression using 1987-2000 and 1984-2000 data. Figure 17 therefore shows four risk decompositions:

- 1987-1999 data including a constant;
- 1987-1999 data excluding a constant;
- 1987-2000 data excluding a constant; and
- 1984-2000 data excluding a constant.

As can be seen, the risk profile according to this method remains fairly constant, with around three quarters of the variation in returns being unexplained and most of the rest being attributable to US equity returns, with US treasury bond returns apparently playing very little part. However, US treasury bond returns are apparently more important for the longer time period than any of the shorter ones.

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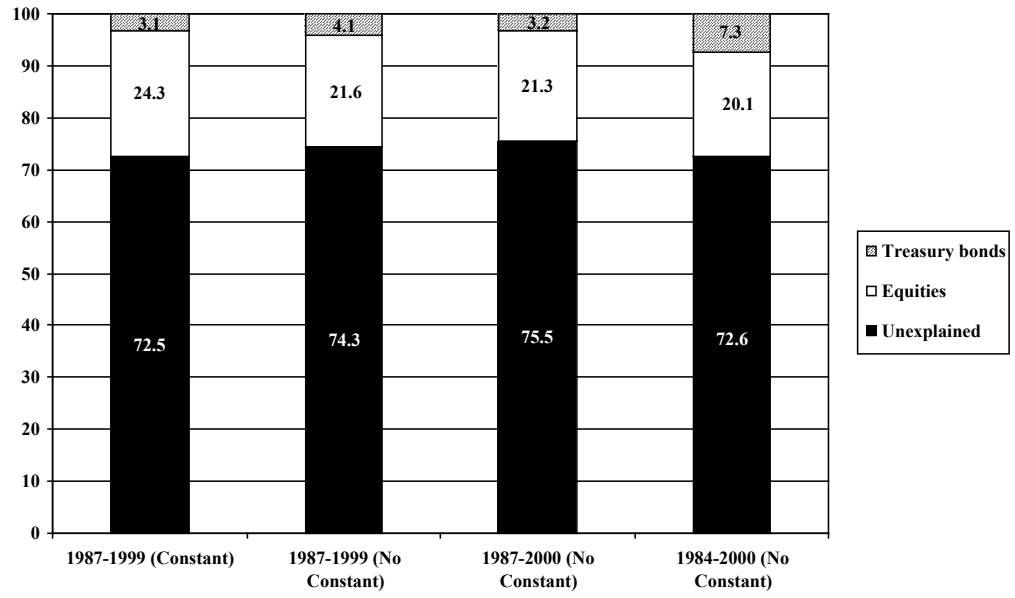
[4] A regression model was run of the form: $y_t = a + b.x1_t + c.x2_t + \varepsilon$ where y_t is the monthly return on US high yield corporate debt; $x1_t$ is the monthly return on US equities; $x2_t$ is the monthly return on US treasury bonds; ε is an error term; and a, b and c are constants.

The variance was then calculated as: $Var(y) = Var(a + b.x1 + c.x2 + \varepsilon)$ which can be rewritten as: $Var(y) = b^2.Var(x1) + c^2.Var(x2) + 2\rho_{x1,x2}.b.c.\sigma_{x1}.\sigma_{x2} + Var(\varepsilon)$ where $\rho_{x1,x2}$ is the correlation coefficient between $x1$ and $x2$.

If this is rewritten in terms of sums of squared deviations (SSDs) from the means of all variables, complications arising from the different degrees of freedom of the various variance estimates are avoided: $SSD(y) = b2.SSD(x1) + c2.SSD(x2) + interaction\ term + SSD(\varepsilon)$

The terms can be standardised in terms of $SSD(y)$ (the total variability) and the interaction term attributed in proportion to $x1$ and $x2$ (which also avoids the problem of displaying the interaction term if it is negative) to give the unknown proportion of variability and that attributable to $x1$ and $x2$.

Figure 17: Risk decomposition of US high yield corporate debt (%)



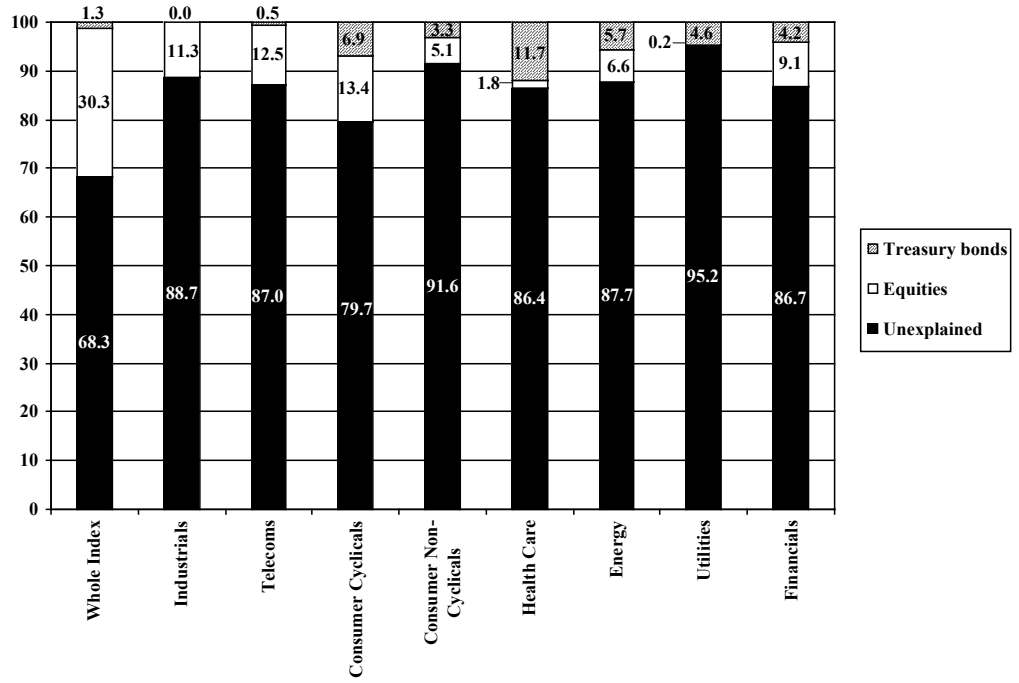
Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Morgan Stanley Capital International

How much of the unexplained variation, though, is explainable by the fact that sector composition of the equity index is different to that of the high yield corporate bond index? One way of investigating this is to match up corresponding sectors from the equity and high yield corporate debt indices and carry out the same risk decomposition for these sectors. I do this and the results are shown in figure 18, although it is worth noting that the sample period for the data is shorter, starting in January 1995, since this is the date from which MSCI data became available for sectors (under the new classification).

One interesting observation is that for the index as a whole, the unexplained proportion of high yield corporate debt returns is much lower than for the longer periods. This could be explained by the fact that the data set excludes the more turbulent, earlier years of the high yield corporate debt market.

Figure 18 also shows that rather than increasing the explanatory power, looking at individual sectors actually reduces the explanatory power of the equations. There are several possible explanations for this. The first is that the companies in the equity sectors are so different to those in the corresponding high yield corporate debt sectors that, since the sectors chosen do not represent the universe, the correlation between those equities and high yield corporate debt is low. A second explanation is that the correlation between the asset classes is spurious and that the true relationship between equity and high yield debt is lower than suggested by ABN Amro. Following on from this, it might also be true to say that the best way to look at the interaction between the two asset classes is to look more deeply than just analysing the returns.

Figure 18: Risk decomposition of US high yield corporate debt for individual sectors (%, 1995-2000)



Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Morgan Stanley Capital International

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4. Calculation of the Beta for High Yield Corporate Debt

4.1 Introduction

The start of this is part of the analysis is very similar to that in the previous chapter. However, instead of simply looking at the returns of the various asset classes, I look at the returns in excess of the risk free rate when calculating the standard deviation of returns. This is because the risk free rate is supposed to have a standard deviation of zero (being risk free), whereas in fact the monthly standard deviation is only very small (0.08%). This makes no difference to the standard deviations at four decimal places. The figures are given in table 7. Ideally, one-month treasury bill rates would be used to give the risk free rate of return, as they offer a risk free return over the investment horizon being considered (i.e. one month). However, as a proxy, I use the US discount rate, so the risk free asset class is US cash, the returns for which are also shown in table 7.

Table 7: **Monthly return statistics for US asset classes, the market portfolio and the optimal portfolio (1990-2000)**

Asset Class	Sample standard deviation calculated using returns in excess of cash (%)	Mean (%)
Cash	N/A	0.40
Treasury bonds	1.20	0.65
Investment grade corporate debt	1.35	0.67
High yield corporate debt	2.10	0.75
Equities	4.02	1.30
Market Portfolio	2.72	1.03
Optimal Portfolio	1.45	0.79

Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Morgan Stanley Capital International; US Treasury

The analysis in this chapter introduces the idea of a market portfolio, being the portfolio containing all assets in proportion to their market weights. As before, I restrict the universe to US investments, but I include investment grade corporate debt in this analysis since it makes up a large part of the US bond market. The market portfolio therefore consists of:

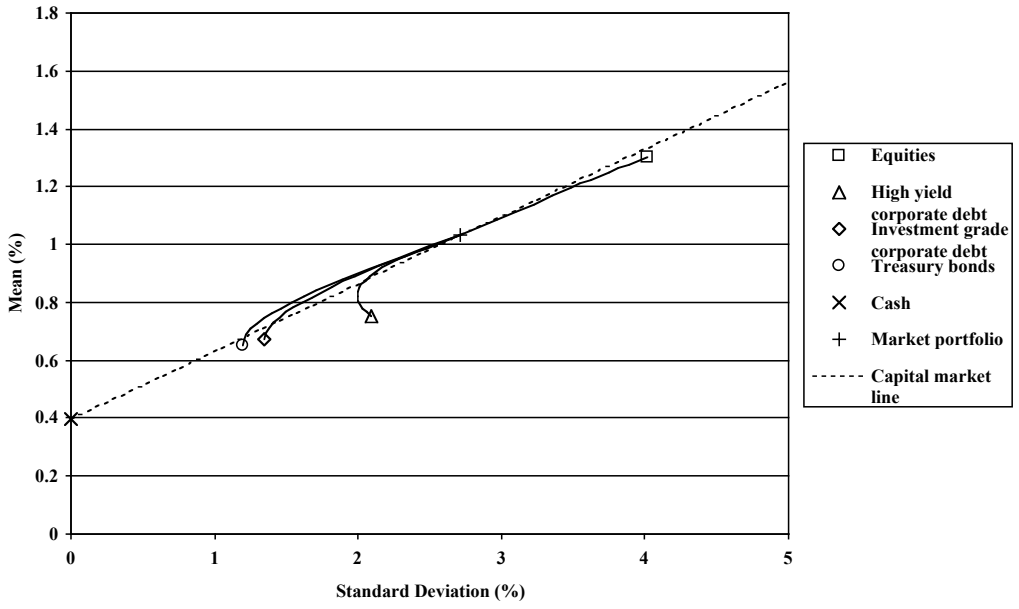
- US treasury bonds;
- US investment grade corporate debt;
- US high yield corporate debt; and
- US equities.

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 1990-2000 is used since the market value of the MSCI index is unavailable prior to 1990. The start- and end-of-period market portfolios are given with the optimal portfolio (described later) in table 8.

4.2 Capital Market Line Analysis

The first part of the analysis I carry out in this section looks at the relationship between the market portfolio and the risk free asset. 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 [1]. Also, 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.

Figure 19: Capital market line analysis using monthly return statistics for US asset classes (1990-2000)

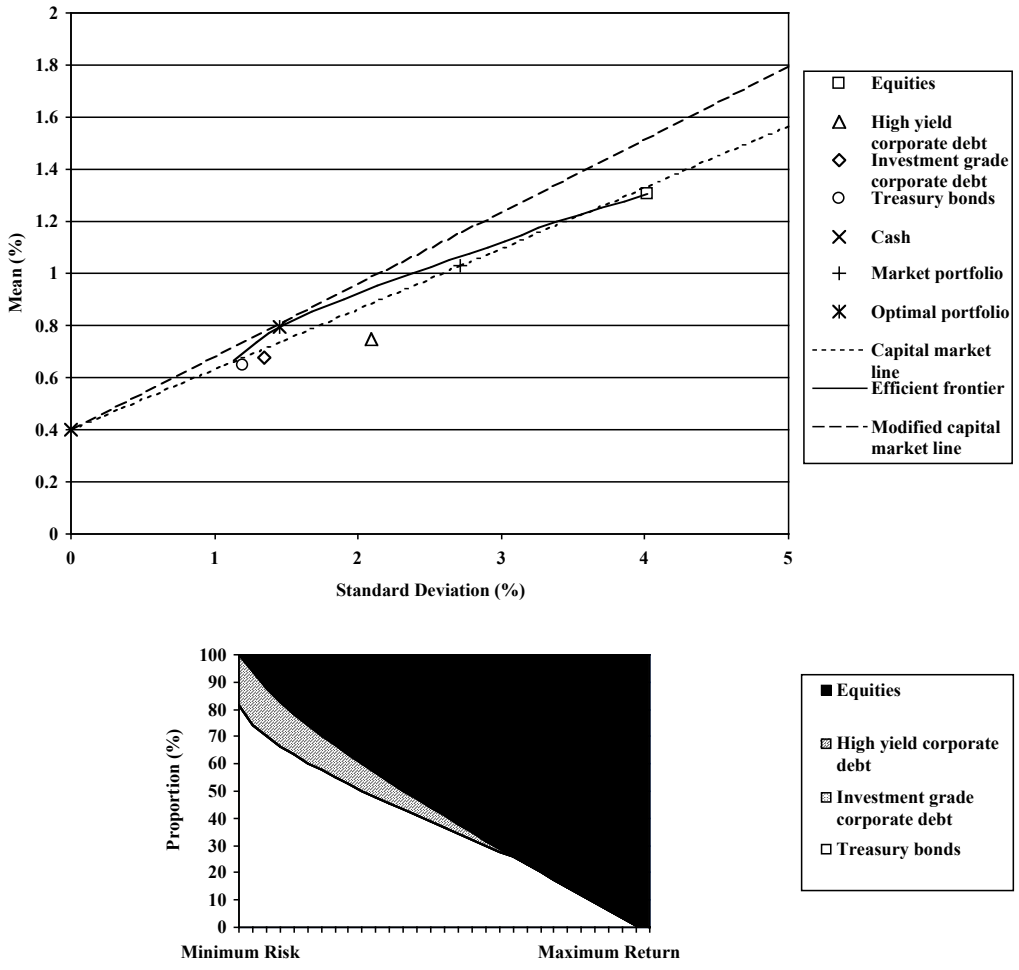


Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Morgan Stanley Capital International; US Treasury

Each of the asset classes lies below the capital market line, as is shown in figure 19. However, figure 19 also shows that there are combinations of asset classes with the market portfolio that lie above the capital market line, in particular those combinations involving bond asset classes. Also, the portfolios involving combinations of equities and the market portfolio lie below the capital market line.

I also calculate the efficient frontier [2] using the solver in Microsoft Excel [3]. If this is shown, as in figure 20, then the market portfolio appears to be inefficient, being placed some way below the frontier. Also, the capital market line is supposed to be tangential to the efficient frontier, which it is not. It is possible to draw a line from the risk free asset on the vertical axis that is tangential to the efficient frontier and to derive the portfolio at this point (again using Microsoft Excel solver). I call this the modified capital market line and the portfolio the optimal portfolio. The asset mixes making up the optimal and market portfolios are shown in table 8. 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.

Figure 20: Modified capital market line analysis using monthly return statistics for US asset classes (1990-2000)



Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Morgan Stanley Capital International

What this shows is that there are far higher proportions of both treasury bonds and high yield corporate debt in the optimal portfolio than in the market portfolio, and that investment grade corporate debt does not feature at all (although given that it does not feature in any of the portfolios for this sample period, this is not surprising).

Table 8: Composition of the minimum risk, market and optimal portfolios (1990-2000)

Asset Class	Minimum risk portfolio	1990 market portfolio (%)	2000 market portfolio (%)	Optimal portfolio (%)
Treasury bonds	81.7	33.6	12.6	62.2
Investment grade corporate debt	0.0	14.1	9.7	0.0
High yield corporate debt	18.3	1.4	2.1	18.6
Equities	0.0	50.8	75.7	19.2

Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Morgan Stanley Capital International; US Treasury

4.3 Beta Calculation

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 [4]. The calculation can be done using either the actual returns or the returns in excess of the risk free asset. Theoretically, the answers should be the same, since the risk free asset should have standard deviation of zero. In practice, with the dataset I use, the answers differ only after two decimal places. The beta for each asset class is given in table 9.

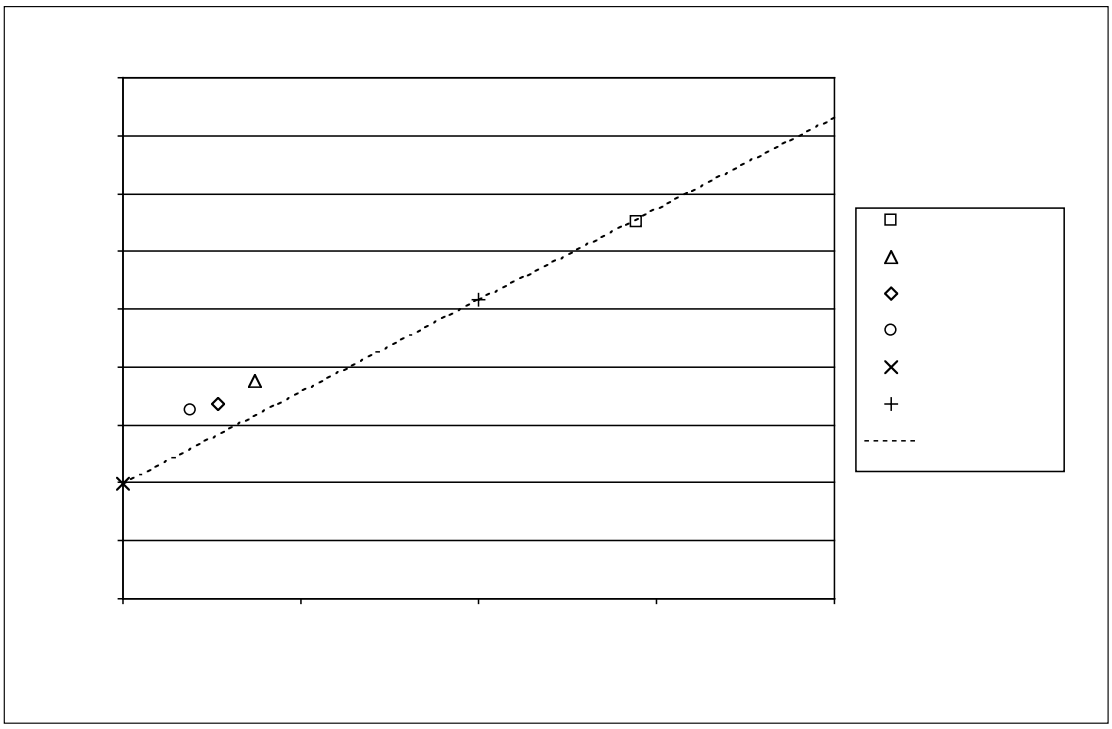
Table 9: **Beta for US asset classes (1990-2000)**

Asset Class	Beta
Treasury bonds	0.19
Investment grade corporate debt	0.27
High yield corporate debt	0.37
Equities	1.44

Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Morgan Stanley Capital International; US Treasury

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 21, 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.

However, if regressions are run of each bond asset class against the market portfolio (all net of the risk free rate of return), then it can be shown that the intercept term is not significant at the 5% level, the t-statistics being 1.768, 1.618 and 1.956 for treasury bonds, investment grade corporate bonds and high yield corporate bonds respectively. In other words, although bonds appear to be undervalued, the degree of undervaluation is not significant.



Another interpretation of the apparent undervaluation of the bond asset classes is that CAPM estimation of expected return[5] 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 1990 and 2000 – an argument that holds water given the fall in inflation and, therefore, interest rates in the 1990s.

[5] The CAPM expected return is calculated as:

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

where ER_S is the expected return on the stock (or, in this case, 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.

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[1] Tobin: Liquidity Preference as Behaviour Towards Risk (Review of Economic Studies, February 1958)
[2] Markowitz: Portfolio Selection (Journal of Finance, March 1952)
[3] Microsoft Corporation: Excel X for Mac (1985-2001)
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5. Income Analysis of High Yield Corporate Debt

5.1 Introduction

Much of the preceding work has concentrated on the market value of high yield corporate debt. However, a more appropriate indication of the usefulness of the asset class to pension schemes might be to consider the income that a portfolio of high yield corporate debt 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 [1] 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.

5.2 Asset-Only Analysis

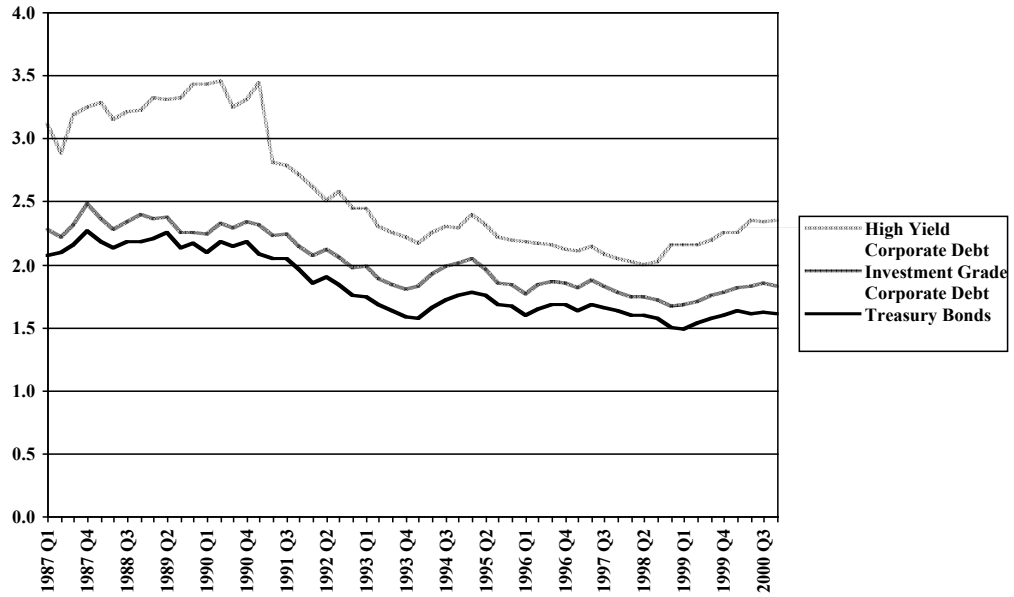
There are two ways in which the income-producing potential of high yield corporate debt can be analysed. The first (and crudest) method is to consider the running yield of various bond asset classes. The quarterly running yields are constructed from monthly data in the Lehman Brothers series [1].

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 22. This data is only available for high yield corporate debt from 1 January 1987. 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. In other words, a more sophisticated asset projection model would probably show treasury bonds to have a significant influence on high yield corporate debt returns.

Figure 22: Comparison of the running yield of US bond asset classes (%)

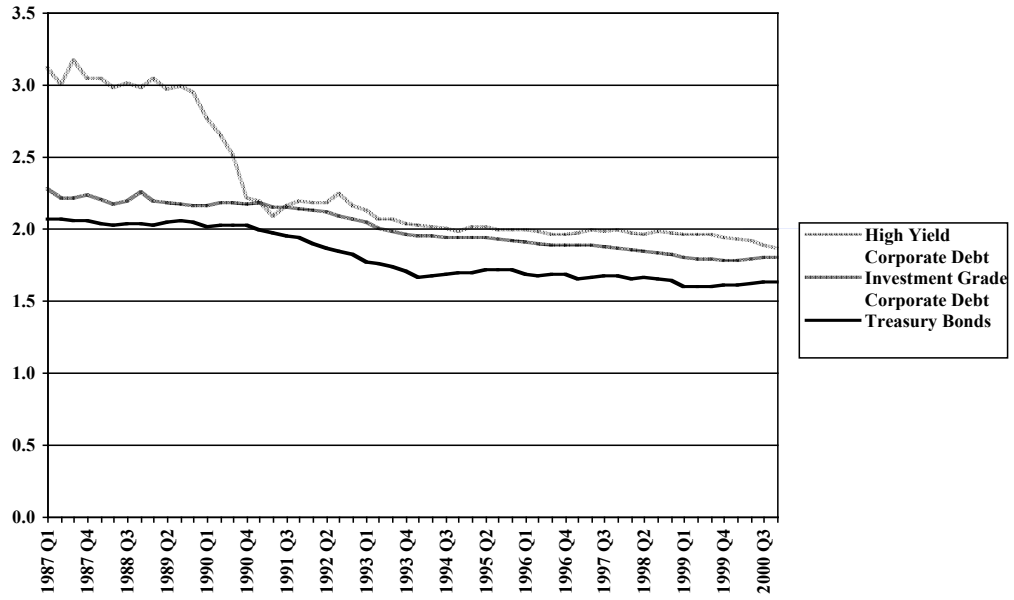


Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"

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 23. 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. It is also a stable income after around 1990.

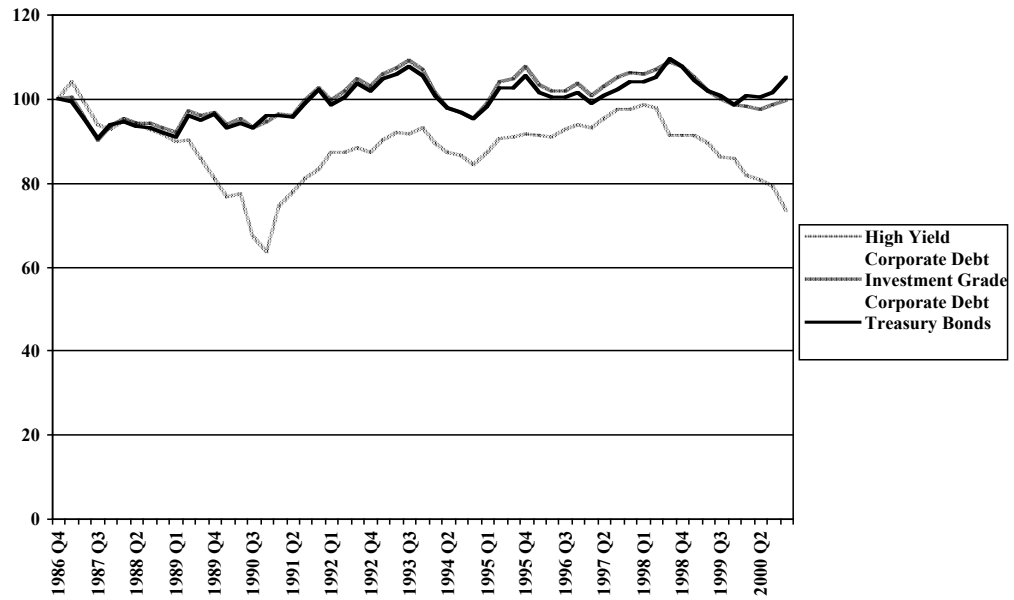
Figure 23: Comparison of the quarterly coupon payments from portfolios of US bonds ($ per $100 initial investment)



Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"

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 24 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).

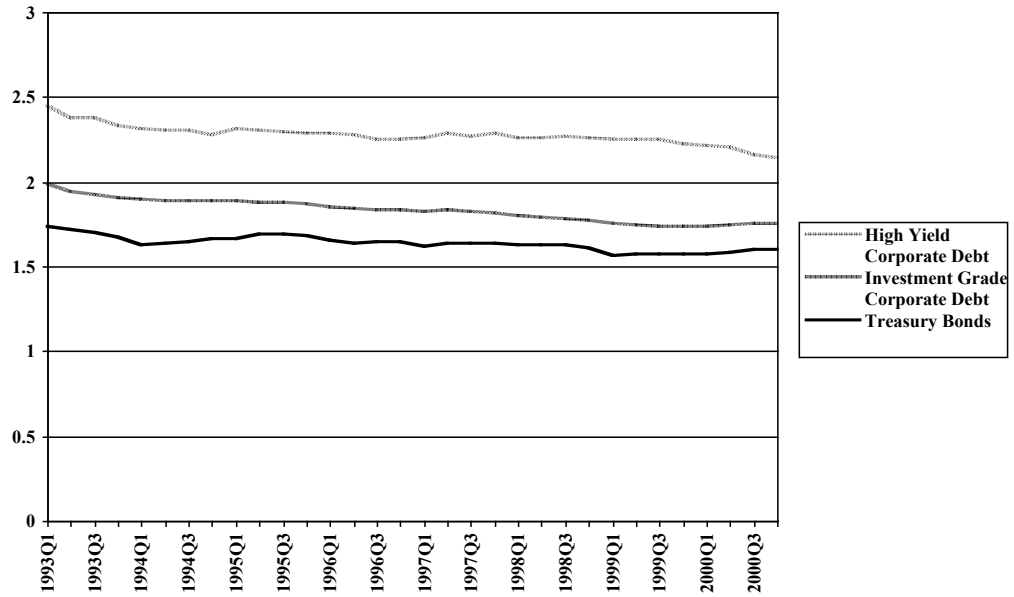
Figure 24: Comparison of the market value of portfolios of US bonds ($)



Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"

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. This is after the crisis and subsequent recovery of the early 1990s, and the results are shown in figure 25. As can be seen above, high yield corporate debt provides a smooth – and high – level of income. However, it is important to note that this assumes that a well-diversified portfolio is held.

Figure 25: Comparison of the coupon payments from portfolios of US bonds - recent data ($ per $100 initial investment)



Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"

5.3 Asset-Liability Analysis

So, on an asset-only basis, there is a strong cashflow-based case for investing in high yield corporate debt. However, what happens when liabilities are added?

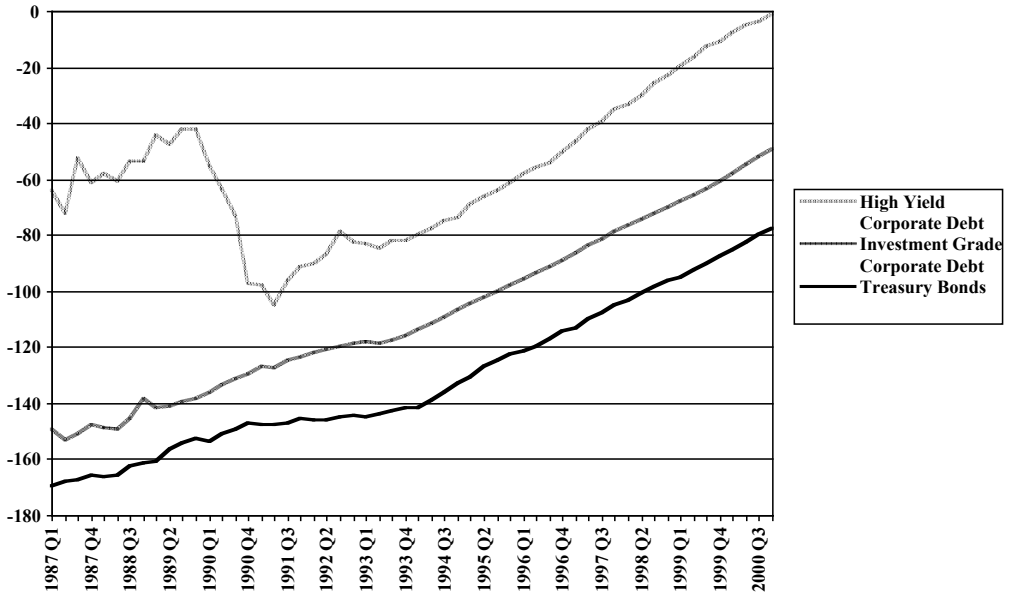
I carry out two sets of calculations. The first assumes no new retirements and no new contributions, whereas the second assumes that there are sufficient additional retirements to maintain a stationary population. In both cases, a retirement age of 65 is assumed.

It is assumed that there are no increases to pensions in payment. However, in the ongoing retirements scenario, wages (and thus initial pensions) are assumed to increase in line with US pay (private industry workers, wages and salaries only) [2].

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 cashflow for each asset class is the quarterly income less the quarterly pension payment

The first calculations are shown in figure 26. It is assumed here that there are no additional retirements, so the portfolio of pensioners being considered is a closed population and the only income received is coupon income. I also assume that assets are initially equal to the liabilities calculated using long-dated US treasury bond yields and the US RP-2000 mortality tables [3], assets and liabilities both being equal to $10,000,000. I use the US RP-2000 mortality tables for consistency with the liabilities, although I do not believe that the tables chosen have a significant effect on the conclusions. I assume that no contributions are made in respect of any surplus or deficit. As might be expected, the net cashflow is negative. This is to be expected because, in a closed population, some of the liability would be met by coupon income but some would be met by bond redemption payments or asset sales; if all of the pension payments could be met from coupon payments then, in this example, there would be capital remaining of the same order of magnitude as the initial investment once the last pensioner had died, unlikely since assets were initially set equal to liabilities. The net cashflow is, though, increasing through the term. Again, this might be expected given that the pension payments will reduce as pensioners die.

Figure 26: Net cashflow for a pensioner port folio invested in US bond asset classes ($000's, no retirements, no surplus)

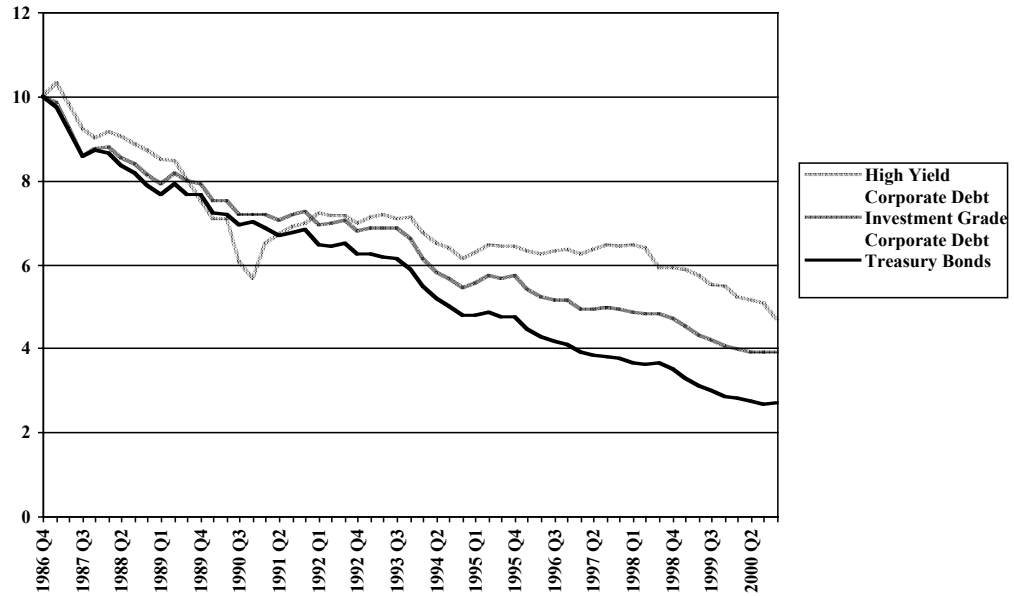


Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Society of Actuaries, "The RP-2000 Mortality Tables"

The crucial point to note about this chart is that the net cashflow position is best for high yield corporate debt. Even in the early 1990s, where heavy defaults hit coupon payments, the income from that portfolio still resulted in the smallest negative cashflow positions.

However, is this at the expense of capital protection? How does the market value of assets change over the period? This is an interesting question because although the statistic under consideration is cashflow, market values are required in a number of "real life" valuations. The answer to the question is given in figure 27. This shows that, apart from a blip between 1989 and 1991, the market value of high yield corporate debt remains above the other asset classes, apparently without undue volatility.

Figure 27: End-of-month asset value for a pensioner port folio invested in US bond asset classes ($m, no retirements, no surplus)



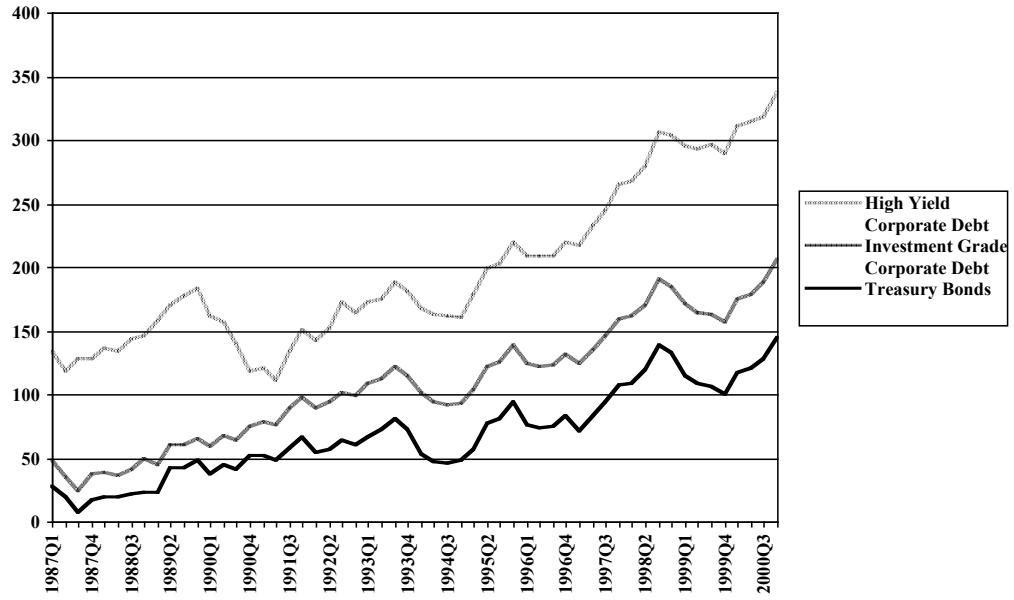
Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Society of Actuaries, "The RP-2000 Mortality Tables"

It is worth considering what happens in a pensioner portfolio where retirements are ongoing. As mentioned above, in this scenario, I allow for a stationary population of pensioners. In other words, I assume that there is exactly the number of retirements from an active population each quarter to keep the number of pensioners constant.

The contribution assumed to be paid to the fund on an individual's retirement is calculated as the value of the new liabilities using the long-dated US treasury bonds yield at retirement as the discount rate and the RP-2000 mortality tables. The net cashflow for this scenario is shown as figure 28.

This chart is similar to figure 26 and also supports the use of high yield corporate debt in pension schemes. The main differences are the fact that the net cashflow is positive (because of the added income from retirements) and the increased volatility of cashflow (which arises because of the variable cash paid to the fund in respect of new retirements).

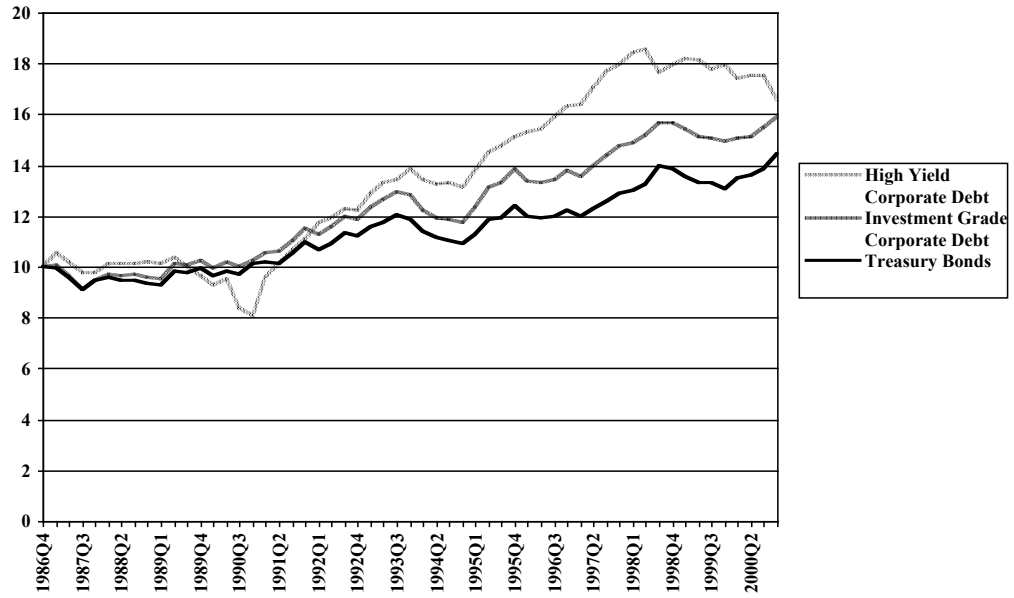
Figure 28: Net cashflow for a pensioner port folio invested in US bond asset classes ($000's, retirements, no surplus)



Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Society of Actuaries, "The RP-2000 Mortality Tables"; Bureau of Labor Statistics: "Employment Cost Index Historic Listing"

The chart of the fund value is again supportive of the use of high yield corporate debt in pension fund portfolios. This time, the asset values are increasing because of the positive net cashflow, but the portfolio of US high yield corporate debt still has the greatest market value of any of the portfolios.

Figure 29: End-of-month asset value for a pensioner port folio invested in US bond asset classes ($m, retirements, no surplus)



Source: Lehman Brothers, "Global Family of Indices, Fixed Income Research"; Society of Actuaries, " The RP-2000 Mortality Tables"; Bureau of Labor Statistics, "Employment Cost Index Historic Listing

Calculations involving an initial asset value in excess of or below the initial value of liabilities tell a similar tale. The only difference is the scale on the cashflow chart and the direction of the asset value chart.

So for liability matching, high yield corporate debt is good from a cashflow point of view but bad from a market value point of view. At the risk of harking back to older valuation methods, this suggests that a discounted cashflow approach (allowing for the risk of default) should be used when high yield corporate debt is being valued for comparison with liabilities.

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[2] Bureau of Labor Statistics: Employment Cost Index Historical Listing (Bureau of Labor Statistics, 2001)
[3] 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.

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 is a concern that the European high yield corporate debt market is so concentrated in telecoms. This problem could be mitigated by investing in a diversified global high yield corporate debt portfolio.

Additional analysis is needed. 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.

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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[3] Duval, Teeger & Yakoubov: The TY Model – A Stochastic Investment Model for Asset and Liability Management (Presented to the Staple Inn Actuarial Society on 16 November 1999)
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