

Actuarial Society of India

Examinations

November 2005

SA6 –Investment

Indicative Solutions

Q.1)**i) Risks faced by the office**

Actuarial risk: ie the risk that company cannot meet its liabilities or solvency minimum. [1]

Relative performance risk: ie risk that poor performance is achieved relative to competitor's funds. [1]

Credit risk: ie the risk that a counterparty to an agreement will be unable or unwilling to fulfill their obligations. [1]

Operational risk: ie the risk of loss due to fraud or mismanagement within the life office. [1]

With Profit

The main risk is failing to meet the sum assured and bonuses declared to date and beyond that failing to achieve a sufficiently high investment return (and thus future bonuses) to meet policyholders' reasonable expectations (PRE) in the light of returns achieved by other funds. [0.5]

If returns on investments fall sufficiently and bonuses are reduced, this will have an effect on levels of future business. [0.5]

If these levels fall substantially, this may lead to a rise in the level of the company's average costs per policy, since these will be spread over a smaller number of policies. [0.5]

If the office mismatches the guaranteed liabilities by (for example) overweighting equities and underweighting gilts, there is a risk that gilts out-perform equities. Investing in line with industry averages implies a degree of mismatching) particularly if the office has high guaranteed sums assured). [0.5]

Unit-linked

There is some risk from low long-term performance. There are a number of reasons for this. [0.5]

Future fund management charges will depend upon the value of units. If these units do not rise in value sufficiently, then the fund management charge may be inadequate.

[1.5]

There will probably be some non-unit reserves held.

[0.5]

Future sales will depend upon investment performance relative to peers.

[1.5]

[Total 8]

ii) Long term distributions

A possible distribution for the with profit and unit linked funds might be as follows:

	With Profit Fund	Unit linked
Equities	48%	58%
Fixed interest	20%	10%
Property	15%	5%
Overseas equities	10%	20%
Overseas fixed interest	2%	2%
Index linked	3%	2%
Cash	2%	3%

In each case, most of the equities would be in blue chip and medium sized companies. Most of the overseas exposure would be in the major world markets (ie the USA, Japan, UK).

[Total 3]

iii) Current reasons for tactical switch

Short-term moves away from the long-term distribution may be made in order to enhance returns. This will be in response to views of the prospects for the economic factors underlying each category compared with current market valuations.

The Indian economy appears to be quite robust. Equity prices have become attractive and valuations look more reasonable, but it is possible the expected global upturn in the economy may not materialize, in which case markets could lose any gains seen since the start of 2003.

Currently equities in India are standing on much more justifiable valuations. This makes a further fall seem less likely and a rise more likely than previously.

However US equities are still very highly priced and yields are still below 2% pa.

UK bonds are standing on low yields by historical standards (eg long-dated gilts on 4.9%).

Any rise in inflation will also be bad for bonds, even though there is little prospect of this at present. So the bond weighting may need to be reduced.

The high yields on property may make them attractive, although it is not easy to invest in property on tactical grounds other than by using property company shares.

If we are currently uncertain about market movements and in recent years markets have been more than usually volatile), we may want to move to a more closely matched position or put more into cash.

If we currently expect rupees to rise (fall) we would want to reduce (increase) holdings of overseas assets.

[4]

b)

Synthetic funds are constructed using derivatives on the underlying assets rather than holding the assets themselves.

First we need to calculate our degree of exposure to the index, for example the amount by which the fund would go up if there was a one point index. We then use this figure to buy an appropriate number of futures. We need pay no money for these initially. So the money in the fund is invested in short-term cash deposits. At expiry of the futures we “roll over” our exposure, ie we sell the expiring future and buy new three month futures on the index. Theoretically, the money market interest on our assets is sufficient to offset the loss in the value of the futures that occurs as the three month period goes by, leaving us with a profit that matches exactly any rise or fall in the index.

In a word, dividends. Any fund that is assessed against a capital value index, rather than a total return index, ought to be able to outperform. The fund will be receiving regular dividends on the stocks in its portfolio. The fund ought therefore to be able to reinvest the dividend proceeds to augment its performance.

c) For this reason most trackers use a total return index.

[5]

A commodity future is a real asset in the sense that its price will reflect expectations of inflation over its future life. However, since the life of a future is relatively short (measured in months rather than years), the inflationary effect at current low levels of inflation may well be small, and changes in expectations of future inflation over the lifetime of the future are likely to be swamped by price volatility caused by other

factors. A future on a commodity price index may be a best match for inflation (especially “cost push” inflation).

[3]

The risks would be as follows:

- High volatility of asset values, leading to the possibility of sudden losses.
- Asset prices are unlikely to reflect changes in the values of the institution’s liabilities.
- There may also be a currency mismatch if the future is priced in, say, dollars
- A high degree of expertise is needed to trade profitably

[2]

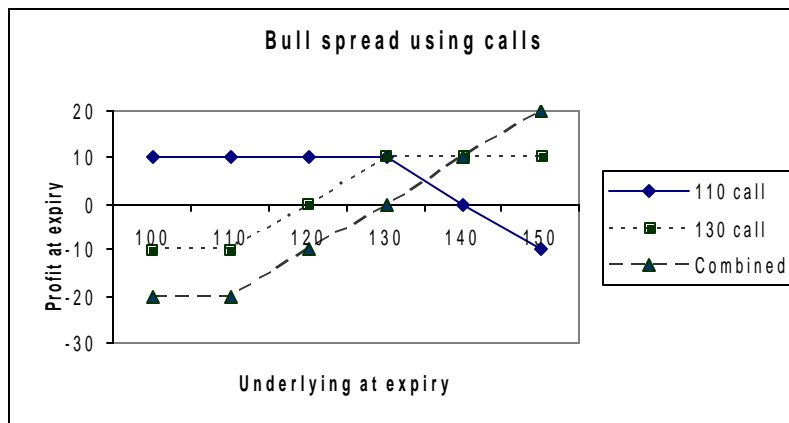
[Total 5]

d)

i)

(a) A bull spread using calls

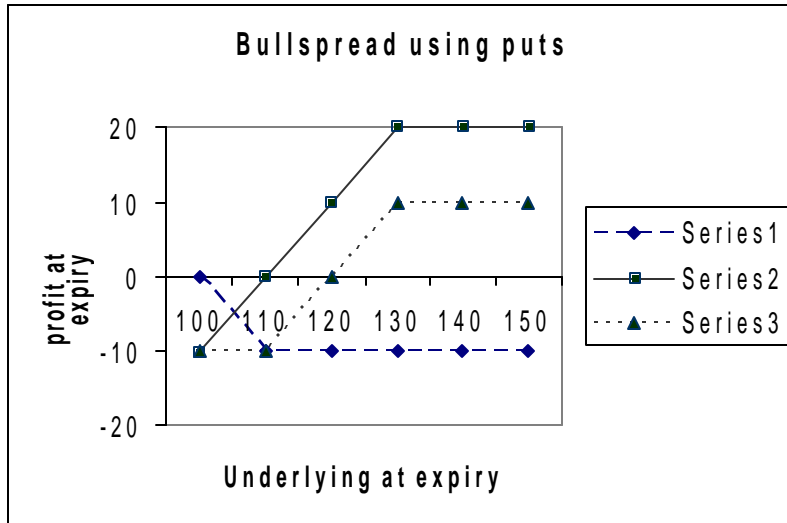
This is formed by the purchase of one call and the sale of another with different strikes, for example purchase the March 1.10 call and sell the March 1.30 call. This will initially cost 0.13 and the profit and loss at expiry diagram would like this:



[3]

(b) A bull spread using puts

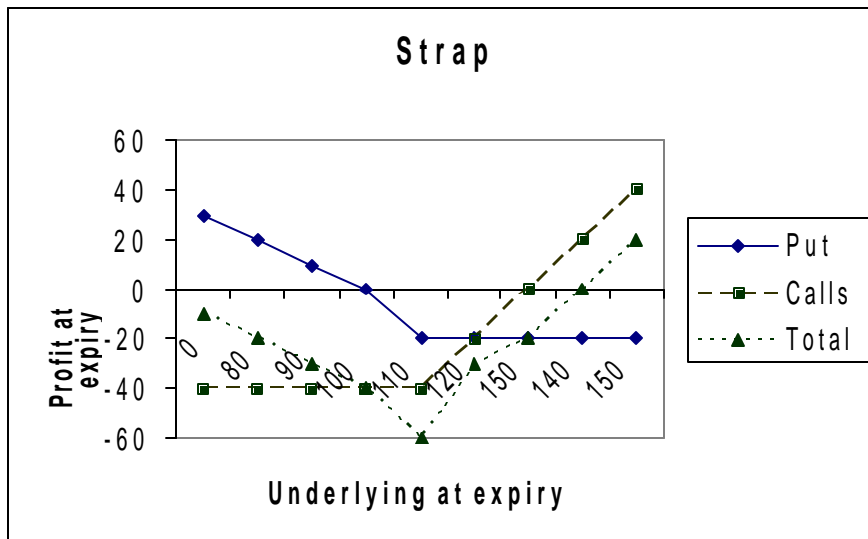
This is formed by buying a put with a 1.10 strike and selling a put with a 1.30 strike. Profit at expiry would look like this (assuming we are using March options):



[3]

(c) Strap using calls and puts

This is formed by buying 2 calls and buying one put all with the same strike. Again we have chosen the March calls and puts with the 1.10p strike price for the following diagram but the later calls would work perfectly (as would a strategy using the 1.30 strike price).



[3]

ii) Diagonal spread

A diagonal spread involves buying one option and selling another (both calls or both puts) where both the maturity and the exercise prices are different.

For example it would be possible to sell a March 1.10 call and buy a June 1.30 Call. At the expiry of the shorter option this would give a similar pay-off to the bull spread.

[3]

iii) Flex options

Flex options are :

- exchange traded European style options
- that allow the buyer to specify the strike price, maturity date, and notional principal.

[2]

Uses of Flex options:

- These are of particular use to traders who are hedging particular liabilities that have option like characteristics. It is possible to eliminate the timing mismatch between asset (ie the option) and underlying liability that can occur with standardized exchange-traded products because it is possible to match the expiry date exactly.
- They also avoid the gamma and vega mismatches which occur: for example, near the money options with a long time to run have high vega but little gamma whereas near the money options, with little time to run, have the opposite. Because longer options tend to have more time to run, have the opposite. Because longer options tend to have more time value and hence less gamma, it may be difficult to match both the delta and gamma of assets and liabilities if the duration of the asset and liability are different.

[4]

[Total 15]

i) Why it could be allowed such a high level of gearing

Financial gearing can be defined as the ratio of total capital in a fund

$$(ie) \frac{debt + equity}{equity} \text{ or simply as } \frac{debt}{equity}$$

[1]

Therefore, if the equity capital falls to a very low level, gearing will by definition become very high. Yet, so long as the equity capital (ie net asset value) is positive, the fund might be regarded as being technically solvent. In the limit, the level of gearing could tend towards infinity before the fund becomes insolvent.

If the fund holds “market –neutral arbitrage”, this should have been fairly low risk (losses on one asset would tend to be matched by gains on another asset) and a relatively high level of gearing may have seemed appropriate.

The regulatory environment varies from country to country. It is likely that the regulators had very little control or contact with the hedge fund. However, even if regulators intervene when (or before) the solvency margin is breached, the action they take may not be sufficient to stop solvency falling further (and hence gearing rising). This is particularly true when there are “sharp falls in a number of major markets”. Note that it would be unusual for a regulator to wind up a fund automatically immediately a minimum solvency level was breached, particularly if the reported net asset value was still positive.

- These parties should take appropriate steps to ensure that an investment fund remains solvent. They might do this in a number of ways including modeling (explicitly or implicitly) the value of the fund under a number of possible future scenarios.
- In addition, there may have been insufficient control to encourage the fund managers to avoid risk. For example, all or part of their remuneration may have been linked to the upside performance of the fund with little or no downside penalty.
- The main creditors in an investment fund will be banks and other investors providing loan capital finance. At the time that they lend money, it is normal for creditors to consider (eg by looking at credit ratings) the level of gearing of the funds that they lend money to. It is possible that the level of gearing in the hedge fund was not excessive at the time that money was lent but that subsequent losses eroded the level of capital cover.

For some creditors, the level of cover may have been eroded over time by subsequent borrowing by the fund (although debt investors normally try and restrict a fund’s ability to do this).

- It is also possible that the level of gearing was high at the time that at least some of the debt finance was arranged. This may have happened:
 - in return for a high rate of interest (an/or as part of a structured financing arrangement that involved creditors also taking some of the equity capital)

- because the creditors had already lent money and thought that it was better to lend more money once the fund got into difficulties to stop liquidity problems harming the value of the existing investment (ie they may have decided that the risk of a larger loss was worth taking), compared with the certainty of losing what had previously been invested)
- as a result of fraud, lack of information and/ or irrational behaviour.

[10]

ii) Hedge fund performance data

Hedge funds are not obliged to present the performance measurement companies with data on all of the hedge funds that the company manages. Therefore the funds can select only the best performing funds to include in the analysis. [1]

When a fund introduced, the managers often use computers to simulate how the fund would have performed if it had existed over the previous 10 years. This 'backfilling' has the effect of improving the collective data. [1]

Hedge funds that do not survive are not included in the data. Therefore there is an element of selection bias in the statistics. [1]

The investments underlying the hedge fund are often unmarketable and can be valued only infrequently by directors of the fund. Therefore the fund may seem to be less volatile than it actually is, reducing the measured beta. [1]

Hedge fund performance data has been shown to exhibit features that are not observed in the underlying asset markets (skewing etc). (This leads observers to suggest that the data is not 100% reliable. [1]

[Any 4 (4)]

iii) Other types of fund

Event-driven

These funds focus on specific situations that revolve around an event (such as a take-over battle) where the assets in question become very volatile in the short term.

By gaining a high level of expertise in the event, the hedge fund manager can gain a competitive advantage and hence superior performance. [3]

Global fund

These funds do not aim to be market-neutral, in fact they specifically target markets that they want to be exposed to. They will then take on a high level of gearing and use the cash to invest in the selected assets.

For example, a fund may borrow heavily in pounds on a fixed basis and invest in the US bond market.

[3]
[Total 20]
[Grand total of Q.1 (60)]

Q.2)

(i) Total return in 2002

In both sets of calculations it is assumed that adding in income at the end of each quarter is sufficiently accurate.

All Share

The dividend yield on the All Share is historic, so it is better to use the dividend yield at the end of each quarter rather than at the beginning. Arguably, an even bigger lag should really be used.

1. $\left(\frac{1,561.97}{1,682.17}\right)\left(1 + \frac{0.0372}{4}\right) - 1 = -6.28$
2. $\left(\frac{1,463.35}{1,561.97}\right)\left(1 + \frac{0.0404}{4}\right) - 1 = -5.37\%$
3. $\left(\frac{1,510.97}{1,463.35}\right)\left(1 + \frac{0.0398}{4}\right) - 1 = 4.28\%$
4. $\left(\frac{1,521.44}{1,510.97}\right)\left(1 + \frac{0.0402}{4}\right) - 1 = 1.70\%$

Total return = $0.9372 \times 0.0463 \times 1.0463 \times 1.0428 \times 1.0170 - 1 = 5.9\%$

Gilt index

$$1. \frac{168.23 + 3.53 - 0}{191.27} - 1 = -10.20\%$$

$$2. \frac{154.75 + 6.57 - 3.53}{168.23} - 1 = -6.21\%$$

$$3. \frac{153.58 + 9.81 - 6.57}{154.75} - 1 = +1.34\%$$

$$4. \frac{155.93 + 12.21 - 9.81}{153.58} - 1 = -3.09\%$$

$$\text{Total return} = 0.8980 \times 0.9379 \times 1.0134 \times 1.0309 / 1 = -12.0\%$$

(ii)

(a) Attribution analysis

(1) Actual rates of return in each sector

(a) equities

(b) gilts

$$1998 \quad \frac{404.8}{0.4 \times 1,100} - 1 = -8.0\%$$

$$\frac{168.23 + 3.53 - 0}{0.6 \times 1,100} - 1 = +4.0\%$$

$$1999 \quad \frac{567.0}{0.4 \times 1,191.2} - 1 = +19.0\%$$

$$\frac{838.4}{0.6 \times 1,191.2} - 1 = +17.3\%$$

$$2000 \quad \frac{722.6}{0.4 \times 1,505.4} - 1 = +20\%$$

$$\frac{1,056.8}{0.6 \times 1,505.4} - 1 = +17.0\%$$

$$2001 \quad \frac{947.7}{0.4 \times 1,879.4} - 1 = +26.1\%$$

$$\frac{1,490.7}{0.6 \times 1,879.4} - 1 = +32.2\%$$

$$2002 \quad \frac{974.6}{0.4 \times 2,537.9} - 1 = -4.0\%$$

$$\frac{1,370.5}{0.6 \times 2,537.9} - 1 = -10.0\%$$

$$\text{Equities total } 0.92 \times 1.19 \times 1.2 \times 1.261 \times 0.96 / 1 = +59.0\% \text{ over 5 years}$$

Gilts total: $1.04 \times 1.173 \times 1.170 \times 1.322 \times 0.91 = +69.8\%$ over 5 years

(2) Actual total return

1998	$1,091.2 \div 1,100 - 1$	= -0.8%
1999	$1,405.4 \div 1,191.2 - 1$	= 18.0%
2000	$1,779.4 \div 1,505.4 - 1$	= 18.2%
2001	$2437.9 \div 1,879.4 - 1$	= 29.7%
2002	$2,345.1 \div 2,537.9 - 1$	= -7.6%

Total (time-weighted) return:

$0.992 \times 1.18 \times 1.182 \times 1.297 \times 0.924 = +65.8\%$ over 5 years

(3) Total return with actual sector split, but index stock performance

1998	$0.4 \times -9.7 + 0.6 \times 4.3$	= -1.3%
1999	$0.4 \times +20.7 + 0.6 \times +18.8$	= +19.6%
2000	$0.4 \times +20.5 + 0.6 \times +16.9$	= +18.3%
2001	$0.4 \times +28.4 + 0.6 \times +34.5$	= +32.1%
2002	$0.4 \times -5.9 + 0.6 \times -12.0$	= -9.6%

Total (time weighted) return:

$0.987 \times 1.196 \times 1.183 \times 1.321 \times 0.904 = +66.8\%$ over 5 years

(4) Returns with benchmark sector split (50/50) and index performance

(a) Overall

1998	$0.5 \times -9.7 + 0.5 \times +4.3$	= -2.7%
1999	$0.5 \times +20.7 + 0.5 \times +18.8$	= +19.8%
2000	$0.5 \times +20.5 + 0.5 \times +16.9$	= +18.7%
2001	$0.5 \times +28.4 + 0.5 \times +34.5$	= +31.5%
2002	$0.5 \times -5.9 + 0.5 \times -12.0$	= -8.9%

Total (time-weighted) return:

$$0.973 \times 1.198 \times 1.187 \times 1.315 \times 0.911 = +66.8\% \text{ over 5 years}$$

(b) Benchmark performance over 5 years by sector

Equities total : $0.903 \times 1.207 \times 1.284 \times 0.941 - 1 = 58.7\%$ over 5 years

Gilts total : $1.043 \times 1.188 \times 1.169 \times 1.345 \times 0.88 - 1 = 71.4\%$ over 5 years

Summary of attribution

% effective return	Equity stock From (1) (a) against data in question	Gilt stock From (1) (b) against data in question	Total stock (2) (3)	Sector (3) (4)	Total (2) (3)
1998	+1.7	0.3	+0.5	+1.4	+1.9
1999	-1.7	-1.5	-1.6	-0.2	-1.8
2000	-0.5	+0.1	-0.1	-0.4	-0.5
2001	-2.3	-2.3	-2.4	+0.6	-1.8
2002	+1.9	+2.0	-1.6	+0.7	-0.9
Arithmetic 5yr total 1998-2002	-0.9	-2.0	-1.6	+0.7	-0.9
Geometric 5yr total 1998-2002	+0.3	-1.6	-1.0	+1.0	0

Comments

Overall performance has been broadly neutral in terms of the geometric return over the five years.

However, based on arithmetic returns the fund under performance over the 5 years.

These apparently contradictory comments result from the fund out performing in falling markets and under performing in rising markets. The lower volatility of the fund relative to the index improves the fund's geometric average relative to the arithmetic average.

The fund under-performed in the middle three years, but out performed the benchmark in the first and last year.

- Sector selection (being overweight in gilts) was positive, but stock selection (particularly within gilts) was negative. This was because the gilt market outperformed the equity market over the period.
- The method used attributes the stock selection on the overweight sector position to 'stock' selection. Had it been allocated instead to 'sector' selection both stock and sector selection would have appeared more neutral.
- Although the arithmetic average equity performance was worse than the index, the geometric average was marginally better because of the less volatile performance.

[15]Alternative solution to **(ii) (a)** on amounts**ii)****a)** Attribution analysis

Benchmark fund split 50/50, with index performance

	Equities	Gilts	Total
31 Dec 97	500	500	1,000
1 Jan 98	550	550	1,100
31 Dec 98	496.7	573.7	1,070.4
1 Jan 99	585.2	585.2	1,170.4
31 Dec 99	706.3	695.2	1,401.5
1 Jan 00	750.8	750.8	1,501.5
31 Dec 00	904.7	877.7	1,782.4
1 Jan 01	941.2	941.2	1,882.4
31 Dec 01	1,208.5	1,265.9	2,474.4
1 Jan 02	1,287.2	1,287.2	2,574.4
31 Dec 02	1,211.3	1,132.7	2,344.0

Fund with sector split (40% equities 60% gilts), but with index stock performance.

	Equities	Gilts	Total
31 Dec 97	400	600	1,000
1 Jan 98	440	660	1,100
31 Dec 98	397.3	688.4	1,085.7
1 Jan 99	474.3	711.4	1,185.7
31 Dec 99	572.5	845.1	1,417.6
1 Jan 00	607.0	910.6	1,517.6
31 Dec 00	731.4	1,064.5	1,795.9
1 Jan 01	758.4	1,137.5	1,895.9
31 Dec 01	973.8	1,529.9	2,503.7

1 Jan 02	1,041.5	1,562.2	2,603.7
31 Dec 02	980.1	1,374.7	2,354.8

Sector : $2,354.8 - 2,344.0 = + 10.8$

Stock profit: $2,345 - 2,354.8 = -9.7$

Overall : $2,345.1 - 2,344.0 = +1.1$

Note that it is difficult to give the gilt/equity split of the stock profit. We cannot simply use the 31 December 2002 figures for this because we rebalanced the benchmark portfolios. By rebalancing, all the prior years, profits from both sectors is spread between the two asset classes. A calculation based on the December 2002 figures would inevitably suggest that the stock profit or loss was more or less equal from the two classes

the only difference would come from 2002 alone). A correct calculation would be very tedious from this amounts data (unless a spreadsheet was available) because we would have to extract the profit or loss from each year separately.

b)

(ii) Outlook over next three years (from May 2004)

It is probably reasonable to assume that current market values correctly discount the market's views of future inflation.

With the current nominal gross redemption yield on long dated fixed interest of 4.9% and a 1.9% real gross redemption yield on index linked stocks we might have :

$$4.9 = 1.9 + 2.8 + 0.2$$

ie the market currently expects 2.8% average inflation and demands a 0.2% inflation risk premium.

If expectations of inflation reduce from the current expectations then index linked gilts will under perform.

This could happen if inflation decreased as a result of slower economic growth or lower commodity prices.

Conventional stocks will under perform if inflation is more than currently expected.

This could happen if, for example, the currency began to fall as Britain approached membership of the Euro or if commodity prices started to rise sharply.

An increase in the supply of index-linked stocks due to an unexpected change in funding policy could make conventional gilts out-perform index linked.

A future increase in demand for index-linked stocks relative to conventional stocks (eg due to an increase in institutions' proportions of real liabilities) would help index-linked to out perform.

[7]

(iii) Factors to consider when formulating investment strategy

A key concern is the total return (net of any overseas taxes and expenses). The extent to which the sponsoring employer can accept volatility in the funding rate in order to allow an aggressive investment strategy needs to be considered, alongside the expected returns from each asset category.

The (less than 50% of) liabilities that are in respect of actives will be real in nature (linked to members' earnings). These should be matched by real assets.

The bulk of the liabilities are pensions in payment. The nature of these will depend upon the nature of pension increases granted. They may be a mixture of fixed and real . The nature of any deferred pensions also needs to be allowed for (eg there will probably some form of revaluation to retirement).

The liabilities are fairly long-term, although some of the pensioner liabilities will be shorter.

Most or all of the liabilities should be sterling denominated. This limits the scope for overseas investment.

We need to consider any negative liability outgo (eg future premiums or contributions).

The small surplus of assets over liabilities may allow some investment freedom, although (depending upon the risk attitude of the trustees) the fund may want to avoid an excessive mismatch against the value of its liabilities on an MFR basis.

The fund may be declining (given that over half of the liabilities are in respect of pensions in payment), in which case some liquidity / high income may be needed.

(7)

(iv) Problems in making significant changes to investment allocation

The main problem is the possibility of shifting market prices (both on sale of existing portfolio and purchase of new assets). With huge money invested in equities the pension fund may be big enough to move the market in certain stocks.

A partial solution to this problem is to use derivatives to gain the required exposure immediately, and then to conduct a gradual sale of the portfolio. Institutions do use this technique in practice.

Dealing costs and research costs will be incurred (commission, stamp duty and market bid-offer spreads).

The problems are particularly acute when unmarketable securities are involved, or where the normal market size for deals in the securities is small.

[6]
Total [40]
