TIME VARIATION IN EQUITY RETURNS

Adrian Bruce FitzGerald

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DECLARATION

Except where specific reference is made to other sources, the work presented in this thesis is the original work of the author. The work has not been submitted, in whole or in part, for any other degree.

Adrian B. FitzGerald

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ABSTRACT

Investors accept that there is uncertainty, or risk, associated with equity investment returns. Consequently, equities are normally priced so that they provide a premium to the returns available on risk-free investments. Equity returns, however, are cyclical. There can be long periods when equity returns greatly exceed risk-free returns; there can be long periods when the premium disappears altogether. This thesis explores the influences and driving forces in equity markets, with a particular emphasis on the UK equity market. Both rational and irrational influences are examined and discussed.

A General Literature Review examines the general progression in academic thinking in the area of equity pricing over four decades and takes a close look at the concepts of market efficiency and the challenges mounted by behavioural finance. The "equity risk premium puzzle" is also examined. Chapters 3 to 6 contain empirical studies of the variation in UK equity returns over time from four angles. The chapters look, respectively, at: macro-economic influences on the equity market; the relationship between equity returns and market volatility; the impact of variation in risk-free returns; a full decomposition of both ex-ante and ex-post equity returns.

Reassuringly, the results confirm that the UK equity market is driven, in the main, by economic factors. However, the results also indicate that the full set of influences on the equity market is complex. The analyses undertaken suggest that significant swings occur in the risk premium element of expected equity returns. The results also suggest that there are periods when the UK equity market may be in disequilibrium with other financial markets.

It is not the contention that many of the puzzles that have confronted equity market researchers over recent decades are now resolved by the analyses undertaken and presented in this thesis. It is to be hoped, however, that a useful platform has been built from which further investigation and analysis can be taken forward. In particular, it is suggested that comprehensive surveys of long-term expectations could lead to a better understanding of equity market mechanisms.

CHAPTER 1 – INTRODUCTION

This chapter sets out the aim and objectives of the thesis, discusses the historical background to equity investment and explains the structure to be found herein.

1.1 AIM AND OBJECTIVES

The concept of the equity risk premium represents a cornerstone in modern financial market theory. Equity investors should expect an investment return in excess of that available from risk-free investments as compensation for the additional uncertainty attached to future cash flows.

Ibbotson and Sinquefield (1976) in the US and Dimson and Brealey (1978) in the UK provided the first comprehensive assessments of the risk premium that equity investors have achieved. Both studies concluded that the risk premium, measured arithmetically, has averaged approximately 9% p.a. historically. Indeed, as a consequence of these findings, a risk premium of the order of 6% to 9% was recommended as the norm to be used in financial modelling.

The subsequent three decades have witnessed intense debate as to whether a premium of this order is a realistic expectation for the future. Mehra and Prescott (1985), in identifying "the equity premium puzzle", were at the forefront in questioning the scale of the reward earned by equity investors.

The same three decades have also witnessed mounting challenges from behaviourists such as Shiller (1981), Summers (1986) and De Bondt and Thaler (1985). The debate has focussed on the volatility of the equity market, the apparent propensity of investors to overreact and the substantial swings in equity returns that can occur through time as a result. The market Crash of October 19th 1987 merely served to fan the flames of the debate.

The aim of this thesis, therefore, is to analyse how, and why, equity returns – and equity risk premia in particular – vary significantly over time. More specifically, the objectives are:

(a) to explore the key elements of the theoretical debate surrounding equity return variation;

(b) to analyse the historical variation in UK equity returns from four different angles, including a full decomposition of ex-ante and ex-post returns into rational elements. Questions to be explored include:

   (i) is there evidence of a rational linkage between the equity market and the variation in the macro-economy?
   (ii) what is the relationship between equity returns and observed volatility?
   (iii) is the volatility of the equity market "excessive", as some observers would advocate, or can volatility be explained by changes in fundamental factors?
   (iv) what equity risk premium could have been expected in the past, given prevailing macro-economic conditions?
   (v) what equity risk premium was actually earned in the past and what factors explain the difference between this ex-post measure and the ex-ante measure?

(c) to discuss the implications of the findings.

1.2 AN HISTORICAL PERSPECTIVE

Ordinary shares, equities, or common stock - as they are referred to in the United States – are issued by limited liability companies as risk capital. UK company law requires ordinary shares to have a nominal value but this nominal value bears little relation to the market value of the shares at any time.

Ordinary shareholders have voting rights and collectively, therefore, have control of the company. They have the right to share in any distribution of dividend, in proportion to their percentage shareholding, and they have the right to a proportion of any residual assets in the case of dissolution.

A key characteristic of equities – which is a particular focus of this thesis – is that both future dividend income and future share values are at all times uncertain. It is for this reason that equity investors seek a higher expected return than that which is available on alternative risk-free investments. This higher return is referred to as the equity risk premium.

1.2.1 The long history

Table 1.1, which draws on data to be found in Goetzmann and Ibbotson (2006), summarises the long-term performance of equities in both the United Kingdom and the United States since exchanges were first established.

Table 1.1 Summary statistics for LSE and NYSE equities

		Arithmetic Mean (%)	Geometric Mean (%)	Standard Deviation (%)
Total period (1701-2000)				
	LSE	3.1	2.1	15.7
	NYSE	5.6	3.9	18.4
Eighteenth century				
	LSE	1.4	0.5	14.4
	NYSE	7.6	6.6	15.0
Nineteenth century				
	LSE	1.5	1.2	8.5
	NYSE	4.7	3.2	17.7
Twentieth century				
	LSE	6.9	4.9	21.8
	NYSE	6.3	4.3	19.6

The statistics were compiled by splicing together indices constructed with different methodologies and samples; some biases and inconsistencies are therefore inevitable in the results. Note that the indices used measure capital appreciation alone, not total returns.

The table shows that the long-term, annual, geometric capital appreciation of London Stock Exchange (LSE) equities over the total period was 2.1; the equivalent average for New York Stock Exchange (NYSE) equities was 3.9%. The annual standard deviations in annual performances were 15.7% and 18.4% respectively.

It is particularly interesting to note that the appreciation rate in LSE equities was much lower than that of NYSE equities over the eighteenth and nineteenth centuries but more than matched the appreciation rate of NYSE equities over the twentieth century. The standard deviation in returns for both markets was higher during the twentieth century than during earlier periods.

1.2.2. Valuation of equities

Whilst quoted equities have existed for over 300 years, there is little evidence of any valuation theory prior to the twentieth century. Indeed, history shows that, periodically, equity markets appear to have been driven in the main by intense speculation. Such speculation was certainly evident in the US equity market during the 1920s, for example, fuelled by the widespread conviction that "*God intended the American middle class to be rich*" (Galbraith, 1955: 19). The Great Crash of 1929, and the subsequent ten-year Great Depression, arguably provided the trigger for practitioners and academics to set their minds to establishing a realistic theory of equity valuation.

Practitioners who led the way included Graham and Dodd (1940), whose *Security Analysis* became the authoritative reference work for the investment profession. Graham and Dodd observed that, during the speculative period of the 1920s, equity investors abandoned a valuation approach based on past records and tangible assets and switched to a new-era concept of valuation based entirely on expected earnings trend. The resultant approach, the authors argued, concealed two weaknesses that could result in "untold mischief":

(a) the fundamental distinction between investment and speculation was abolished and:
(b) investors ignored the price of a stock in determining whether or not it was a desirable purchase.

It was Graham and Dodd's plea that investors should revert to a more realistic valuation approach. In particular, they argued that investors should capitalise *average* earnings at some suitable figure, where the latter is related to the going long-term interest rate.

The 1930s also witnessed the development of an approach that was more actuarial in style than the commonsensical, and arguably conservative, approach of Graham and Dodd. That is, the theoretical "present value" approach.

The concept of present value and discounting was not a twentieth century invention. Staubus (1965) cites, for example, the published work of Sir Isaac Newton in the late seventeenth century, which included the present values of annuities and other related tables. Likewise, John Playford's *Vade Mecum*, a companion of information for use in conducting business affairs, was published around the same time and also contained discount tables.

The first reference to present value theory, as applied to equities, is attributed to Wiese (1930) who stated that: *"The proper price of any security, whether a stock or a bond, is the sum of all the future income payments discounted at the current rate of interest in order to arrive at present value"* (Wiese, 1930: 5)

The real pioneer in this field was John Burr Williams (1938) who identified that *"investment analysis until now has been altogether unequal to the demands put upon it [and this] should be clear from the tremendous fluctuations in stock prices that* *have occurred in recent years."* He consequently set out *"To outline a new sub-science that shall be known as the Theory of Investment Value and that shall comprise a coherent body of principles like the Theory of Monopoly, the Theory of Money and the Theory of International Trade"* (Burr Williams, 1938: Preface).

Like Wiese, Williams argued that equity investment value is the present value of all future dividends. Specifically, for companies with growing dividends, share value is given by: $\pi_0 \sum_{t=1}^{\infty} \omega^t$

where: π_0 = Historic dividend

ω^t = $(1 + g)^t/(1 + i)^t$

and: $\omega^t < 1$ if $g < i$

Gordon (1962) was later responsible for popularising the present value approach, introducing what has become commonly known as the Gordon growth model, viz:-

Share price (P) = Expected dividend (D)/(r – g)

where: r = appropriate discount rate

g = expected long-term growth

Rearranging, provides an expression for the implied equity rate of return:-

E(r) = D/P + g

The Gordon valuation methodology forms the basis of the empirical analyses described in Chapters 3, 5 and 6.

1.2.2 Slow development in the UK

Despite a long history of equity trading, the development of any valuation theory was relatively slow to develop in the UK. It is interesting to note, for example, that in an address to the Institute of Actuaries in 1960, Weaver and Fowler (1960) felt the need to highlight the fact that: *"the assessment of industrial ordinary shares has not yet been discussed by the Institute"* (Weaver and Fowler, 1960: 281)

The most authoritative investment manual of that period, compiled by Whyte (1950), also provides the flavour of an unrefined approach to equity investment and an under-developed understanding of equity risk and return:-

"…….the scope for gain is often great, the pitfalls are many……..Investment in equity shares is essentially a matter for dynamic and not for static thought. In some cases rational forethought is feasible. In other cases any view of future prospects can be little better than guessing…"

"…..the difference between [the equity] yield and the yield currently ruling on other investments is frequently termed the 'risk premium'. It is a reflection of the risks involved; of the hopes and fears for the future. Thus, if the gilt-edged yield on irredeemable stocks happens to be $3^1/_2$%, and the yield on an equity share is 5%, the difference of $1^1/_2$% will be viewed as the risk premium; a measure of what investors think is a fair reward for the extra risk involved" (Whyte, 1950: 103).

Prior to the 1960s, therefore, dividend yield and cover tended to be the focus for equity appraisal. The earnings yield of companies was also sometimes used as a valuation benchmark. The end of the 1950s heralded a new era, however, marked by a reversal in the equity-gilt yield gap. Investors started to appreciate the true long-term value of equities, thanks to the work of Gordon and others, described above. That is, the total return from equities is represented by the sum of the dividend yield and expected growth. And it is this total return – not the dividend yield alone – which should offer a premium to the risk-free alternative.

The introduction of Corporation Tax in the UK in 1965 was also responsible for a shift in emphasis from equity dividend yields and cover to price-earnings ratios, bringing UK valuation more into line with US practice. Use of price-earnings ratios, in nominal and relative terms, remains today the commonest approach to equity valuation used by investors.

1.2.4 Equity return variation

History shows that, however the valuation of equities has changed over time, equity investors have had a roller-coaster experience. Table 1.1 showed that equity returns have varied considerably over the past three centuries. Substantial variation is often also experienced over shorter periods, as Table 1.2 illustrates. Viewed on a geometric basis, the twenty year period from end-1977 through to 1997 provided handsome returns to equity investors, both in nominal and real terms. The equity risk premium was also significantly rewarding. In contrast, equity returns failed to match inflation during the 1968-1977 decade. Over the past decade, equities have provided a positive real return but have failed to match the returns provided by bonds i.e. a negative equity risk premium.

Table 1.2 Annual average returns

	……......Arithmetic…...……			…………....Geometric…….....			
	Equities	**Bonds**	**Risk premium**	**Equities**	**Bonds**	**Risk premium**	**RPI**
1968-1977	21.8	9.0	12.8	11.3	7.0	4.0	11.5
1978-1987	21.3	13.3	8.0	21.0	12.5	7.6	8.0
1988-1997	16.2	13.9	2.3	15.4	12.8	2.3	4.5
1998-2007	7.3	9.6	-2.3	6.1	8.6	-2.3	2.8
TOTAL PERIOD	**16.6**	**11.4**	**5.2**	**13.3**	**10.2**	**2.8**	**6.6**

Raw data source: DataStream

1.3 RATIONALE AND STRUCTURE

This thesis attempts to analyse in detail the variation in equity returns through time. Both expected and achieved returns are analysed.

1.3.1 A note on analytical approach

The empirical analyses of returns in UK markets presented in Chapters 3, 5 and 6 of this thesis utilise the Gordon growth model (see section 1.2.2 above). Share prices are assumed to represent the present value of all future dividends, where those dividends are discounted at a rate that is composed of a risk-free rate and a risk premium. It also assumes that future dividends grow indefinitely at a constant rate.

The attraction of the Gordon model is its simplicity and its intuitive appeal, particularly where it is being used to model expected returns from a mature, developed market. It is acknowledged, however, that more complex, multi-stage growth models should be used where immature, fast growing companies or markets are being analysed or where abnormal growth patterns are envisaged.

The Gordon growth model also assumes a pure cash dividend stream which stretches indefinitely into the future and which grows at a rate that is a function of the growth in future corporate earnings. It is acknowledged that this, too, can be an over-simplistic assumption. Share buy-backs are now often substituted for cash dividends, notably in the US. Equally, dividend growth can be interrupted or distorted by government action. The imposition of dividend controls in the UK prior to 1980 is an example of the latter. Equally, the taxation regime implemented by a government can have a substantial impact on the present value of market assets to certain categories of investors. The removal of dividend tax privileges from the UK pension funds in 1997 provides a good example of this phenomenon.

Some commentators, such as Fabozzi (1999), also highlight the fact that the dividend discount model assumes that the investor's horizon matches the time used in the model, an assumption that does not always reflect reality. Again, this is fully acknowledged. Indeed, there is no attempt in the analyses presented in this thesis to construct valuation models which reflect the idiosyncrasies of investors. There is a strong argument, for example, for hypothesising that investors' horizons vary over time and, moreover, that different behavioural traits will come to the fore at different times. Should this be the case, the valuations indicated by the long-term Gordon intrinsic valuation model will inevitably deviate from the valuations suggested by methods which attempt to model changes in investors' preferences, perceptions and time horizons.

It is this fact which, if anything, highlights the attractions of using the Gordon growth model in analyses of this type. The Gordon model offers a theoretically sound, consistent intrinsic valuation. It indicates the valuation that should be placed on equities given the assumptions and the inputs to the model. Or, viewed in reverse, it can be used to indicate the return that is on offer, given market prices and given the assumptions and inputs. Although significant deviations can be expected from theoretical intrinsic values, it can be hypothesised further that, over a long period of time, underlying trends in market and theoretical intrinsic values will converge.

It could be argued, for example, that expected long-term equity returns may not be formulated by investors in the way presented in Chapter 6. Nevertheless, it could be argued further that the long-term averages and trends in expected returns and risk premia calculated in this way are likely to converge with those of investors' actual ex-ante expected returns and risk premia, however the latter may have been determined. Moreover, the "abnormal" peaks and troughs in expected risk premia, which will be discussed in Chapter 6, may be regarded to be, in part, an indication of periods of extreme divergence between theoretical, intrinsic valuations and market/investor-driven valuations.

1.3.2. Structure of the thesis

Chapter 2 provides a general review of previous work related to the area under investigation. Inevitably, this includes a discussion of the concepts of efficiency and rationality within equity markets as well as the challenges to the efficiency hypothesis. Chapter 2 also looks in detail at the "equity risk premium puzzle" and the numerous reasons promoted by Cochrane (1997), Cornell (1999) and others in explaining this puzzle. Studies undertaken in recent years to determine ex-ante values for the risk premium are also summarised.

Chapters 3 to 6 contain accounts of empirical studies carried out to explore various aspects of return variation in the UK equity market. Previous literature relevant to each specific study is reviewed in the first part of the relevant chapter.

Chapter 3 examines the relationship between equity markets and underlying macro-economic variables. Key US and UK studies are identified and discussed. An analysis of the linkages between the UK equity market and movements in underlying macro-economic variables is then presented. The methodology used is built on that adopted by Fama (1990) in exploring relationships in the US equity market.

If it is assumed that equity prices reflect the discounted value of future dividends, then some relationship should be observed between prices and changes to both expected future dividends and the rate at which such dividends are discounted. Unexpected changes in GDP growth or industrial production, for example, would have implications for the growth of most companies quoted within the stock market. In the short-term, it is likely that the impact on equity prices would come from a change in the rate at which future dividends are discounted (i.e. a change in the equity risk premium, a part of the denominator in the discounting process). A more pronounced, sustained change in macro-economic conditions might also influence long-term dividend growth expectations (i.e. equity prices might change because of a change in the numerator).

The analysis presented in Chapter 2 seeks to identify whether these theoretical links between equity prices and the macro economy exist. Reassuringly, the analysis does indeed show that the UK equity market is driven, in the main, by rational economic factors, such as levels of economic activity and movements in long-term interest rates.

Chapter 4 explores the nature of equity market volatility and its predictive capabilities. Investment management is usually presented as the process of selecting an efficient combination of available assets based on the expected returns and risk characteristics of those assets. And risk is usually defined in terms of historic standard deviation or variance. But can historic volatility be relied on as a predictor of future returns. Or, is this assumption an over-simplification?

Summaries of previous studies undertaken in this specific area, such as those of Merton (1980), French et al (1987), Schwert (1989) and Priestley (2001), are summarised and discussed. An analysis of UK market volatility for the period 1963-2003 is also presented. The study investigates the relationship between volatility and equity returns, concluding that historic volatility is a poor predictor of future excess returns and that there is a strong, negative relationship between excess equity returns and contemporaneous volatility. A GARCH analysis confirms that the most significant element of this latter relationship is the correlation between returns and “unanticipated” volatility.

A partial decomposition of equity returns is presented in Chapter 5. The intention of this study is to look more closely at the “excessive” volatility arguments of Shiller (1981) and to show that, in fact, a substantial portion of UK equity market variability can be attributed to a variation in discount rates. In other words, variation in risk-free returns (i.e. usually the main component in the discounting process) accounts for much of the “excessive” volatility suggested by Shiller. The study assumes, like Shiller, that at any point in time investors had perfect foresight of future dividends. But instead of discounting these expected dividends at a constant discount rate, the study assumes, realistically, that over time the discount rate will vary, partly because of changes in risk-free returns available. Such an assumption is shown to result in significant volatility, even if a constant risk premium is assumed for the additional component of the discount rate. A second stage of the analysis looks at implied discount rates if the actual UK equity market levels are taken to represent the present value of all known future dividends. The analysis suggests that, in addition to the variation in the risk-free element of the discount rate over time, there are substantial swings in the ex-ante equity risk premium.

A full decomposition of UK equity and bond market returns is presented in Chapter 6. Ex-ante and ex-post returns and premia are analysed for the period 1963-2005 and decomposed into specific elements. To the best of the author's knowledge, the detailed methodology employed – whilst building on the basic Gordon growth approach – is unique. The study views the UK index-linked market as an integral part of the theoretical equilibrium between the UK financial markets and data from that market provides important input to the study. A significant difference was found between ex-post and ex-ante estimates of the annual equity risk premium, the latter being three percentage points lower than the former. Much of this difference can be attributed to the fact that equities enjoyed an unexpected re-rating (i.e. lowering in dividend yields) over the period.

Chapter 7 summarises the main findings from each of the empirical studies and presents the main conclusions of the thesis. The implications for future research are also identified.

CHAPTER 2 – GENERAL LITERATURE REVIEW

2.1 INTRODUCTION

Equity markets can display considerable volatility and equity returns can be subject to substantial cyclical and secular variation. The key questions are:

- What factors cause this variation in returns?
- Are these factors rational, irrational, or a mix of the two?
- Do these factors change over time?

It is not the intention in the following review to provide a comprehensive survey of previous work undertaken on all aspects of equity return variation. The intention is:

(a) To discuss the general progression in academic thinking in the area of equity pricing, over the past four decades in particular. Previous studies relating to specific aspects of the analyses presented in Chapters 3 to 6 will be discussed at the start of the relevant chapters.

(b) To highlight key analyses within each sub-section and, to identify contrasting views.

(c) To build a platform for empirical analyses of returns from the UK equity market. The empirical analyses in Chapters 3 to 6 focus on market returns and the variation in those returns. As such, the discussion in this chapter focuses mainly, but not exclusively, on top-down (i.e. market level), rather than cross-sectional, empirical research.

The Efficient Market Hypothesis (EMH) has been at the core of academic debate on asset pricing over the past four decades. And many challenges to the EMH have been mounted over this period in a bid to “explain” what might appear to be unusual or irrational behaviour or observations. The EMH necessarily, therefore, becomes the starting point for this review.

2.2 THE EFFICIENT MARKET HYPOTHESIS

An efficient market is one in which "security prices at any time 'fully reflect' all available information" (Fama 1970). Or, from a more pragmatic point of view:

"A market is efficient with respect to information set θ_t if it is impossible to make economic profits by trading on the basis of information set $\theta_{t.}$" (Jensen 1978: 96).

Tests of the Efficient Market Hypothesis (EMH) revolve around the definition of the information set. Three forms of the EMH are identified in the literature:

(a) The weak form. Prices fully reflect the information implied by all prior price movements.
(b) The semi-strong form. As well as reflecting all past news, prices will act instantaneously and without bias to new published information.
(c) The strong form. Prices not only reflect all published information but also all relevant, knowable information not yet published.

Empirical testing of the market pricing mechanism has been undertaken for over 100 years. In a pioneering work, Bachelier (1900) derived the theory that speculative prices must follow a random walk. He then compared the statistical distribution of price behaviour expected from his theory with observed distributions of price changes of certain government securities on the Paris Bourse. A close match between the observed distributions and expectations was found.

2.2.1 Early tests of the weak form

The advent of computerisation in the second half of the 20th century enabled researchers to undertake far more rigorous testing of stock market prices. Kendall (1952), for example, analysed patterns in 19 UK actuaries' indices over the 1928 to 1938 period. He computed serial correlations for each series, lagging the data over 1 to 19 weeks, and concluded that such serial correlation as was present in the series was so weak as to dispose of any possibility of being able to use them for prediction:

"*Investors can, perhaps, make money on the Stock Exchange, but not, apparently by watching price-moments and coming in on what looks like a good thing"* (Kendall, 1952: 113).

There were, however, some observations that required further explanation. The aggregate series (e.g. All Industrials), in addition to the Investment Trusts and Stores series, did display some significant serial correlation. Kendall concluded that this "*rather disturbing"* evidence could be caused through the aggregation methodology and further inferred that wherever possible econometricians should study individual series rather than aggregates.

Alexander (1961) questioned whether the weekly intervals used by Kendall were appropriate, arguing that short-term fluctuations might very easily swamp any underlying trends. More specifically, he surmised that Kendall's correlations – close to zero in most cases – could possibly be a consequence of the combination of the negative contributions of the reactions and the positive contributions of the trends. If this was the case, the first-order serial correlations of daily price changes might have been negative, the first order correlation of weekly changes might have been close to zero while the first order serial correlations of monthly or bimonthly changes might have been significantly larger than zero.

Alexander tested this possibility, using the same data as Kendall. Serial correlations were computed on the same actuaries' series, using intervals of 1, 2, 4, 8, and 16 weeks. While occasional high value correlations were observed over periods of more than one week, the overall conclusion was that the results did not give any substantial support to the hypothesis that longer period intervals lead to increased correlations. All in all, he concluded, the random walk hypothesis was confirmed.

Attacking the problem from another angle, Alexander set out to test for non-randomness by assuming that the existence of trends in stock market prices may be *"masked by the jiggling of the market"* (Alexander, 1961: 255*).* He consequently set about filtering out all movements smaller than a specified size and examined the remaining movements. As an example, a 5% filter test would trigger the following actions: go long and stay long if the market moves up by more than 5%; go short and stay short if the market falls by more than 5%. All moves of less than 5% were ignored.

Filter tests using various filters, ranging from 5% to 50%, were applied to the Dow Jones and Standard & Poor's industrial averages for the period 1897 to 1959. Notional profits, before commission, were calculated and compared with the results of a buy and hold policy. A sample of the results is shown in Table 2.1.

Table 2.1 The Alexander results

Period	**Filter size:**	**5%**	**10%**	**20%**	**30%**	**50%**	**Buy& Hold**
1897 – 1914	Profit/year (%)	20.5	4.6	7.8	3.2	-3.9	3.2
1914 – 1929	Profit/year (%)	15.8	10.0	10.3	8.6	-2.1	14.1
1929 – 1959	Profit/year (%)	36.8	16.8	7.8	7.0	8.5	3.0

The results uniformly favoured the smaller filters over the buy and hold method, albeit that no adjustment was made for transaction costs. Alexander concluded that this success stemmed from a characteristic of stock price behaviour other than that implied by the upward long term trend alone. In other words, while price changes may appear to follow a random walk over time, a move, once initiated, tends to persist.

A number of criticisms were advanced following publication of Alexander's results, the most serious being that his methodology introduced persistent bias. Consequently, Alexander revisited his analysis, making allowance for the biases that had been highlighted. The changes made substantially reduced the profitability of the filters, in some cases replacing profits with losses. Indeed, only rarely did the filter results compare favourably with the buy and hold strategy. Alexander concluded:

"The big bold profits of Paper 1 must be replaced with rather puny ones. The question still remains whether even these profits could plausibly be the result of a random walk. But I must admit that the fun has gone out of it somehow" (Alexander, 1964: 423).

2.2.2 Early tests of the semi-strong form

The semi-strong form of the efficient market model is concerned with the way in which new information is assimilated in stock prices. More specifically, it is concerned with both the speed and the magnitude of the reaction.

An important, early research study in this area was undertaken by Ball and Brown (1968), who set about exploring the reaction of stock prices to new information. The "new information" used in the study was the "good news" or "bad news" associated with the publication of corporate annual income numbers. Data for 261 US companies were analysed over the period 1957-1965.

The first stage of the analysis involved determining the "normal" change in any company's annual income for any given change in aggregate market income. Historical company income data were regressed on aggregate market income data and the resultant coefficient was taken to be a useful indicator of future expectations, given any forecast change in aggregate market income. Thus subsequent changes in corporate income could be categorised as either "good news" or "bad news".

"Good news" and "bad news" portfolios were constructed and their relative performance examined for the one year period prior to the announcement date. The results showed that there was consistent relative performance in the direction anticipated. In other words, "good news" stocks consistently outperformed prior to announcement; "bad news" consistently underperformed. Moreover, 85 to 90 per cent of the net effect of the new information appeared to be assimilated prior to the actual news announcement. Clearly, market participants were making use of other sources of information during the year to predict successfully what the eventual outcome might be.

Other approaches to testing the semi-strong form of the EMH have involved examining the performance success of expert investors. Do the funds managed by such investors, benefiting from access to all new, published information, consistently outperform performance benchmarks or passive funds?

Jensen (1968) carried out one such analysis, looking at the performance of 115 US mutual funds over the period 1955 – 1964. Benchmark returns were set, and subsequent performance analysed, using the standard market model of Sharpe, Litner and Treynor:

$$R_j - R_f = \alpha_j + \beta_j(R_m - R_f) + \mu_j$$

A positive value for the intercept α_j would indicate that the expert investor has an ability to forecast security prices; a negative value would indicate that the investor tends to perform even worse that a portfolio constituted by random selection. The error term, μ_j, in the above model was anticipated to be zero and serially independent.

The results over the period analysed were as summarised in Table 2.2

Table 2.2 The Jensen results

Item	Mean	Median	Minimum	Maximum
α	-0.011	-0.009	-0.008	0.058
β	0.840	0.848	0.219	1.405
r^2	0.865	0.901	0.445	0.977

The results highlight:

- the below-average systematic risk of the average fund
- the close fit of the data, as indicated by the average r^2 of 0.865
- the poor average performance achieved by the fund managers, as indicated by the average α of -0.011

The average alpha of -0.011 – an average, annual return of 1.1% less than that warranted by the average level of systematic risk – showed clearly that the funds were not able to forecast security prices well enough to recover research expenses, management fees and commission expenses.

The alphas were also estimated on the basis of returns calculated gross of all management expenses. The average alpha was again negative, at -0.4% per annum, suggesting that the funds were not able to increase returns enough over the 20 year period examined to recoup even their brokerage commissions (the only expenses which were not added back to the fund returns).

2.2.3 Tests of the strong form

The strong form of the EMH suggests that *all* available information – both public and private – is fully reflected in security market prices. It would be impossible to make abnormal returns consistently in such a market by making use of information not already made public.

The Jensen investigation, described above, supports the semi-strong form of the EMH; that is, it seems impossible to gain abnormal returns consistently using publicly-available information. The results can also be interpreted as evidence that the strong form of the EMH does not hold inasmuch as professional money managers do not appear to be able to profit from any access to privileged or “inside” information.

The difficulty in testing the strong form of the EMH, of course, is the fact that insider trading is now illegal in most markets. Part V of the Criminal Justice Act, 1993, for example, seeks to prevent insider trading in the UK whilst the 1934 Securities Exchange Act, backed up by many subsequent SEC rulings, seeks to control illegal, insider trading within the US. Empirical work has therefore tended to be concentrate on studies of legal insider trading, that is legitimate trading of a company’s securities by company officials and as reported to the SEC.

An early study of this nature was undertaken by Jaffe (1974) who studied the impact of insider trades in the US equity market between 1962 and 1968. The information regarding trades was obtained from the *Official Summary of Insider Trading*, the monthly report listing the transactions of corporate officials. Jaffe concluded that insiders do possess special information and that significant abnormal returns could be earned through intensive trading in the relevant stocks.

A more comprehensive study was undertaken by Finnerty (1976). A total of over 30,000 'insider' transactions was examined from the period 1969-1972, 9,602 buy transactions and 21,487 sell transactions. Insider buy portfolios and insider sell portfolios were formed for each month of the three year period and subsequent outperformance for various holding periods was measured using the Jensen (1968) market model approach.

The subsequent performances of the portfolios were as anticipated: the buy portfolios outperformed their benchmark for all holding periods; the sell portfolios underperformed their benchmark for all holding periods. In both cases, the most significant abnormal performance occurred in the first month following the formation of the portfolios.

Finnerty concluded that insiders are able to outperform the market by making use of privileged information and that the strong form of the EMH could be refuted.

The first attempt to obtain evidence on the degree of profitability of insider trading in the UK market was undertaken by Pope et al (1990). The data set used comprised directors' transactions recorded in the Stock Exchange's Weekly Official Intelligence for periods between April 1977 and December 1984.

Pope et al tracked the performances of BUY portfolios and SELL portfolios within the sample in addition to tracking the performance of the total sample over several sub-periods. The total sample produced cumulative abnormal returns of between 4% and 6% over six month periods following disclosure of insider trades. Short trading in the SELL portfolios would have made a superior contribution to that of the BUY portfolios. Over the period 1983/84, for example, the cumulative abnormal returns on the total sample and the BUY and SELL portfolios would have been 5.8%, 2.5% and -9.9% respectively.

Empirical studies have not confined themselves entirely to investigations of "legal" insider trading. Keown & Pinkerton (1981), for example, investigated evidence of insider trading relating to merger announcements during the 1970s. Data was gathered for 194 US firms that were the targets for bid activity over the period 1975 to 1978. Prices were gathered for a period of 126 trading days prior to the bid announcement and 31 trading days post announcement.

The cumulative residual for the total sample turned positive 25 days prior to the announcement date and approximately one half of the total cumulative residual was achieved prior to the announcement, as Table 2.3 shows. The authors concluded that illegal trading on non-public information of this type abounds and that it is possible to earn significant excess returns from its use. They also concluded that their results supported the semi-strong form of the efficient market hypothesis inasmuch as the market reaction to the new public information is completed by the day after the announcement.

Table 2.3 Merger event study results

Day	Daily Residual (%)	t-stat	Cumulative Residual (%)
-15	0.079	0.38	2.677
-10	0.424	2.18	4.124
-5	0.670	2.90	6.764
-4	1.260	4.93	8.025
-3	1.060	3.71	9.084
-2	1.620	5.09	10.704
-1	2.551	5.93	13.255
0	12.020	11.53	25.275
1	1.443	3.21	26.718
5	0.231	1.19	26.831
10	-0.144	1.15	27.042

2.2.4 Early conclusions

The early evidence therefore suggested that the weak and semi-strong forms of the EMH hold, at least in terms of the more pragmatic definition of the EMH provided by Jensen. Mechanical trading systems cannot be used to generate superior returns consistently. Moreover, new information appears to be assimilated into security prices quickly and, arguably, "correctly" with the result that the application of fundamental analysis also fails to produce regular abnormal profits. Tests of the strong form of the EMH have been less prolific and more difficult to interpret in view of the legal and regulatory background. However, the evidence suggests that markets are not efficient in the strong form.

Any conclusion relating to the early tests of the EMH is best summarised by Fama (1970):

> "*…...the evidence in support of the efficient markets model is extensive, and (somewhat uniquely in economics) contradictory evidence is sparse. Nevertheless, we certainly do not want to leave the impression that all issues are closed. The old saw, 'much remains to be done' is relevant here as elsewhere"* (Fama, 1971: 416).

2.3 RETURN PREDICTABILITY

Part of the challenge to the EMH that has been mounted over the past three decades has been the identification of anomalies. Research falling into this category includes tests for return predictability arising from:-

- Under-reaction/over-reaction
- Valuation indicator levels
- Mean reversion
- Winner/loser strategies

Whilst embracing different terminology, tests in this area all essentially attempt to identify whether, contrary to the EMH, security prices do not always follow a random walk. Moreover, is it possible to exploit any such non-randomness?

2.3.1 Under-reaction to earnings announcements

The semi-strong form of the EMH argues that new information is swiftly assimilated into security prices. The speed of assimilation is such that investors cannot consistently exploit that information to earn abnormal returns.

Evidence started to emerge in the 1970s, however, which suggested that securities yield systematic excess returns following earnings announcements. Moreover, these excess returns persisted. In other words, unexpected news, good or bad, did not appear to be immediately incorporated in security prices.

Ball (1978) reviewed twenty studies that appeared consistently to support the under-reaction argument and disputed the findings. He suggested that experimental design was probably the cause of the apparent effects. In particular, the standard two parameter market model used in most of the testing omits variables that do contribute to the equilibrium level of prices. The identification of apparent "anomalies", he argued, was simply an identification of mis-specification of the model.

Bernard & Thomas (1989) also set about replicating earlier studies and confirmed evidence of post-announcement drift. US companies were ranked according to the degree of earnings surprise and subsequent drift was found to increase monotonically. The top decile, for example, would have produced an abnormal return of approximately 4.2% over the 60 days subsequent to earnings announcements. Arguing that these results presented *"several vexing, conceptual, and econometric questions"* they concluded that the phenomenon could be attributed to pricing errors related to unavoidable transaction costs.

2.3.2 Dividend yield as a predictor

The predictive power of dividend yields has been analysed by many researchers, including Fama and French (1988a, 1988b). Fama and French studied the returns on portfolios of NYSE stocks for return horizons from one month to four years. Regressions of returns on yields typically explained less than 5% of monthly or quarterly return variances but a much larger component of long-horizon returns. For example, regressions of returns on yield were shown to explain more than 25% of the variances of two to four year returns. Out-of-sample results confirmed the in-sample evidence that the explanatory power of yields increased with the return horizon.

Fama and French concluded that there are transitory or "temporary" components of prices. Shocks to expected returns generate shocks in the opposite direction to current prices. On average, the immediate shock to prices equates to the cumulative future price changes generated as these "revised" returns are delivered.

2.3.3 Mean reversion

Mean reversion studies have also looked at the apparent tendency for "erroneous" market moves eventually to be corrected. An important and comprehensive study of this type was undertaken by Poterba and Summers (1988) on both US and non-US data.

Mean reversion implies that there may be observed periods of serial autocorrelation in prices during which prices and fundamental values diverge. However, over longer time periods this divergence is corrected. One approach to assessing the randomness or non-randomness of returns, adopted by Poterba and Summers, is the use of the variance–ratio test. Put simply, if a stock price follows a random walk then the return variance should be proportional to the return horizon. For example, the variance of monthly returns would be expected to be one twelfth the value of the variance of annual returns. The general model adopted by Poterba and Summers compared the variance of monthly returns derived from returns over varying periods with the variance of monthly returns derived from annual returns, viz:-

The Variance-ratio, $VR_k = [var(r^k)/k]/[var(r^{12})/12]$

where: k= number of months in period examined

This statistic would converge to unity if returns over any period are uncorrelated but would fall below one if the mean reversion trends, described above, were present.

Poterba and Summers analysed four data sets and obtained the following results

(a) Monthly returns on the NYSE indices for the 1926-1985 period

- evidence of positive autocorrelation at intervals of less than one year; evidence of negative serial correlation for periods of more than one year. Eight year returns, for example, found to be around four, rather than eight, times as variable as one year returns.

(b) Market returns over intervals from 24 to 96 months from 1871-1985

- evidence of negative serial correlation at long lags but pre-1925 evidence weaker than post 1925 evidence.

(c) Returns from 17 non-US markets over varying periods since 1919

- most markets displayed negative serial correlation at long intervals. Positive serial correlation at short intervals also found to be pervasive.

(d) Monthly returns on 82 individual US securities for the period 1926 to 1985

- some evidence of mean reversion, but weaker than evidence for markets.

Like Fama and French, therefore, they found persuasive evidence of transitory components in stock prices. In speculating as to the causes of this phenomenon, Poterba and Summers were inclined to the view that these components did not arise through any ex-ante change in returns but rather through the actions of noise traders. They concluded that:

> *"Only by comparing models based on the presence of noise traders with models based on changing risk factors can we judge whether financial markets are efficient in the sense of rationally valuing assets, as well as precluding the generation of excess profit"* (Poterba and Summers, 1988: 54).

Balvers et al (2000) recently contributed wider evidence of mean reversion in stock markets by analysing both Morgan Stanley Capital International and IMF data across 18 countries over the period 1969 to 1996. Their conclusions were:-

- An absence of mean reversion is rejected across markets at the 5% or 1% significance level.

- This finding is confirmed with both sets of data and adds to the controversial evidence of mean reversion first provided for US stock prices by Fama & French and Poterba & Summers, as discussed in 2.3.2 and 2.3.3.
- Following a shock to stock prices, it takes approximately three to three and a half years for these prices to revert halfway to their fundamental values.
- Contrarian investment strategies can be developed to generate economically significant excess returns.

2.3.4 Winner –v- loser strategies

The predictability of security prices has also been examined closely from a behavioural angle, the hypothesis being that most people overreact to unexpected and dramatic news events. (A broader discussion of Behavioural Finance is contained in Section 2.5).

De Bondt and Thaler (1985) tested this hypothesis by examining the returns to 'winner' and 'loser' portfolios for the period between 1926 and 1982. Portfolios of common stocks were constituted at any date from the best and worst performing stocks over the previous 36 months and the excess performance of each portfolio measured over the subsequent 36 months. Sixteen non-overlapping periods were examined.

The results were found to be consistent with the over-reaction hypothesis. Loser portfolios outperformed the market, on average, by 19.6% over the three year measurement periods; the winner portfolios tended to underperform by 5%. A very strong January effect was observed. Interestingly – and in agreement with the claims of the acknowledged father of value investing, Benjamin Graham – most of the over-reaction unravelled over the second and third years of the test periods.

Jagadeesh & Titman (1993) were among others who found evidence of the success of shorter-term momentum strategies. US stocks were grouped into winners and losers over six month periods between 1965 and 1989. It was found that buying the winners and selling the past losers would have generated substantial excess returns over subsequent six month periods. The authors argued that this was possibly evidence of overreaction on the part of investors who move prices away from long-term value temporarily. Alternatively, they argued it could be evidence that the market under-reacts to information about short-term prospects but over-reacts to information about long-term prospects.

2.3.5 Predictability – some later evidence

An important addition in recent years to the literature on the success of the dividend yield as a predictor has been provided by Goetzmann and Jorion (1995). A re-examination of the evidence, using much longer market histories, confirms that dividend yield does appear to have some, albeit marginal, ability to predict stock market returns. The authors argue, however, that the evidence may be affected by survivorship.

More specifically, an analysis of UK stock market data over the total period 1871 to 1992 showed that there was no evidence of predictability. The results for sub-periods showed significantly different results. Predictive ability over the 1871-1926 period appeared to be weak and, if anything, negative (i.e. high yield predicted lower return) while predictive ability over 1927 -1992 was strong and in the direction anticipated.

Goetzmann and Jorion suggested that one explanation for these results may be that there was an irrational fear of equities in the pre-World War I era and that a clear structural break can be observed around the 1920s. Alternatively, they suggested the predictability results could be explained in terms of survivorship. In particular, the evidence of predictability for post 1926 data appeared to be driven by an outlier – 1974 – a period when there were genuine concerns about the futurity of the existing financial system. An exceptionally high dividend yield in 1974 was followed by a burst of exceptionally strong stock market performance.

Clearly, the evidence is open to interpretation but one conclusion could be that survivorship tends to bias inference in favour of finding that dividends help predict long-horizon returns. The authors concluded:

"If the chances of a market disappearing are truly zero, then the predictability we found in recent UK data is consistent with the market overreaction hypothesis. Otherwise, the predictability of future returns based on dividend yields may be overstated" (Goetzmann and Jorion, 1995: 506).

A tool much-favoured by UK investment practitioners during the 1980s and 1990s was the gilt-equity yield ratio (GEYR). A high level of the GEYR indicated that holdings in equities should be reduced and holdings of gilts increased; a low level indicated the opposite. These decision rules were commonly based on GEYR levels of 2.4 and 2.0 respectively.

The GEYR earned a considerable reputation for its ability to predict successfully switching opportunities between equities and gilts. Academic studies (see Clare et al, 1994, for example) tended to support the GEYR as a successful predictive tool. However, there was little attempt to explain the rationale behind the GEYR through any detailed decomposition.

This failure was corrected later in the 1990s when the GEYR became the subject of much closer scrutiny following a period of poor performance as a predictive tool. Levin and Wright (1998) and FitzGerald (2003), for example, have more recently attempted to decompose the GEYR by applying the basic Gordon valuation model:

$$P_0 = d_1/(r - g)$$

and assuming that the discount rate used by equity investors is the sum of the risk-free rate (the gilt yield) and a risk premium.

The following summarises FitzGerald's analysis. Rearranging the model shows:-

Expected equity return = equity dividend yield + expected dividend growth.

The risk premium can therefore be stated as:-

Equity risk premium = equity yield + expected dividend growth – gilt yield

A rearrangement of this relationship leads to an expression for the yield gap, an indicator more commonly used prior to the adoption of the yield ratio:

Yield gap = expected dividend growth – risk premium

The yield gap will therefore tend to narrow when a high risk premium is available and widen when the premium on offer shrinks. The expected dividend component in this relationship does, of course, introduce considerable noise. Real dividend growth cannot be expected to remain constant over time; the size of the component will also vary with inflation. Consequently, there is a danger that the indicator can be misinterpreted. FitzGerald argued that the yield ratio has in the past provided a partial solution to this problem by providing a crude inflation adjustment to the yield gap. Dividing both sides of the yield gap equation by the equity yield gives:

Yield ratio = 1 + yield gap/equity yield.

Because the equity yield has historically been positively correlated with inflation, the yield ratio has, until recently, proved to be a better indicator of relative returns than the yield gap. But it was argued that the decision rules applicable for much of the 1980s and 1990s are no longer relevant in a new era of low interest rates and low inflation, since the “normal” range has shifted downwards significantly.

Levin and Wright (1998) also noted that the GEYR is particularly sensitive to changes in inflation expectations and examined the success of revised decision rules which took account of changes in expectations. A strategy utilising revised rules outperformed the traditional approaches and a buy and hold strategy by a wide margin. No claims are made, however, that the success of their revised approach destroys the credibility of the EMH. Indeed, Levin and Wright stated:

> *"We do not enter this debate [as to the cause of any predictable component of returns] except to point out that the superior trading performance of our GEYR adjusted trading rule may not be attributable to market inefficiency"* (Levin and Wright, 1998: 10).

2.4 EXCESS VOLATILITY

Further questioning of the EMH arrived in the late 1970s and early 1980s in the form of variance testing and variance bounds analysis. Put simply, the claim was that the volatility of security prices appears was far greater than what should be expected if securities were efficiently priced.

2.4.1 Early work

LeRoy and Porter (1981) were the first to mount this challenge with respect to the equity market. They argued that if prices are viewed in the traditional way, as the present value of a future earnings stream, and assuming that no earnings are retained, then stock prices should be less volatile than the volatility of the earnings. Stock prices can be viewed as "a kind of" weighted average of earnings, and an average is generally less volatile than its components.

They argued, moreover, that stock prices are an average of expected, rather than actual, earnings and since expected earnings can plausibly be assumed to regress towards a mean in the increasingly distant future, it follows that expected earnings should show less dispersion than actual earnings, further reducing the anticipated dispersion of stock prices.

LeRoy and Porter also developed and tested a theory for defining the bounds on the volatility of security prices. The upper bound is the volatility that would be evident if there were no means of forecasting future earnings; the lower bound is the volatility if there were leading indicators that provided perfect forecasting ability.

Tests were performed on earnings and price data for the S & P Composite Index, GE, GM and AT&T. The conclusions were:

- The data for two of the individual stocks were consistent with the theory that stock prices should be less volatile than earnings but the coefficient of dispersion for AT & T and the S & P Index was several times higher than that of earnings.
- The upper bound test for volatility was "flagrantly violated" in all four data sets.
- Based on both aggregated and disaggregated data, stock prices appeared to be more volatile than is consistent with the efficient capital markets model.

2.4.2 The Shiller argument

Shiller (1981) tackled the same problem. As in the LeRoy and Porter study, prices at any time were assumed to represent the present value of all future cash flows, in this case dividends. However, if a series of ex-post rational prices is constructed (i.e. the level of the market index at any point is calculated by discounting all the known dividends occurring thereafter), it is found to display far less volatility than the stock market actually displayed.

Analysing US market data from 1871, Shiller concluded that price volatility was at least five times higher than the volatility of dividends would imply:

> *"The failure of the efficient markets model is thus so dramatic that it would seem impossible to attribute the failure to such things as data errors, price index problems, or changes in tax laws"* (Shiller, 1981: 434).

The following simulation illustrates the thrust of the basic Shiller argument. In this case, a variation of the Shiller methodology is applied to the UK equity market over the period from 1963-2005. The main difference in methodology is that nominal, rather than real, series are used in the analysis. The final effect, however, is similar.

Figure 2.1 charts the actual FTSE All-Share Index against a simulated "notional" equivalent. The latter was derived as follows.

It was assumed that the actual FTSE All-Share Index level at the end of 2005 was "correct" and was a true reflection of the discounted dividends expected from 2006 onwards. The actual annual divided growth experienced over the 43 year period is, of course, known, as is the average annual return earned over the period. It is assumed further that investors in the past had perfect foresight of future long-term dividend growth and that any shorter-term volatility in the stock market level was caused by shorter-term fluctuations in annual dividend growth.

The notional index is constructed by working backwards from 2005, calculating an index level at the end of each year which represents the discounted value of the dividend and capital value anticipated for the following year. Thus the end 2004 notional index level is the discounted value of the anticipated 2005 dividend and the end-2005 index level. The end-2003 notional level is the discounted value of the anticipated 2004 dividend and the simulated end-2004 index level, and so on.

Figure 2.1 FTSE All-Share Index - Simulated –v- actual index

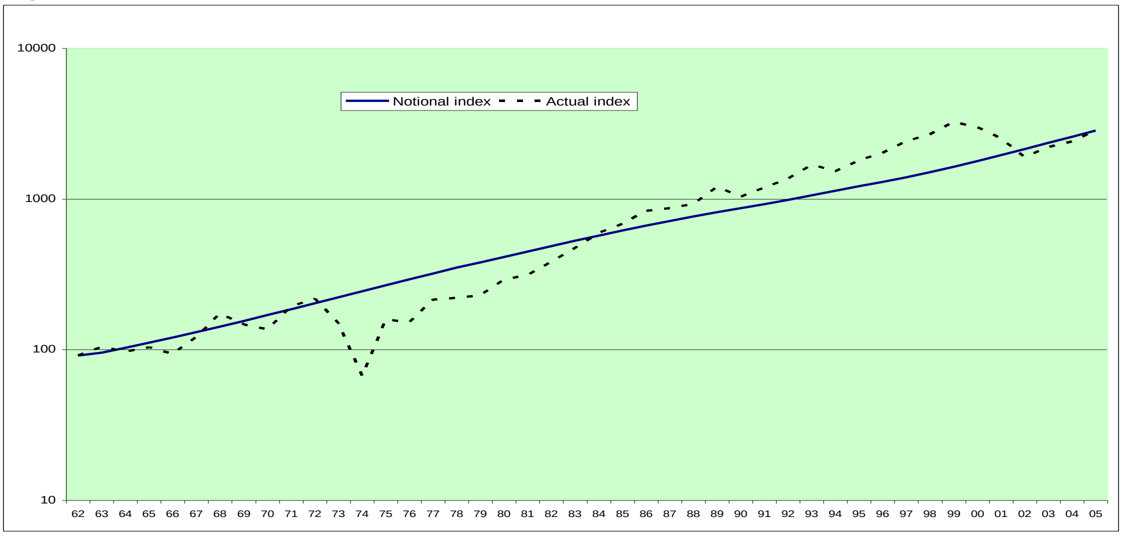

Figure 2.2 FTSE All-Share Index – Deviation (%) from trend

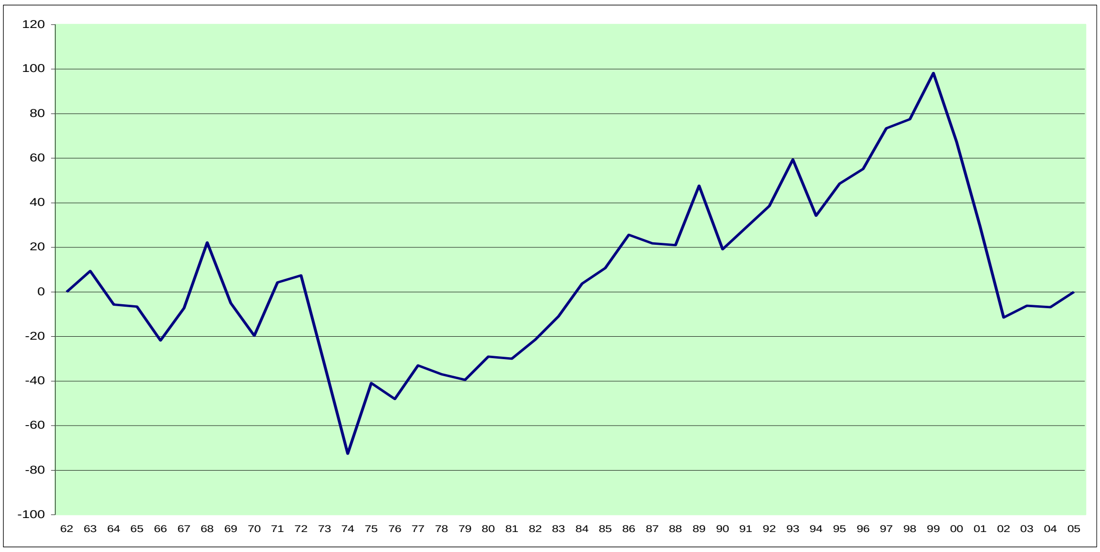

Figure 2.1 shows that the actual index proved to be far more volatile than the simulated values. Moreover, the actual index appears to stray away from trend and for such a divergence to be sustained for lengthy periods.

Figure 2.2 highlights this divergence. During the bear market of 1974 the UK market appeared to fall to just 30% of its long-term "trend" value. A correction was eventually completed by 1984. Through much of the 1980s and 1990s the stock market appears to have been sustained at levels well above long-term trend until a major correction was experienced over the 2000-2002 period.

2.4.3 Varying the discount rate

A key feature of Shiller's initial work and the simulation described above is that the discount rate used is assumed to remain constant, at the average of the total return earned by investors over the total period under examination.

Some recognition was given to the fact that such "excess volatility" may be attributable to changes in interest rates (i.e. the discount factor). But the problem that Shiller identified was that expected real interest rates could not be identified directly. Indeed, he argued further that the movements in expected interest rates that would justify the variability in stock prices would have to be very large – much larger than the movements in nominal interest rates over the sample period.

Grossman & Shiller (1981) did subsequently examine further what would happen if the constant discount assumption was relaxed. The appropriate discount rate, they argued, is the marginal rate of substitution between consumption today and consumption in the future. Moreover, if the variability of stock prices implies that this marginal rate varies, it must be assumed that consumers have a better method for forecasting future consumption than using only current consumption. Grossman and Shiller consequently used a constant relative risk aversion utility of consumption function to determine varying discount rates over the 1889-1979 period.

With the risk aversion coefficient in their model set at certain levels, Grossman and Shiller found that the volatility of discounted "perfect foresight" dividends was fairly similar to the volatility of the actual market, at least until about 1950.

Kleidon (1986) found that subsequent work on later data was not successful in extending the Grossman and Shiller findings in this area.

2.4.4 Straying from fundamental value

An important contribution to the debate on apparent, excess volatility was made by Summers (1986). Summers argued that market prices do stray frequently and substantially from fundamental values. As evidence, the author cited the discounts available on closed end funds, the anomalous pricing in the British gilt market and the large takeover premiums that are frequently paid, even in cases where there are no obvious economic advantages to combination.

Summers' analysis suggested that *"a more catholic approach*" should be taken to explaining the behaviour of speculative prices. More specifically, it may be possible to model the process by which errors are incorporated into asset prices:

> *"Such an approach seems preferable to insisting on the basis of very weak available evidence that market valuations are always rational"* (Summers, 1986: 600).

In more recent research, Bulkley and Harris (1997) re-examined the question as to whether excess price volatility might be caused by excess volatility in earnings expectations. Regression analysis was undertaken on US stock information, based on a model of the form:

$$eg_{it} = \alpha + \beta eg^{f}_{it} + \varepsilon_{it}$$

where: eg_{it} = actual annual average earnings growth of firm *i* over five years from the start of year *t*

eg^{f}_{it} = analysts' forecast of long run earnings growth for the same period

Under rational expectations the slope coefficient in the above regression should approximately average unity. For a sample of about 500 companies, tested over the period 1982-1989, the β coefficient found was just 0.19. The coefficient of determination was zero. Further analysis revealed that greater overall forecasting accuracy could have been achieved by disregarding the forecasts for individual companies and replacing them with the average forecast for all companies.

Whether this poor forecasting ability accounts at least in part for excess price volatility, requires proof of some price dependency on earnings. Bulkley and Harris showed that, in fact, there was a highly significant relationship between cumulative returns and analysts' forecasting errors. In other words, the prospects for high growth firms tended to be overstated and the firms' shares subsequently underperformed. The opposite phenomenon was observed for the lower growth firms. When the authors analysed stock market performances for the extreme cases in their sample – the fastest growing 5% and the slowest growing 5% - they found a cumulative difference of 60% over a five year period in favour of the lower growth firms.

2.5 THE CHALLENGE FROM BEHAVIOURAL FINANCE - THE BASIC TENETS

In summary, there are three main planks to the efficient market hypothesis:

- Investors, in general, behave rationally. Moreover, it is argued, evidence of predictability and other phenomena discussed in sections 2.3 and 2.4 can normally be explained by rational variation in expected returns (Fama 1991). More specifically, such rational variation in expected returns can be attributed to either shocks to tastes for current versus future consumption or to technology shocks.

- In circumstances when noise, or the actions of irrational investors, drive prices away from fundamental value, arbitragers will step in and return prices to their "true" fundamental levels.

- The consequence for investors in such an environment is that it is not possible to earn abnormal economic returns consistently.

Few would dispute the last of these tenets. Numerous academic tests, such as the early tests described in section 2.2 have provided support for the weak and semi-strong form of the efficient market hypothesis. Additionally, most traditional active managers know only too well how difficult it is to beat their performance benchmark consistently (see the evidence contained in Malkiel, 2003, for example). By contrast, there are, no doubt, many hedge fund managers who would claim that they are regularly delivering proof that they can take advantage of superior trading techniques and/or exploiting pricing anomalies in order to gain superior returns regularly. Notwithstanding these claims, the evidence as to whether abnormal economic returns can be earned consistently by them without exposure to abnormal risks is still inconclusive. Indeed, evidence is emerging of a very significant positive correlation between abnormal returns and value at risk (see Bali et al, 2007, for example).

A more intense debate has centred on the first of the above tenets, however: to what extent do investors always behave "rationally"? Moreover, does "efficiency" imply that securities are always "correctly" priced at their true fundamental valuation, given the information available at that point in time?

2.5.1 Behavioural traits

By the late 1970s even Jensen, the arch supporter of the efficient market hypothesis, was led to conclude that: "……*we seem to be entering a stage where widely scattered and as yet inconclusive evidence is arising which seems to be inconsistent with the theory*" (Jensen, 1978: 95).

At around this time, also, there was a growing interest in the evidence compiled by cognitive psychologists on the way in which people form beliefs, preferences and expectations. Taversky and Kahneman (1974, 1981, 1986) were at the forefront of the exploration in this field of behavioural finance.

The focus of the attack on the efficient market hypothesis by behavioural theorists is the concept of "rationality". Indeed, Statman (1999) provides an interesting summary of the "battle" between standard finance and behavioural finance:

"People are 'rational' in standard finance: they are 'normal' in behavioural finance. Rational people care about utilitarian characteristics but not value-expressive ones, are never confused by cognitive errors, have perfect self-control, are always averse to risk, and are never averse to regret.

Standard finance asks for too much when it asks for market efficiency in the rational sense…….. We would [all] benefit from the insights of behavioural finance by accepting market efficiency in the beat-the-market sense but rejecting it in the rational sense" (Statman, 1999: 26).

The following discussion, which is based largely on the survey compiled by Barberis and Thaler (2003), and contained in Constantinides et al (2003), briefly describes some of the key findings of cognitive psychologists working in this area.

Overconfidence

People tend to be over-optimistic and, consequently, over-confident. This leads to investors overestimating both their chances of success and also their degree of knowledge.

Barber and Odean (1999) argue that this overconfidence explains the high level of trading on financial markets. In an extensive study of trading by investors at discount brokerages, the authors found that trading profits were insufficient to cover trading costs. Moreover, the securities bought tended to underperform the subsequent performance of securities sold.

Representativeness

Investors often appear to base investment decisions on perceived patterns in markets and to place too little weight on logical probabilities. This illusion can manifest itself in the extrapolation of past trends into the future or can lead investors to believe that "good" companies must make "good" investments.

Representativeness also leads to the bias of sample size neglect. Investors facing new opportunities will often form judgements based on too few observations. Conversely, some investors who may have knowledge of the true probability distribution of events may be affected by the "gambler's fallacy", the belief that trends must inevitably reverse. Sample size neglect may lead to investors failing to take profits because of a belief that a recent trend must continue whilst, in contrast, the "gambler's fallacy" may result in investors failing to take advantage of a trend that has newly become established.

Conservatism

Conservatism is the opposite of representativeness. The latter may lead investors to assume that a limited set of observations is representative of a known model while conservatism may lead investors to underweight recent evidence. In other words, they are reluctant to concede that a new trend is confirmed until they have the benefit of a much larger set of observations.

Regret

Regret is the feeling of sorrow that arises after making a decision that turns out to be wrong. Regret risk is the risk that a feeling of regret may come about. Examples of the avoidance of regret in the investment world are:

- Herding as a result of peer group pressure. In many situations investors may choose to follow the actions of fellow investors since this is viewed as the “safe” thing to do. In turn, this may result in market bubbles.

- The reluctance to replace money managers who have underperformed. This often arises because of a fear on the part of fiduciaries that the performance of that manager may reverse when he or she has departed.

Framing

Framing is the manner in which an investor conceives the possible outcomes associated with a decision. Tversky and Kahnemann (1981) argued that *“the frame that a decision-maker adopts is controlled partly by the norms, habits, and personal characteristics of the decision-maker”* (Tversky and Kahnemann, 1981: 1124). Rational choice, the authors argued, should not reverse with changes of frame. However, they observed that choices do change: investors often shift their view of the relative desirability of options when viewing the possible options from a different standpoint.

The following example, presented by Montier (2003), illustrates how context sensitivity can lead to conflicting results.

Consider the following concurrent decisions:

The first decision is to choose between

(a) a sure gain of £2,400 or
(b) a 25% chance of a £10,000 gain and a 75% chance of gaining nothing

The second decision is to choose between

(c) a sure loss of £7,500 or
(d) a 75% chance of a £10,000 loss and a 25% chance of losing nothing

Tests show that most people would choose (a) as their first decision. Whilst (b) offers a higher expected return (£2,500), the prospect of an extra £100 is not enough to tempt most people to chance gaining nothing. With the second decision it is found that most people would choose (d): they would take the opportunity to avoid a loss altogether.

If the outcomes of the two decisions are taken together, however, we find that the joint decision process has resulted in an anomalous overall outcome. Thus:

Choices (a) and (d) have an overall expected outcome of £2,400 - £7,500 = -£5,100
Choices (b) and (c) have an overall expected outcome of £2,500 - £7,500 = -£5,000

The discarded choices together offer the lower expected loss.

2.5.2 The limits of arbitrage

Behavioural finance argues therefore that there are a number of psychological factors at work which suggest that investors do not always behave rationally. In other words, the first of the main planks of efficient market theory - as introduced at the start of section 2.5 – often does not hold: it is claimed that investors frequently behave irrationally.

What about the second plank of the theory, that the action of arbitragers will ensure that any deviations from “true” fundamental value are eliminated? Here too, behavioural finance, suggests that this assumption can be challenged. Pure efficiency theory would characterise arbitrage as a risk-free activity that requires no capital.

Much of the arbitrage activity in today’s financial markets is undertaken by hedge funds and proprietary trading desks. In turn, a significant proportion of this activity can be said to be imperfect arbitrage. That is, the trading is not in perfect substitutes and, therefore, there is a risk that, for good fundamental reasons, apparent mispricings are not corrected. The Long-term Capital Management collapse provides an extreme and salutary lesson on the risks associated with imperfect arbitrage.

This phenomenon cannot be used as an argument against efficient market theory since the traders should always be aware that there is no guarantee of profits. However, it is claimed that, even where arbitrage activity uses perfect substitutes, a considerable time might elapse before any pricing efficiency is corrected. Consequently, arbitragers may be forced to close out positions at a loss.

Horizon risk therefore is the risk that the time that elapses before a mispricing is corrected is longer than anticipated. An arbitrage return of 5% earned over an expected correction period of 60 days, for example, represents an attractive annualised return of 34.6%. If the correction period in fact averages 120 days then the annualised return falls to 18.6%; at 240 days the comparable return is 7.7%. In some cases, the correction period may be even longer, even eliminating the net profits of the arbitragers. In extreme cases, the mispricing may worsen, forcing the arbitragers to close positions as capital providers withdraw funding in the face of rising losses.

Apparent, sustained mispricings are well documented in the literature (see, for example, Thaler, 2005). The closed end fund puzzle, twin stock pricing anomalies and the anomalous pricing of technology stock carve-outs are commonly cited examples.

Figure 2.3, for example, shows the actual stock market value of Royal Dutch Petroleum shares relative to their “true” market value. The latter is 1.5 times the value of Shell Transport and Trading since the two companies merged their interests on a 60:40 basis at the start of the twentieth century.

Figure 2.3 Premium/Discount of Royal Dutch relative to Shell

Raw data source: DataStream

The Figure shows that there have been periods of significant and sustained deviation from the theoretical relationship that should exist between the two companies. An arbitrager buying Royal Dutch and shorting Shell in 1979, for instance, in view of the anomalous 10% discount of the former, would have experienced a worsening position over the next three years. Indeed, the discount widened to over 30% and, in fact, did not close entirely until 1984. Conversely, an arbitrager looking to take advantage of the relative cheapness of Shell in 1993 would have had to wait until 2001 for the pricing anomaly to be corrected.

This anomaly is commonly identified as noise trader risk. Whatever the underlying reason, there is a risk that a relative mispricing will deteriorate in the short term if, as in this case, two assets are perfect substitutes. Moreover, where there is a history of sustained mispricing – as in this case and others – many short-term arbitragers will avoid taking positions in view of the short term risk.

Royal Dutch Petroleum and Shell Transport and Trading were unified within a Royal Dutch Shell parent company in July 2005. Royal Dutch Petroleum shareholders received 60% of the share capital of the new Royal Dutch Shell whilst Shell shareholders received 40%. Whilst the two types of shares are largely identical, some differences in pricing can still occur because the dividends on the two types are denominated in different currencies and subject to different tax treatments.

2.6 TIME VARIATION IN EXPECTED RETURNS

As discussed in 2.4.3, an inherent weakness in early volatility testing was the assumption that expected returns are constant. But later research acknowledges that this assumption is unrealistic and that expected returns (discount rates) do vary over time. Moreover, this variation in expected returns is the source of significant volatility.

Chapter 5 of this thesis discusses a partial decomposition of expected equity returns, building on the approach adopted by Shiller (1981). Chapter 6 discusses a full decomposition of returns in which changes in expected return are attributed to changes in the following factors:

- real rates of interest
- the inflation risk premium
- long-term real dividend growth expectations
- the equity risk premium

The last of these factors, the equity risk premium, has been the subject of considerable debate and scrutiny in recent years and the progression of the debate over what has become known as the “risk premium puzzle” is worthy of inclusion here.

2.6.1 The equity risk premium

The equity risk premium is the annual return earned on ordinary shares (common stock) over and above the risk-free rate. The latter can be defined in various ways, including the return available on short-term instruments, such as Treasury Bills, or the return available on long-term government bonds. Another variation in definition arises from the fact that the risk premium can be measured arithmetically or geometrically, the latter measure always being lower than the former.

Early assessments of the equity risk premium relied on ex-post measures. Ibbotson and Sinquefield (1976), for example, measured the annualised returns on US equities and Treasury Bills experienced over the period 1926-74 and computed a risk premium of 6.1% p.a. when measured geometrically, or 8.8%, when measured arithmetically.

The first authoritative work on the equity risk premium in the UK market was produced by Dimson and Brealey (1978). The authors measured the ex-post, arithmetic risk premium over the period 1919 to 1977. The De Zoete equity index was used as the equity benchmark; the Treasury Bill rate was used as the measure of the risk-free rate. The average annual premium for the period examined was found to be 9.2% p.a., a result very similar to that of Ibbotson and Sinquefield,

Dimson and Brealey's aim in measuring the risk premium over a long period was to provide "*a guide as to what investors expect the risk premium to be in the future"* (Dimson and Brealey, 1978: 14). Indeed, a risk premium of the order of 6%-9% was subsequently assumed for many years by academics and practitioners alike. In other words, the experience of the past was commonly used as an unbiased estimate of the future.

2.6.2 A puzzle identified

This practice started to come under severe challenge in the 1980s. In particular, academics identified a large discrepancy between the returns predicted by consumption-based pricing models and the empirical findings. This discrepancy was described by Mehra and Prescott (1985) as the "Equity Risk Premium Puzzle". Cochrane (1997) and Cornell (1999) have both presented useful interpretations of the arguments along the following lines.

Economic theory suggests that the risk premium available on a security can be described by a model of the form:

$$\text{Risk premium} = \gamma \operatorname{cov}(\Delta c, r) = \gamma \sigma(\Delta c)\sigma(r)\operatorname{corr}(\Delta c, r)$$

Where: γ = utility function (degree of risk-aversion)

Δc = proportional change in consumption

r = return from risky security

$\sigma(r)$ = variability in asset return

$\sigma(\Delta c)$ = variability in consumption

$corr(\Delta c,r)$ = correlation between asset returns and changes in consumption.

The required risk premium will increase according to the degree of risk-aversion, the riskiness associated with asset returns and consumption changes and the correlation between consumption changes and asset returns. The last factor can be explained by the fact that investors will be more attracted to (and therefore require a lower premium from) assets which will provide greater returns when consumption growth declines and vice versa.

Dividing both sides of the above equation by the variability in asset returns provides us with an expression for the Sharpe ratio, thus:

Sharpe ratio = Risk premium/$\sigma(r)$ = $\gamma\sigma(\Delta c)corr(\Delta c,r)$

Empirical work suggests that the ex-post risk premium is of the order of 9% p.a. and that the historical standard deviation in equity returns is 18%. The observed Sharpe ratio therefore is around 0.5.

The problem identified is that the figure of 0.5 is more than 10 times greater than what theory suggests the number should be. Cochrane suggests that the following are reasonable inputs to the model above. Variability in consumption growth of approximately 1% per annum, a correlation coefficient of around 0.2 and a risk aversion coefficient between 1 and 2, the latter being the standard range commonly used in economic models. Putting these together gives a theoretical Sharpe ratio of just 0.004 – a value less than 1% of the observed value.

It is this apparent gulf between empirical estimates of the Sharpe ratio and the consumption-based asset pricing model that Mehra and Prescott (1985) described as the risk premium puzzle.

Numerous reasons have been promoted in explaining this puzzle, including:

(i) The correlation between asset returns and changes in consumption is higher than generally assumed. Certainly, there is a case for assuming that this correlation is higher over longer periods. A decade-long rise in the stock market, for example, is highly likely to lead to greater consumption. But, as Cochrane points out, even plugging in a correlation of corr(Δ,r) = 1, σ(Δc) = 0.01 and $\gamma < 10$ implies a Sharpe ratio less than 0.1.

(ii) Fear of market crashes pushes up the ex-ante risk premium, as conjectured by Reitz (1988). Also, the returns of stock markets such as the US and UK, which have survived for many decades, will show a survival bias.

(iii) Investors may be far more risk averse than economists normally assume. That is, γ in the Sharpe ratio relationship above is too low. However to obtain a Sharpe ratio of 0.5 would suggest that a γ value of around 250 is needed, a figure that is extremely difficult to justify. Consider, for example, the relationship between interest rates and consumption growth:

$$\text{Real risk-free rate} = \text{constant} + \gamma E(\Delta c)$$

A γ value of 250 would imply that large variations in interest rates must accompany variation in consumption growth. This is not an observed phenomenon.

(iv) The required premium is higher than suggested by standard economic models owing to behavioural influences such as myopic loss aversion. Benartzi and Thaler (1995) suggest that investors are more sensitive to losses than to gains.

Moreover, investors evaluate their portfolios frequently. This combination, they argue, leads to investors demanding a high premium as a reward for accepting high variability.

(v) The period investigated by Mehra and Prescott, 1889-1978, may not be representative of the very long term. Indeed, Siegel (1992) extended the period of analysis both backward and forward and concluded that the observed equity risk premium was much lower both before and after the 1889-1978 period. The US ex-post premium, for example, was found to average 1.7% over the period 1800-1888 and 3.8% from 1979-1990. This compares to the average premium observed for the 1889-1978 period of 6.3%. An explanation is provided by the fact that much higher risk-free rates prevailed both before and after the period in question whilst average equity returns were largely constant. This result was observed for both the US and the UK.

2.6.3 Ex-post measures challenged

It was common, accepted practice, even a decade ago, to use a measure of the historical equity risk premium for applications such as the capital asset pricing model. In recent years, however, users have become increasingly aware of the potential dangers in assuming that history is a reliable guide to the future. More specifically, interest and research has focused on what historical expectations might have been, rather than the ex-post outcomes.

Forward-looking estimates of the equity risk premium have consequently been lowered over the past decade. Welch (2000), for example, surveyed 226 financial economists in late 1998, asking them to forecast the average annual risk premium over the next 30 years. The mean forecast was 7.1%; the median was 7.0%; and the range ran from 1% to 15%. The author also highlighted the fact that the most popular finance textbook available at that time, Brealey and Myers' "Principles of Corporate Finance", recommended that its readers applied a risk premium figure of 8.2% - 8.5%. Welch updated his earlier survey in 2001. On this occasion, the mean forecast for the premium was found to be 5.5%, 1.6% below the expectation of three years earlier.

Much of the earlier evidence was based on findings from the US and UK stock markets. More recently, studies have been extended to include analyses of returns from other markets. Dimson, Marsh and Staunton (2003), for instance, have provided a 103 year history of risk premia for 16 stock markets. The geometric mean premium was found to average 3.8%; the arithmetic mean averaged 5.9%.

The authors stressed, however, that even premia based on long histories are not necessarily good guides to the future. Moreover, they identified a substantial increase in premia over the second half of the 20th century for 14 of the 16 markets and attributed this to:

- rapid technological and management enhancements
- declining transaction and monitoring costs, which helped to underpin equity prices
- declining inflation and interest rates during the last two decades of the century
- declining required returns owing to diminished business and investment risk.

The authors argued that this combination of factors is unlikely to be repeated and that historical risk premia should be adjusted downwards in developing forecasts for the future. A forward-looking, compound premium of around 3% p.a. (5% arithmetic mean) was suggested.

2.6.4 Ex-ante analyses

The discussion here has concentrated on the main debate surrounding the risk premium puzzle and, in particular, the evidence thrown up by studies of the historical premium experienced by investors worldwide. A number of studies have been undertaken in recent years into reconstructing historical expectations for the risk premia, taking into account economic and market data available at each point of estimation. In other words, researchers have investigated the ex-ante, rather than the ex-post, equity risk premium.

Blanchard (1993) simulated expected returns and equity risk premia for the US market from 1929 to 1993, applying regression analysis to four main variables: lagged inflation and nominal interest rates, dividend yields and lagged, real capital gains on equities. His simulations indicated that premia rose from 3% to 5% in the early 1930s, peaked at more than 10% in the late 1940s and dropped to 2% – 3% by the end of his analysis.

Arnott and Bernstein (2002) applied a Gordon valuation approach to the US market for the period 1810 - 2001 and concluded that the historical average expected premium was 2.4% pa., albeit that the premium displayed a wide range of values over the 192 year history. The authors concluded that *"it is dangerous to shape future expectations based on extrapolating.....lofty [ex-post] historical returns"* (Arnott and Bernstein, 2002: 80).

Fama & French (2002) undertook a similar analysis of ex-ante risk premia in the US market for the period 1872-2000. They found that for much of the period – from the start to around 1950 – ex-ante returns were very similar to ex-post returns. However, a very different story emerged for the later period. A Gordon valuation approach indicated an average expected return of 2.6% for the period 1951 – 2000, actual ex-post returns for that period averaged 7.4%. Fama & French also concluded, therefore, that *"the average stock return of the last half-century is a lot higher than expected"* (Fama and French, 2002: 637).

FitzGerald (2001) applied similar techniques to the UK financial markets. The average ex-ante premium for UK equities for the period 1950-1999 was found to average just 1.4% compared with an ex-post average return of 9.2% pa. FitzGerald concluded that *"there is no justification for assuming that the historical equity risk premium will be repeated"* (FitzGerald, 2001: 16).

A more recent analysis of the ex-ante equity premium in the UK has been undertaken by Vivian (2007) who applied the Fama & French (2002) methodology. This confirmed that historical ex-ante premia appear to have been much lower than ex-post premia, primarily due a declining discount rate during the latter part of the 20th century.

A comprehensive analysis of ex-ante expectations in the UK financial markets and a full decomposition of both ex-ante and ex-post returns in both the equity and bond market is contained in Chapter 6 of this thesis. A detailed discussion of the methodologies adopted by the authors cited above, and others, is also provided.

2.7 THE FULL CIRCLE

This chapter began with a discussion of the efficient market hypothesis and subsequently looked at the challenges to the hypothesis. What conclusions may be reached?

2.7.1 The efficiency debate

In recent years, Fama (1991, 1998) has responded to the challenges to EMH. In two major reviews of the literature he concluded, not surprisingly, that despite claims of anomalous and irrational behaviour in equity markets, there is insufficient evidence to abandon the EMH. His main arguments are:

- The EMH suggests that the expected value of abnormal returns is zero. It may well be possible to observe cases of overreaction or underreaction, but these happen by chance. Moreover, anomalies tend to spilt fairly evenly between overreaction and underreaction.

- The evidence on long-term anomalies does not suggest that the EMH is no longer a viable working model for three main reasons. Firstly, the evidence often arises because researchers have dredged for anomalous results. Secondly, many apparent anomalies, such as long-term return reversals, can be explained by rational asset pricing models such as Fama and French's three-factor model. Thirdly, anomalies tend to disappear when alternative approaches are used to measure them.

- Behavioural models have been developed to explain how the judgement biases of investors can produce apparent overreaction and underreaction. The Barberis, Schleifer and Vishny (BSV) model and the Daniel, Hirshleifer and Subramanyam (DHS) model are two such models. However, the evidence does not indicate that these models can explain apparent anomalies any better than the market efficiency model and rational analysis.

Malkiel (2003) also scrutinised the market efficiency debate and the evidence that apparently discredits the EMH and has also reached the conclusion that many of the predictable patterns that have been discovered may simply be the result of data mining. But he also looked more closely at 'seemingly irrefutable cases of inefficiency', notably the stock market crash of October 1987 and the internet bubble of the late 1990s.

With regard to the one-third drop in market prices which occurred in October 1987, Malkiel acknowledges that behaviourists would argue that such a phenomenon can only be explained by psychological considerations. Such an explanation is normally based on the evidence that the basic elements of the market valuation equation did not change rapidly or significantly over the period in question.

Malkiel argues, however, that a number of rational factors could have affected investors' views about the proper value of the stock market around that time. The first factor he identifies is the rise of nearly 150 basis points in long-term Treasury bond yields in the two weeks prior to the Crash. Additional risk factors identified and associated with the run-up to the Crash included the threat of a "merger tax" being imposed by Congress and the threat of actions to encourage a fall in the dollar exchange rate. Whilst not arguing that psychological factors were totally irrelevant in explaining the 1987 Crash, therefore, Malkiel argues that much greater weight should be placed on the rational reaction of investors to these significant changes taking place in the external environment.

Malkiel has more sympathy with the behaviourists' arguments in relation to the internet bubble of the late 1990s. He agrees that, in retrospect, valuations were based on '*outlandish and unsupportable claims'* (Malkiel, 2003: 75). Moreover, he argues, there were no obvious arbitrage opportunities available at that time. The fact is that investment professionals were – with the benefit of hindsight – egregiously wrong, and the extent of any 'bubble' was only clear in retrospect. Indeed, investors seeking to profit from arbitrage opportunities at that time (i.e. by shorting overvalued internet stocks) faced considerable short-term risks. The rational policy for arbitragers – who tend to have short horizons – would have been to 'go with the flow'.

Malkiel's overall conclusion is that the stock market is broadly efficient. Professional investors are not able to outperform market benchmarks consistently and the evidence is that markets are remarkably efficient in the utilisation of information. He does concede, however, that market efficiency is not perfect. Pricing irregularities do occur, and predictable patterns can emerge and persist for short periods. Moreover, extreme 'anomalies', such as the internet bubble are the exception rather than the rule.

2.8 THE LESSONS OF HISTORY

As discussed in section 2.4, some of the challenges to the EMH have been built on over-simplified assumptions, notably an assumption that expected equity returns remain fairly constant over time. At the heart of this thesis, however, is the assumption that expected returns from the equity market *do* vary over time. Returns available on alternative assets, including risk-free assets, do vary over time and must affect required equity returns. Additionally, it will be assumed that the risk premium required must vary over time as economic and/or political prospects change. In short, this thesis will assess the degree to which market behaviour that hitherto has been described as anomalous or irrational can be "explained" by rational circumstances.

The literature in this area throws up at least three important observations:

(a) Financial markets are driven by expectations. Thus, it is dangerous to assume that ex-post experience is a reliable guide to what those expectations might have been.

(b) The large variation over time in the observed ex-post values of the risk premium suggests that expectations can also vary widely over time.

(c) Equity values represent present values of future long-term expectations. Critically, small changes in expectations can result in a significant short-term variation in equity values.

The four empirical studies of equity market behaviour that follow make use of, and build on, the work of the past decades, as presented above. The studies analyse behaviour at the total market level. Much of the historical analysis discussed in this chapter has centred on the US financial markets, whereas the empirical studies in this thesis will concentrate on the UK markets. Whilst many ideas and techniques may be transferable from one market to the other, it is possible that significant differences in scale, structure and investor objectives may result in different observed behaviour patterns within the different markets.

CHAPTER 3 EXPLAINING EQUITY RETURN VARIATION -THE MACRO APPROACH

3.1 INTRODUCTION

Chapter 2 reviewed the general literature relating to stock market efficiency and the challenges to the Efficient Market Hypothesis. The discussion also focussed on the debate relating to the variation in expected returns and whether such variation can be attributed to rational or irrational forces.

An obvious starting point in attempting any empirical analysis of the variation in expected returns and prices is an examination of the linkages between stock market performance and the macroeconomic environment. And the intrinsic valuation model developed by John Burr Williams (1938) and Gordon (1962) provides a useful tool for hypothesising as to just what forces might drive expected returns and equity prices. Macroeconomic variables relating to growth in the economy might be expected to influence the numerator (i.e. future cash flows), for example, while variables relating to real interest rates might be expected to influence the denominator (i.e. the discount rate). In reality, of course, the valuation process is likely to be far more complex than these superficial observations would suggest. It could be argued, for instance, that cyclical variation in economic growth should not influence long-term expectations significantly and that any impact on valuations initially comes about through changes in the risk premium element of the discount rate. That is, the impact is on the denominator rather than the numerator, a suggestion supported by Cochrane (2005).

Notwithstanding the apparent linkage between equity valuations and macroeconomic forces, there is limited evidence in the UK relating equity market variation to the variation in macro-economic variables. This is surprising given the fact that the price-earnings ratio – which, in effect, is a shortcut approach to intrinsic valuation – is by far the commonest valuation tool in use by analysts and money managers and that corporate earnings - at least in aggregate – will, in turn, be driven by changes in macro-economic conditions.

The purpose of this chapter is to examine the key US and UK research published in this area and, in particular, to extend and apply to the UK equity market the methodology developed by Fama & French (1989) and Fama (1990) for measuring the explanatory power of a range of macro-economic variables. The work of these authors in this area has been identified by Cochrane (2005) as providing "the comforting link" between stock and bond markets, inasmuch as movements in variables such as the 'term spread' appear to forecast returns from both markets.

3.2 US STUDIES

A considerable body of research relating US equity returns to changes in the macro-economic environment started to appear in the 1980s. The following is a discussion of some of the key works that emerged.

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3.2.1 Chen, Roll & Ross (1986)

Chen, Roll and Ross (1986) set out to close the "embarrassing gap" that they identified between the theoretically exclusive importance of systematic state variables and our ignorance of their identity. By the modern diversification argument that is implicit in capital market theory, it is only these general, systematic factors which will influence the pricing of large stock market aggregates.

Their study assumed that stock prices are explained by the standard dividend discounting process, viz:

$$P = \frac{E(c)}{K}$$

where c is the dividend stream and k is the discount factor. The systematic forces needing to be identified are those that change the discount factor and the expected cash flows. Changes in the riskless interest rate and/or the risk premium will therefore influence returns. Changes in the term structure will also influence discount rates. Expected cash flows were viewed as being influenced by both nominal and real forces. Expected inflation influences both the expected nominal values of expected cash flows as well as the discount rate. Chen et al also argued, however, that unanticipated inflation can also influence asset values owing to relative price changes. Changes in the expected level of real production affect the real value of cash flows and therefore stock returns.

The analysis focused on monthly changes in the returns on portfolios of stocks. The monthly series of annual growth rates in industrial production was included because stock prices involve the valuation of cash flows over long periods in the future and may not be highly related to contemporaneous monthly changes.

The variables analysed are shown in the table below.

Table 3.1 Macro variables

MP(t)	Monthly growth in industrial production
YP(t)	Annual growth in industrial production
E[I(t)]	Expected inflation
UI(t)	Unexpected inflation
RHO(t)	Real interest rate
DEI(t)	Change in expected inflation
URP(t)	Risk premium
UTS(t)	Term structure

Unanticipated inflation was estimated using inflation forecasts implied in Treasury bill rates (as discussed in Fama & Gibbons, 1984).

The variable URP was intended to capture changes in risk premia and was defined as the difference between the redemption yields available on “Baa and under” corporate bonds and long-term government bonds.

Changes in the term structure were also identified as possible indicators of changes in prevailing risk premia. The term structure variable, UTS, was defined as the difference between long-term government bond yields and Treasury bill yields.

Relationships between changes in the above state variables and notional returns on New York Stock Exchange indices were analysed for the period from 1953 to 1983.

The results indicated that stock returns can be explained by a factor model of the form:

$R = a + b_{mp}MP + b_{dei}DEI + b_{UI}UI + b_{UPR}UPR + b_{UTS}UTS + e$

where the betas are the loadings on the state variables. In recognition of the fact that stock returns appear to be related to firm size, and in an attempt to improve the discriminatory power of the analysis, portfolios were formed on the basis of firm size. Returns on the portfolios were then tested against the state variables shown in the above model.

MP, UI and UPR were found to be significant over the entire sample period, while UTS was marginally so. The inflation-related variables, DEI and UI, were found to be highly significant in the 1968-77 period and insignificant both earlier and later.

Equally-weighted and value-weighted market indices were then added to the analysis, in turn, to test the pricing influence of the market overall. Neither had a significant effect, indicating that the overall influence of the market is relatively low when compared with the influence of the underlying state variables.

Finally, the influence of exposure to changes in real per capita consumption and changes in oil prices were examined. Neither factor was found to be of significance.

Chen et al concluded that there is convincing evidence that stocks are priced according to their exposure to state variables and changes in those state variables and that these variables can be identified through the application of simple and intuitive financial theory.

3.2.2 Roll (1988)

Roll (1988) set out to investigate the paradigm which ascribes asset-price movements to:

(i) unpredictable movements in pervasive economic factors

(ii) unpredictable changes in a firm's market environment (i.e. industry information) and

(iii) unpredictable events specific to the firm itself

Roll used both a single factor (market) model and a multi-factor APT model to examine the relationship between asset price movements and systematic influences. Data for all stocks listed on the NYSE and AMEX during the period 1982-1987 were analysed.

The mean R^2s were found to be, respectively, 0.179 for the market model and 0.244 for the APT. Of the 2030 stocks included, 77.4 percent had a higher R^2 with the multi-factor model. Roll did not attempt to identify the factors within the APT model, merely noting that the first factor was very highly correlated with the overall market and that the remaining four factors were uncorrelated with this first factor and with each other. Roll also examined whether R^2s are higher for larger firms as a result of their greater diversification but the evidence did not support this hypothesis.

The impact of systematic influences on different industries was also analysed. However, the explanatory power of systematic influences was found to be similar from one industry to the next.

The third element of the pricing paradigm is the influence of unique, specific information on prices. Roll surmised that, given the limited R^2s uncovered for systematic and industry influences, much of the movement in assets must be "explained" by specific news. Or, put another way, R^2s found by using CAPM or APT models should rise substantially if data for days on which specific news was announced were to be excluded from the analysis. The results were, in fact, found to be "extremely disappointing". The average CAPM R^2 was found to be 0.163 with all data and 0.177 with non-news data. The average APT R^2 was found to be 0.205 with all data and 0.221 with non-news data. The distributions of the news data and the non-news data, however, were found to be significantly different, (the kurtosis fell sharply when news events were excluded). This led Roll to conclude that asset price changes might occur as a result of a mixture of traders acting on private information and occasional frenzy unrelated to concrete information.

3.2.4 Fama & French (1989)

Fama and French (1989) examined the relationship between the variation through time of expected returns and business conditions. The specific questions asked were:

(a) Do the expected returns on bonds and stocks move together? In particular, do the same variables forecast bond and stock returns?
(b) Is the variation in expected bond and stock returns related to business conditions?

Data for securities on the New York Stock Exchange during the period 1926 – 1987 were analysed. The results indicated that expected excess returns on corporate bonds and stocks did indeed move together. Dividend yields successfully forecast both stock and bond returns. Predictable variation in stock returns was also found to be tracked by variables commonly used to measure default and term (or maturity) premia in bond returns. The default spread was defined to be the difference between the yield on a market portfolio of corporate bonds and the yield on Aaa bonds. The term spread was defined to be the difference between the Aaa yield and a one-month bill rate.

Fama and French argued that the default spread is a business-conditions variable: high during periods when business is persistently poor and low when the economy is persistently strong. They viewed the term spread as an indicator of shorter-term market conditions: it is low near business cycle peaks and high near troughs. The three indicators – dividend yield, default spread and term spread – therefore forecast stock and bond returns and the implied variation in expected returns is negatively related to long- and short-term variation in business conditions.

Two possible explanations were offered for these observations. First, when business conditions are poor, income is low and expected returns on bonds and stocks might be high to encourage substitution from consumption to investment. When business conditions are good and income is high investors are satisfied with lower expected returns. The other possible reason presented was that the variation in expected returns with business conditions is due to variation in the perceived risks of bonds and stocks.

3.2.5 Balvers et al (1990)

A considerable body of research had emerged by the end of the 1980s, including the Fama and French study discussed above, which related to the predictability of stock returns. Explanations for predictability fell primarily into two areas: (a) irrationality, such as fads, speculative bubbles, or noise trading or (b) rational variation in expected return over time. The purpose of the Balvers et al study was to present a robust, theoretical explanation for the latter.

At the heart of their model was the assumption that, in attempting to maximise utility, investors attempt to smooth consumption by adjusting their required return on assets. Consequently, returns should be predictable to the extent that aggregate output is predictable. This phenomenon, it was argued, is consistent with the efficient market hypothesis since attempts to exploit the predictability will increase variation in consumption, thus decreasing expected utility. The proposition to be tested, therefore, was that current period output measures should predict part of the future variability in asset returns.

Empirical testing of their model with US market and economic data produced evidence of a 20 per cent level of return predictability, based on annual returns, and a 50 per cent level of predictability for overlapping five year periods.

3.2.6 Fama (1990)

Fama (1990) expanded on the Fama and French (1989) study and identified three sources of variation in stock returns:

(a) predictable return variation due to variation through time in the discount rates that price expected cash flows (as identified by Fama & French, 1989),

(b) shocks to expected cash flows and

(c) shocks to discount rates.

The variables used to describe each source were as follows:-

(a) Expected returns

D(t)/V(t) – the dividend yield on the value-weighted NYSE portfolio

DEF(t) – the default spread, defined as the difference in the yields on a broad portfolio of corporate bonds and the yield on Aaa bonds.

TERM(t) – difference between Aaa corporate bond yields and one-month T-bill yields

(b) Shocks to expected cash flows

P(t, t + x) – the growth in industrial production up to x quarters ahead. Preliminary testing showed that industrial production explained as much, and sometimes more, return variation as other real-activity variables.

(c) Shocks to discount rates (expected returns)

DSH (t, t + 1) – residual from first order autoregression fit to the default spread series

TSH (t, t + 1) - residual from first order autoregression fit to the term spread series.

[no shock variable is derived for the yield since "shocks" are largely caused by changes in the stock prices themselves]

Stock data for the period 1953-1987 from the New York Stock Exchange were analysed. Real returns were regressed against the term spread and either the dividend yield or the default spread. The results for annual observations are summarised below.

$$R(t, t+T) = b_0 + b_1X(t) + b_2TERM(t) + b_3DSH(t, T+T) + b_4TSH(t, T+T) + e$$

where: X(t) is either D(t)/V(t) or DEF (T)

Table 3.2 Multiple regression results

	X(t) =D(t)/V(t)		X(t) = DEF(t)	
	b	**t(b)**	**b**	**t(b)**
Constant	- 0.35	-3.15	-0.13	-2.11
X(t)	9.55	3.93	26.52	3.34
TERM(t)	2.81	1.84	3.42	2.20
DSH(t, t+T)	-12.69	-1.74	-8.54	-1.38
TSH(t, t+T)	0.51	0.72	-0.14	-0.21
R^2	0.33		0.28	

The yield, default spread and term spread were all shown to be significant as predictors of future returns. However, the evidence relating to the shocks to DEF(t) and TERM(t), particularly the latter, was weak. TSH(t, t+T) was therefore omitted when the production growth variable was added into the regressions viz:

$$R(t, t+T) = b_0 + b_1X(t) + b_2TERM(t) + b_3DSH(t, T+T) + b_4P(t, T+x) + e$$

where: P(t, t+T) was included for numerous leading periods up to 24 months ahead

Table 3.3 Multiple regressions including leading production growth

	X(t) =D(t)/V(t)		X(t) = DEF(t)	
	b	**t(b)**	**b**	**t(b)**
Constant	-0.31	-4.19	-0.13	-3.11
X(t)	7.62	4.42	19.71	3.73
TERM(t)	0.32	0.24	0.63	0.46
DSH(t, t+T)	6.34	1.24	9.79	2.25
P(t, t+3)	0.01	0.01	-0.16	-0.28
P(t+3, t+6)	0.77	2.68	0.71	1.82
P(t+6, t+9)	1.46	3.99	1.37	3.62
P(t+9, t+12)	2.13	8.26	2.16	7.91
P(t+12, t+15)	2.57	4.29	2.72	4.17
R^2	0.59		0.56	

The results with industrial production added in showed that the yield and default spread retained their significance. Growth in industrial production up to a full year ahead was also strongly correlated with real stock returns. The losers in the regression were the term spread and shocks to the default spread.

Fama concluded that a large fraction of the variation in stock returns is explained by time-varying expected returns and forecasts of real activity. He did observe, however, that the regressions may overstate explanatory power given that the variables were chosen on the basis of goodness of fit rather than as the directives from a well developed theory. He noted further that some of the "explained" variation in return may not be rational. Fama conjectured, however, that if the variables that drive the rational variation in stock prices were somehow revealed then the R^2 values found in the analyses summarised above may even understate the rational proportion of the variation in returns.

3.2.7 A vector autoregression approach

The use of contemporaneous and lagged regressions, such as in the Fama analysis described above, has appeal because of its relative simplicity. However, it was met with criticism because of its inability to identify the channels through which news variables affect asset prices.

It could be argued, for example, that a variable such as industrial production may be associated with stock market movements. But there is a need to identify whether it is changes in industrial production itself which is causing changes in expected cash flows or whether both industrial production and stock prices are responding to changes in interest rates.

Vector autoregresssion (VAR) is an increasingly popular technique for analysing such relationships. A VAR has two or more dependent variables. Moreover, each of the variables is analysed in relation to lagged values of itself and all the other variables. It is common to set the same lag length (e.g. 4) for each of the variables in each of the equations. The VAR approach has gained a good reputation for its forecasting ability. However, VAR can be viewed controversially inasmuch as it is atheoretical. That is, it simply models a relationship between each variable and lagged values of itself and all the other variables; it does not attempt to explain the theoretical relationship in a macroeconomic sense.

Campbell and Ammer (1993) used a VAR approach in analysing the relationships between asset returns, interest rates, inflation and other information used by investors. Unexpected excess equity returns were expressed in terms of revisions to future cash flows (dividends), real interest rates and future excess stock returns. Specifically:-

$$e_{t+1} - E_t e_{t+1} = (E_{t+1} - E_t)\left\{\sum \rho^j \Delta d_{t+1+j} - \sum \rho^j r_{t+1+j} - \sum \rho^j e_{t+1+j}\right\} \quad \text{........3.1}$$

where: e_{t+1} = log excess return in period t+1

E_t = expectation at time t

d_{t+1} = real dividend paid in period t+1

r_{t+1} = log real interest rate from t to t+1

ρ = log-linear approximation parameter

The VAR approach defined a vector of state variables that helped to forecast the excess returns. Included in the vector were: the excess stock return (e_t), real interest rate (r_t), change in 1 month bill rate ($\Delta y_{1,t-i}$), 10 year and 2-month yield spread ($s_{n,t}$), log of the dividend yield (d_t-p_t) and the relative bill rate (rb_t), defined as the difference between the current bill rate and a 1-year backwards moving average. Thus, the state vector was stated as:

$$z_t = [e_t , r_t , \Delta y_{1,t} , s_{n,t} , d_t - p_t , rb_t]$$

and was assumed to follow a first-order VAR process

$$z_{t+1} = Az_t + w_{t+1}$$

where: A represented the coefficient matrix of the VAR and *w* was the error vector.

The key results for A over the period 1952 - 1987 are shown in Table 3.4. The table shows the most significant results from the 36 vector coefficients. Yield, for example was found to be the best predictor of excess return while real interest rates, the yield spread dividend yield and real bill rate followed persistent AR(1) processes.

Table 3.4 Vector results

Variable	Key relationship	Coefficient	Standard error
e_{t+1}	$d_t - p_t$	0.363	0.213
r_{t+1}	r_t	0.431	0.070
$\Delta y_{1,t+1}$	$s_{n,t}$	0.078	0.040
$s_{n,t+1}$	$s_{n,t}$	0.860	0.037
$d_{t+1} - p_{t+1}$	$d_t - p_t$	0.999	0.004
rb_{t+1}	rb_t	0.889	0.058

Campbell and Ammer extended this analysis by estimating changes in excess returns from the error vector and by decomposing variance into the components implied by the equation 3.1 above. The R^2 for forecasting excess stock returns was admitted to be "quite modest", at just 7%. Variance in news about future dividends was estimated to account for 15% of total stock variance while news about future excess returns was attributable for around 70% of total variance. Real interest rates appeared to play only a minor role.

3.2.8 Schwert (1990)

Table 3.5 Annual observations - Period 1919-1988

	(t) =D(t)/V(t)		X(t) = DEF(t)	
	b	**t(b)**	**b**	**t(b)**
Constant	-0.20	-2.60	0.02	0.61
X(t)	5.83	4.21	6.37	2.03
TERM(t)	-0.10	-0.07	-1.14	-0.71
DSH(t, t+T)	-19.05	-5.55	-20.14	-4.96
P(t, t+3)	-0.51	-2.20	-0.43	-1.75
P(t+3, t+6)	-0.22	-0.93	-0.16	-0.59
P(t+6, t+9)	0.04	0.16	0.17	0.63
P(t+9, t+12)	0.55	2.16	0.49	1.60
P(t+12, t+15)	0.62	3.01	0.64	2.98
R^2	0.39		0.34	

Schwert (1990) set out to investigate the stability of the relations estimated by Fama (1990) using different data for a much longer period, 1919-1988. The results for the total period are shown in Table 3.5. The results for two sub-periods, 1919-1952 and 1953-1988 are shown in Tables 3.6 and 3.7. The results for 1953-1988 are similar to Fama's. The yield variable was highly significant, as was the growth in industrial production up to a year ahead.

Table 3.6 Annual observations - Period 1919-1952

	(t) =D(t)/V(t)		X(t) = DEF(t)	
	b	**t(b)**	**b**	**t(b)**
Constant	- 0.21	-0.89	0.01	0.10
X(t)	5.95	1.54	12.18	2.68
TERM(t)	-1.61	-0.64	-4.79	-2.17
DSH(t, t+T)	-17.35	-4.57	-22.69	-5.86
P(t, t+3)	-0.31	-1.32	-0.29	-1.23
P(t+3, t+6)	- 0.08	-0.31	- 0.11	-0.38
P(t+6, t+9)	0.04	0.13	0.21	0.75
P(t+9, t+12)	0.48	1.73	0.22	0.69
P(t+12, t+15)	0.45	2.45	0.42	2.61
R^2	0.44		0.49	

Table 3.7 Annual observations - Period 1953-1988

	(t) =D(t)/V(t)		X(t) = DEF(t)	
	b	**t(b)**	**b**	**t(b)**
Constant	-0.31	-3.87	-0.03	-0.55
X(t)	7.32	4.75	-2.23	-0.44
TERM(t)	0.50	0.31	2.11	1.06
DSH(t, t+T)	2.81	0.52	6.28	0.77
P(t, t+3)	-0.62	-1.08	-0.94	-1.35
P(t+3, t+6)	0.16	0.34	0.18	0.30
P(t+6, t+9)	1.26	3.21	1.30	2.48
P(t+9, t+12)	2.15	5.03	2.18	3.73
P(t+12, t+15)	2.38	3.56	2.31	3.10
R^2	0.56		0.44	

Yield was also found to be reasonably significant over the earlier period, 1919-1952, although, interestingly, the shock to the default spread showed up as the most significant variable in explaining return variation. The market appeared to anticipate changes in industrial production up to 15 months ahead.

Schwert concluded that the fact that stock returns can be related to future real activity over a much longer period strengthens Fama's own conclusions since pre-1953 data would undoubtedly contain much more measurement error than later data.

3.2.9 Kothari & Shanken (1992)

Kothari & Shanken (1992) noted that previous research, such as Fama (1990) and Schwert (1990) has typically used proxies for rational expectations, such as ex-post actual data. As a result, the true expectation is measured with error.

The authors attempted to complement earlier work by using two sets of variables - dividend yield and the growth rate in investment - as proxies for initial expectations of dividend growth. They noted the evidence, as in Barro (1990), that changes in investment are significantly predictable. Testing also revealed a significant positive correlation between contemporaneous investment growth and dividend growth.

The return in a period was considered to be the sum of the expected return, any deviation from expected dividend growth during the year and the present value of any changes to longer-term growth expectations.

In practice, the authors restricted themselves to a three year model:

$$R = a + a_0 U(GD) + \Sigma a_j \Delta E(FGD_j) + e$$

where:

$U(GD)$ = unanticipated dividend growth in the return year

$\Delta E(FGD_j)$ = change in value attributable to a change of growth expectations in year j [j takes a value 1, 2, 3]

a_j = discount factor

e = disturbance term that captured variation in changes beyond year 3.

A simplified form of the above model, using contemporaneous and future dividend growth rates, was applied to US market data for the period 1927-1985. The following results were obtained:

$$\text{Return} = \underset{(0.03)}{0.04} - \underset{(0.13)}{0.05GD} + \underset{(0.14)}{1.01FGD_1} - \underset{(0.14)}{0.16FGD_2} + \underset{(0.13)}{0.24FGD_3}$$

$R^2 = 0.506$. Figures in parentheses are standard errors.

Since this regression result used ex-post, rather than ex-ante data, the results were distorted by measurement error. Ideally, the independent variables should have contained only information that arrived during the return year. The authors therefore expanded their analysis to capture measurement errors contained in the ex-post data. The proxies used to achieve this were the dividend yield (which is negatively correlated with growth expectations), the growth in private non-residential investment in the return year (GI) and one year ahead (FGI) and the actual market returns in the three years following the return year.

$$\text{Return} = \underset{(0.08)}{-0.11} + \underset{(0.15)}{0.55GD} + \underset{(0.16)}{0.69FGD_1} - \underset{(0.16)}{0.02FGD_2} + \underset{(0.16)}{0.41FGD_3} \underset{(0.19)}{-0.71GI} + \underset{(1.85)}{5.56D/P} \underset{(0.13)}{-0.12FR_1}$$

$$\underset{(0.12)}{-0.40FR_2} \underset{(0.10)}{-0.18FR_3} + \underset{(0.22)}{0.37FGI}$$

$R^2 = 0.721$. Figures in parentheses are standard errors.

Adding in the "ex-ante proxies" raised the R^2 from 51% to 72%. Most of the estimates were statistically significant, notable exceptions being FGD_2 and FR_1.

Kothari and Shanken argued that their methodology – in particular the use of future returns in the regression modelling – simply and effectively mitigated the problems associated with realised cash flow variables.

3.3 KEY UK STUDIES

UK studies of the relationship between equity returns and macro-economic data have been based on the methodologies developed in the US, as described above. A discussion of the most significant investigations follows.

3.3.1 Cheng (1995)

The objective of the Cheng (1995) study was to analyse the relationship between UK security returns and economic indicators and to identify the set of economic variables which corresponded most closely with factors obtained using traditional factor analysis. Such analysis attempts to find the relationship between returns and a range of pricing factors. The study used canonical correlation methods, which allowed investigation of two sets of variables, in this case economic variables and stock market variables.

Monthly security returns were collected for the period 1965 to 1988 and analysed using an Arbitrage Pricing Theory (APT) model of the type:

$$R_t = E(R_t) + b_1F_1 + b_2F_2 + \ldots\ldots\ldots + b_kF_k + \varepsilon$$

where:

R_t = random security return in period t

$E(R_t)$ = expected return in period t

b_i = sensitivity of the return to fluctuations in factor F_i

ε = the unexplained or "unsystematic" component of return

As the author admitted, one of the difficulties in applying a factor analysis of this type is that it does not offer any theoretical or empirical grounds for identifying the economic nature of the factors.

The analysis, nevertheless, identified two stock market factors, one displaying a far higher factor loading than the other. Further regression testing in fact revealed that only the more significant factor, together with the risk-free rate, were important for pricing over the period, findings that were consistent with the capital asset pricing model. Cheng noted, however, that the APT factor model only "explained" 11% of the variation in security returns over the 24 year period which, he argued, could be attributed in part to problems such as non-stationarity and non-linearity.

The second part of Cheng's study examined a set of UK market and economic variables in order to estimate the number and loadings of the factors that represent the UK economy. The variables were subjected to maximum-likelihood factor analysis and the conclusion was reached that there are three major factors underlying the UK economy. The first factor encompassed general market-wide variables, including share indices, the second factor included variables such as the longer leading and lagging economic indicators whilst the third factor embraced variables such as GDP and industrial production.

The final part of Cheng's analysis was to link and compare the set of security return factors obtained with the set of economic factors. The strongest linkage was found between the first, most significant, security return factor and the first economic factor. Since the first economic factor is driven, in turn, by stock market share indices, Cheng inevitably reached the conclusion that market return plays the dominant role in influencing security returns.

3.3.2 Black and Fraser (1995)

Black and Fraser (1995) explored the extent to which the conditional risk associated with the UK equity market can be captured by financial variables which proxy for business conditions in the economy. The study assumed that excess equity returns have a non-linear dependence on risk which, in turn, can be described by a generalised class of autoregressive conditional heteroscedastic (GARCH) model of the form:

$R_t = Ø + \Theta h_t + \varepsilon$

$\varepsilon \mid I_{t-1} \sim N(0, h_t^2)$

$h_t^2 = \alpha_0 + \alpha_1 \varepsilon_t{}^2{}_{-1} + \alpha_2 h_t{}^2{}_{-1}$

where:

R_t = excess return on the portfolio at time t (the study analysed results for both the FT All Share Index and the FT Ordinary Share Index)

h_t^2 = conditional error variance – a function of the past squared error (ϵ_{t-1}^2) and the last period's conditional variance

I_{t-1} = information set available at time t-1

Excess return was defined as the total return in any period (capital performance plus dividend yield) less the return available on three-month Treasury bills. The conditional variance of the UK equity market, found from fitting the GARCH model to the excess return data, was shown to increase over periods of falling share prices (e.g. 1972-74 bear market and 1987 Crash) and decrease during sustained bull periods.

Black and Fraser extended the analysis by including three indicators of future business conditions in the excess return equation. Adopting in part the methodology of Fama (1990), the ex-ante variables used to predict business conditions were dividend yield (FTADY), term spread (TERMSP) and default spread (DFALTSP). All three were assumed to be inversely related to business conditions. Thus the excess return equation became:

$$R_t = \O + \Theta h_t + \O_1 TERMSP_{t-1} + \O_2 DFALTSP_{t-1} + \O_3 FTADY_{t-1} + \varepsilon_t$$

The notable feature arising from the GARCH analysis was that, in this case, the parameter in the above equation applying to the conditional variance was no longer significant. However, the three indicators of future business conditions were seen to be significant, implying that they can capture, at least in part, the time variation in expected excess returns. The authors' broad conclusion, therefore, was that the results are supportive of the business conditions hypothesis, as developed by Balvers et al (1990).

3.3.3 Pesaran and Timmermann (2000)

Whilst recognising the significance of earlier work, Pesaran and Timmermann (2000) argued that researchers of equity return predictability needed to avoid the construction of models which benefited from hindsight. That is, models need to reflect genuine, ex-ante predictability. To this end, they argued, models need to reflect the “real time” behaviour of investors, taking into account the fact that the relative importance of business factors can change over time, as may the belief of investors as to which set of factors is the most meaningful at any time.

The authors therefore distinguished between three hierarchies of regressors. At the highest level was the set of “core variables”, so-called because they are assumed to be important on theoretical grounds. These core variables are always included in any analysis.

The regressors in the second, or “focal”, set are always worthy of consideration for inclusion in view of their ability to capture changes in risk premia available owing to business fluctuations. Some of these regressors may be excluded at any time, however, depending on the objectives of the modelling process.

The first and second set of regressors form the “base set.” A third and final set is considered as potentially relevant only if there is clear evidence that the base set fails to serve its purpose.

Table 3.8 Three regressor sets

First set (A)	**Second set (B)**	**Third set (C)**
FT All-Share yield	Change in 3 month T-bill rate	Change in industrial production
3 month T-bill rate	Change in consols yield	Change in money supply (M0)
Retail price inflation	"January effect" dummy	Change in oil price

The authors analysed monthly excess returns from the UK market over the period 1965-93. The excess returns were regressed on all the variables shown in Table 3.8 and a further three dummy variables for the periods January 1975, February 1975 and October 1987. Performances during these periods were considered to be extreme outliers.

The significance of the regressors is shown in Table 3.9. In all cases, the signs were as expected from theory and from previous US studies. The dividend yield showed a positive correlation with excess returns possibly, the authors argued, because of mean reversion, investor over-reaction or persistent time-varying risk premia. The R^2 of the regression was 0.33; this fell to 0.12 when the dummies were removed.

Pesaran and Timmermann also explored the impact of allowing the choice of regressors from the second and third sets to vary over time, the choice being determined by the type of model selection criterion being used. Previous literature related to this area had suggested the Schwarz, Akaike and R^2 approaches, all three of which are likelihood based and assign different weights to the 'parsimony' and 'fit' of the models. The authors found that the Akaike and R^2 approaches tended to give similar outcomes and included a greater number of regressors than the Schwarz approach. Their analysis also suggested that the best forecasting model changed considerably over time. (A useful discussion of model selection criteria, including reference to the Pesaran and Timmermann methodology is contained in Dell'Aquila and Ronchetti, 2006).

Table 3.9 Significance of regressors

Regressors	t-stats
Jan 1975 dummy	8.62
Feb 1975 dummy	3.95
Oct 1987 dummy	-5.12
January dummy	1.88
FT All-Share yield	2.70
3 month T-bill rate	0.06
Retail price inflation	-1.77
Change in 3 month T-bill rate	0.25
Change in consols yield	-1.63
Change in industrial production	2.43
Change in money supply (M0)	-2.29
Change in oil price	-4.31

Table 3.10 compares the results of a buy-and-hold strategy in the UK equity market with those that would have been achieved by switching between equities and T-bills, according to the predicted outlook for equities. Results are shown for policies based on the three approaches discussed above and on a model which utilised all the regressors over the entire period. No leverage was permitted, nor was shorting in either of the assets (equities and T-bills).

As the results show, a buy-and-hold strategy in the equity market would have provided the superior return over the entire period. However, the Sharpe ratios (excess return/standard deviation) would have been far superior for the switching portfolios, even after transaction costs. The analysis identified two periods (1973-5 and 1981) when there appeared to be persistently negative excess returns. Avoidance of equities during these periods in part explains the superior risk-return trade-off of the switching portfolios. The authors conceded that it was not possible to establish conclusively how, or why, negative risk premia appeared to exist during these periods but suggested that factors such as ‘noise trading’ or ‘psychological’ factors may offer explanations.

Table 3.10 Switching results, 1970 - 1993

	Mean Return (%)	S.D. of return (%)	Sharpe ratio
Market portfolio (FT A-S)	20.96	36.55	0.297
T-bills	10.12	2.63	n/a
Switching portfolios:			
Akaike	18.18	9.70	0.830
Schwarz	20.27	11.28	0.899
R^2	18.22	9.87	0.821
All regressors	16.74	16.98	0.390

Note: results exclude transaction costs

3.3.4 Lovatt and Parikh (2000)

Lovatt and Parikh (2000) applied the Fama (1990) methodology to the UK market for the period 1980 to 1994. The choice of the period 1980-94 was guided by two considerations. First, the authors wanted a good number of observations before and after the market fall of October 1987 so that the bull market, followed by the market fall, would be set in a longer-term context. Secondly, the authors decided to limit the period to one in which monetary policy had been consistently used to control inflation, hence the decision to start the sample period in the year following the election of the Conservative Government.

The dependent variables used were the monthly, quarterly and annual real total returns on the FT-All Share Index calculated on a moving monthly basis. The independent variables used were the FT-All Share dividend yield, the default spread of corporate bonds, the term spread, shocks to the default spread and quarterly percentage changes in industrial production. Shocks to the default spread were measured by the residuals from a first-order regression fit to the observations.

The results are shown in Table 3.11. As in Fama's model, the annual results were better than the monthly and quarterly estimations. The yield coefficient and the production coefficient were positive, as anticipated; however, the coefficient related to the term spread was surprisingly negative. The authors concluded that, in general, the model provided a reasonably good explanation for real equity returns.

Table 3.11 Fama's model applied to the UK

	Monthly t-ratio	**Quarterly t-ratio**	**Annual t-ratio**
Constant	-3.65	-3.02	-1.56
Yield	3.78	3.06	1.85
Term spread	-2.36	-1.97	-0.71
Shock to default spread	-3.17	-1.85	-4.05
IP(t, t+3)	1.76	1.96	1.12
IP(t+3, t+6)	3.89	3.10	1.69
IP(t+6, t+9)	1.41	3.07	2.95
IP(t+9, t+12)	2.08	1.36	2.75
IP(t+12, t+15)	2.07	3.08	3.27
IP(t+15, t+18)	1.69	1.37	3.05
IP(t+18, t+21)	0.86	1.51	1.85
IP(t+21, t+24)	0.48	-0.36	1.97
R-squared	0.15	0.24	0.35

.**Table 3.12 Alternative Lovatt/Parikh model**

	t-ratio
Constant	-1.32
Dividend yield	2.49
Inverted yield curve	-1.61
Expected GDP growth	1.02
Expected inflation	-1.37
R-squared	0.24

Lovatt and Parikh did nevertheless highlight the problem with the Fama model for forecasting purposes, notably that it made use of leading variables. They tackled this problem by making use of expectational data. 'Historic' forecasts of real GDP and inflation were obtained from the National Institute of Economic and Social Research. Real GDP was anticipated to have a positive influence on returns; inflation was anticipated to be inversely related to returns, inasmuch as higher expected inflation is associated with higher expected interest rates.

The results derived using this alternative model are shown in Table 3.12. The model explained a slightly smaller proportion of the variance than the annual version of the Fama model and not all the estimated parameters were significant

3.4 A NEW ANALYSIS OF UK MARKET RETURNS, 1963-2003

The second half of this chapter will present an up-to date analysis of the linkages between the UK equity market and macroeconomic variables. As in Lovatt and Parikh (2000), the Fama (1990) methodology will form the basis of the analysis. The period analysed, however, is not confined to that of the last Conservative government and embraces torrid economic and market conditions as well as the calmer conditions that prevailed during most of the period analysed by Lovatt and Parikh. The range of macroeconomic variables used is also extended.

The analysis looks at the relationship between real equity returns and macroeconomic changes for:

- Quarterly periods
- Annual periods, non-overlapping (i.e. calendar years)
- Annual periods, overlapping (i.e. moving the 12 month period a quarter at a time).

3.4.1 The Fama variables

At the heart of the approach adopted by Fama (1990), discussed in section 3.2, is the assumption that equity prices represent discounted values of future cash flows. In a perfect world prices would rise steadily and investors would receive the constant returns implied in the discount rate. In an imperfect world, however, returns will vary. It is assumed that this variation has three sources:

(a) predictable variation due to variation in the discount rates, the expected returns
(b) shocks to the discount rate
(c) shocks to expected cash flows.

The variables used to examine return variation were as follows.

Dependent variable

Real returns on the value-weighted NYSE market portfolio

Expected returns

(i) Dividend yield on the NYSE market portfolio

(ii) Default spread, defined as the difference between the yield at time t on a portfolio of corporate bonds and the equivalent yield on a portfolio with Aaa ratings

(iii) Term spread, defined as the difference between the yield at time t on the corporate bond portfolio and the one-month Treasury bill rate.

These three variables capture the variation in expected returns in response to business conditions. In other words they attempt to capture a measure of the risk premium on offer. When business conditions are strong, confidence is high, default and term spreads narrow and dividend yields tend to fall. The reverse is the tendency when business conditions are poor.

Shocks to expected returns

(i) Shock to the default spread as measured by the residual from first order autocorrelation fit

(ii) Shock to the term spread as measured by the residual from first order autocorrelation fit

Yield shocks cannot be used since these are largely driven by price changes.

Shocks to expected cash flows

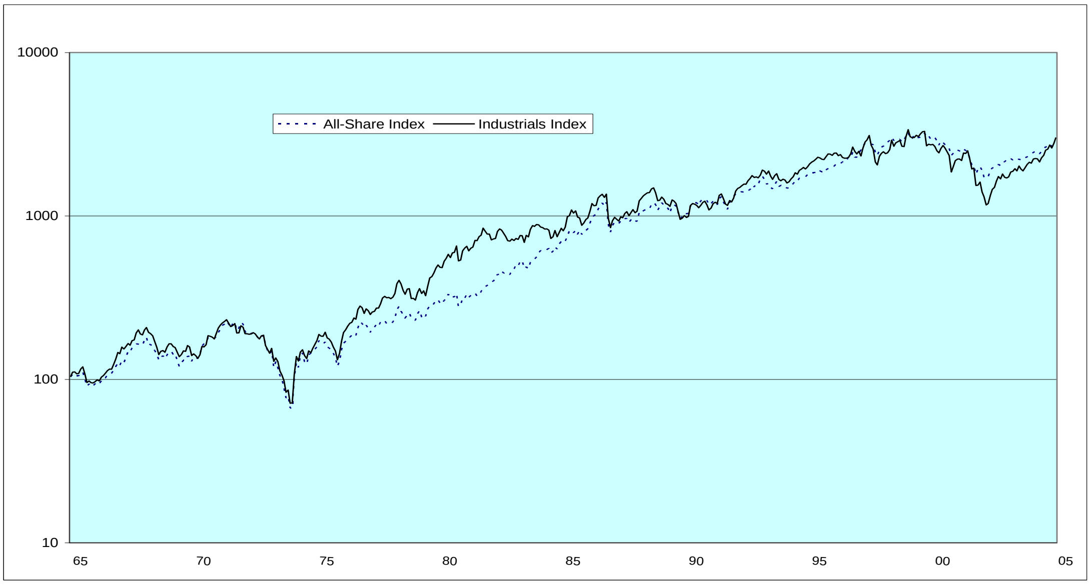
(i) Growth in industrial production up to 4 quarters ahead.

3.4.2 UK variables

A discussion is presented here of a new and equivalent analysis of UK equity market variability. The variables selected are shown in Table 3.13. Sources of raw data and methodologies applied to obtain derived data are shown in Table 3.14. The dependent variable in the analysis is the real total return on the UK equity market (as represented by the FTSE All-Share Index). Returns are regressed against the remaining indicators and "shocks" are as defined in Table 3.13.

The FTSE All-Share index was used to represent the UK market since this is the broadest index available. It captures approximately 98% of available market capitalisation at any point of time. It is recognised that an extended analysis which examined relationships between macroeconomic variables and different segments of the market – by viewing the industrial segment financial segments separately for example – might reveal additional, interesting results. However, given the high, historical correlation between such segments and the total market index – 96% in the case of the industrials (see Figure 3.1) - it was concluded that this initial analysis should utilise the total market benchmark.

Figure 3.1 – All-Share index –v- Industrials index



Whilst the Fama (1990) methodology was considered to be the most appealing and authoritative of those employed in this area, it was felt that the range of indicators could be extended. Market volatility was included, therefore, as an additional indicator of uncertainty and, therefore, of potential risk premia. Additional 'shocks to expected returns' incorporated in the analysis relate to unanticipated changes in volatility and both long and short term interest rates. Additional 'shocks to cash flows' incorporated are changes in corporate real earnings and dividends, changes in GDP and changes in consumer expenditure. Exchange rate movements are, of course, important to the UK corporate sector. However, since exchange rate movements would eventually impact corporate earnings, it was not considered necessary to include separate exchange rate series in the analysis. Further, more detailed analyses might nevertheless consider their inclusion, especially if relationships in more specific sectors (e.g. manufacturing) are being investigated. As in Fama (1990), shocks were measured as the residuals from first order correlation values.

It was also considered worthwhile including inflation in the analysis, given the dramatic impact that changes in inflation have had on the UK economy over the period under investigation and also the perceived negative correlation between inflation and real corporate profitability.

Table 3.13 Variables selected for UK analysis

Dependent variable	
MRR(t, t+1)	Market real, total return (FTSE All-Share index)
Indicators of "predictable" expected return	
DIVY(t)	Market dividend yield at time t
DEF(t)	Default spread at time t
TERM(t)	Term spread at time t
VOL(t)	Volatility at time t
"Shocks" to expected returns	
DEFSH(t, t+1)	Unanticipated (% pt) change in default spread
TERMSH(t, t+1)	Unanticipated (% pt) change in term spread
VOLSH(t, t+1)	Unanticipated (%pt) change in volatility
CONSH (t, t+1)	Unanticipated (% pt) change in consols yield
TBILLSH(t, t+1)	Unanticipated (% pt) change in Treasury bill yield
"Shocks" to cash flows	
RCECH(t, t+1)	Real corporate earnings change
RCDCH(t, t+1)	Real corporate dividends change
GDPCH (t, t+1)	GDP volume growth
IPCH(t, t+1)	Industrial production change
CONEXCH(t, t+1)	Consumer expenditure change
Other	
RPICH(t, t+1)	Retail price index change

Note: "Shocks" are derived as the residuals from first order autocorrelation values

Dividend yields and notional, corporate earnings and dividends were compiled, or derived from, FTSE Actuaries data. The following methodology and adjustments were applied:

(i) Dividend yields were recorded “gross” prior to 1998 but have been recorded “net” since 1998, reflecting the dividend tax changes introduced in 1997. The immediate effect at the changeover was to reduce the gross yield for the FTSE All-Share index by 18%. For consistency in this analysis, published yields since 1997 have been grossed up by a factor of 0.82.

(ii) Notional corporate earnings were derived from: (Index level/index P/E). The P/E was not derived for the FTSE All-Share index prior to 1993; the FTSE Industrials data were therefore used. A series based on FTSE All-Share data was used from 1993, the two derived series being spliced together at that point. Notional corporate dividends were derived from: (Index level x index yield/100). FTSE All-Share data were used.

(iii) Companies report some months after the end of their trading year. Final dividends are not paid until some months after being reported. The derived earnings and dividend series were therefore transformed to "real time" by lagging by six months in each case. For example, the dividends and earnings reflected in the index data at mid calendar year are taken to represent broadly the earnings and dividends associated with the previous December year-end trading year.

As discussed above, the 'shocks to expected returns' used in the analysis were the residuals from first order autocorrelation values. For example, an autocorrelation analysis suggested that the term spread at time t+1 would be expected to be:

0.112 + 0.880*(term spread at time t) [$R^2 = 0.781$]

The 'shock' recorded at time t+1 was the difference between the observed value and this predicted value i.e. the unpredicted element.

Table 3.15 shows the means, standard deviations and autocorrelation lag coefficients for each of the variables defined. The period analysed is end-1963 to end-2003. Note that there is little autocorrelation in market real returns whilst dividend yields, default spreads and term spreads are reasonably persistent.

Table 3.14 Data sources

Item	**Source**
FTSE All-Share Index	FT publications/DataStream
FTSE All-Share Yield	FT publications/DataStream
FTSE All-Share P/E (from 1993)	FT publications/DataStream
FTSE Industrials P/E	FT publications/DataStream
Consols ($2^1/_2$) Yield	Bank of England Quarterly/Financial Statistics
Long-dated gilt yield (20 years)	Bank of England Quarterly/Financial Statistics
Treasury Bill yield (91 days)	Bank of England Quarterly/Financial Statistics
Company Debenture yield	Bank of England Quarterly/Financial Statistics
Long-dated index-linked yield (from 1981)	Bank of England Quarterly/Financial Statistics
Retail Price Index (all items)	National Statistics
Gross Domestic Product (volume)	National Statistics
Index of Production (total industries)	National Statistics
Household Consumer Expenditure	National Statistics

Derived data

Item	**Methodology**
Index of real company earnings	Notional earnings derived from Index/Index PE. Lagged 6 months and deflated by the RPI.
Index of real company dividends	Notional dividends derived from (Index * Index yield). Lagged 6 months and deflated by the RPI.
UK equities – total return index (quarterly)	One quarter of dividend yield (using start index and end quarter notional dividend) added to capital performance in any quarter.
Consols ($2^1/_2$%) – total return index	One quarter of start income yield added to capital performance in any quarter
3 month Treasury Bills – total return index	One quarter of quoted interest yield at start used
Default spread	Difference between yield on company debentures and long-dated gilt yield
Term spread	Difference between consols yield and T-bill yield
Volatility	Standard deviation in daily market returns

Figure 3.2 – Cumulative real earnings and dividends

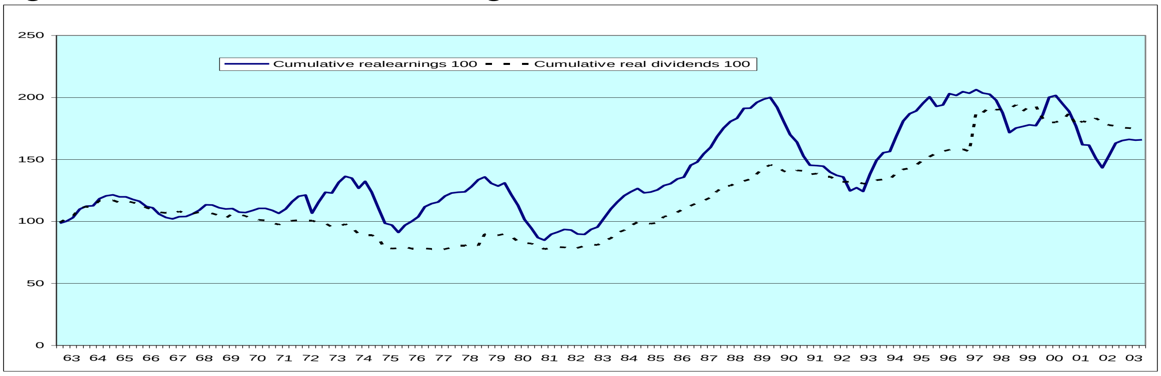


Figure 3.3 – Inflation (RPI) –v- Long bond yield

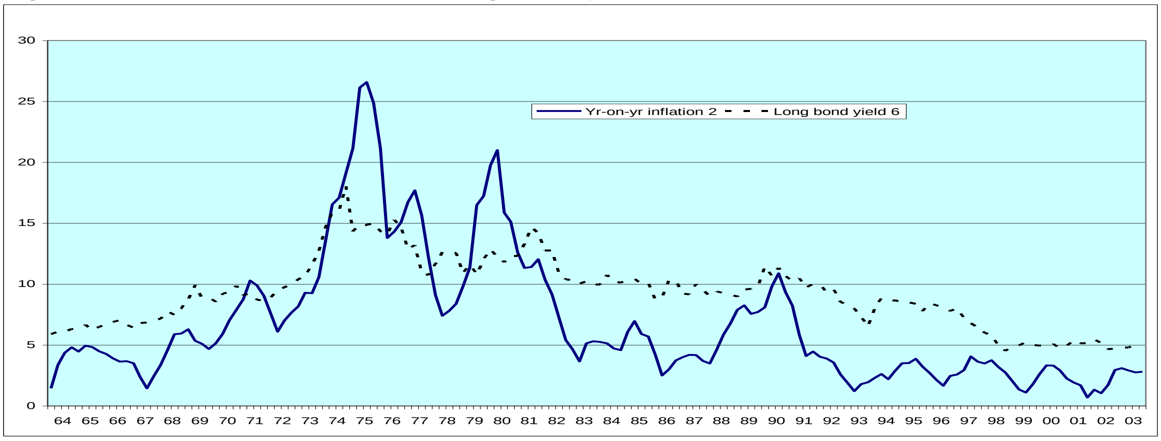


Table 3.15 Means, standard deviations and autocorrelations – quarterly data

			Lag :-							
	Mean	Sdev	1	2	3	4	5	6	7	8
MRR(t, t+1)	0.020	0.106	0.040	-0.010	0.030	-0.120	-0.110	0.000	-0.020	0.020
DIVY(t)	0.045	0.013	0.880	0.740	0.630	0.520	0.450	0.420	0.400	0.360
DEF(t)	0.983	0.448	0.710	0.650	0.610	0.530	0.440	0.420	0.380	0.320
TERM(t)	0.993	2.023	0.880	0.780	0.670	0.580	0.510	0.430	0.360	0.300
VOL(t)	0.136	0.068	0.350	0.310	0.260	0.270	0.270	0.300	0.110	0.100
DEFSH(t, t+1)	-0.001	0.319	-0.220	0.090	0.150	0.120	-0.050	0.120	0.060	0.040
TERMSH(t, t+1)	0.000	0.947	0.020	0.030	0.000	-0.040	0.050	0.000	-0.060	-0.020
VOLSH(t, t+1)	0.000	0.064	-0.070	0.160	0.110	0.120	0.120	0.230	-0.020	0.080
CONSH (t, t+1)	0.004	0.710	-0.040	0.070	0.040	-0.050	-0.040	0.050	0.050	0.130
TBILLSH(t, t+1)	-0.002	1.092	0.150	0.030	-0.100	0.020	-0.110	0.110	-0.010	0.020
RCECH(t, t+1)	0.006	0.042	0.480	0.300	0.200	0.060	-0.100	-0.050	-0.050	-0.050
RCDCH(t, t+1)	0.003	0.028	0.120	0.130	0.100	0.230	0.100	0.090	0.010	0.200
GDPCH (t, t+1)	0.006	0.010	-0.040	0.050	0.180	-0.030	0.030	0.120	-0.020	-0.170
IPCH(t, t+1)	0.004	0.017	0.120	0.060	0.030	-0.030	-0.090	0.000	-0.070	-0.080
CONEXCH(t, t+1)	0.008	0.052	-0.280	-0.380	-0.270	0.900	-0.240	-0.380	-0.260	0.870
RPICH(t, t+1)	0.016	0.015	0.570	0.540	0.420	0.640	0.380	0.400	0.340	0.510

As Figures 3.2 and 3.3 illustrate, the period 1963 – 2003 embraced significant regime changes. The 1970s were characterised by high inflation, industrial unrest, declining real corporate earnings and dividends and exceptional market volatility, particularly over the 1972-1975 period. The impact of the latter on the results of this analysis is discussed in Section 3.4.7. Exchange controls and dividend controls were also a feature until the Conservative party regained power in that year.

The post-1979 period, in the main, has been characterised by lower inflation and interest rates, positive corporate earnings and dividend growth, a policy of privatisation and a floating exchange rate (at least for most of the period).

3.4.3 Leading/lagging relationships

The UK stock market tends to lead real activity and for many years was used as a component of the Central Statistical Office's longer leading cyclical indicator. However, following a review of the indicators in 1993 (reported in Moore, 1993), the equity market index was replaced as a longer leading component by the inverted yield curve. The stock market index, with a median lead time of eight months, has subsequently been used as a component of the shorter leading indicator.

The next stage in the analysis, therefore, was to analyse the stock market for its leading properties by regressing returns on changes in real activity indicators. The relationship between market returns and anticipated inflation was also analysed. The results are shown in Table 3.16.

In most cases the strongest relationship was found to be between market returns and real activity a full four quarters into the future. The results also confirmed the findings of Fama and others that industrial production "explains" the variation in real equity market returns more than any of the other variables.

It is interesting at this point to note that the stock market appears to lead changes in inflation and that the relationship is negative. However, there is insufficient evidence in this analysis to reach any firm conclusions regarding the effects of inflation on the equity market. What is known, of course, is that the high inflation of the 1970s had a detrimental effect on the real profitability of the corporate sector which, in turn, was in part responsible for the severe 1972-1974 bear market.

3.4.4 Explaining quarterly variability

Table 3.17 shows the explanatory power of all the variables. The "best fit" is chosen in the case of the lagging variables. The real quarterly returns over the period t to t+1 are regressed on variable values at time t in the case of the first group of predictors, the expected return predictors.

Table 3.16 The market as a leading indicator (quarterly data)

Quarterly returns -v- RCECH (t, t+1)

	R^2	t-stat
Coincident	0.007	-0.22
Mkt leading by:-		
1Q	0.001	0.38
2Q	0.002	0.62
3Q	0.011	1.35
4Q	0.052	2.93
5Q	0.032	2.29

Quarterly returns -v- RCDCH (t, t+1)

	R^2	t-stat
Coincident	0.027	2.09
Mkt leading by:-		
1Q	0.013	-0.61
2Q	0.019	1.71
3Q	0.071	2.19
4Q	0.081	2.05
5Q	0.001	0.39

Quarterly returns -v- GDPCH (t, t+1)

	R^2	t-stat
Coincident	0.001	0.28
Mkt leading by:-		
1Q	0.011	1.31
2Q	0.001	0.30
3Q	0.042	2.65
4Q	0.057	3.08
5Q	0.000	-0.22

Quarterly returns -v- IPCH (t, t+1)

	R^2	t-stat
Coincident	0.001	-0.39
Mkt leading by:-		
1Q	0.009	1.23
2Q	0.010	1.25
3Q	0.032	2.29
4Q	0.079	3.68
5Q	0.005	0.91

Quarterly returns -v- CONEXCH (t, t+1)

	R^2	t-stat
Coincident	0.022	-1.90
Mkt leading by:-		
1Q	0.002	-0.12
2Q	0.006	0.95
3Q	0.022	1.90
4Q	0.015	-1.50
5Q	0.002	-0.52

Quarterly returns -v- RPICH (t, t+1)

	R^2	t-stat
Coincident	0.002	-0.62
Mkt leading by:-		
1Q	0.004	0.78
2Q	0.032	-2.31
3Q	0.033	-2.33
4Q	0.022	-1.87
5Q	0.008	-1.11

Not unexpectedly, dividend yield is found to be very significant and the best of the expected return predictors. The relationship between returns and the default spread and volatility is negative, surprisingly, but is statistically insignificant. The sign associated with the term spread is positive, as expected, but its statistical significance is low.

Table 3.17 Expected return predictors (quarterly data)

Variable	**R^2**	**t-stat**
DIVY(t)	0.067	3.42
DEF(t)	0.001	-0.44
TERM(t)	0.009	1.19
VOL(t)	0.001	-0.46
DEFSH(t, t+1)	0.001	-0.45
TERMSH(t, t+1)	0.017	-1.69
VOLSH(t, t+1)	0.06	-3.2
CONSH (t, t+1)	0.372	-9.79
TBILLSH(t, t+1)	0.084	-3.85
RCECH(t+4, t+5)	0.052	2.93
RCDCH(t+4, t+5)	0.081	2.05
GDPCH (t+4, t+5)	0.057	3.08
IPCH(t+4, t+5)	0.079	3.68
CONEXCH(t+3, t+4)	0.022	1.9
RPICH(t+3, t+4)	0.033	-2.33

Note: The "best fitting" series is used where the predictor variable is lagged

The relationship between returns and the shock variables are all in the direction to be expected. An unanticipated rise in the long interest rate (CONSH), for example, is associated with a negative reaction in the equity market. Shocks to volatility and short and long term interest rates are all statistically significant, the latter especially so. Shock movements in long interest rates “explain” over 37% of variation in quarterly returns.

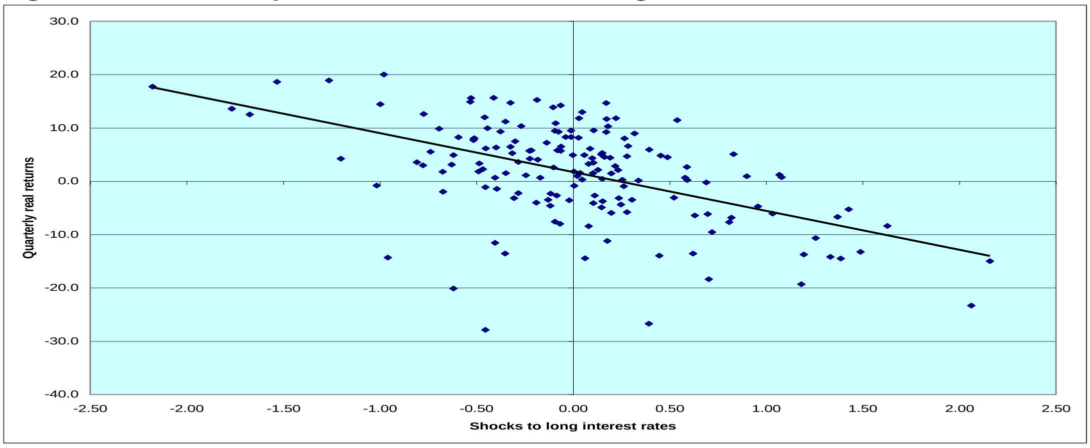
3.4.5 Testing the combined power

A Minitab 14 stepwise regression procedure was used to find the most powerful combination of the explanatory variables. Again, the lagging characteristics of the real activity variables were taken into account. In other words, the explanatory variables were lagged where previous analysis, as shown in Table 3.17, indicated that the equity market appear to discount ahead. The resultant model of best fit was:

Real quarterly return = -6.106 –9.07CONSH –0.399VOLSH+1.76DIVY-3.7DEFSH
(-10.39) (-4.01) (3.59) (-1.88)
Adjusted R-squared = 0.478

The stepwise regression technique is periodically criticised for encouraging data mining by researchers. Nevertheless, the results achieved here appear sensible. The signs attaching to the variables are as expected and the variation in returns 'explained' is approximately double that achieved in the earlier study by Lovatt and Parikh (2000). One possible explanation is that Lovatt and Parikh confined themselves to the variables defined by Fama and did not, for example, look specifically at the impact of shocks to long interest rates. As the above equation and Figure 3.4 show, that variable is highly significant.

Figure 3.4 Quarterly returns –v- shocks to long interest rates



3.4.6 Analysis of annual variation in return (non-overlapping)

Annual, non-overlapping, real returns were also regressed against the same set of explanatory variables. The periods were calendar years. Thus, for example, the real return in 2003 was associated with the dividend yield at the end of 2002.

Table 3.18 shows the means, standard deviations and autocorrelations for the 1963-2003 period. Note the negative first order autocorrelation for the annual returns themselves.

Table 3.19 shows the extent by which the stock market anticipates changes in real activity. As one would expect, given the equivalent results for quarterly data, the market tends to lead most variables by a full year (4 quarters). The important exception to this generalised observation is industrial production, where the best fit is found with coincident data. Again, industrial production is found to be the most powerful of the real activity variables.

Table 3.18 Values for annual, non-overlapping data

			…..Autocorrelations for annual lag……..			
	Mean	St Dev	1	2	3	4
MRR(t, t+4)	0.090	0.252	-0.25	-0.12	-0.11	0.14
DIVY(t)	0.046	0.015	0.42	0.28	0.15	0.19
DEF(t)	1.014	0.487	0.66	0.38	0.16	0.04
TERM(t)	0.816	2.037	0.51	0.20	0.19	-0.05
VOL(t)	0.128	0.069	0.14	0.01	0.08	-0.09
DEFSH(t, t+4)	0.000	0.363	0.04	0.02	-0.11	-0.14
TERMSH(t, t+4)	-0.078	1.776	-0.08	-0.23	0.23	-0.15
VOLSH(t, t+4)	0.039	0.075	-0.37	-0.10	0.12	-0.11
CONSH (t, t+4)	2.715	1.710	0.26	0.30	0.01	0.19
TBILLSH(t, t+4)	2.500	2.418	0.00	-0.03	0.16	-0.20
RCECH(t, t+4)	0.028	0.126	0.17	-0.07	-0.09	0.27
RCDCH(t, t+4)	0.016	0.065	0.41	0.18	-0.02	-0.10
GDPCH (t, t+4)	0.025	0.020	0.30	-0.15	-0.22	-0.12
IPCH(t, t+4)	0.014	0.037	0.02	-0.23	-0.20	-0.07
CONEXCH(t, t+4)	0.025	0.024	0.23	-0.15	-0.24	-0.10
RPICH(t, t+4)	0.067	0.053	0.78	0.56	0.40	0.43

Table 3.20 shows the explanatory powers of all the variables. Lags are taken into account in the case of relevant real activity variables. Looked at on this annual basis, market dividend yield takes over as the single most powerful predictor. Volatility is again disappointing as a measure of future return, the sign of the relationship being the opposite of that expected. The sign associated with the term spread relationship is as expected but the variable trails a long way behind the dividend yield in terms of predictive powers.

Stepwise regression on the full set of explanatory variables (taking into account lead/lags) resulted in the following model of annual return variability:

Annual real return = -37.17 + 10.7DIVY –5.3CONSH+4.4GDPCH-2.0TERMSH
(7.19) (-3.39) (3.12) (-1.49)

Adjusted R^2 = 0.689

Table 3.19 The market as a leading indicator (annual non-overlapping)

Annual returns -v- RCECH (t, t+4)	R^2	t-stat	Annual returns -v- RCDCH (t, t+4)	R^2	t-stat
Coincident	0.013	-0.71	Coincident	0.005	0.48
Mkt leading by:-			Mkt leading by:-		
4Q	0.176	6.44	4Q	0.102	2.07
8Q	0.009	0.6	8Q	0.078	1.77
12Q	-0.034	-1.12	12Q	-0.004	-0.37
16Q	-0.011	-0.62	16Q	0.049	1.34

Annual returns -v- GDPCH (t, t+4)	R^2	t-stat	Annual returns -v- IPCH (t, t+4)	R^2	t-stat
Coincident	0	-0.01	Coincident	0.344	4.52
Mkt leading by:-			Mkt leading by:-		
4Q	0.216	3.24	4Q	0	-0.07
8Q	0.006	0.47	8Q	0.023	-0.94
12Q	0.012	-0.65	12Q	0.008	-0.09
16Q	0	-0.05	16Q	0.059	-1.49

Annual returns -v- CONEXCH (t, t+4)	R^2	t-stat	Annual returns -v- RPICH (t, t+4)	R^2	t-stat
Coincident	0.012	-0.68	Coincident	0.005	0.45
Mkt leading by:-			Mkt leading by:-		
4Q	0.089	1.93	4Q	-0.053	-1.46
8Q	0.036	1.18	8Q	-0.03	-1.07
12Q	0.011	0.64	12Q	-0.007	-0.52
16Q	0.007	0.51	16Q	0.011	0.62

Figure 3.5 Actual returns –v- regression model (annual non-overlapping)

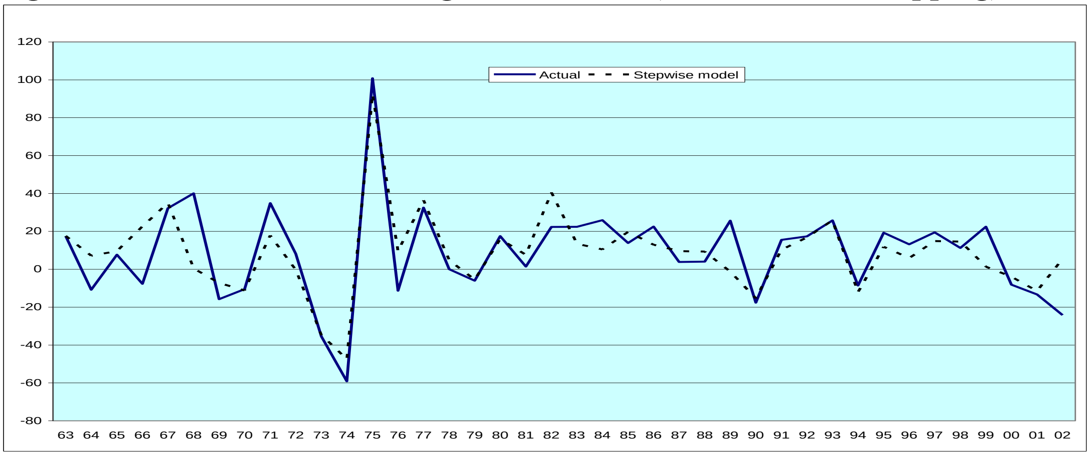


Table 3.20 Expected return predictors (annual non-overlapping)

Variable	R^2	t-stat
DIVY(t)	0.355	4.64
DEF(t)	0	0.04
TERM(t)	0.07	1.72
VOL(t)	-0.03	-1.1
DEFSH(t, t+4)	0.041	-1.3
TERMSH(t, t+4)	0.015	-0.77
VOLSH(t, t+4)	0.059	-1.56
CONSH (t, t+4)	0.215	-3.27
TBILLSH(t, t+4)	0.058	-1.55
RCECH(t+4, t+8)	0.176	2.84
RCDCH(t+4, t+8)	0.102	2.07
GDPCH (t+4, t+8)	0.216	3.24
IPCH(t, t+4)	0.344	4.52
CONEXCH(t+4, t+8)	0.089	1.93
RPICH(t+4, t+8)	0.053	-1.46

Note: The "best fitting" series is used where the predictor variable is lagged

3.4.7 Analysis of annual variation in returns (overlapping)

The previous section looked at the annual variation in returns from calendar year to calendar year. For the sake of completeness, year-on-year returns were also analysed on a quarterly basis (i.e. overlapping). By definition, therefore, the autocorrelations of the series, including that of the return series itself, are much higher, as Table 3.21 shows.

Table 3.22 shows the lagging characteristics of the real activity indicators and retail prices. In all cases, year on year returns appear to anticipate year on year changes over the next year (i.e. the market is leading by 4 quarters.). Again, the industrial production variable appears to have the most exploratory power.

Table 3.23 shows the explanatory powers of all the variables. Looked at on this overlapping basis, industrial production takes over from dividend yield as the most powerful single predictor. The sign of the volatility coefficient is once again negative, opposite to what might be expected, whilst the significant negative correlation between returns and the volatility shock variable suggests that volatility rises during bear phases.

Table 3.21 Values for annual, overlapping data

	Mean	St Dev	…..Autocorrelations for annual lag……..			
			1	2	3	4
MRR(t, t+4)	0.080	0.218	0.71	0.41	0.14	-0.15
DIVY(t)	0.041	0.013	0.88	0.74	0.63	0.52
DEF(t)	0.980	0.450	0.70	0.65	0.61	0.53
TERM(t)	0.990	2.020	0.88	0.78	0.68	0.58
VOL(t)	0.136	0.069	0.35	0.32	0.26	0.27
DEFSH(t, t+4)	0.000	0.319	0.09	0.16	0.13	-0.05
TERMSH(t, t+4)	0.001	0.947	0.03	0.00	-0.04	0.05
VOLSH(t, t+4)	-0.004	0.064	0.16	0.10	0.12	0.12
CONSH (t, t+4)	0.003	0.710	0.07	0.03	-0.06	-0.03
TBILLSH(t, t+4)	-0.001	1.092	0.04	-0.10	0.02	-0.11
RCECH(t, t+4)	0.029	0.123	0.68	0.43	0.18	0.02
RCDCH(t, t+4)	0.016	0.066	0.71	0.55	0.38	0.34
GDPCH (t, t+4)	0.025	0.021	0.58	0.43	0.19	0.13
IPCH(t, t+4)	0.016	0.040	0.53	0.26	-0.01	-0.10
CONEXCH(t, t+4)	0.025	0.027	0.55	0.35	0.10	0.10
RPICH(t, t+4)	0.068	0.054	0.89	0.81	0.73	0.68

The correlation attaching to the long interest rate shock (CONSH) is much lower than that obtained with non-overlapping data, suggesting that the latter was heavily influenced by the extreme market performances over the 1973-75 period. Indeed, repeating the stepwise regression for non-overlapping data, but with the 1973-1975 data removed from the analysis altogether, throws up the following best fit:-

$$\textit{Annual real return} = -11.45 + \underset{(2.46)}{1.70IPCH} + \underset{(2.56)}{6.0DIVY} - \underset{(-1.83)}{3.5VOLSH}$$

Adjusted $R^2 = 0.304$

Note that the long bond variable no longer appears as a significant variable and the adjusted R^2 shows a substantial fall from the original finding of 0.689. A multiple regression which included all the predictor variables and also dummy variables for the years 1973, 1974 and 1975 – as conducted by Pesaran and Timmermann (2000) –

was also undertaken and showed that the dummy variable representing 1974 was the most significant variable.

Table 3.22 The market as a leading indicator (annual overlapping)

12 month returns -v- RCECH (t, t+1)			12 months returns -v- RCDCH (t, t+1)		
	R^2	**t-stat**		**R^2**	**t-stat**
Coincident	0.000	-0.14	Coincident	0.050	2.90
Mkt leading by:-			Mkt leading by:-		
1Q	0.007	1.04	1Q	0.094	4.05
2Q	0.033	2.33	2Q	0.140	5.05
3Q	0.075	3.56	3Q	0.165	5.55
4Q	0.117	4.53	4Q	0.152	5.27
5Q	0.104	4.23	5Q	0.131	4.81

12 months returns -v- GDPCH (t, t+1)			12 months returns -v- IPCH (t, t+1)		
	R^2	**t-stat**		**R^2**	**t-stat**
Coincident	0.007	1.08	Coincident	0.000	0.29
Mkt leading by:-			Mkt leading by:-		
1Q	0.056	3.06	1Q	0.038	2.51
2Q	0.116	4.53	2Q	0.132	4.88
3Q	0.181	5.87	3Q	0.240	7.01
4Q	0.228	6.77	4Q	0.301	8.16
5Q	0.148	5.18	5Q	0.220	6.80

12 months returns -v- CONEXCH (t, t+1)			12 month returns -v- RPICH (t, t+1)		
	R^2	**t-stat**		**R^2**	**t-stat**
Coincident	0.017	1.64	Coincident	0.004	0.84
Mkt leading by:-			Mkt leading by:-		
1Q	0.053	2.98	1Q	0.022	-1.90
2Q	0.076	3.59	2Q	0.056	-3.05
3Q	0.086	3.83	3Q	0.081	-3.71
4Q	0.095	4.04	4Q	0.086	-3.82
5Q	0.045	2.71	5Q	0.077	-3.59

Stepwise regression on the full set of explanatory variables (taking into account leads/lags) resulted in the following model of year-on year variability measured at quarterly intervals.

$$\textit{Year-on-year return} = -36.033 \underset{(5.22)}{+3.28GDPCH} \underset{(9.63)}{+8.90DIVY} \underset{(-2.75)}{-0.71RPICH}$$
$$\underset{(3.10)}{+0.61RCDCH} \underset{(-2.82)}{-0.54VOLSH} \underset{(-2.29)}{-4.10TERMSH} \underset{(-1.70)}{-2.70TBILLSH}$$

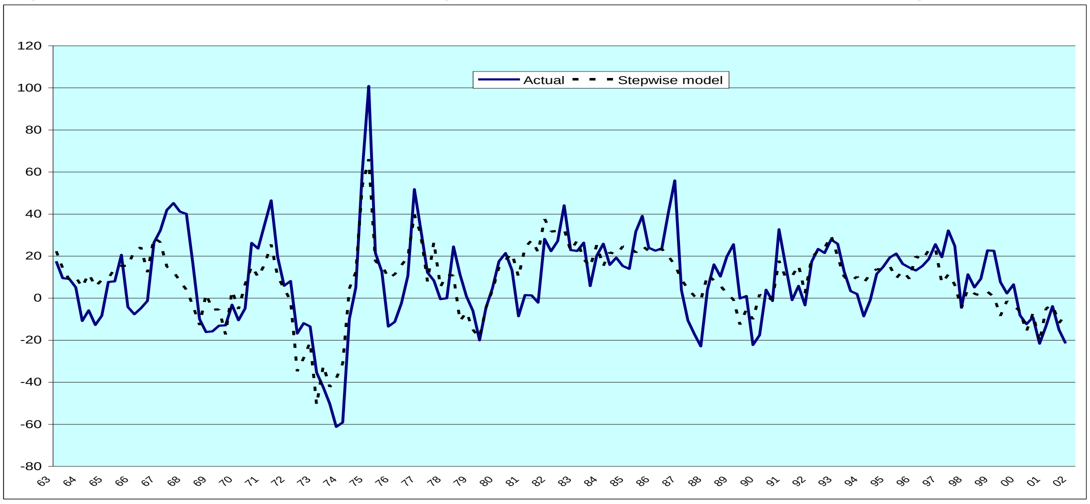
Adjusted $R^2 = 0.577$

Table 3.23 Expected return predictors (annual overlapping)

Variable	R^2	t-stat
DIVY(t)	0.233	6.94
DEF(t)	0	-0.2
TERM(t)	0.013	1.43
VOL(t)	0.002	-0.62
DEFSH(t, t+4)	0.004	-0.84
TERMSH(t, t+4)	0.006	-0.98
VOLSH(t, t+4)	0.096	-4.11
CONSH (t, t+4)	0.049	-2.87
TBILLSH(t, t+4)	0.005	-0.9
RCECH(t+5, t+8)	0.117	4.53
RCDCH(t+4, t+7)	0.165	5.55
GDPCH (t+5, t+8)	0.228	6.77
IPCH(t+5, t+8)	0.301	8.16
CONEXCH(t+5, t+8)	0.095	4.04
RPICH(t+5, t+8)	0.077	-3.59

Note: The "best fitting" series is used where the predictor variable is lagged

Figure 3.6 Actual returns –v- regression model (annual overlapping)



3.5 SUMMARY

This chapter has summarised the main attempts to relate equity market variation to the variation in macro-economic variables. Results for both the US and UK equity markets were analysed. In the main, it can be concluded that, as expected, there is a linkage between equity market performance and expectations regarding the future economic environment. However, methodological shortcomings and measurement errors have to be recognised.

The chapter also discussed the results obtained by applying an extended and unique version of the Fama (1990) methodology to the UK market. The range of predictor variables included in the analysis was wider than in previous studies. The inclusion of long interest rates, in particular, showed a very strong relationship when non-overlapping data was used, albeit that the sharp swings in the 1973-75 period heightened the statistical significance of the results. Nevertheless, the results confirm that the equity market is driven, in the main, by economic factors. Moreover, most of the relationships identified were of the type and direction anticipated.

It is conceded, however, that the analysis benefits from hindsight. Actual outcomes are used as input activity variables, for example, rather than forecasts. Indeed, it is highly likely that less of the variability of the equity market would have been explained had forecast data been used. However, it is of particular interest to note the power of the equity market as a leading indicator of activity over the period analysed.

Identification of a meaningful linkage between the macroeconomy and the stock market provides reassurance and a useful stepping stone. But what is not yet answered is the question posed by Cochrane (2005): just how much stock market movement can be tied to the macroeconomy through *"harder-to-measure time-varying risk premia rather than "easier-to-understand cashflows"* (p)? It is this question that will be addressed in full in subsequent chapters.

CHAPTER 4 ANALYSING MARKET VOLATILITY

4.1 INTRODUCTION

The trade-off between expected return and risk lies at the heart of much of accepted financial theory. Moreover, many specific theoretical models, and their applications, use a measure such as standard deviation or variance as a surrogate for risk. Applications of the CAPM, Black-Scholes model and portfolio optimisation models, for example, all utilise measures of variability, and often some form of historic variability is used.

Increasingly, however, the relevance and usefulness of such measures have been challenged. Improved econometric forecasting techniques have enhanced the viability of certain financial models – for example, developments in the field of ARCH/GARCH modelling. Nevertheless, many fundamental concepts remain challenged and challengeable.

The nature of stock market volatility, and the relationship between market volatility and expected asset returns, has been the subject of extensive academic review and scrutiny over the past three decades. Answers have been, and continue to be, sought to questions such as:

(a) Is there evidence of a positive relationship between expected returns and observed volatility?

(b) Is there any evidence that measures of volatility can be used to predict future returns?

(c) Does market volatility change over time? How and why?

(d) What is the most successful way of predicting future volatility?

(e) Does the price paid/required for risk-bearing change over time?

(f) What is the relationship between stock market volatility and the volatility of macroeconomic variables?

4.2 SPECIFIC LITERATURE REVIEW

The first part of this chapter will examine the most relevant academic literature covering this specific area. The second part will use some of the techniques, approaches and findings in the literature to investigate the risk/return profile of the UK equity market and, in particular, the nature of volatility in the UK equity market.

4.2.1 Merton's exploratory investigation

Merton (1980) was one of the first academics to query the paucity of research relating to expected equity returns and, in particular, research relating to the possible variation in expected returns over time.

By way of an "exploratory investigation" and in order to motivate further research in the area, Merton presented models of expected return and applied them to market data for the period 1926-1978.

The starting point in Merton's analysis was recognition that the state-of-the-art models in use at that time – which simply added an average, historical risk premium to the prevailing risk-free rate – were failing to take into account changing risk preferences and requirements over time. Merton argued that, assuming the variance in market returns is a sufficient measure of its risk, a reasonably general specification of the equilibrium expected excess return could be written as

$$\alpha - r = Yg(\sigma^2)$$

where $(\alpha - r)$ is the expected excess return over the risk-free rate, Y is a reward-to-risk ratio and σ^2 is the variance in market returns. Merton tested variations of the above model - including one in which the reward-to-risk ratio was assumed to remain constant for an appreciable period of time - and one in which the right hand side of the above expression was assumed constant (i.e. the state-of-the-art model). The principal conclusions from Merton's exploratory investigations were:

- in estimating models of the expected market return, a non-negativity restriction should be explicitly included since the expected risk premium must always be positive

- estimators which use realized returns should be adjusted for heteroskedasticity, that is the tendency towards volatility clustering.

A criticism of Merton's approach, however, was that it utilised contemporaneous, rather than ex-ante, measures of volatility. Merton chose months as the measurement periods for excess returns and standard deviations. One approach to estimating the standard deviation of the market in any month would have been to estimate it from daily return observations within the month. However, Merton adopted an approach, which estimated the standard deviation of the market at any point from the six monthly returns prior to that point and the subsequent six monthly returns.

4.2.2 Use of ex-ante data

French, Schwert and Stambaugh (1987) also examined the relationship between the expected market risk premium and risk, as measured by stock market volatility. However, in recognition of the problems perceived in Merton's approach, they confined themselves to the use of ex-ante data. Two approaches were made in investigating the relation between expected stock returns and volatility: use of univariate autoregressive integrated moving-average (ARIMA) models and use of generalised autoregressive conditional heteroskedasticy (GARCH) models.

Monthly standard deviations in returns on the Standard & Poor's Composite Index were derived for the period 1928-1984. The monthly standard deviations were derived from daily observations within the month. The calculated standard deviations were noted to trace a non-stationary moving average process, being highly auto-correlated and decaying only slowly beyond lag three. Conditional forecasts for standard deviations were constructed therefore using a third-order moving average model based on changes in monthly standard deviations (i.e. using first differences in logarithms). This showed autocorrelation close to zero beyond lag three.

The predicted standard deviations were found to track the actual standard deviations closely although the series was smoother. The time series models were found to be stable over time and the residuals appeared to be random. The fitted values were taken to represent the predictable volatility in returns; the difference between actual volatility and the predicted element was taken to represent unpredicted volatility.

Excess returns – defined as the difference between monthly NYSE equity returns and one month Treasury bill returns - were then regressed on each of the predicted and unpredicted elements. The results showed:

- there was limited evidence of a relation between expected risk premiums and predictable volatility
- there was a reliably negative relation between excess returns and unpredicted volatility

French et al also examined the relationship between excess returns and predictable volatility using both ARCH and GARCH models. The original Engel (1982) ARCH model took the form:

excess return = $\alpha + \varepsilon_t$ (the mean return equation) $\varepsilon_t \sim N(0, \sigma_t^2)$,

$$\sigma_t^2 = a + \varepsilon_{t-1}^2$$

where the forecast variance, σ_t^2, is a function of news about volatility from the previous period, as measured by the squared residual, ε_{t-1}^2, from the mean return equation. Fama et al modified the expression for the variance of ε above by using the average of the previous twenty-two squared errors instead of the previous squared error alone. This modification reflected the observation that squared excess returns decayed slowly, suggesting that σ_t^2 is related to many lags of the squared errors.

Volatility was also modelled by a GARCH model of the form:

$$\sigma_t^2 = a + \sigma_{t-1}^2 + \varepsilon_{t-1}^2 + \varepsilon_{t-2}^2$$

Deriving predicted volatility from the latter model, French et al then analysed the relation between excess returns and volatility through an in-mean model of the type:

$$\text{Excess return} = \alpha + \beta\sigma_t^2 + \varepsilon_t - \theta\varepsilon_{t-1}$$

where the moving-average term is included to capture the effect of non-synchronous trading. The analysis was performed on daily data.

The results of the GARCH analysis indicated:

- In contrast to the ARIMA results, there was a reliably positive relationship between expected risk premiums and predicted volatility for one month ahead

- There was a reliably negative relationship between realised risk premiums and unexpected volatility.

In conclusion, French et al noted that, while some evidence was found of a positive relation between expected risk premiums and predictable levels of volatility, the variability of realised returns had fluctuated widely over the period examined. The authors concluded that it was difficult to discriminate among alternative specifications of the reward-for-risk relationship and that future work was needed before any such discrimination could be made.

4.2.3 A lack of consensus

The important work of Merton and French et al in analysing volatility and the returns associated with volatility prompted numerous other studies, particularly with regard to US evidence. But no strong consensus view emerged about either the relationship between expected returns and statistical measures of volatility or the success of GARCH modelling techniques in this area.

Akgiray (1989) concluded that daily US stock returns exhibited significant levels of second order dependence and that the return-generating process can be regarded as an autoregressive process with conditionally heteroskedastic innovations. Consequently, he found that GARCH (1,1) models fitted the data very satisfactorily. Moreover, he found evidence that out-of-sample forecasts generated by GARCH models proved to be superior to historical estimates. Importantly, however, Akgiray found a very different picture when applying a similar analysis to weekly and monthly returns. Notably, he concluded that the latter are not as leptokurtic as daily returns and also that there is little evidence of autocorrelation in either series.

Baillie and DeGennero (1990), on the other hand, found that a GARCH in-mean model provided a good description of both daily and monthly returns data. However, they also reached the conclusion that that there is very little evidence for a statistically significant relationship between returns and volatility, prompting them, in turn, to argue that there is a need for research into other measures of risk.

4.2.4 Time-varying persistence in expected returns

The aforementioned studies concentrated mainly on evidence relating to the relationship between expected returns and volatility. Priestley (2001) added another dimension to the debate by assuming that the variation in expected returns is caused by changes in the price of risk (i.e. the coefficient attaching to volatility) in addition to changes in the level of volatility.

Persistence in expected returns was characterised by a simple AR(1) model:-

$E_t h_{t+1} = \varnothing E_{t-1} h_t + u_{t-1}$

where h_t is a period return, u_{t-1} represents news about returns and a value of $\varnothing$ close to 1 represents a high degree of persistence. Since a share price represents the discounted value of all expected cash flows, a small change in return news (i.e. u_{t-1}) may cause a significant change in price. Persistence was previously shown by Campbell (1991) to approximate to $1/(1 - \Theta)$. Thus an estimate of $\varnothing = 0.9$ would imply a capital loss of 10% if the expected return in the current period rises by 1%.

Excess returns on the S & P Composite Index were derived for the period 1871 – 1997. Conditional variance was modelled by assuming a GARCH (1,1) process. A small set of instrumental variables, including the dividend yield in excess of short-term interest rates and changes in short-term interest rates, was used to model the price of risk. The product of the price of risk and the conditional variance provided an estimate of expected returns over the period examined (1871-1997) and thereby estimates of the persistence in returns over time.

Priestly found that, for the whole period examined, the estimate of Ø was 0.856, implying an asset price change of almost 7% for a 1% change in expected returns. (Campbell had previously estimated 4% - 5%). Priestley's main objective, however, was to investigate if, and how, persistence changes over time. His resultant investigation revealed a substantial variation in persistence over time, implying that news affects asset prices differently at different times. An attempt was also made to find the cause of this variation by regressing changes in persistence on changes in the price of risk, changes in conditional variance and lagged values of persistence itself, thus:

$$\begin{aligned}\Delta\text{persistence} = \underset{(0.88)}{2.112} &+ \underset{(0.41)}{1.388}\Delta\text{price of risk} \\ &+ \underset{(153.64)}{95.781}\Delta\text{conditional variance} \\ &- \underset{(1.29)}{0.263}\text{lagged persistence}\end{aligned}$$

The above results confirmed that changes in the price of risk had a positive and significant effect whilst changes in volatility were not shown to be significant. Thus it could be concluded that stock prices will be affected more by news when the price of risk is high. Priestley's intuitive explanation for this change in effect was the relation to the riskiness of the economy, in particular the existence of credit cycles.

4.2.5 Relationship with macroeconomic volatility

Whatever the success, or otherwise, of attempts to relate expected and achieved returns to changes in volatility, it has become increasingly accepted that stock returns display heteroskedastic patterns; that is, the volatility associated with returns changes over time. Moreover, it has become accepted that ARCH and GARCH models in their various forms provide the best means of modelling conditional variance over time.

An obvious question is whether there are significant relationships between conditional stock market volatility and macroeconomic volatility. Early work in this area was undertaken by Officer (1973) who analysed the variability of New York Stock Exchange indices over the period 1897-1969. This analysis was in part triggered by the observations of other authors that the variability of the US market had declined over the period 1926 to 1960. Suggestions advanced for this decline had included the formation of the Securities and Exchange Commission (SEC), the introduction of margin requirements, and the substantial increase in the number and range of stocks that had occurred over that period.

Officer's study confirmed a decline in stock volatility over the period in question but argued that it could be better described as "*a return to normal levels of variability after a period of abnormal behaviour in the 1930s.*"

Having examined the effects of the establishment of the SEC and the broadening of the security base, Officer hypothesised that it was not these factors that were significant in reducing the variability of the market but, rather, changes in economy wide factors and business fluctuations. He therefore concentrated on the relationship between market variability and industrial production variability and found that the behaviour of industrial production during the 1930s was distinctly different from that displayed before or after. The conclusion, therefore, was that market-factor variability can be related to business fluctuations.

4.2.6 The Schwert analysis

Schwert (1989) built on the work of Officer and others to take a more comprehensive look at the question as to why stock market volatility changed over time, noting that the monthly variability in US stock returns over the period from 1857-1987 varied from 2% to 20% per month.

The monthly variability in stock returns from 1885 onwards was derived from daily return data; variability prior to 1885 was estimated from rolling 12-month monthly data. Stock variability was analysed in relation to changes in the variability of a number of financial and economic indicators including: inflation, the monetary base, bond returns, short-term interest rates and industrial production.

Schwert's main conclusions were:

(a) As Officer and others had found, stock market volatility during the 1930s was indeed exceptionally high. Moreover, Schwert concluded that the excess volatility displayed over this period could not be adequately and rationally explained by changes in maroeconomic variables and that it remained "a volatility puzzle".

(b) Many economic variables display more volatility during recessions

(c) There is weak evidence that macroeconomic volatility can help to predict stock (and bond) volatility. There is stronger evidence to suggest that financial asset volatility helps to predict future macroeconomic volatility.

(d) A small portion of changes in stock volatility can be attributed to a positive relationship between stock volatility and financial leverage.

(e) There appears to be a positive relationship between trading activity and stock volatility.

4.2.7 The Asness analysis

Asness (2000) more recently also noted shifts in financial market volatility over time and linked these shifts to changes in equity dividend yields. He also noted that researchers such as Fama and French (1988a) had concluded that equity dividend yields are good predictors of long-horizon returns. In other words, high equity yields indicate that investors have become more risk averse and indicate that higher expected returns are being demanded. Low yields indicate the opposite.

Asness hypothesised that the level of equity yields at any point in time, relative to bond yields, is a function of the relative volatilities of the two asset classes. More specifically, he formulated the following testable model:

$$D/P = \gamma_0 + \gamma_1 Y + \gamma_2 \sigma(\text{Stocks}) + \gamma_3 \sigma(\text{Bonds}) + \varepsilon_{D/P}$$

Where:

D/P = Stock (equity) dividend yield

Y = Bond yield

σ(Stocks) = volatility of stock returns

σ(Bonds) = volatility of bond returns

$\varepsilon_{D/P}$ = error term

Asness hypothesised further that γ_1 would be positive, γ_2 would be positive and γ_3 would be negative.

Rolling 20-year annualized monthly returns volatilities for US equities and bonds were generated for the period 1946 to 1998 using trailing data (i.e. the data began in 1926). A period of 20 years was chosen since this was perceived to be representative of a generation but Asness found that his results were still robust when shorter time frames were examined.

The estimate found for the above equation was:

$$\underset{(-0.05)}{D/P = 0.00\%} + \underset{(28.77)}{0.35Y} + \underset{(39.51)}{0.23\sigma(\text{Stocks})} - \underset{(-25.69)}{0.31\sigma(\text{Bonds})}$$

Asness interpreted this result as showing that equity and bond yields are strongly positively related and the difference between them is a function of the weighted difference in volatilities.

Further analyses were performed in order to overcome the criticism that the initial work was merely an in-sample analysis and could be interpreted as data mining. Notably, Asness examined whether the variation in equity yields could be explained by a time trend. The volatility model, described above, was shown to be far superior. Rolling out-of-sample regressions using the volatility model were also undertaken and the results compared to those of from other rolling models. Again, the volatility model was shown to produce the statistically superior results. Finally, Asness examined the effects of using the volatilities from non-overlapping 20 year periods and concluded that the results provided compelling evidence that the required equity risk premium appears to rise (fall) following periods of high (low) equity volatility relative to bond volatility.

A tenet of modern finance is that there is a linkage between volatility and expected return. However, this linkage is difficult to identify if realised returns are used as surrogates for ex-ante returns. By using yields as a proxy for returns, Asness provides a useful contribution to evidence of the theoretical linkage between expected returns and perceived risk.

4.2.8 The Shiller contribution

Chapter 2 contained a brief discussion of Shiller's arguments relating to the excess volatility of markets in the context of market efficiency. No specific review of market volatility would be complete without expanding on the work of Shiller and others in this area and examining the main arguments and implications.

Shiller's original (1981) work on equity market volatility showed that the rational ex-post counterpart, p^*, of a stock price index displayed far less volatility than the actual index, p. The smoother behaviour of p^* is due to the fact that the present value methodology relates p^* to a weighted-average of dividends. While dividend growth does vary over time, it does not vary enough to cause major movements in p^*.

Now, the efficient markets model does not say that p equals p^*. The efficient markets model asserts that $p_t = E_t(p_t^*)$; that is, p_t is the optimal forecast of p_t^*. The forecast error can be defined as $u_t = p_t^* - p_t$, or we can write $p_t^* = u_t + p_t$. The forecast error will be uncorrelated with the forecast. The variance relationship will therefore be $var(p_t^*) = var(u_t) + var(p_t)$, or, $var(p_t) \leq var(p_t^*)$. It is claimed that this latter relationship is clearly violated when a stock price index and its ex-post rational counterpart are compared.

One possible reason for this apparent violation is that the ex-post counterpart is calculated by using a constant discount rate. Shiller also demonstrated the impact of allowing the discount rate to vary by setting it equal to the ex-post real commercial rate plus a constant risk premium. While this introduced greater volatility into the ex-post series it did not completely explain the apparent violation of the variance relationship. Shiller's conclusion was that only serious investigation of psychological and popular models featuring irrationalities or fads will help to explain the divergence between actual and justifiable performance.

Later, more sophisticated attempts to introduce variation into the discount rate also failed to fully explain the variability of the equity market, Campbell and Shiller (1988a), for example, used vector auto-regressive methods to examine the linkage between dividend yields, real growth expectations and discount rates. Four measures of discount rates were examined: a real constant rate and rates that varied according to changes in real interest rates, real consumption data and stock return variance. While the results showed that dividend yields responded to changes in real growth expectations, as expected, the results gained from allowing the discount rate to vary were disappointing. Short-term interest rates, consumption growth and the volatility in stock returns were all found to be unhelpful in explaining stock price movements.

Cochrane (1991), in a review essay, summarised the implications of these results. Volatility tests, such as those presented by Shiller, were initially interpreted as "scientific" tests of market efficiency, a phenomenon overlooked by conventional finance's focus on expected returns. Now, Cochrane argued, volatility tests are understood to be tests of discount rate models. Moreover, the results thrown up by such tests merely serve to highlight the fact that current discount models are deficient and a challenge exists to construct better models of fundamentals. The debate as to whether psychological and sociological factors also need to be built into our models, he argued, is "not likely to end soon."

4.3 THE UK EVIDENCE

Poon and Taylor (1992), like French et al (1987) and others, addressed two empirical relationships between stock returns and volatility. Firstly, the hypothesis that there is a negative relationship between unexpected returns and unexpected volatility. Secondly, the hypothesis that there is a positive relationship between expected returns and expected volatility. Theirs was the first study to test the hypotheses on UK data.

Daily, weekly, fortnightly and monthly returns on the FT All-Share index were analysed over the period January 1965 to December 1989. All return series displayed fat tails compared with the normal distribution.

Estimates of monthly volatility were derived using daily data. These estimates were then split into predictable and unpredictable components using an autoregressive moving average model. Again like French et al, Poon and Taylor also applied GARCH models to derive conditional volatilities. Both returns and excess returns were regressed against volatilities predicted by each method. Positive relationships were found but none was found to be significant (although all t-statistics exceeded 1.0). An analysis of the relationship between returns and unexpected volatility found a significant, negative relationship when volatility was measured by standard deviation but no significant relationship when variance was substituted for standard deviation.

Fraser and Power (1997) set out to consider the dynamics of price changes for a sample of equity markets, including the UK. More specifically, they examined the relationship between the weekly conditional volatility of stock returns and the flow of information into the market place. The period January 1988 to October 1994 was analysed.

The authors applied an expanded form of the GARCH conditional variance model which incorporated a dummy variable. Thus:

$$h_t^{2} = \omega + \Sigma\gamma h_{t-i}^{2} + \Sigma\delta\varepsilon_{t-I}^{2} + \lambda D_{t-1}$$

and the variance is conditional on the variances from previous periods, the square of previous residuals, ε^2, and a dummy variable, D_{t-1}. The latter takes a value of unity when the ex-post return for the last period is negative and a value of zero otherwise. This variable was designed to capture the so-called ‘leverage effect’ whereby volatility is thought to increase in the wake of returns that are below expectations.

An extension to the analysis also considered the effect on conditional volatility of unanticipated information or news. Proxies for such unanticipated information were derived by applying autoregressive models to volume series.

The results from the GARCH model described above and which incorporated a dummy variable to reflect past market conditions indicated that the UK equity market is particularly sensitive to past experience. The t-value associated with the dummy variable was 2.9 and therefore statistically significant. Results for the UK were not significant when a proxy for unanticipated information was included in the GARCH process.

McMillan et al (2000) analysed a variety of statistical and econometric models of UK stock market index volatility. Daily, weekly and monthly frequencies were analysed. Both in-sample characteristics and the success of out-of sample forecasts were analysed. A total of ten volatility forecasting models were considered including the historical mean, moving average, random walk, exponential smoothing, exponentially weighted moving average, simple regression, GARCH, TGARCH, EGARCH and component-GARCH models.

The results indicated that the random walk model (which assumes that the optimal forecast of next period volatility is the last observation) provided vastly superior monthly volatility forecasts to the forecasts provided by the other modes. The random walk, moving average and recursive smoothing models provided moderately superior weekly volatility forecasts; the GARCH, moving average and exponentially smoothing models provided superior daily forecasts. The authors' results also confirmed the conclusions of previous researchers that careful interpretation is required – in particular with regard to the relative success of GARCH models – if October 1987 Crash data is included in the analysis.

Morelli (2002) attempted to determine the relationship between conditional stock market volatility and conditional macroeconomic volatility based upon monthly UK data. The period from January 1967 to December 1995 was observed. The analysis was based on the standard assumption that security prices are the discounted present values of expected future cash flows. The conditional variance will therefore depend on the conditional variances of expected cash flows and discount rates and the conditional covariances between them.

Monthly stock market returns were derived from FT All Share Index data. The macroeconomic variables selected included industrial production, real retail sales, money supply, an exchange rate variable, and inflation. The analysis covered the period 1967-1995.

GARCH/ARCH models were used to establish conditional volatility series for both the market returns and the macroeconomic series. The ability to predict stock market volatility from stock market volatility was analysed as well as the reverse: the ability of conditional stock market volatility to predict conditional macroeconomic volatility.

The results proved disappointing. A regression analysis of conditional stock market volatility on all macroeconomic volatilities, for example, showed an explanatory power of just 4.4%. None of the macroeconomic volatilities showed significance at either the 5% or 10% level. The author concluded that*: "the volatility in the macrovariables selected does not explain the volatility in the stock market."*

4.4 AN ANALYSIS OF UK EQUITY MARKET VOLATILITY, 1963-2003

Academic studies of stock market volatility in the UK are limited in number and scope in comparison with the US. The purpose of this section, therefore, is to investigate key aspects of UK stock market volatility over a relatively long period. Aspects to be considered are:

- The basic characteristics of UK stock market returns and volatility
- Market volatility as a predictor of excess returns
- The contemporaneous relationship between volatility and returns
- Modelling of future volatility
- The relationship with macro-economic volatility

The discussion in this chapter will focus on the historical standard deviation in returns as the principal measure of stock market volatility although it is acknowledged that this measure has its limitations as a predictor of future risk. The underlying assumption in using standard deviation is that asset returns form a normal distribution with parameters that are stable over time. However, studies by Fama (1963), Mandelbrot (1963) and many others have shown that distributions of share returns often display fat tails (i.e. are leptokurtotic) and are skewed.

Other features of financial market returns that are well documented and cited by Poon (2005) include:

- there is often a "long memory effect" observed in return volatility. i.e the decay rate in volatility is slow.
- there is often evidence of volatility clustering, as will be discussed in Section 4.4.3.
- volatility tends to increase following negative returns, a phenomenon described as "the leverage effect".
- the returns and volatilities of different assets and markets tend to move together.

Models used to forecast volatility, taking into account the above features to a lesser or greater degree, tend to fall into four main categories:

- models based on historical volatility which can range from being simple averages to being very sophisticated multivariate models
- models in the ARCH family (note that a GARCH model is applied in Section 4.4.7)
- other stochastic volatility models such as the Monte Carlo Markov Chain approach.
- volatilities implied in option pricing.

In a major review of volatility forecasting models, Poon and Granger (2003) conclude that the evidence is that financial market volatility is clearly forecastable. The debate remains on just how far ahead one could accurately forecast and to what extent volatility changes can be predicted. The option pricing models were found to contain most information about future volatility with little to differentiate the performances of the other three classes.

4.4.1 The basic characteristics

Figures 4.1, 4.2 and 4.3 illustrate the volatility in UK equity market returns since 1962. Table 4.1 quantifies the main features. Monthly, quarterly and annual returns were analysed.

Movements in the FTSE All-Share Index were taken to represent movements in the total market. Total returns were calculated by adding in a proportion of dividend yield at the start of any period and then by chain-linking successive periods. Thus, the total return for any month was given by:-

$$TR_m = DY_0/12 + ((I_1 - I_0)/I_0 - 1)$$

where: I_0 and I_1 are index levels at the start and end of the month
DY_0 = Dividend yield at the start of the month.

and the total return in any quarter, for example, was calculated from:

$$TR_q = (1 + TR_{mt})(1 + TR_{mt+1})(1 + TR_{mt+2}) - 1$$

where: TR_{mt} is the total return in the first quarter of the month

The two features that dominate any cursory examination of monthly and quarterly returns are, firstly, the sharp sell-off followed by a steep rise at the bottom of the 1973-74 bear market and, secondly, the October 1987 Crash. Whilst the former effect is also highlighted in annual returns, the 1987 effect disappears. Indeed, 1987 as a whole was a positive year for UK equities, despite the sharp October fall.

Table 4.1 UK Stock market return characteristics

	n	Mean	SE Mean	StDev	Min	Med	Max	Skewness	Kurtosis
Monthly	492	1.17	0.26	5.80	-26.35	1.35	54.00	1.15	14.87
Quarterly	164	3.63	0.86	10.95	-27.23	4.72	79.93	1.63	13.07
Annual	41	16.29	4.72	30.19	-51.66	16.35	151.24	1.91	9.54

Figure 4.1 Monthly returns

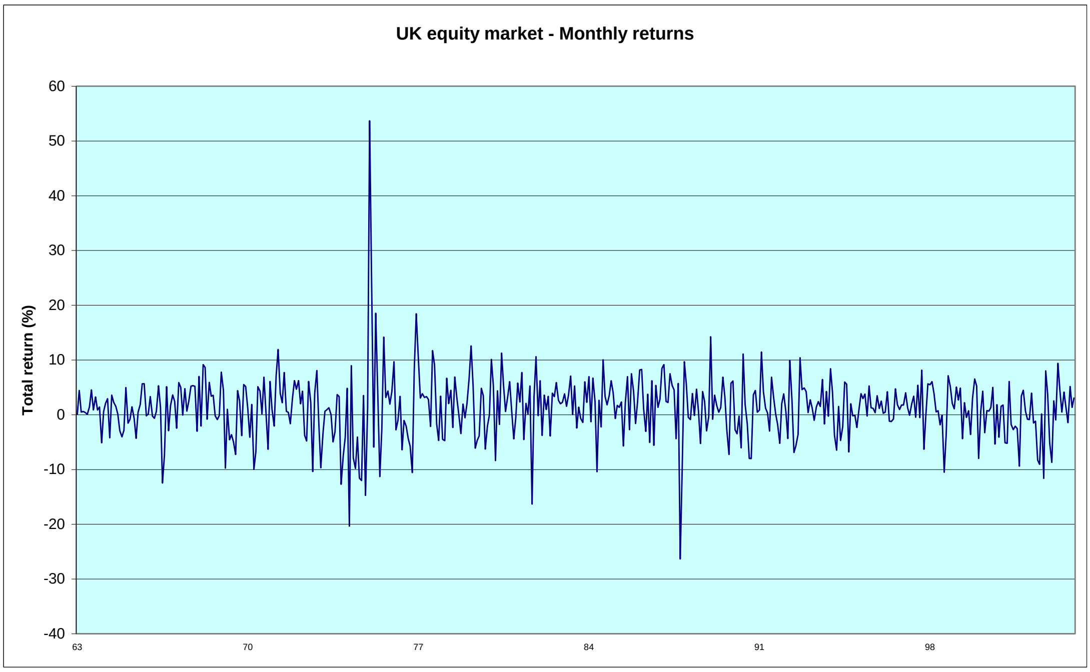


Figure 4.2 Quarterly returns

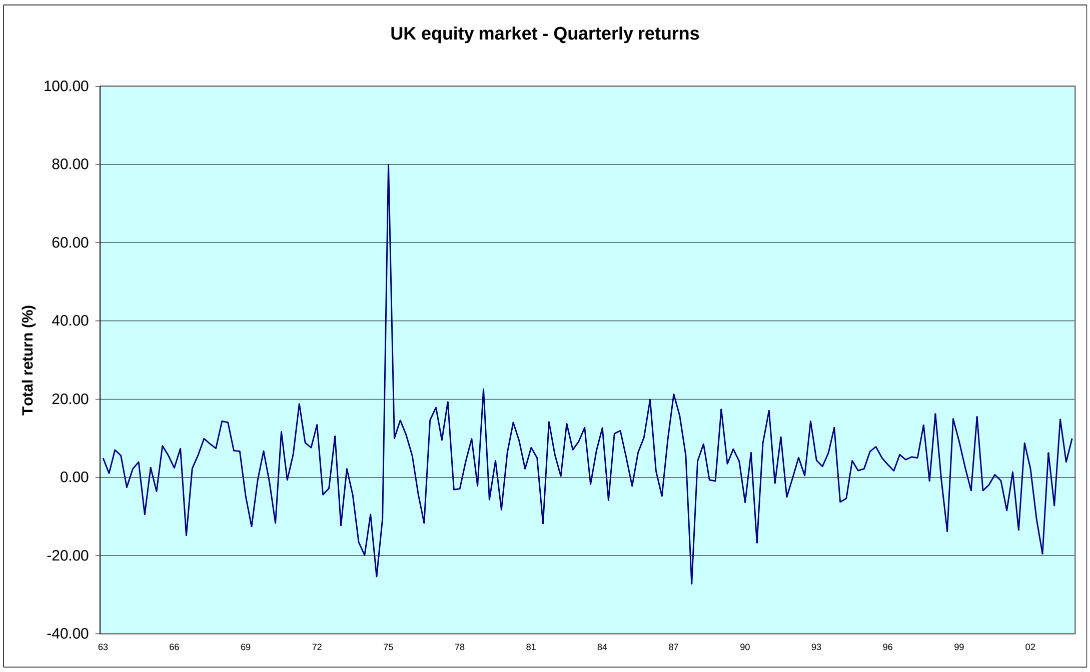
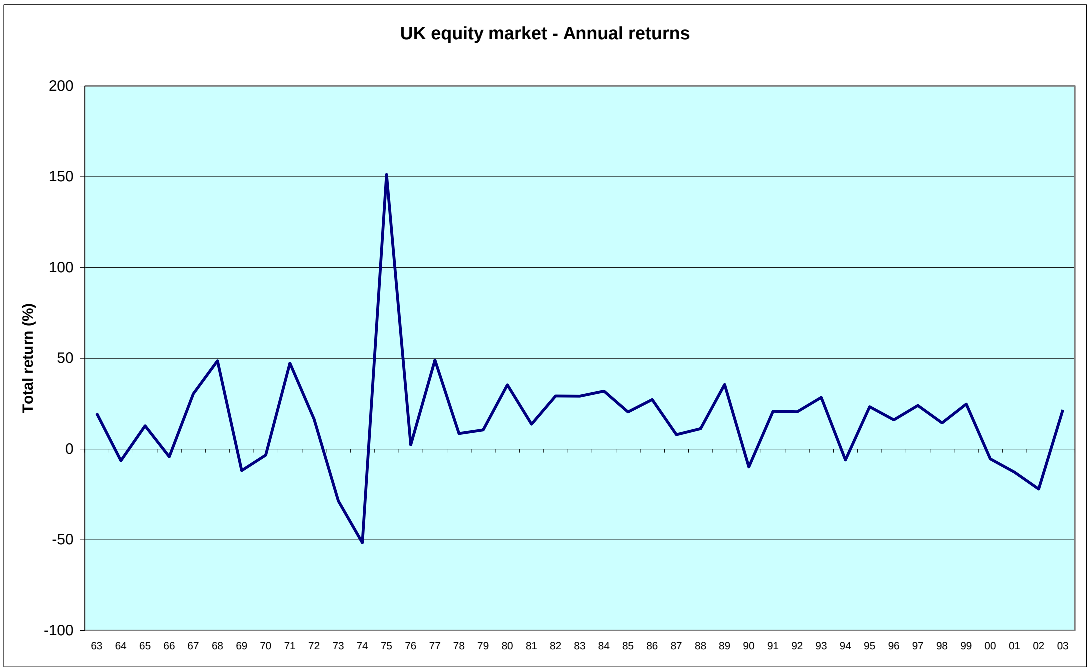


Figure 4.3 Annual returns



4.4.2 Volatility in returns

The analysis above illustrates the volatility of the UK equity market over the whole period of 41 years examined. The standard deviation of the market calculated on monthly, quarterly and annual bases is 5.80%, 10.95% and 30.19% respectively.

The key subject of this analysis, however, is how, and why, the volatility of the equity market changes over time. Additionally, given that statistical measures of volatility are commonly used to represent the perceived "riskiness" of assets, including equities, can changes in volatility be used to predict future excess returns?

Previous approaches to measuring trends in volatility over time have focused on:

- Measuring the variability in a moving window of monthly returns (e.g. Merton, 1980), or

- Estimating the variability in monthly returns from daily returns within any month (e.g. French et al, 1987).

Both measures are calculated for comparison (see Figures 4.4 and 4.5 below) but subsequent analyses utilise monthly variability estimated from daily returns (i.e. utilising the latter approach). It can be argued that the latter approach is superior, firstly because calculations depend solely on contemporaneous observations and secondly, because no over-lapping observations are used.

For ease of comparison, all standard deviation estimates shown are annualised figures. Thus the standard deviation in daily returns in any month is expressed as a monthly figure by applying a factor of: √[number of trading days in month]. Monthly returns are then annualised by applying a factor of √12. This approach ignores any autocorrelation between adjacent returns but it will be shown in section 4.4.3 that there is minimal autocorrelation in monthly excess returns.

Figures 4.4 and 4.5 show that the final stages of the 1972-74 bear market and the 1987 Crash were periods of exceptional market volatility. Figure 4.5, in particular, highlights just what an isolated and unusual incident the 1987 Crash proved to be. An examination of the trends in Figure 4.5 also suggests a negative relationship between volatility and market returns. The rise in volatility during the more recent 2000-2002 bear phase of the market, followed by a decline in volatility during the start of the recovery phase in 2003, illustrates this phenomenon well.

Figure 4.4 UK market volatility (rolling average)

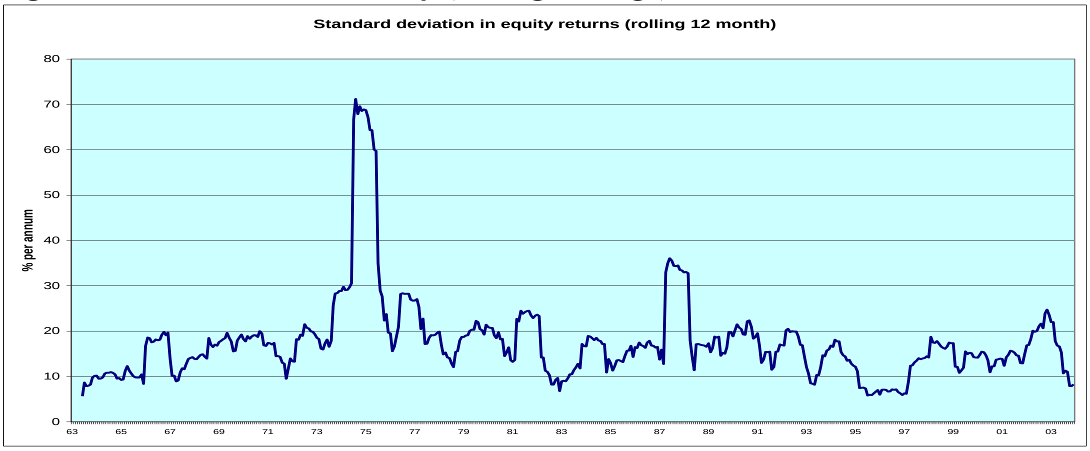
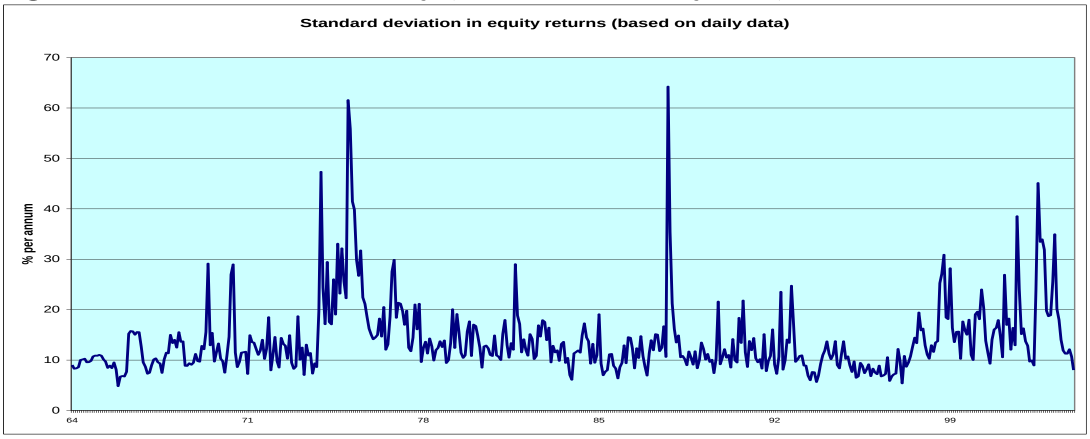


Figure 4.5 UK market volatility (derived from daily data)



4.4.3 Volatility clustering

Clustering in return volatility is a well-documented feature of many financial markets. Volatile periods can persist for some time before a market returns to normality. Indeed, the ARCH model, initially designed by Engel (1982) was designed to capture volatility persistence. As would be expected, therefore, the autocorrelation in observed volatility for the UK market decays only slowly. Indeed, as Table 4.2 shows, the autocorrelation of monthly volatility is still significant at lag 12.

An established premise of traditional financial theory is that there is a reward for bearing risk. In other words, above-average returns should accompany abnormal risk-taking. However, here we start to see the evidence that this is not always the observed outcome in the UK equity market.

Table 4.2 Autocorrelation of observed volatility

Lag	1	2	3	4	5	6	7	8	9	10	11	12
Correlation	0.632	0.478	0.410	0.326	0.332	0.311	0.255	0.236	0.209	0.228	0.198	0.184
t-stat	13.85	7.83	5.98	4.44	4.36	3.92	3.12	2.83	2.46	2.66	2.27	2.09
LBQ	193.06	304.12	385.51	437.27	491.33	538.50	570.33	597.68	619.16	644.91	664.25	680.96

Table 4.3 Excess returns - Autocorrelation

	Monthly			Quarterly			Annual		
Lag	Correlation	t-stat	LBQ	Correlation	t-stat	LBQ	Correlation	t-stat	LBQ
1	0.12	2.67	7.17	0.056	0.72	0.53	-0.282	-1.81	3.51
2	-0.10	-2.20	12.18	-0.034	-0.44	0.73	-0.126	-0.75	4.23
3	0.07	1.61	14.9	0.027	0.34	0.85	-0.097	-0.57	4.67
4	0.03	0.68	15.39	-0.136	-1.74	4.03	0.051	0.88	5.76
5	-0.11	-2.43	21.73	-0.141	-1.78	7.48	-0.027	-0.15	5.79
6	-0.02	-0.34	21.86	-0.027	-0.35	7.62	-0.187	-1.66	7.54

Table 4.3 shows the autocorrelation in excess returns for the three return intervals analysed. Excess returns are calculated as total returns over and above the returns from 3 month T-bills over the same period.

The only observation of real significance in Table 4.3 is the autocorrelation at lag 1 in the case of monthly excess returns. Here we see a positive correlation in subsequent returns; however, this trend reverses by lag 2. The results indicate therefore that high (low) volatility might persist for some time but that such conditions are seldom accompanied by prolonged periods of low (high) excess returns.

4.4.4 Volatility as a predictor

Can measures of market volatility be used reliably to predict future excess returns? Table 4.4 indicates that the answer is no.

A range of predictors was calculated for each of the return intervals analysed and their reliability as predictors was measured using least squares regression. Monthly variability, for example, "explained" only 0.5% of the excess returns achieved in subsequent months. None of the predictors achieved results of significance at the 5% level.

4.4.5 Contemporaneous relationships

More statistically significant relationships are obtained, however, if we examine contemporaneous relationships, as shown in Table 4.5. The monthly statistics, for example, indicate that declining volatility is associated with rising excess returns and vice versa.

Table 4.4 Volatility as a predictor of excess returns

Predictor	Monthly excess returns		Predictor	Annual excess returns	
	t-stat	R^2		t-stat	R^2
PMVol	1.482	0.005	EPYVol	-0.693	0.013
PQAVol	1.610	0.005	PYAVol	1.156	0.035
P3MWAVol	1.536	0.005	P3MWAVol	0.531	0.008
P6MWAVol	1.652	0.006	P6MWAVol	1.207	0.038
	Quarterly excess returns		P12MWAVol	1.476	0.056
	t-stat	R^2			
EPQVol	-0.020	0.000	P24MWAVol	1.282	0.043
PQAVol	1.361	0.012	TrendVol	1.570	0.062
P3MWAVol	0.974	0.006	PYMChVol	0.837	0.019
P6MWAVol	1.350	0.012			

Legend

PMVol = Previous month volatility
PQAVol = Previous quarter average volatility
P3MWAVol = Previous 3 month weighted-average volatility
P6MWAVol = Previous 6 month weighted-average volatility
EPQVol = End previous quarter volatility
PQAVol = Previous quarter average volatility
EPYVol = End previous year volatility
PYAVol = Previous year average volatility
P12MWAVol = Previous 12 month weighted-average volatility
P24MWAVol = Previous 24 month weighted average volatility
TrendVol = Latest trend in volatility
PYMChVol = Previous year trend (monthly change)

The outstanding result, however, is the strong, negative relationship between the trend in monthly volatility (average percentage point change) during any year and the excess return for that year (t-stat = -5.8, R^2 = 0.475). In this case, the annual trends in monthly volatility are calculated using a simple ordinary least square regression model. Excess returns are, in turn, regressed on the estimated volatility trends.

The strong negative relationship between annual excess returns and volatility trends is highlighted further in Figure 4.4. The sharp decline in volatility which accompanied the market recovery in 1975 has a significant impact on the overall statistical relationship (the R^2 falls to 0.305 if the 1975 observation is omitted).

A strong inverse relationship has also been observed in recent years: declining volatility during strong market conditions in 1999 and rising volatility throughout the 2000 – 2002 bear phase. The most likely explanation for this phenomenon is a behavioural one: as uncertainties are removed, confidence is restored and a clear upward trend is established. The reverse takes place during a bear phase.

Table 4.5 Excess returns and volatility – Contemporaneous relationships

Monthly data

Excess return -v-	T-stat	R^2
VolM	-1.273	0.003
ChVolM	-3.237	0.021

Quarterly data

Excess return -v-	T-stat	R^2
VolQ	-0.106	0.000
ChVolQ	-1.602	0.016

Annual data

Excess return -v-	T-stat	R^2
VolA	0.955	0.024
ChVolA%pt	-0.217	0.001
ChVolA%	-1.051	0.029
ChDY%pt	-1.020	0.027
ChDY%	-1.658	0.069
TVDYMCh	-5.785	0.475

Legend

VolM = Average volatility during month
ChVolM = Change in average volatility from previous month
VolQ = Average volatility during quarter
ChVolQ = Change in average volatility from previous quarter
VolA = Average volatility during year
ChVolA%pt = Change (%pt) in average volatility from previous year
ChVolA% = Change (%) in average volatility from previous year
ChDY%pt = Change (%pt) in volatility during year
ChDY% = Change (%) in volatility during year
TVDYMCh = Trend in volatility during year (monthly change)

4.4.6 Subsequent volatility

Thus far, the results suggest that volatility is a poor predictor of future excess returns but that there is evidence of a negative contemporaneous relationship between volatility and excess performance.

To complete the picture, there is a case for examining whether there is any evidence of a significant relationship between excess returns and subsequent volatility. In other words, does volatility rise (fall) – not just contemporaneously – but subsequent to negative (positive) excess returns.

The results in Table 4.6 provide the answer. Monthly volatilities were regressed, in turn on one, two and three month excess returns. The sign of the regression in each case is negative, as expected; but the results were not significant at the 5% level.

Table 4.6 Subsequent volatility

Monthly volatility -v-

One month return		Two month return		Three month return	
t-stat	R^2	t-stat	R^2	t-stat	R^2
-1.311	0.004	-1.539	0.005	-1.547	0.005

Monthly volatility-v- Sentiment indicator:

t-stat	R^2
-4.94	0.048

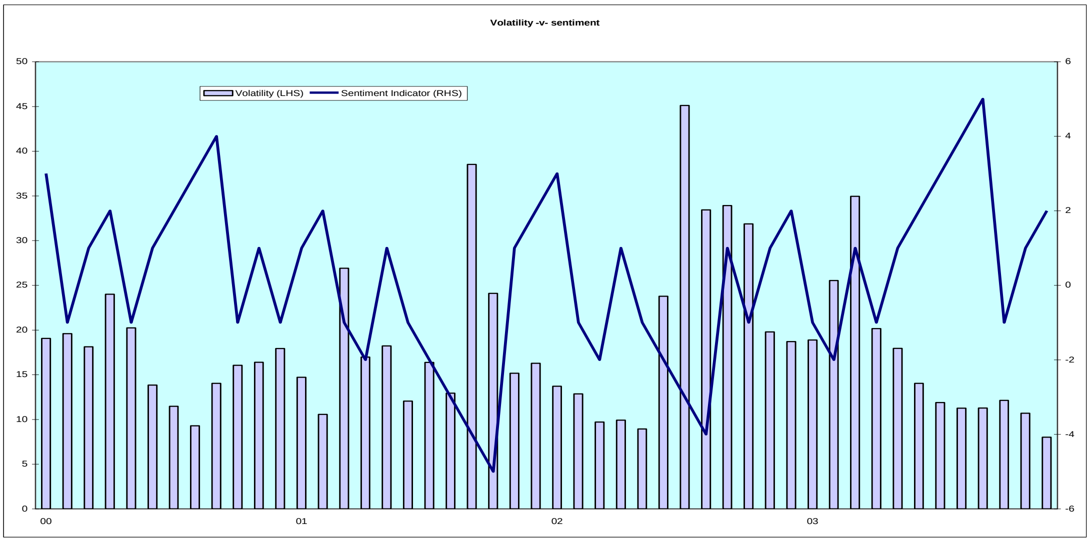
Note: sentiment indicator measures number of successive months of positive (+) or negative (-) excess returns

A more interesting result was obtained, however, by constructing a simple "sentiment indicator". Numerous indicators have been adopted or developed by practitioners and academics to judge whether securities have becoming "overbought" or "oversold" as a result of behavioural influences. Examples are the level of public offerings, mutual fund flows and investment trust discount levels. Even weather patterns and the results of sporting fixtures have been held responsible for pricing patterns. Baker and Wurgler (2007) provides a comprehensive discussion of such indicators.

The simple indicator adopted for this study is the number of consecutive positive or negative monthly excess returns experienced up to the current month. Thus, for example, the indicator would be +5 if there had been five consecutive months of positive excess returns or –3 if there had been three consecutive months of negative excess returns. The underlying concept, of course, is that uncertainty – and therefore volatility – is likely to increase as a bear phase becomes more prolonged. Conversely, investors can be expected to become more confident – and therefore more committed to their investments – when a bull phase is sustained.

The results in Table 4.6 show a strong negative relationship between volatility and the sentiment indicator. Figure 4.6 illustrates this relationship over the bear and bull phases of recent years.

Figure 4.6 Sentiment indicator



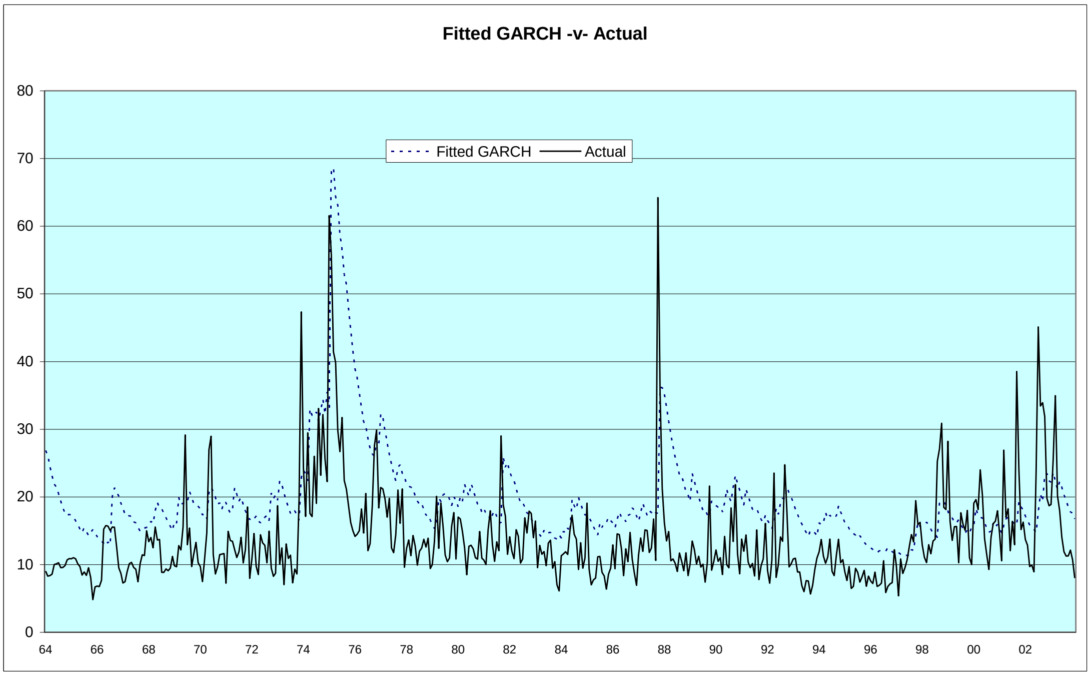
4.4.7 A GARCH analysis

A volatility clustering effect is experienced in most financial markets. Periods of "normal" volatility are interspersed with periods of high, sometimes sustained, volatility. Or, put more technically, markets exhibit autoregressive conditional heteroskedasticity (ARCH).

The ARCH process assumes that the current conditional variance in returns is a weighted-average of past squared unexpected returns. Thus:

$\sigma_t^2 = a + a_1\varepsilon_{t-1}^2 + a_2\varepsilon_{t-2}^2 + a_3\varepsilon_{t-3}^2 + \ldots\ldots$ where : $\varepsilon_t \sim N(0, \sigma_t^2)$, A generalisation of this model, the GARCH model, requiring far fewer parameters in normal circumstances, was introduced by Bollerslev in 1986.

Figure 4.7 UK market volatility – fitted GARCH values



The full GARCH (p, q) model adds in previous variance estimates to the above equation, thus:

$$\sigma_t^2 = a + a_1\varepsilon_{t-1}^2 + a_2\varepsilon_{t-2}^2 + a_3\varepsilon_{t-3}^2 + \ldots\ldots + b_1\sigma_{t-1}^2 + b_2\sigma_{t-2}^2 + + b_3\sigma_{t-3}^2\ldots..$$

However, it is usually sufficient to use a GARCH (1,1) model which uses just one lag of past squared errors and one lagged variance forecast:

$$\sigma_t^2 = \omega + a\varepsilon_{t-1}^2 + b\sigma_{t-1}^2$$

where: $\omega > 1$ and $a, b \geq 0$

Figure 4.7 shows the results of a GARCH (1,l) analysis of excess returns over the 1963 – 2003 period (EViews 5 econometric software was used). The dotted line shows the fitted standard deviation in returns; the unbroken line shows the actual monthly standard deviation derived, as previously, from daily data within months. The equation of the fitted line is given by:

	Value	**Standard error**
Constant (ω)	1.129897	0.213416
Coefficient (a)	0.112061	0.025117
Coefficient (b)	0.861185	0.034768

Note that all values are statistically significant and that the sum of the a and b coefficients is close to unity, implying that shocks to conditional volatility are highly persistent.

4.4.8 Forecasting volatility

A GARCH model appears to provide a sound description of historic trends in market volatility. But, can GARCH models be used to predict future volatility or future excess returns?

The results of an exercise to answer these questions are shown below. A GARCH (1,1) model was estimated for the 1963 – 1979 period with the following coefficients:

	Value	**Standard error**
Constant (ω)	1.128316	0.631655
Coefficient (a)	0.137835	0.043682
Coefficient (b)	0.853240	0.049647

Subsequent values for conditional volatility were then found by rolling forward the model month by month so that an additional month's data was used in the estimation. Thus conditional volatility at the end of 1982, for example, was estimated from 1963-1982 data. The estimated out-of-sample forecasts are illustrated by the dotted line in Figure 4.8 below. The estimated values of conditional volatility were then viewed as the "anticipated" elements of subsequent volatility and the residual portions were treated as the "unanticipated" elements.

Although not quite the mid-point of the data set, end-1979 was chosen as the starting point for out-of-sample forecasts simply because that year represents a distinct "end of an era" in the minds of many investors (i.e. change of Government, end of exchange and dividend controls etc.).

Table 4.7 shows the observed relationship over the 1980-2003 period between these elements of volatility and subsequent market excess returns. As previously shown, there is a very strong, negative correlation between excess returns and contemporaneous volatility. Moreover, the linkage would appear to be between excess returns and the volatility unanticipated by the GARCH model. There would appear to be a slight positive correlation between anticipated volatility and excess returns, although this relationship is not statistically significant over shorter periods (e.g. one month). Note that the linkage between excess returns and unanticipated volatility accords with previous research such as that undertaken by French et al (1987) for the US market. They interpreted the negative relation between the two to be evidence of a positive relation between expected risk premiums and ex ante volatility.

Figure 4.8 UK equity market volatility – out-of-sample forecasts

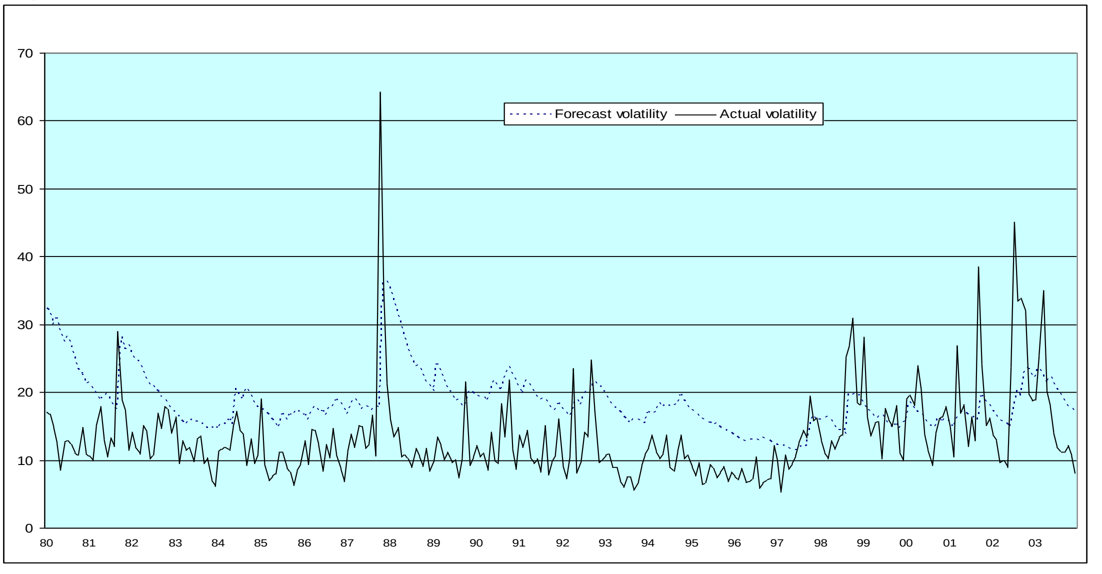


Table 4.7 Anticipated and unanticipated volatility

Excess return period	….Anticipated vol…. t-stat	R2	…......Actual vol…... t-stat	R2	...Unanticipated vol…. t-stat	R2
One month	0.943	0.003	-6.236	0.12	-6.426	0.126
Two months	1.461	0.007	-6.727	0.037	-6.915	0.144
Three months	1.402	0.007	-7.641	0.171	-7.296	0.158
Six months	2.108	0.016	-9.136	0.229	-3.209	0.035
Twelve months	1.383	0.007	-11.193	0.313	-1.846	0.012

Note: Anticipated volatility is value predicted by GARCH (1,1) model
Unanticipated volatility is difference between actual and predicted value

4.4.9 Relationship with macro-economic volatility

Table 4.8 Market and macroeconomic volatility

Panel A - Changes in quarterly volatility

-versus - change in Consols yield (CY)

	R^2	t-stat
Coincident	0.0136	-1.4751
CY(-1)	0.0013	0.4520
CY(-2)	0.0026	0.6409
CY(-3)	0.0040	-0.7854
CY(-4)	0.0036	0.7476
CY(+1)	0.0468	2.7759
CY(+2)	0.0009	0.3653
CY(+3)	0.0002	-0.1806
CY(+4)	0.0112	1.3236

-versus - change in Industrial Production (IP)

	R^2	t-stat
Coincident	0.0003	0.2177
IP(-1)	0.0209	-1.8288
IP(-2)	0.0013	0.4567
IP(-3)	0.0001	-0.0881
IP(-4)	0.0034	-0.7298
IP(+1)	0.0008	-0.3553
IP(+2)	0.0049	0.8780
IP(+3)	0.0228	1.9029
IP(+4)	0.0098	-1.2340

-versus - change in Consumer Spending (CS)

	R^2	t-stat
Coincident	0.0055	0.9362
CS(-1)	0.0110	-1.3200
CS(-2)	0.0025	-0.6259
CS(-3)	0.0020	0.5539
CS(-4)	0.0043	0.8128
CS(+1)	0.0032	0.7154
CS(+2)	0.0008	-0.3565
CS(+3)	0.0034	-0.7286
CS(+4)	0.0005	0.2894

-versus - change in Real Corporate Earnings (RCE)

	R^2	t-stat
Coincident	0.0021	0.5738
RCE(-1)	0.0004	-0.2392
RCE(-2)	0.0010	-0.3919
IRCE-3)	0.0120	-1.3710
RCE(-4)	0.0014	-0.4563
RCE(+1)	0.0000	-0.0519
RCE(+2)	0.0003	0.2142
RCE(+3)	0.0000	0.0669
RCE(+4)	0.0010	0.3971

Panel B - Changes in quarterly volatility (Excluding 1987 effect)

-versus - change in Consols yield (CY)

	R^2	t-stat
Coincident	0.0178	-1.6803
CY(-1)	0.0065	1.0033
CY(-2)	0.0014	0.4613
CY(-3)	0.0042	-0.8048
CY(-4)	0.0039	0.7740
CY(+1)	0.0338	2.3298
CY(+2)	0.0048	0.8637
CY(+3)	0.0013	0.4466
CY(+4)	0.0076	1.0762

-versus - change in Industrial Production (IP)

	R^2	t-stat
Coincident	0.0001	0.1195
IP(-1)	0.0317	-2.2561
IP(-2)	0.0056	0.9275
IP(-3)	0.0058	-0.9424
IP(-4)	0.0030	-0.6743
IP(+1)	0.0001	-0.1455
IP(+2)	0.0080	1.0117
IP(+3)	0.0292	2.1455
IP(+4)	0.0105	-1.2724

Previous academic work has suggested that there is only a weak link between stock market volatility and macro-economic volatility. Indeed, and as discussed previously, a recent analysis by Morelli (2002) concluded that: "the volatility in the macrovariables selected does not explain the volatility in the stock market."

The results of a similar analysis for the period 1963-2003 are shown here. Quarterly changes in stock market volatility were regressed against changes in long interest rates (consol yields), industrial production, consumer spending and real corporate earnings (notional FTSE All-Share index earnings). Coincident, leading and lagging relationships were examined in each case.

Only two results in Panel A of Table 4.8 are of significance. There appears to be a negative correlation between market volatility and anticipated changes in industrial production, as one might expect. This also confirms Morelli's findings. Additionally, stock market volatility appears to rise (fall) in the quarter following a rise (fall) in long interest rates (Morelli did not include volatility in the long interest rate as a predictor). The results in Panel B, derived after omitting the influence of the 1987 Crash, confirm the significance of these two relationships.

4.4 SUMMARY

This chapter has reviewed previous important studies of the nature of equity market volatility and the relationship between excess returns and volatility. An updated analysis on the UK equity market has also been presented which examines the excess return/volatility relationship from a number of different viewpoints. The analysis confirms that this relationship is complex. The key findings are:

- The variability of the UK equity market since 1963 calculated on monthly , quarterly and annual bases is 5.8%, 10.95% and 30.19% respectively. Exceptional volatility was witnessed at the bottom of the 1973-74 bear market and at the time of the 1987 Crash.

- Autocorrelation analysis shows that observed volatility decays only slowly. Indeed, the analysis of monthly volatility shows a statistically significant autocorrelation at lag 12. In contrast, excess returns display little or no positive correlation beyond lag 1.

- Measures based on observed volatility are generally poor predictors of excess return.

- There is a strong, negative relationship between excess returns and contemporaneous volatility. Moreover, there is some evidence that such trends in volatility can persist in response to achieved returns.

- A GARCH (1,1) model of conditional volatility provides a good fit to observed volatility over the 1963-2003 period. An out-of-sample analysis indicates that the main linkage between excess returns and volatility is largely confined to the "unanticipated" element of volatility.

- There appears to be a frustratingly weak link between market volatility and macroeconomic volatility, as previous research has concluded.

CHAPTER 5 - A PARTIAL DECOMPOSTION OF EXPECTED RETURNS

5.1 INTRODUCTION

The analysis contained in this relatively short chapter builds on the basic methodology of Shiller (1981) in examining the apparent "excess" volatility of equity markets. In so doing, the chapter also serves as a preface to chapter 6, in which a unique and more comprehensive decomposition of UK market returns is discussed in full.

The intention here is to demonstrate that:

(a) variation in the opportunity cost of investing in equities (i.e. the returns available on risk-free alternative investments) can explain a substantial proportion of observed volatility

(b) there is a case for believing that wide swings also occur in the risk premium demanded by (or available to) equity investors. This could explain a significant proportion of any apparent "excess" volatility.

As discussed in chapter 2, the thrust of Shiller's argument is that a strong linkage should be observed between the progress in equity prices and dividends, given that equity prices should reflect the present value of all future dividends expected by equity investors. Shiller observed that the volatility of equities is, in fact, many times the volatility of dividends.

Figure 5.1 below is a reproduction of Figure 2.2 in chapter 2. It compares the progress of the UK All-Share index since 1962 with that of an index simulated by discounting the end 2005 All-Share Index level and all dividends to be received subsequent to the date of observation. In other words, it assumes that the end 2005 index level is a "correct" valuation of dividends to be received from 2006 to infinity.

Additionally, it assumes that investors at all times between 1962 and end-2005 had perfect foresight of the dividend stream to end-2005. All dividends and the end-2005 index value are discounted back at a constant discount rate (the average rate of return earned, 13.1%).

The result is that the actual equity index displays far greater volatility than the simulated index. Figures 5.2 and 5.3 present the results even more dramatically. Figure 5.2 shows the deviation of the simulated index from its long-term trend (measured as the percentage deviation from the regression line of best fit). The range of the deviation is from -6% to +8%. A positive deviation is observed for the 1980s following the lifting of dividend controls; a negative deviation is observed for the 1990s when dividend growth slowed and, in particular, following the abolition of the dividend tax in 1997 (note that the analysis uses notional, gross dividends which were effectively cut as a result of the 1997 tax measures). Figure 5.3, which monitors the progress of the actual index around its long-term trend, shows far greater volatility. The index stood at 68% below trend at the bottom of the 1974 bear market and stood at 74% above trend prior to the Crash in October 1987.

Figure 5.1 Simulated –v- actual UK equity market index

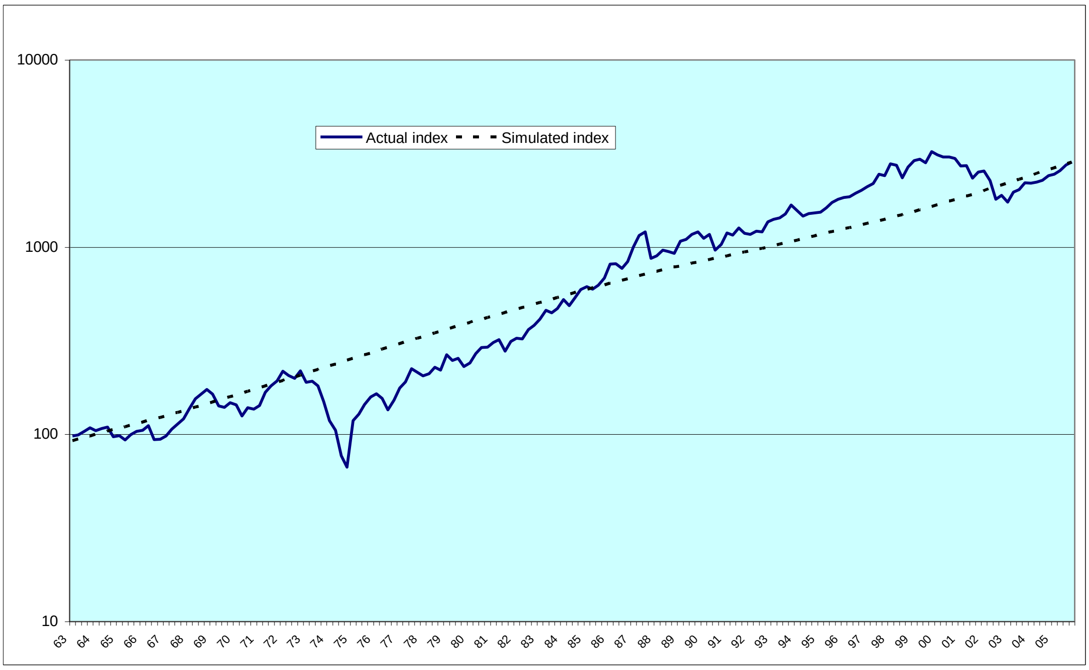


Figure 5.2 Deviation from trend – simulated index

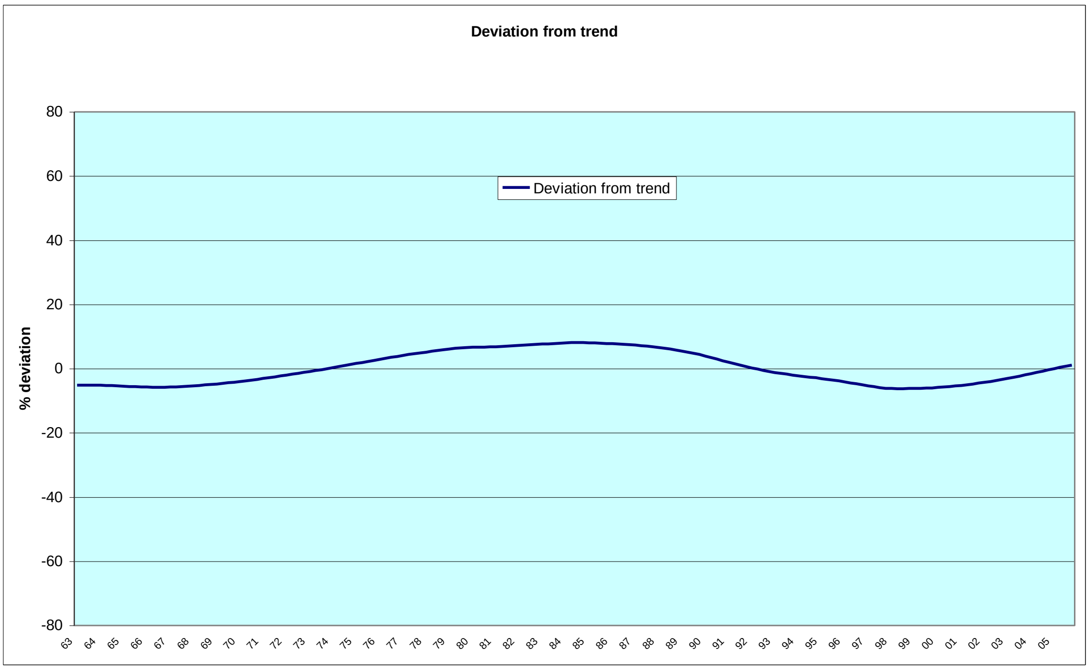
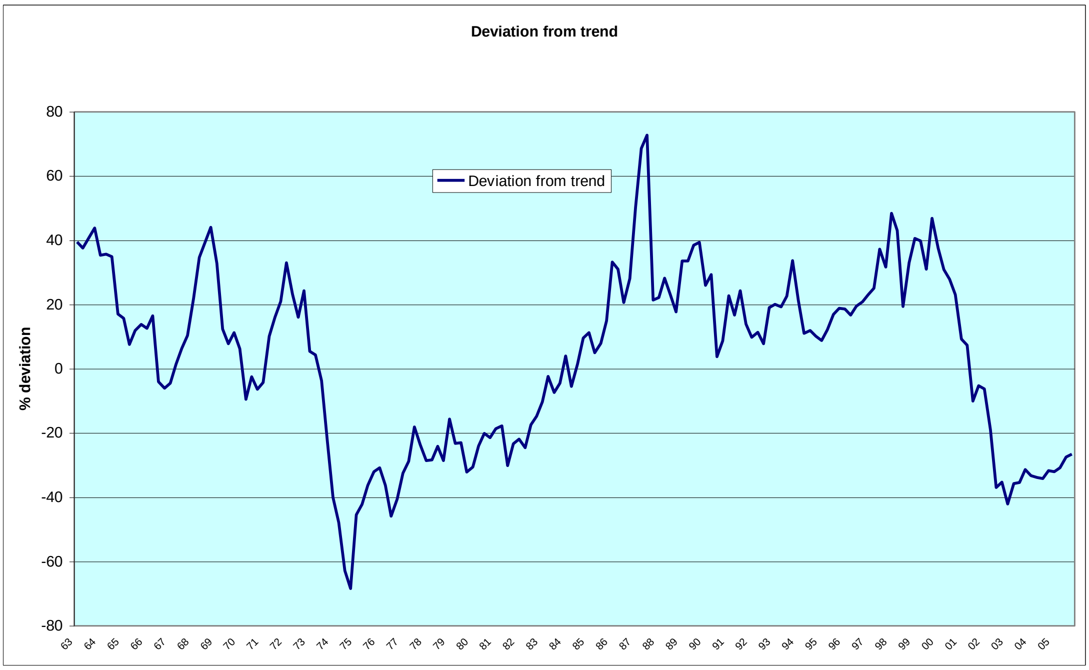


Figure 5.3 Deviation from trend - actual index



5.2 VARYING THE RISK-FREE RATE

Nominal values for both dividend growth and discount rates were used in the analysis of the equity market described above. This is in contrast to the Shiller approach which used real values for the relevant series. The overall effect is likely to be similar because inflation has an impact on both the numerator (nominal dividends) and the denominator (one component of which will be the risk-free nominal rate). It is recognised, of course, that the effects of inflation are complex and the effects on the numerator and denominator will not always perfectly offset each other. However, the purpose of this next stage in the analysis was to show the broad impact on volatility if the risk-free component of the discount rate was allowed to vary. A more precise and detailed analysis – which takes into account the specific impact of inflation on the different variables - is applied in the more comprehensive decomposition described in Chapter 6.

The expected return on equities at any point in time was assumed to be given by:

Alternative, long-term risk-free rate available + equity risk premium

The yield on government $2^1/_2$% Consols was used as the long-term, risk-free alternative to equity investment. The peak in the Consols yield during the period of analysis was 18.0% in December 1974; the low point was 4.1% in December 2005, at the close of the period under investigation.

This next stage in the analysis was again to simulate the trend in the UK equity market since 1962 assuming, as before, that investors had perfect foresight of the dividend stream to the end of 2005 as well as the end-2005 equity market level. Instead of discounting at a constant rate, however, the discount rate was varied according to the movement in the risk-free component. No attempt was made to vary the risk premium element. Instead, a constant element was added to the Consols yield at any point. The average nominal return over the entire period was 13.1% pa; the average Consols yield was 8.9%. The difference, 4.2%, was therefore used as the constant risk premium element.

Figure 5.4 Comparing the simulations

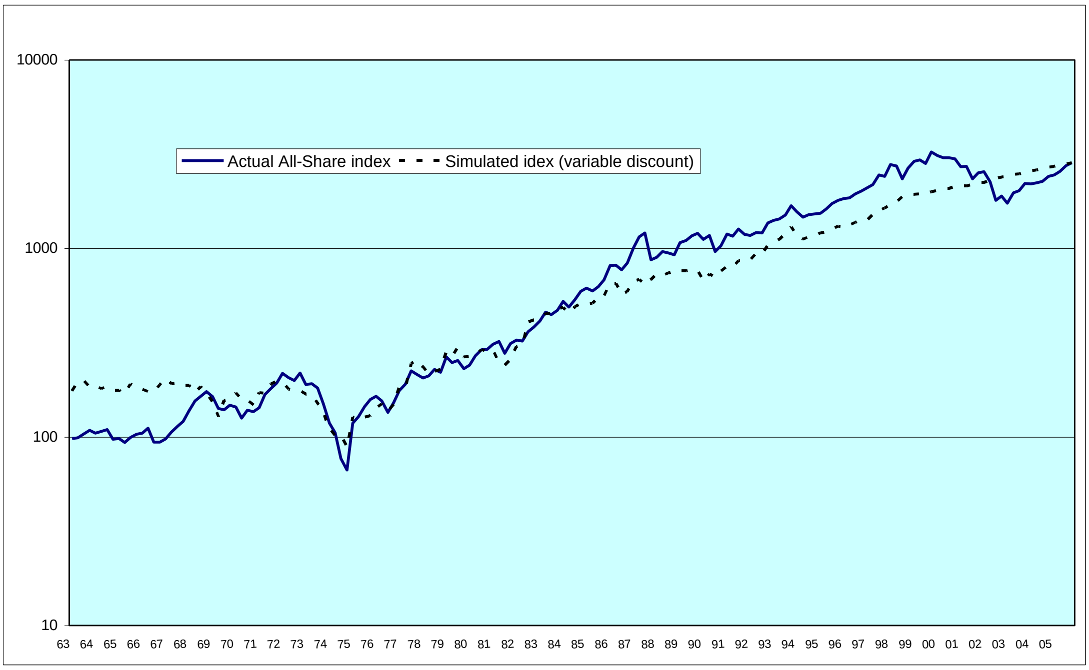


Table 5.1 Annual standard deviation in returns

Actual All-Share Index	Simulated index (constant discount)	Simulated index (variable risk-free rate)
21.14%	0.44%	16.24%

Note: Simulated index (constant discount) assumes that investors have perfect foresight and discount future dividends at a constant rate
Simulated index (variable risk-free rate) assumes that investors have perfect foresight and discount dividends at a rate that incorporates the prevailing risk-free rate.

The final two columns of Table 5.2 (a full quarterly analysis is contained in Appendix 1) show the variable discount applied in the simulation and the resultant, simulated index. Figure 5.4 above illustrates that, unlike the initial simulation – conducted using a constant discount rate – the simulated index does display significant volatility. Indeed, the annualised standard deviation in returns for this second, simulated index was 16.2% compared with an equivalent figure of 21.1% for actual returns achieved.

5.3 A VARYING EQUITY RISK PREMIUM

Thus far, we have assumed that changes in the expected return on equities are caused in part by changes in risk-free rates of return. And it would appear that such changes could add significantly to the volatility of the equity market. But what about changes in the second main element of expected equity returns, the equity risk premium? In this case, we cannot rely on historical fact in the analysis. All that can be examined is the implied equity risk premium prevailing at any point in the past.

The "perfect foresight" analysis of historical trends was therefore extended to find the degree to which swings in the equity risk premium might explain the remaining portion of historical equity market volatility. In this case, the implied rate of return on the equity market was determined (using the Excel internal rate of return function) at each point in the past, again assuming that investors had perfect knowledge of future dividends and the end-2005 index level.

The assumption being made is that the end-2005 index level represents the discounted value of all dividends from 2006 to infinity. What is being applied here, therefore, is a two stage discounting model, where a constant discount rate is effectively being assumed from 2006, while the internal rate of return being estimated is for a variable period up to the end of 2005. At end 1962, for example, the internal rate of return estimated is for a period of 43 years. At end 2004, the rate of return estimated is for a single annual period. Consequently, it could be argued that the results become less and less meaningful as the period of observation shortens since the returns become less and less reliable as indicators of what very long-term expectations might have been.

Notwithstanding this qualification, the analysis does provide some interesting and believable results. The final column of Table 5.3, for example, shows trends in the implied equity risk premium. The latter were found by subtracting the Consols yield available at any point from the available internal rate of return on equities.

As discussed above, the results for more recent years are arguably distorted. Leaving those aside and examining the longer history, the analysis shows that the equity risk

Table 5.2 Simulating the equity index

Date	All-Share Index	All-share Yield	Notional Dividend	Simulated Index (Note A)	Variable discount rate (%) (Note B)	Simulated Index (Note C)
31/12/1962	95	4.35	4.11	95	9.8	181
31/12/1963	109	4.08	4.43	98	10.0	185
31/12/1964	97	5.18	5.03	106	10.5	177
31/12/1965	104	5.23	5.42	114	10.7	183
30/12/1966	94	5.79	5.44	123	10.9	190
29/12/1967	121	4.38	5.31	134	11.3	189
31/12/1968	174	3.24	5.63	146	12.2	171
31/12/1969	147	3.85	5.67	159	13.1	159
31/12/1970	136	4.39	5.98	173	14.1	148
31/12/1971	193	3.25	6.29	190	12.8	197
29/12/1972	218	3.15	6.87	208	14.2	175
31/12/1973	150	4.77	7.14	227	16.9	134
31/12/1974	67	11.71	7.83	249	22.2	88
31/12/1975	158	5.47	8.65	273	19.2	130
31/12/1976	152	6.42	9.76	299	18.9	148
30/12/1977	215	5.28	11.33	327	14.9	256
29/12/1978	220	5.79	12.75	356	16.7	228
31/12/1979	230	6.87	15.79	388	16.2	266
31/12/1980	292	6.10	17.83	421	16.5	282
31/12/1981	313	5.89	18.44	457	18.3	258
31/12/1982	382	5.26	20.10	496	14.6	418
30/12/1983	471	4.62	21.74	539	14.2	475
31/12/1984	593	4.42	26.21	583	14.3	509
31/12/1985	683	4.34	29.64	630	14.2	556
31/12/1986	835	3.98	33.25	679	14.5	589
31/12/1987	870	4.33	37.68	730	13.7	686
30/12/1988	927	4.69	43.46	782	13.4	761
29/12/1989	1205	4.19	50.48	835	14.0	764
31/12/1990	1032	5.46	56.36	887	14.9	756
31/12/1991	1188	4.93	58.55	942	14.2	855
31/12/1992	1364	4.31	58.78	1004	12.7	1034
31/12/1993	1682	3.46	58.20	1074	10.7	1304
30/12/1994	1521	4.02	61.16	1151	12.9	1169
29/12/1995	1803	3.82	68.88	1233	12.0	1316
31/12/1996	2014	3.76	75.71	1317	12.0	1418
31/12/1997	2411	3.23	77.88	1408	10.7	1638
31/12/1998	2674	2.50	66.85	1523	8.7	1949
31/12/1999	3242	2.12	68.73	1651	9.2	1998
29/12/2000	2984	2.23	66.54	1798	8.9	2139
31/12/2001	2524	2.63	66.38	1963	9.4	2228
31/12/2002	1894	3.55	67.23	2149	8.9	2395
31/12/2003	2207	3.10	68.43	2359	9.2	2520
31/12/2004	2412	3.00	72.37	2593	8.7	2695
31/12/2005	2847	3.00	85.41	2847	8.3	2847

Notes

A Present value of the end 2005 index and all expected dividends to end 2005 discounted at a constant rate of 13.08% per annum.

B Prevailing rate of return on $2^1/_2$% Consols + 4.2% equity risk premium

C Present value of the end 2005 index and all expected dividends to end 2005 discounted at the prevailing rate of return on $2^1/_2$% Consols + 4.2% constant equity risk premium.

Table 5.3 The implied equity risk premium

Date	All-Share Index	Notional dividend	Internal rate of return (%) (Note A)	Consols yield	Implied equity risk premium (%) (Note B)
31/12/1962	95	4.11	12.85	5.59	7.3
31/12/1963	109	4.43	12.53	5.81	6.7
31/12/1964	97	5.03	13.58	6.31	7.3
31/12/1965	104	5.42	13.64	6.48	7.2
30/12/1966	94	5.44	14.73	6.66	8.1
29/12/1967	121	5.31	13.67	7.06	6.6
31/12/1968	174	5.63	12.10	7.99	4.1
31/12/1969	147	5.67	13.53	8.87	4.7
31/12/1970	136	5.98	14.60	9.87	4.7
31/12/1971	193	6.29	12.96	8.64	4.3
29/12/1972	218	6.87	12.77	9.97	2.8
31/12/1973	150	7.14	16.02	12.70	3.3
31/12/1974	67	7.83	26.07	18.01	8.1
31/12/1975	158	8.65	17.29	14.98	2.3
31/12/1976	152	9.76	18.67	14.70	4.0
30/12/1977	215	11.33	16.40	10.72	5.7
29/12/1978	220	12.75	17.07	12.54	4.5
31/12/1979	230	15.79	17.60	12.01	5.6
31/12/1980	292	17.83	16.16	12.30	3.9
31/12/1981	313	18.44	16.38	14.13	2.2
31/12/1982	382	20.10	15.36	10.39	5.0
30/12/1983	471	21.74	14.27	9.97	4.3
31/12/1984	593	26.21	12.94	10.12	2.8
31/12/1985	683	29.64	12.35	10.05	2.3
31/12/1986	835	33.25	11.20	10.25	0.9
31/12/1987	870	37.68	11.41	9.50	1.9
30/12/1988	927	43.46	11.42	9.16	2.3
29/12/1989	1205	50.48	9.48	9.83	-0.4
31/12/1990	1032	56.36	11.48	10.66	0.8
31/12/1991	1188	58.55	10.57	9.99	0.6
31/12/1992	1364	58.78	9.65	8.53	1.1
31/12/1993	1682	58.20	7.88	6.55	1.3
30/12/1994	1521	61.16	9.57	8.68	0.9
29/12/1995	1803	68.88	8.02	7.78	0.2
31/12/1996	2014	75.71	7.02	7.78	-0.8
31/12/1997	2411	77.88	4.82	6.45	-1.6
31/12/1998	2674	66.85	3.46	4.51	-1.0
31/12/1999	3242	68.73	0.14	5.01	-4.9
29/12/2000	2984	66.54	1.49	4.74	-3.2
31/12/2001	2524	66.38	5.83	5.16	0.7
31/12/2002	1894	67.23	18.15	4.71	13.4
31/12/2003	2207	68.43	16.98	5.02	12.0
31/12/2004	2412	72.37	21.62	4.52	17.1
31/12/2005	2847	85.41	-	4.10	-

Notes

A The annual internal rate of return that equates the All-Share index level at that data with the end 2005 index level and dividends to be received up until end 2005

B The annual internal rate of return minus the prevailing consols yield premium available reached a peak, 8.1%, in December 1974 and reached a low point, -1.5%, in September 1987 (a full quarterly analysis of the results is contained in Appendix A). These points heralded, respectively, the major resurgence in the equity market during 1975 and the near-30% Crash in the equity market in the fourth quarter of 1987.

5.4 A MORE COMPREHENSIVE ANALYSIS REQUIRED

The analyses described above suggest that, when perfect foresight is assumed regarding future dividend flows, the volatility of the equity market can broadly be attributed to two main factors: changes in risk-free rates of return available and changes in a risk premium element.

Whether the latter can be explained in terms of irrational behaviour is another matter altogether. All that these analyses have shown is that there appear to be significant swings in this risk premium element, however caused.

Investors do not have perfect foresight. They can only estimate the course of future dividend growth. The consequent uncertainty is, therefore, another element contributing to the volatility of equity returns. Indeed, a relatively small change in long-term real growth expectations - which would translate into an equivalent adjustment to the dividend yield – can have a significant impact on current levels.

A more complex model is required, however, in order to gain a better understanding of reality. Perfect foresight models or ex-post measures (e.g. for the equity risk premium) are poor – and arguably dangerous – substitutes for ex-ante estimates, however difficult and imprecise such estimates might be.

Such an attempt is made in Chapter 6. Expected returns from both equities and the risk-free asset returns are decomposed into more precise elements with a view to gaining a more realistic and comprehensive understanding of market volatility. The aim is also to measure the implied, “pure”, ex-ante risk premium available in the past.

CHAPTER 6 – TIME VARIATION IN EQUITY RETURNS – A FULL DECOMPOSITION

Other studies (e.g. Fama and French, 2002, Vivian, 2007) have indicated that there would appear to be a significant divergence between ex-post measures of the equity risk premium and estimates of the ex-ante premium historically. The purpose in this chapter is to present a full, up-to-date decomposition of both equity and bond returns in the UK markets since 1963. A detailed explanation for the divergence between ex-post and ex-ante measures of the equity risk premium is also presented

6.1 THE COMPONENTS

The relevant components of the expected returns from equities and long-dated bonds are identified in the following discussion. An underlying assumption is that the equity and bond markets reflect the actions and expectations of rational, risk averse long-term investors.

The expected return on equities can be viewed through the Gordon growth relationship as:

EER = EDY + EIR + ERDG …………….(6.1)

where: EER = Expected equity return
EDY = Expected dividend yield
EIR = Expected long-term inflation rate
ERDG = Expected long-term real dividend growth rate.

The expected equity return is assumed to exceed the return available on a risk-free alternative by a risk premium (ERP). The yield on undated gilts is used as the relevant risk-free benchmark against which to judge the returns available on equities.

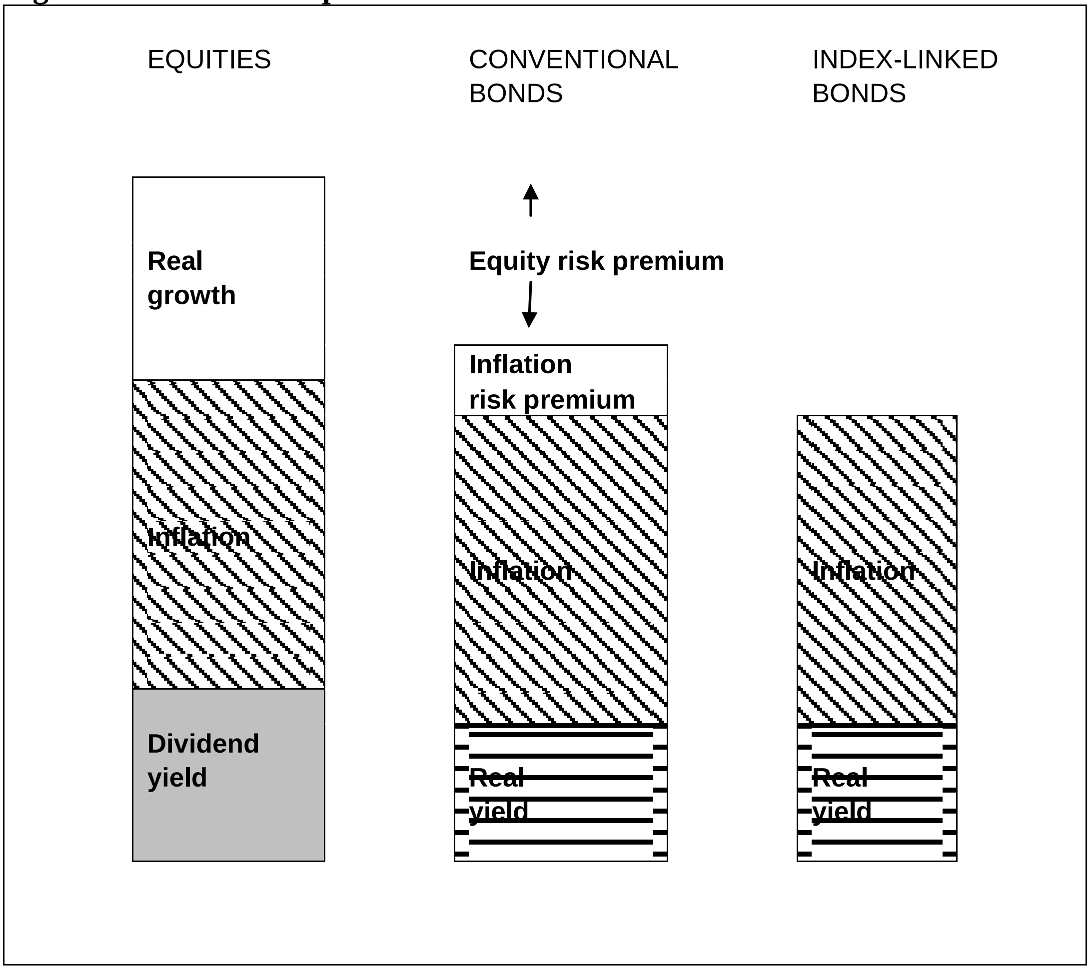
For the purposes of this study, the yield on long gilts ($2^1/_2$% undated consols are used in the analysis) can be viewed as:-

GY = RRR + EIR + IRP………………..(6.2)

where: GY = Long gilt yield
RRR = Real rate of return
EIR = Expected long-term inflation rate
IRP = Inflation risk premium

Note that equation (6.2) is an adjusted version of the Fisher effect (in this context, the standard Fisher equation would be: GY = RRR + EIR + RRR*EIR). The third, insignificant term on the right hand side is removed and a separate term for an inflation risk premium is included.

Figure 6.1 Return components



The difference between the expected returns from equities and bonds, the expected equity risk premium (ERP), can be derived by relating (6.1) to (6.2) :-

EDY + EIR + ERDG = RRR + EIR + IRP + ERP……………….(6.3)

Thus:-

ERP = EDY + ERDG – RRR – IRP…………………………(6.4)

Alternatively, we can view the expected dividend yield as:-

EDY = ERP + RRR + IRP – ERDG……………..(6.5)

In essence, we need to decompose expected returns into five components in order to start to understand the variation in returns through time, namely:

- Expected inflation
- The inflation risk premium
- Expected long-term real dividend growth.
- The real rate of interest
- The expected equity risk premium

The following section contains a discussion of each of these components and describes previous attempts to measure historical values.

6.1.2 Expected inflation

Many studies in the area of return variation pay only scant attention to expected inflation levels, preferring simply to concentrate on analyses of real returns. Inflation is, of course, incorporated into the Gordon growth model both through the numerator (the growth in cash flows) and through the denominator (the inflation element in the discount rate). The Gordon growth model could therefore be written as:

$$P = D_1/(r - g)$$

where: r = real risk-free rate of interest
g = real dividend growth

However, for the purposes of this study, inflation is retained as a separate component of return for two main reasons:-

(a) As will be discussed in the next sub-section, a significant inflation risk premium may be embedded within nominal risk-free rates over certain periods. If such a premium exists, it is likely to be highly and positively correlated with inflation expectations. Moreover, this element would need to be incorporated into the Gordon growth model even if the discount rate and dividend growth rate are expressed in real terms.

(b) As will be discussed, there is much evidence of a negative relationship between inflation and equity returns. One causal linkage may be between expected inflation, real productivity and real growth expectations. These relationships need to be examined more closely.

The high period of inflation in the 1970s encouraged many researchers to examine the inflation-hedging properties of assets. Fama and Schwert (1977), for example, analysed US data for the 1953-1971 period. They concluded that:-

- Only private, residential real estate was a complete hedge against both expected and unexpected inflation.
- Government bonds were complete hedges against expected inflation and the expected nominal returns varied directly with the expected inflation rate.
- Contrary to conventional wisdom, common stocks returns were negatively related to expected inflation.

Fama & Schwert conceded that they were unable to identify the economic origins of the negative relationship between equity returns and expected inflation but suggested two possible causes: some as yet unidentified phenomenon or some market inefficiency in impounding information about future inflation.

Solnik (1983) extended the analysis of the relationship between equity prices and inflation to a further eight major equity markets. A Fisherian model of the real expected equity return was applied, of the form:-

$$r_t = \alpha + \beta_1 I_t + \beta_2 (I_{t+1} - I_t) + \varepsilon_t$$

where β_1 and β_2 are coefficients for inflationary expectations (I) and revisions in expectations respectively. Both are expected to be zero under the null hypothesis that expected real returns are determined solely by real factors.

Tested on US data, the model confirmed the previous findings of Fama and Schwert, that there was a negative relationship between real equity returns and inflation expectations. Likewise, the results for all the other markets confirmed a negative relationship (β_1 and β_2 were negative in all cases except for Canada where the β_1 was positive).

Geske and Roll (1983), along with many others, attempted to provide an explanation for the negative relationship between stock returns and both expected and unexpected inflation. Their evidence suggested the following chain of events. A random real shock affects stock returns which, in turn, signals changes in the real economy. Government expenditures do not change immediately in response to such a signal and any required changes in Government funding is accommodated through changes to the monetary base. The latter, in turn, affects the pricing of other short-term securities and, possibly, real interest rates. Thus it is the equity market which signals changes in interest rates and expected inflation, rather than the reverse. An analysis of data over the previous three decades supported this causal link.

Blanchard (1993), Arnott & Bernstein (2002) and Ilmanen (2003) all attempted to simulate past inflation expectations using regression techniques. Ilmanen used regression results for early years combined with survey forecasts from 1951 onwards. Best & Byrne (2000) did not attempt to simulate inflation as a separate variable but used survey 10-year forecasts of nominal GDP growth as proxies for expected long-term dividend growth. FitzGerald (2001) derived inflation expectations from the difference between conventional bond yields and the real rates of interest available on long index-linked gilts (the “inflation gap”).

6.1.3 The inflation risk premium

Although accounting for a relatively small part of total return variability, the inflation risk premium is the cause of considerable controversy. There appears to be no consensus regarding its size or, even, sign.

Nevertheless, the inflation risk premium has in the past been recognised as positive and possibly significant by the UK Government. One reason given for the introduction of index-linked gilts in 1981, for example, was that the Government's cost of funding would be reduced because investors would not require an inflation risk premium on index-linked, as opposed to conventional, gilts (Rutterford, 1983).

The launch of index-linked securities in the UK provided a valuable opportunity for researchers to examine the composition of the yield gap between conventional and index-linked gilts. Arak and Kreicher (1985) undertook work on some of the early data, comparing the two types of securities over the period 1981-84 and drawing inferences regarding inflation expectations and any implied risk premium. Their analysis suggested that *"those who are willing to assume (boldly) that the uncertainty premium is zero"* are likely to overstate inflation expectations. However, they concluded that *"questions remain about the size of the risk premia."*

Woodward (1990), compared index-linked and conventional gilt data over the period 1982-89, but side-stepped any measurement of the inflation risk premium, arguing:

> *"The inflation risk premium is likely to vary, possibly, but not necessarily, with the expected inflation rate…………Calculation of this premium proved to be an intractable problem. In the analysis to follow, the premium was assumed to be zero. No method was adopted to deal with the inflation risk because none seemed superior to ignoring it altogether"* (Woodward, 1990: 377),

Woodward did concede, however, that future research into the measurement of the inflation risk premium on bonds would be valuable in refining the estimates of inflation expectations derived from a comparison of data from the two types of instruments.

Chu et al (1995) derived estimates of the inflation risk premium using a regression model in which the premium was assumed to be a function of:

R_{bt} = Nominal interest rate on 3-month T-bill
Π = Expected inflation rate (ARCH model estimate)
Q_{gt} = Real yield on long index-linked
σ^2_{π} = Expected variance in inflation.

The average premium for the 1985-91 period examined was found to average 2.41% and was significant at the 1% level. The authors claimed this as evidence that high nominal interest rates over the period examined were a result of significant inflation premia rather than a result of high riskless interest rates and that:

> *"The size and significance of the inflation risk premium indicate that investors are willing to accept a lower real return on the index-linked gilt when they recognize that both nominal bonds and equity assets are poor hedges against uncertain inflation"* (Chu, 1995: 889).

More recent evidence has been provided by Breedon and Chadha (2003), who investigated the large excess returns of some 200 basis points provided by nominal bonds over their index-linked equivalent. The question addressed was whether this excess return reflected lower than expected inflation or whether it reflected a fair compensation for bearing inflation risk.

Analysing UK gilt data for the period 1983-98, Breedon and Chadha reached the following conclusions:

- There was consistent over-estimation of inflation, of the order of 200 basis points across maturities and through time.
- An inflation risk premium of up to 50 basis points seemed plausible.
- Expected inflation and any inflation risk premium were positively correlated.
- The remaining element of the excess returns earned on nominal bonds cannot be fully explained.

6.1.4 Simulating the inflation risk premium

Despite growing evidence of the existence of an inflation risk premium, most attempts to measure ex-ante market expectations ignore the inflation risk premium. Indeed, the author's attempt to estimate the historical trends in the inflation risk premium over a reasonably long period – by assuming it to be represented by a portion of the "inflation gap" – is the only known attempt (see FitzGerald, 2001).

6.1.5 Expected long-term dividend growth

Two main approaches have been used to incorporate growth measures in the Gordon growth model:

- The use of "realistic expectations" which are modelled from economic data available at the time in question
- The use of current, short-term experience.

The latter approach was adopted by Fama & French (2002) and Vivian (2007). Fama & French argued that:

"In sum, the behaviour of dividends for 1951 to 2000 suggests that future growth is largely unpredictable, so the historical mean growth rate is a near optimal forecast of future growth" (Fama and French, 2002: 651).

In examining the period 1810 to 2001, Arnott & Bernstein (2002) utilised the basic Gordon relationship but substituted GDP growth together with a dilution factor instead of expected dividend growth. The dilution factor reflected the fact that, historically, aggregate dividend growth had lagged GDP growth, mainly due to the dilutive effect of increases in shares outstanding and the introduction of new enterprises. The model used was therefore:

$$ERSR(t) = EDY(t) + ERGDP(t) + EDGR(t)$$

where: ERSR(t) = expected real stock return from time t
EDY(t) = expected dividend yield at time t
ERGDP(t) = expected real per capita GDP growth starting at time t
EDGR(t) = expected annual dilution of real GDP as it flows through to real dividends.

The annual dilution factor used was the average of the dilution experienced over the whole long history and the dilution experienced over the prior 40 years. The average effect was found to be a dilution of 60 basis points.

The expected real per capita GDP growth was estimated in similar fashion by combining the very long-term average with the prior 40 years' experience. This produced an average forecast of 1.8% pa.

Ilmanen (2003) built on the work of Arnott & Bernstein and provided a useful discussion of the wide range of inputs possible to the dividend discounting process. In particular, the long-term growth rate was identified as the main cause for debate. Historical analyses use various data sources: earnings data, dividend data or adjusted GDP data, as discussed above. The problem with dividend data is that growth is arguably understated since the 1970s because of a shift towards share repurchases. As Dimson, Marsh and Staunton (2003) highlight, there is also now considerable evidence that, historically, real dividend growth has lagged real GDP growth in most developed economies. An additional problem is whether to input real or nominal expected growth rates. Basing future growth trends on the historical, nominal can lead to significant overstatement if inflation is assumed to stay at a much lower level than in the past.

The inputs chosen by Ilmanen were:-

- The earnings yield multiplied by a constant 0.59 payout ratio as a proxy for sustainable dividend yield. It was argued that quoted dividend yields tend to understate true yields because of share buy-backs.
- The long-term average for real earnings growth was used as a proxy for future expected growth. An average of 10, 20, 30, 40 and 50 years' growth rates was used, thereby giving additional weight to more recent years. These averages proved to be very unstable – varying from -4% to +6% - and unreasonable as ex-ante estimates for certain

periods. The averages were “anchored” therefore at 2%, thereby providing a plausible range between 0 and 4% most of the time.

FitzGerald (2001) simulated past expectations by using trailing 10 year average real dividend growth rates. Like Ilmanen, the distribution range was restricted (from -2% to +3%) in order to make the final results more plausible.

Best & Byrne (2001) assembled ex-ante estimates for the equity risk premium in the US and UK markets using survey data. As discussed in section 6.1.2, long-term dividend growth was derived from consensus forecasts for medium-term earnings forecasts and forecasts for longer-term GDP growth. The authors recognised that this approach required a number of important conditions to hold, notably for the stock market to be representative of the economy as a whole and for the overseas earnings of companies to grow at a similar rate to domestic earnings.

6.1.6 The real rate of interest (real yield)

The traditional Fisher relationship states that the nominal interest rate at any point is composed of an expected real return and an expected inflation rate. Arguably, this basic relationship can be expanded to incorporate an inflation risk premium.

The variation in real rates of return can be attributed to the capital expenditure generating process. Increasing real activity will put pressure on existing capital stock, raising the real return on the stock, thereby inducing greater capital expenditure. Equilibrium is established within a mature economy such that resources are allocated efficiently between consumption and investment.

As Fama & Gibbons (1982) pointed out, however, this capital expenditure argument does not explain why real returns appear to be negatively related to expected inflation. The explanation, they argued, lies in the fact that the negative relation between inflation and real activity that comes out of the monetary sector combines with the positive relation between expected real returns and real activity that comes out of the capital expenditure process. The result is the apparent negative relation between expected inflation and expected real returns.

A measure of the real rate of interest has been readily available in the UK market since 1981 in the form of the yields available on British Government index-linked securities.

Both the coupon and principal payments on index-linked securities are linked to the level of the UK retail price index (RPI). The securities are indexed with a lag. Both coupon and principal payments are linked to the level of the RPI published seven months prior to the payment date (three months since 2005). Since the RPI figure published in any month relates to data collected in the previous month, the effective, total lag is eight months (four months).

Index-linked yields have provided valuable input to the expected return modelling process for the period since 1981. However, it is recognised (Scholtes, 2002; Hurd & Relleen, 2006) that illiquidity in the index-linked market, particularly in the early years, may have been responsible for some distortions in the market. Indeed, it is argued that the decline in real rates in recent years results from the expanded liquidity of the index-linked markets and the removal of a liquidity discount (i.e. removal of a return premium).

While index-liked real rates of return provide valuable input since 1981, alternative methods are required to complete the longer picture. Three main approaches have been used in the past:

- Use of a constant. FitzGerald (2001), for example, used a constant 3.5% pa, a figure based on the conclusions of Wilkie (1994).
- Use of a current window or recent moving-average of inflation as a surrogate for long-term inflation expectations [see, for example, Brooke et al (2000)]. Market real rates of return are then assumed to be the prevailing conventional bond yield less the inflation surrogate.

- Use of a regression technique of the type adopted by Arnott & Bernstein (2002) and Ilmanen (2003) which relates, say, ten years of inflation data after any date to three prior years. The regression model at any point uses all available data at that point and indicates the long-term inflation expectation. Again, market real rates of return are assumed to be the prevailing conventional bond yield less the inflation surrogate. A regression approach was also adopted by Blanchard (1993) in which inflation expectations were simulated through a model that incorporated lagged real capital gains and yields on equities and lagged inflation and nominal bond yields. The difference between nominal bond yields and inflation expectations was assumed to represent the expected real rate of interest.

6.2 THE EX-ANTE EQUITY RISK PREMIUM

The ex-ante expected return on equities is derived from:

Expected return = current year expected dividend yield + long-term expected dividend growth

The equity risk premium on offer is the difference between this expected return and the risk-free alternative available. Most studies define the latter as the redemption yield on a long-term government bond. Fama & French (2002) use the yield on 6 month Treasury bills.

The risk premium can be estimated by comparing real expected returns or nominal expected returns. FitzGerald's preference for the latter approach stemmed from recognition of the inflation risk premium element within conventional bond yields.

The methodologies used in the seven main studies of ex-ante risk premium measurement produced to date, and which have previously been discussed in sections 6.1.2 to 6.1.6, are summarised in the Tables 6.1 to 6.7.

Table 6.1 Blanchard 1993 approach

Variable	Proxy
Expected real dividend growth	Derived from regression model using lagged equity capital gain and yield, lagged long bond yield and lagged inflation (similar variables used in a predictive model for expected yield)
Expected inflation	Derived from regression model using lagged equity capital gain and yield, lagged long bond yield and lagged inflation
Inflation risk premium	Not estimated
Expected real equity return	Expected yield + expected real dividend growth
Expected real risk-free return	Long bond yield - simulated expected inflation
Ex-ante equity risk premium	Expected real equity return - expected real risk-free return

Table 6.2 FitzGerald 2001 approach

Variable	Proxy
Expected growth (G)	Prior 10 year real dividend growth fitted to a distribution band of -2% to +3%
Expected real risk-free return	Real rates of return on long index-linked gilts from 1981. Constant 3.5% assumed prior to 1981.
Expected inflation (I)	80% of "yield gap", where yield gap = Redemption yield on long-dated conventional gilts - Real risk-free rate
Inflation risk premium	20% of "yield gap"
Expected equity return	Current year yield + expected growth
Ex-ante equity risk premium	Expected equity return - yield on long-dated conventional gilts

Table 6.3 Best & Byrne 2001 approach

Variable	Proxy
Expected growth (G)	Based on consensus earnings forecasts + nominal GDP forecasts
Expected inflation	Embedded in nominal GDP forecasts
Inflation risk premium	Not estimated
Expected real equity return	Current year yield + G
Expected risk-free return	Yield on 10 year benchmark bond
Ex-ante equity risk premium	Expected real equity return - expected risk-free return

Table 6.4 Fama & French 2002 approach

Variable	Proxy
Expected growth (G)	One year dividend growth
Expected inflation	Not estimated
Inflation risk premium	Not estimated
Expected real equity return	Current year yield + G (deflated by CPI)
Expected real risk-free return	Annual return on 6-month Treasury paper (deflated by CPI)
Ex-ante equity risk premium	Expected real equity return - expected real risk-free return

Table 6.5 Arnott & Bernstein 2002 approach

Variable	Proxy
Expected growth (G)	Estimates of growth in per capita GDP are based on 40 and 200 year averages. Haircuts applied.
Expected inflation (I)	Next decade inflation model regressed on past 3 years inflation. Resultant model used to predict long-term inflation at any point.
Inflation risk premium	Not estimated
Expected real equity return	Current year yield + G (deflated by expected inflation)
Expected real risk-free return	Redemption yields on 10 year Treasuries (deflated by expected inflation)
Ex-ante equity risk premium	Expected real equity return - expected real risk-free return

Table 6.6 Ilmanen 2003 approach

Variable	Proxy
Expected growth (G)	Average of past 50 years' growth. Anchored at 2%.
Expected inflation (I)	Average of regression model output. Moving 30 year window and survey-based inflation forecasts (from 1951).
Inflation risk premium	Not estimated
Expected real equity return	Current year yield + G (deflated by expected inflation).
Expected real risk-free return	Redemption yields on 20 or 30 year Treasury bonds (deflated by expected inflation).
Ex-ante equity risk premium	Expected real equity return - expected real risk-free return.

Table 6.7 Vivian 2007 approach

Variable	Proxy
Expected growth (G)	One year dividend growth
Expected inflation	Not estimated
Inflation risk premium	Not estimated
Expected real equity return	Current year yield + G (deflated by CPI)
Expected real risk-free return	Return on Treasury Bills (deflated by CPI)
Ex-ante equity risk premium	Expected real equity return - expected real risk-free return

6.3 A FULL DECOMPOSITION OF UK MARKET RETURNS

The following analysis investigates the period from 1963 to end 2005. Whilst analysis of a longer history would have provided a more comprehensive analysis of historical market trends, it was felt that the period of over 40 years examined embraced a sufficiently wide spectrum of economic and market conditions. Attempting to analyse a longer period would also have thrown up numerous data and measurement problems owing to the need to utilise inconsistent and inferior equity indices (the FTSE All-Share Index – the most comprehensive benchmark for the UK equity market was introduced in April 1962). The analytical approach adopted was also determined and influenced by the following factors:

- Apart from the author's earlier work, no major long-term investigation in this area has made extensive use of data from the index-linked gilt market. This is understandable in analysing US markets, since Treasury index-linked securities have only been available in the US since January 1997. However, a 27 year history of index-linked data is now available in the UK. While some of the shortcomings and distortions in the early history of that market must be recognised, it was thought that use of this data would provide a unique and valuable approach to building a picture of historical expectations. As will be discussed, the experience since 1981 is used to construct a model which can then be used over the entire period being analysed.

- Whilst investor expectations are undoubtedly influenced by shorter term trends in economic variables, an assumption being made in this analysis – as stated in Section 6.1 – is that the financial markets reflect the expectations of rational, long-term investors. Historical 5 year or 10 year forecasts – which, in any case, are of limited availability from data vendors – were therefore not considered to be adequate. Equally, use of very long-term actual outcomes, as surrogates for long-term expectations, was also ruled out in view of the relatively short time span being investigated. However, as will be discussed, use was made of 10 year actual outcomes to improve the model developed for growth expectations.

- Previous studies, such as those undertaken by Fama & French (2002) and Vivian (2007) have sought to analyse trends in averages over long periods, not specific changes from year to year (and, indeed, from quarter to quarter). Such studies did not therefore require a picture to be built of realistic historical expectations from year to year. Indeed, annual real dividend growth in the UK over recent decades has ranged from -12% in the 1970s to +10% during the 1980s following the lifting of dividend controls. Use of single year growth outcomes as surrogates for long-term expectations, as in the Vivian study, would therefore result in meaningless annual numbers. However, one of the objectives of the study presented here is to build a complete picture of changes from year to year. More complex models for simulating such expectations are therefore required.

Each of the components of expected return, described in the previous sections, was estimated at quarterly intervals. The methodology adopted was as follows.

6.3.1 Expected long-term inflation and the inflation risk premium

The objective of this part of the analysis is to determine what long-term inflation expectations investors built into their financial asset valuations in the past. Two key assumptions were made:

(a) The “inflation gap” - the difference between long conventional bond yields and long index-linked yields - is composed of a long-term inflation expectation and an inflation risk premium. Moreover, and concurring with the conclusions of Breedon and Chadha (2003), it is assumed that there is a positive correlation between the inflation risk premium and expected inflation. Rules of thumb for the proportional split between expected inflation and the inflation risk premium embedded in the inflation gap were adopted by City analysts following the introduction of index-linked gilts (see, for example, Bain and Hibbert, 1984). Indeed the assumption used by the author in his 2001 study, is that the inflation gap can be split in the proportions 80%:20%. That is, 80% of the inflation gap can be regarded as the inflation expectation and 20% as the inflation risk premium. Justification for an assumed split of this order is presented later in this section.

(b) Inflation expectations at any time are moulded by past experience, shorter-term expectations or a combination of the two.

The first part of the exercise, therefore, is to look at the relationship between the inflation gap since 1981 and a range of trailing and leading inflation indicators, as shown in Table 6.8. Incorporating actual ex-post experience into the “windows” shown does, of course, imply that investors had perfect foresight. Whilst this may be an unrealistic assumption for long horizons, it could be argued that it is more realistic for shorter horizons (e.g. the 2 year horizon incorporated into the 5 year window.

If a realistic and robust model for the inflation gap can be found, the same model could be used to simulate inflation gap levels prior to 1981.

The table below shows the results of regressing the inflation gap on each of the variables in turn for the period 1981-2005.

Table 6.8 Inflation gap analysis,1981-2005

Variable	Definition	Regression results				
		t-stat	R^2	Ave	Min	Max
30YAVEINF	30 year trailing average	0.5860	0.004	7.5	5.7	8.2
20YAVEINF	20 year trailing average	11.438	0.574	7.6	3.6	10.2
15YAVEINF	15 year trailing average	24.672	0.863	7.3	2.7	11.6
10YAVEINF	10 year trailing average	19.098	0.790	6.4	2.4	14.2
5YAVEINF	5 year trailing average	19.351	0.794	5.1	2.1	13.7
5YWININF	5 year window (3 trailing, 2 forward) average	16.252	0.731	4.3	2.0	11.2
10YWININF	10 year window (5 trailing, 5 forward)	22.088	0.834	4.3	2.1	9.5
20YWININF	20 year window (10 trailing, 10 forward) average	18.771	0.784	4.8	2.4	9.9
10YFORINF	10 year forward average	15.466	0.711	3.3	2.1	6.0

A Minitab stepwise regression technique was also applied to uncover the best combination of explanatory variables. A model which combined the 5 year window and the 20 year trailing average - provided the best explanation for the variation in the inflation gap:

Inflation gap = 0.6572 + 0.7030*(5yrwindow) + 0.16771*(20yearave)
(t-stat = 15.85) (t-stat = 4.05)

$R^2 = 0.880$

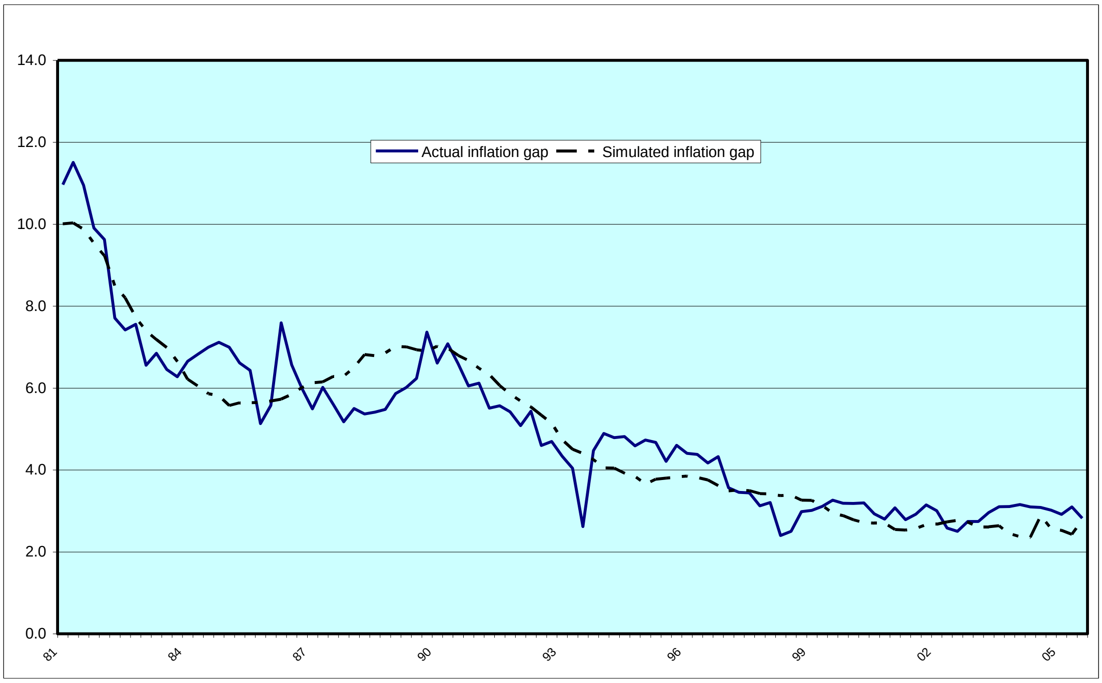
Or, suppressing the constant, the following:

Inflation gap = 0.6869*(5yrwindow) +0. 2555*(20yearave)
(t-stat =15.10) (t-stat = 9.18)

$R^2 = 0.907$

An analysis of sub-periods confirmed that combinations of a 5 year window with a longer-term trailing average consistently proved to provide the most significant fit to trends in the actual inflation gap. Indeed, Figure 6.2 illustrates how well the model described above fits the actual data from the whole period 1982 – 2005.

Figure 6.2 Actual inflation gap –v- simulated inflation gap



Reassuringly, also, the average simulation value over the whole period is almost exactly the same as the observed average (4.96% -v 4.99%). Interestingly, and coincidentally, observed inflation over the 24 year period averaged exactly 80% of the simulated inflation gap (3.96% -v- 4.96%), thus providing support for the past, ad-hoc assumptions adopted by practitioners in the 1980s.

This model, therefore, based on a 24 year history of market trends, provides a means of simulating long-term inflation expectations and inflation risk premia prior to 1981. In other words, the model could be used to derive a notional inflation gap for prior periods and this, in turn, could be split to obtain the two required inflation components.

What method should be used to derive the two inflation components for the period post 1981? They could be derived using the observed inflation gap or a notional gap based on the above model. The advantage of the latter approach is that;

- The method of simulating long-term inflation forecasts for the entire 1963-2005 would be consistent.

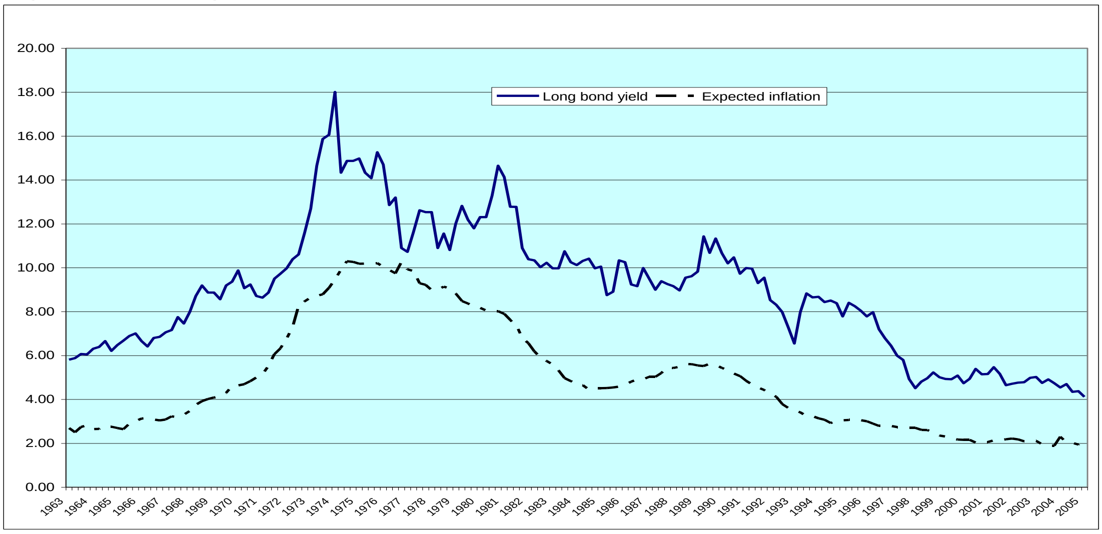
- Any market distortions caused, in particular, by periods of illiquidity in the index-linked market would be smoothed. Figure 6.2 shows this smoothing effect.

This second approach was therefore adopted. However, whilst the simulated inflation expectation derived in this way was used for the entire period of analysis, the actual observed value of the inflation gap was used to simulate the inflation risk premium values for the period 1981-2005. In other words, the inflation risk premium values for 1981-2005 were given by:

Observed conventional bond yield – observed index-linked yield – simulated inflation expectation

This ensured that simulated and observed values knitted together.

Figure 6.3 Long bond yields –v- inflation expectations



A by-product of using the above model to simulate the required inflation components for the period prior to 1982 is that implied real rates of interest could be derived for the period by subtracting the notional inflation gap from the conventional long bond rate prevailing at any point. The full simulation is shown in Appendix 2, Table B. The results, as shown in Table B and, more specifically, the inflation expectation trends shown in Figure 6.3 appear both plausible and realistic.

6.3.2 Simulating long-term real dividend growth expectations

Two key assumptions are made in simulating long-term real dividend expectations:

(a) There is a significant negative correlation between equity yields and expected long-term, real dividend growth (as predicted by the Gordon growth model). Indeed, it is assumed that there is a simple one-for-one negative relationship. A rise of 1% in real growth expectations would result in a fall of 1% in equity yields, all other variables remaining constant and assuming no change in investors' expected returns. Conversely, a fall of 1% in real growth expectations can be expected to result in a rise of 1% equity yields, all other variables remaining constant.

(b) Long-term real dividend growth expectations at any time are moulded by past experience, short and medium-term expectations or a combination of the two.

A range of predictor variables is assembled therefore in order to explain the variation in equity yields over the 1963-2005 period. The historical yield for the FTSE All-Share Index is then regressed against each of these predictor variables. The results are shown in Table 6.9.

In this case, it is the 15 year trailing average, 15YAVEDG, which displays the greatest (negative) co-movement with the equity yield. Whilst the 5 year window again shows a statistically significant relationship, it does not appear to have the same influence as the equivalent inflation window has on the long bond yield.

The most significant variable, 15YAVEDG, ranges in value from -2.6% to 5.1%, arguably too wide a range to be regarded as a realistic indicator of long-term expectations. A Minitab stepwise regression was therefore undertaken incorporating all the variables to see if a combination of variables could provide a stronger and more realistic explanation of equity yield variation.

The following resulted:

Equity yield = 6.646 – 0.512*15YAVEDG – 0.306*10YFORDG - 0.540*30YAVEDG
(-8.88) (-5.90) (-3.22)
+0.055*5YAVEDG
(2.16)

$R^2 = 0.358$

Table 6.9 Real dividend growth analysis

		Regression results				
		t-stat	**R^2**	**Ave**	**Min**	**Max**
30YAVEDG	30 year trailing average	-1.077	0.007	1.6	0.6	2.9
20YAVEDG	20 year trailing average	-6.353	0.191	1.9	-1.2	4.7
15YAVEDG	15 year trailing average	-6.974	0.221	1.8	-2.6	5.1
10YAVEDG	10 year trailing average	-6.036	0.176	1.7	-4.4	6.2
5YAVEDG	5 year trailing average	-3.511	0.067	1.4	-5.9	9.5
5YWINDG	5 year window (3 trailing, 2 forward) average	-2.829	0.045	1.2	-5.9	9.5
10YWINDG	10 year window (5 trailing, 5 forward)	-1.531	0.034	1.3	-4.4	6.2
20YWINDG	20 year window (10 trailing, 10 forward) average	-4.073	0.060	1.6	-1.2	4.0
10YFORDG	10 year forward average	1.922	0.064	1.6	-4.4	6.2
15YA10YF	Weighted average value	-8.560	0.296	1.7	-0.5	3.9

The results of the stepwise regression showed that the first two variables, 15YAVEDG and 10YFORDG, explained most (32%) of the co-movement identified; the remaining two variables explained only a further 4%. For ease of interpretation, therefore, it was decided to confine the final explanatory model to the first two variables. Confining the regression to these variables gave the following result:

Equity yield = 5.465 -0.396*15YAVEDG – 0.171*10YFORDG
(-8.80) (-4.62)

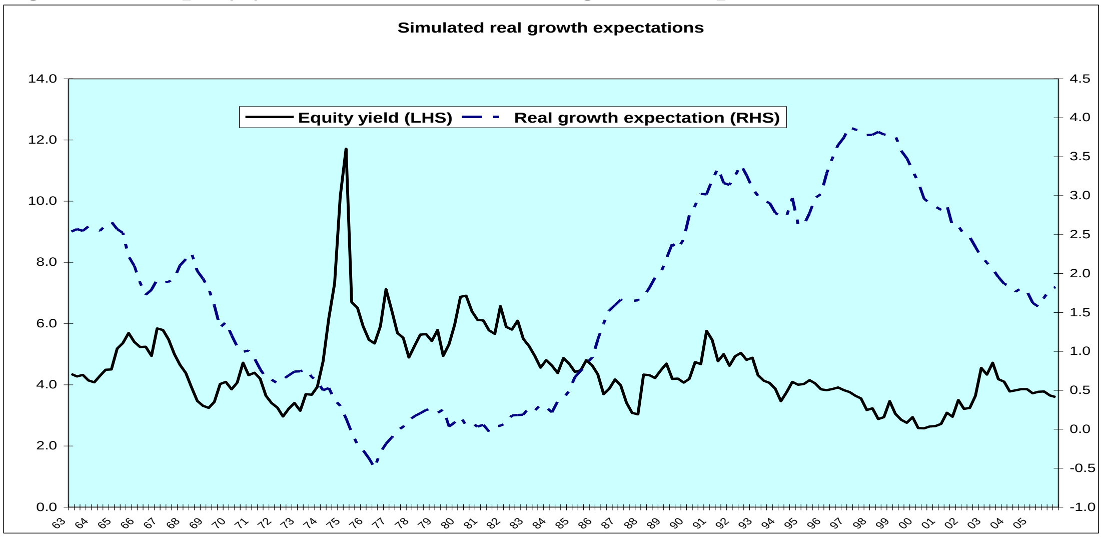
$R^2 = 0.317$

The final step is to construct a new composite series (15YA10YF) by weighting the two predictor variables according to their regression weights. This composite measure is assumed to represent a realistic measure of long-term growth expectations at any point in the past. The relationship between equity market yield and this composite indicator is:

$$\text{Equity yield} = 5.4673 - 0.559*15YA10YF$$
$$(-8.560)$$
$$R^2 = 0.296$$

The full history of this series is shown in Appendix 2, Table B and is illustrated in Figure 6.4.

Figure 6.4 Equity yield –v- simulated real growth expectation



Some interpretation is necessary as to how the addition of the 10 year forecast average, for which the actual average growth experienced is being used as a surrogate, appears to improve the explanatory power. A closer analysis of the data for the period suggests that real growth displays long cyclical trends and is mean-reverting. Relatively high growth gradually declines and tends to be followed by lengthy periods of relatively poor growth, and vice versa. If, for instance, subsequent 10 year growth (10FORDG) is regressed on the most significant indicator identified, the previous fifteen year average (15AVEDG), the following negative relationship is found:

$$10FORDG = 3.045 - 0.851*15AVEDG$$
$$(\text{t-stat} = -13.636)$$
$$R^2 = 0.521$$

The inclusion of both variables in the final predictive model for real growth appears to establish a more balanced picture of what very long term expectations might have been. It could be argued that perfect ten year forecasts would not have been available historically and therefore it is unrealistic to use them in an expectations model. However, this analysis indicates that investors do somehow adjust for likely long-term trend reversal. In the absence of any alternative, objective method of reflecting this perceived behaviour of investors, therefore, it was concluded that a series based on both trailing and subsequent growth experiences was justified and would provide a superior and more realistic simulation of long-term expectations.

6.3.3 Simulating expected returns and ex-ante equity risk premia

All the building blocks are now in place to derive historical values for expected equity returns and ex-ante equity risk premia. It is useful to stress that the first, and main, analysis presented here shows the "implied ERP" at any time. In other words, the residual element on offer in the equity market after all other factors have been taken into account.

Later in the discussion, the results of two supplementary analyses are presented. Firstly, a simulation of the risk/return profile of the equity market under the assumption that the premium required by investors remains constant over time. Secondly, a simulation of the market's risk/return characteristics if the assumed premium is permitted to vary within a "realistic" band. We begin, however, by examining the expected returns and the "implied" premia available historically.

As was discussed at the start of this chapter, the expected equity return at any time is given by the Gordon growth model:

EER = EDY + EIR + ERDG

where:
EER = Expected nominal equity return
EDY = Expected UK market dividend yield (year 1)
EIR = Expected long-term inflation rate
ERDG = Expected long-term real dividend growth rate.

Historical values were therefore derived making use of the values simulated for long-term real dividend growth and inflation expectations.

Expected equity returns averaged 11.4% over the period analysed, the maximum level of 22.4% being achieved at end 1974 and the lowest level, 6.8%, occurring several times during 2005. Most importantly, the standard deviation in expected annual returns is measured at just 3.2%, which is considerably lower than the standard deviation in ex-post returns.

Figure 6.5 Expected returns (end year)

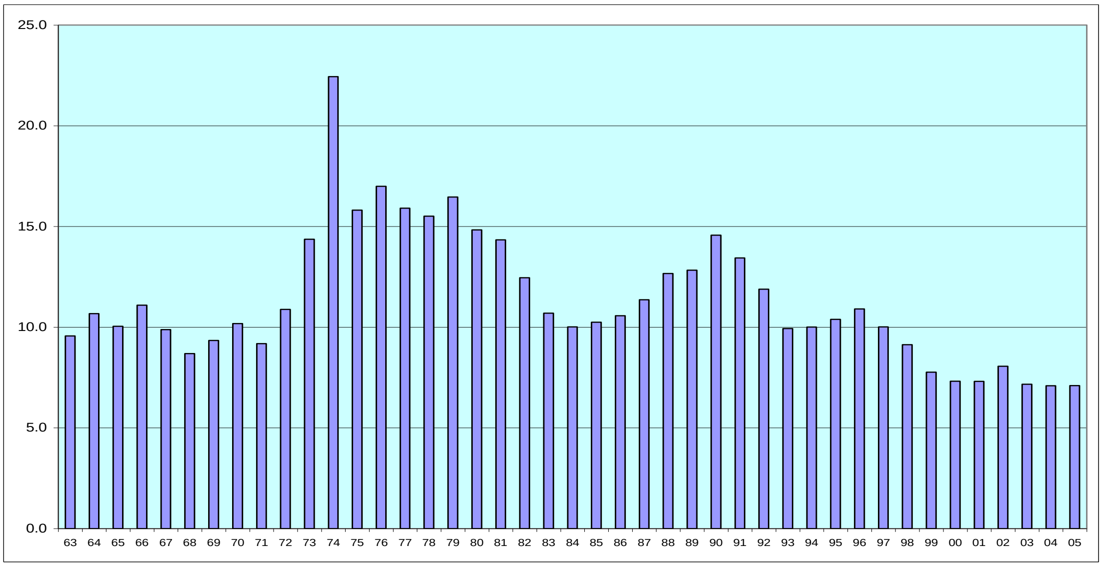
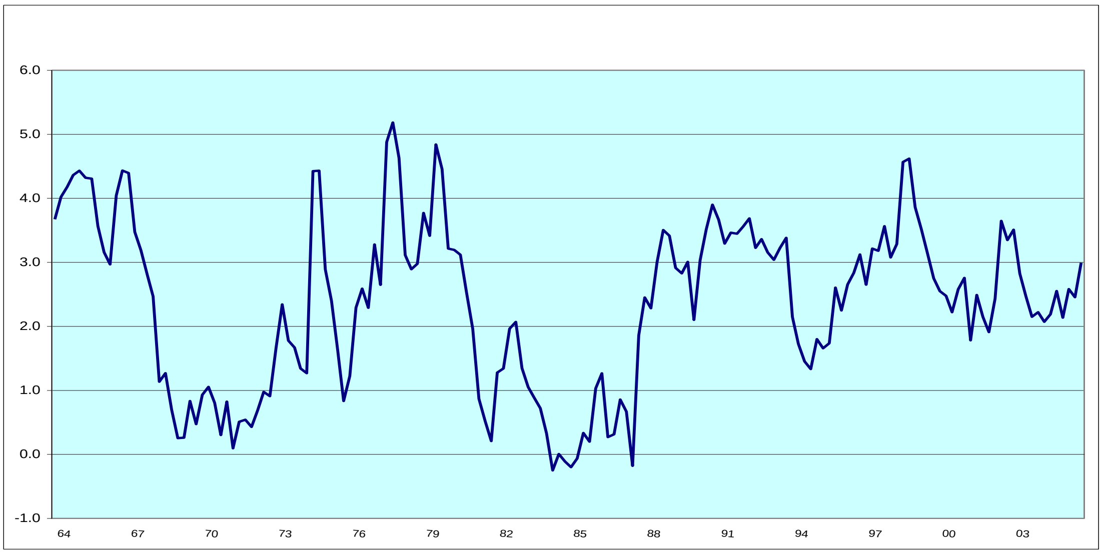


Figure 6.6 The ex-ante equity risk premium



The ex-ante equity risk premium at any point can be derived by subtracting the risk-free rate (the prevailing $2^1/_2$% consols yield) from the simulated expected equity return. The arithmetic-average value for the ex-ante equity risk premium was found to be 2.5% p.a., well below the ex-post average of 5.5% p.a. for the period analysed.

Table G in Appendix 2 provides a complete analysis of how this difference of 3 percentage points arises:

- A windfall average return of 1.5% p.a. arising from unexpected dividend growth.
- A positive re-rating effect which averaged 3.4% pa.
- Less: an unexpected, average bond return of 1.9% pa. (see Appendix 2a, Table F – bond returns averaged 10.8% p.a. compared with an average expectation of 8.9% p.a.).

The following discussion explains in more detail how the first two of these elements arise.

(i) If the dividend yield remains constant, then it can be assumed that capital performance will match dividend growth. However, if there is unexpected growth in dividends then:

unexpected dividend growth effect = unexpected capital performance + unexpected dividend yield

$$= ADG - EDG + ADY_0(ADG - EDG)$$

where: ADG = actual dividend growth during the year
EDG = dividend growth for the year expected at the start of the year
ADY_0 = actual historic yield at the start of the year

(ii) if there is an unexpected change in rating (i.e. dividend yield), then there will also be an unexpected capital gain:

unexpected re-rating effect = $(1 + ADG)(ADY_0/ADY_1 - 1)$

where: ADY_1 = actual historic yield at the end of the year

The following example illustrates the mathematics behind these components.

Example

The start-of-year data/expectations for a stock market index are:

Index level (I_0) = 1200.00
Dividend yield (ADY_0) = 5.00%
Notional aggregate dividend = (1200.00)(0.050) = 60.0
Expected aggregate dividend growth for year (EDG) = 10%

Expected total return = expected capital performance + expected dividend yield
= 10% (assuming unchanged equilibrium dividend yield)
+
5.00(1.1)
= 15.5%

If we assume that the equilibrium dividend yield shifts over the course of the year from 5.00% to 5.50%, despite 20% growth in aggregate dividends (ADG), then the end-of-year picture is:
Dividend yield (ADY_1) = 5.50%
Notional aggregate dividend = 60.0(1.2) = 72.0
Index level (I_1) = dividend/dividend yield = 72.0/0.055 = 1309.09
Actual total return = actual capital performance + actual dividend yield
= $(I_1/I_0 - 1) + ADY_0(1 + ADG)$
= 9.1% + 5.00(1.2)
= 15.1%

The actual return can be decomposed into the following elements:

(i) the expected return (15.5%)
(ii) the unexpected dividend growth effect
= $(ADG - EDG) + ADY_0(ADG - EDG)$
= 10% + 5.00(0.1) = 10.5%
(iii) the unexpected re-rating effect
= $(1 + ADG)(ADY_0/ADY_1 - 1)$
= (1.2)(5.00/5.50 – 1)
= -10.9%

Thus the actual return = 15.5 +10.5 – 10.9 = 15.1%

6.3.4 Decomposing the re-rating effect

The annual re-rating effect – that is, the return caused by an unexpected change in dividend yield - can, in turn, be broken down into its components, viz:

- The effect of a change in real interest rates. A rise in real interest rates will push yields up; a fall will push yields down.
- The effect of a change in long-term real growth expectations. Rising expectations will push yields down; falling expectations will push yields up.
- The effect of a change in inflation risk premium requirements. A rise in the premium will push yields up; a fall will push yields down.
- The effect of a change in equity risk premium requirements. A rising risk premium requirement will push yields up; a falling requirement will push yields down.

The methodology used to attribute the total effect in any year is as follows. As shown above, the unexpected re-rating effect is given by:

$$\text{Total re-rating effect} = (1 + ADG)(ADY_0/ADY_1 - 1)$$

where: ADG = actual dividend growth in any year
ADY_0 = actual dividend yield at the start of the year
ADY_1 = actual historic yield at the end of the year

In other words, the effect of the change in dividend yield adjusted by a dividend growth factor. In any year, therefore, the total re-rating was apportioned to each of the four components according to:

$$\text{Total re-rating effect} \times \frac{\text{Yield change associated with component}}{\text{Total yield change}}$$

The results for 1975 – the year of recovery following the 1972-1974 bear market – offer an extreme example of market performance but can be used to illustrate clearly the method of apportionment adopted.

The dividend yield on the UK equity market fell by 6.24% during 1975, from 11.71% to 5.47%. The decomposition presented here has attributed this fall as follows:

Real interest rate effect	-3.58%
Real growth effect	0.47%
Inflation risk premium effect	0.16%
Equity risk premium effect	-3.28%
	-6.24%

This fall in yield, combined with the dividend growth factor (1975 dividend growth was 10.4%), produced a total re-rating return of:

(11.71/5.47 – 1)(1.104) = 125.9%

This return was then apportioned to changes in each of the four components as follows:

Real interest rate return =	125.9*(-3.58/-6.24) = 72.2%
Real growth return =	125.9*(0.47/-6.24) = -9.4%
Inflation risk premium return =	125.9*(0.16/-6.24) = -3.2%
Equity risk premium return =	125.9*(-3.28/-6.24) = 66.3%
	125.9%

Table E in Appendix 2a shows these detailed results for the whole period examined. The annual average re-rating effect was found to be 3.45%. This can be apportioned to changes in the four components as follows:

Average real interest rate return	= 2.28%
Average real growth effect	= -0.74%
Average inflation risk premium return	= -0.79%
Average equity risk premium return	= 2.70%
	3.45%

It should be noted that this result is similar to that obtained by Fama and French (2002) from their analysis of the US equity market between 1951 and 2000. They concluded that unexpected capital gains were enjoyed over that period as a result of a decline in expected stock returns, the latter manifesting itself in a significant fall in equity yield over the period. Vivian (2007) concludes that UK equity investors also enjoyed unexpected capital gains towards the end of the 20th century. His conclusion is that this was due to either expectations of higher growth post 2004 or a decline in the discount rate.

6.3.5 Additional volatility

This thesis is a study of changes over time in the returns expected by investors in equities, including an analysis of the causes of those changes and the impact of such changes. Volatility is partly caused by changes in expected return. However, additional volatility is also experienced as a result of unexpected factors.

Table 6.10 Return decomposition

	Annual average (%)	Associated volatility (%)
Expected return	**11.4**	**3.2**
<u>Contributions from:</u>		
Unexpected dividend growth	1.5	6.3
Change in real rates of interest	2.3	22.9
Change in real growth expectations	-0.7	9.3
Change in inflation risk premium	-0.8	18.7
Change in equity risk premium	2.7	31.0
Actual return	**16.3**	**29.1**
Unanticipated return	**4.9**	
<u>less</u> Unanticipated bond return	**1.9**	
Unanticipated equity risk premium	**3.0**	

Note: Unexpected dividend growth contribution reflects average capital performance and yield that results from actual dividend growth varying from expectations Contributions from changes in other variables reflect the average capital effects of outcomes varying from expectations (see text for full discussion).

Table 6.10 summarises the annual effect that specific components have on equity returns and the volatility associated with each. The volatility is measured as the standard deviation in the return components that can be attributed to each factor. (The annual average components can be found in Appendix 2a, Tables, C, E, F and G). Table 6.11 shows the correlation between the return components. Note that there is evidence of negative correlation between some of these unexpected return components which has the result of containing the cumulative volatility associated with these sources. Figures 6.7 and 6.8 also highlight the substantial difference in the volatility of actual returns compared with that of expected returns (charts of each of the components are shown in Appendix 3).

As Table 6.10 indicates, changes in the equity risk premium available in the equity market would appear to represent a significant proportion of overall volatility. However, negative correlation between the returns generated by movements in the ex-ante equity risk premium and returns generated from changes in other expectations, suggests that the expected return adjustment process within the equity market is highly complex.

Table 6.11 Correlation between unexpected return components

	DG	RR	RGE	IRP	ERP
Dividend growth (DG)	1.000	0.074	0.561	-0.026	-0.303
Real rates of interest (RR)	0.074	1.000	-0.051	0.057	-0.144
Real growth expectations (RGE)	0.561	-0.051	1.000	0.180	-0.450
Inflation risk premium (IRP)	-0.026	0.057	0.180	1.000	-0.594
Equity risk premium (ERP)	-0.303	-0.144	-0.450	-0.594	1.000

Figure 6.7 Expected annual returns

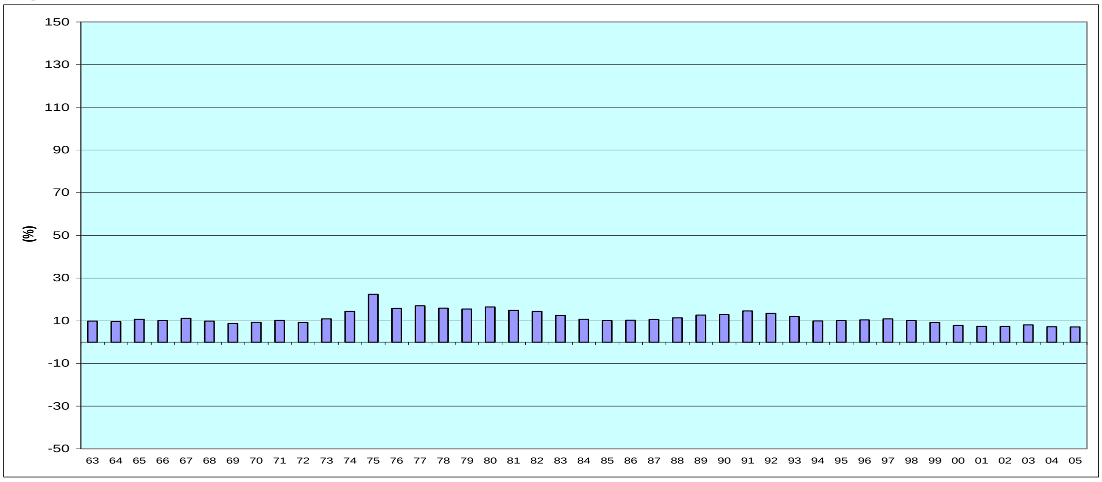
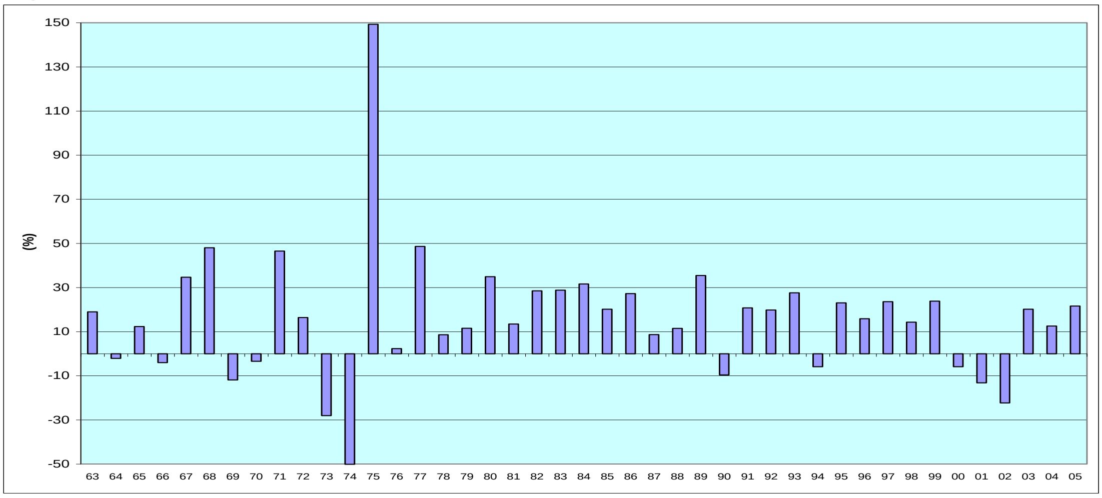


Figure 6.8 Actual annual returns



Traditional financial market theory suggests that the equity risk premium will widen in deteriorating economic conditions – thus providing greater potential returns – and narrow when conditions are improving. Thus, declining expectations regarding future economic growth or expectations of rising interest rates would normally be associated with falling stock market prices.

The results obtained in this analysis, however – notably the negative correlation between the returns caused by changes in risk premium requirements and returns caused by other factors - suggest that this phenomenon is not necessarily observed in practice.

6.3.5 Fixed equity risk premium simulation

Another approach to investigating the impact of changes in the ex-ante equity risk premium on overall volatility is to examine the results if no changes had occurred in the ex-ante equity risk premium. In other words, we assume that investors and markets have reacted to changes in other expectations but have maintained a fixed, constant ex-ante equity risk premium. In this case, the long-term average risk premium of 2.5% was assumed. The actual dividend growth experienced over the period was also used in simulating how the market would have behaved.

Such an exercise was carried out for the 1963-2005 period, making use of the simulation results previously obtained. The procedure therefore was:

(a) the first year expected dividend yield at any point was derived using the relationship discussed at the start of this section, namely:

EDY = ERP +RRR + IRP – ERDG

where: EDY = Expected first year dividend yield
ERP = Expected (ex-ante) equity risk premium (fixed at 2.5%)
RRR = Real rate of return available
IRP = Required inflation risk premium
ERDG = Expected long-term real dividend growth rate.

The observed, historic dividend yield (HDY_0) can then be derived as:

HDY_0 = EDY/(1 + NDG)

where: NDG = First year expected nominal dividend growth

(b) The total return earned from the equity market over any twelve month period was then calculated from:

First year dividend income (yield) + achieved capital performance

These components can be derived from:

First year dividend income = HDY_0(1 + actual first year dividend growth)

Capital performance = HDY_0/HDY_1(1 + ADG)-1

where: HDY_1 = The historic divided yield projected for the end of the period
ADG = The actual dividend growth experienced over the period.

(c) The procedure of decomposition used in the main analysis was also applied in this secondary exercise, thus breaking down the (simulated) observed equity return into:

- The expected return
- Unexpected return due to unexpected dividend growth
- The unexpected return due to a change in real interest rates
- The unexpected return due to a change in long-term real growth expectations
- The unexpected return due to a change in inflation risk premium requirements

In this case, of course, there is no unexpected return attributed to changes in the equity risk premium.

As the results in Table 6.12 indicate, the results are fairly dramatic. In particular, the simulation suggests that declining real rates of interest – especially over the past fifteen years – should have resulted in even greater unexpected returns from equities than actually experienced. Additionally, significant changes in real rates of interest and inflation risk premium requirements should have resulted in volatility much higher than actually observed.

Table 6.12 Return decomposition (Fixed equity risk premium)

	Annual average (%)	Associated volatility (%)
Expected return	**11.4**	**3.2**
Contributions from:		
Unexpected dividend growth	1.5	6.3
Change in real rates of interest	7.5	40.4
Change in real growth expectations	-0.3	10.3
Change in inflation risk premium	3.7	31.2
Simulated return	**23.8**	**65.7**
Unanticipated return	**12.4**	
less Unanticipated bond return	**1.9**	
Unanticipated equity risk premium	**10.5**	

6.3.7 Mispricing or mean-reverting assumptions?

The key to understanding why actual, observed market volatility is lower than that indicated in Table 6.12 can be found in Table 6.11, the correlation matrix.

The main analysis estimates the ex-ante equity risk premium as the residual element after decomposing the expected return from equities into its other elements, such as expected real growth and real rates of interest. However, as the correlation matrix shows, our assumed equity risk premium appears to fluctuate in such a way that unexpected returns from that source are negatively correlated with the unanticipated returns from the other sources, a fact that is counter-intuitive. For example, it would normally be assumed that a rise in investor confidence, and a consequent lowering in the risk premium, would accompany a decline in real rates of interest. The analysis above suggests the opposite: a rising risk premium tends to accompany a decline in real interest rates.

This observed phenomenon is open to a number of interpretations:

- The simulations undertaken to produce historical trends in the explanatory variables have produced a false picture of what actually occurred. In other words, the models constructed to simulate ex-ante expectations are unsatisfactory.

- Equity investors assume that trends in the underlying, explanatory variables will always revert to long-term mean levels. In this way, any potentially positive benefits arising when these variables deviate from their long-term norm will tend to be offset by a deliberate increase in equity risk premium requirements, as the analysis shows. Equally, equity investors will tend to lower their risk premium requirements when negative pressures arise from changes in the other explanatory variables.

- There are periods of mis-pricing, in which the equity market is in disequilibrium with the bond market. The analysis undertaken here assumes, for example, that the equity market will tend to be pushed higher by a decline in real interest rates. However, should the equity market fail to react to the decline in rates, then the analysis will falsely conclude that the potentially positive effects of the decline in real interest rates have been offset by a rising equity risk premium.

The third interpretation, if close to reality, suggests important and intriguing implications. Moreover, can such periods of disequilibrium be identified?

Thus far, this study has examined the outcomes under two scenarios:

(a) The main analysis assumed that the equity market reacted rationally to changes in underlying economic circumstances. Movements in the market which could not be explained by such changes were assumed to be caused by changes in equity risk premium demands i.e. the ERP was the residual element of the analysis. As discussed above, however, it may be that the equity market does not always react rationally to economic change and the analysis is therefore distorting any measurement of equity risk premium requirements.

(b) The second analysis looked at what the likely outcome would have been if equity investors' risk premium requirements remained constant and it is assumed that market movements could be attributed solely to changes in the underlying economic circumstances. As discussed above, this analysis suggested that the equity market would have been even more volatile than it was in practice. The weakness in this approach is that the assumption that risk premia remain constant is unrealistic. The risk-averse nature of investors implies that risk premium requirements do rise as underlying conditions deteriorate and fall in improving conditions.

6.3.8 Realistic risk premium assumption

An even more complex analysis is required, therefore, to get a fuller, more realistic, explanation for equity market behaviour. In a third and final analysis, therefore, it is assumed that the equity risk premium requirements of investors do vary within "realistic" limits. The limits chosen are 1.5% either side of the observed mean, 2.5%

(note that the standard deviation in the observed risk premium is 1.44%). In other words, the minimum “realistic” premium sought is 1% and the maximum 4%.

It is assumed further that changes in the required premium will be closely related to the scale and direction of changes in the underlying economic conditions. A rise in risk premium requirements is therefore assumed to accompany rising real interest rates and/or deterioration in the inflation environment and real growth prospects. Conversely, a fall in premium requirements is assumed to accompany declining real interest rates and/or an improvement is the inflation environment and real growth prospects. In other words, equity yields will tend to rise in deteriorating conditions and fall in improving economic conditions.

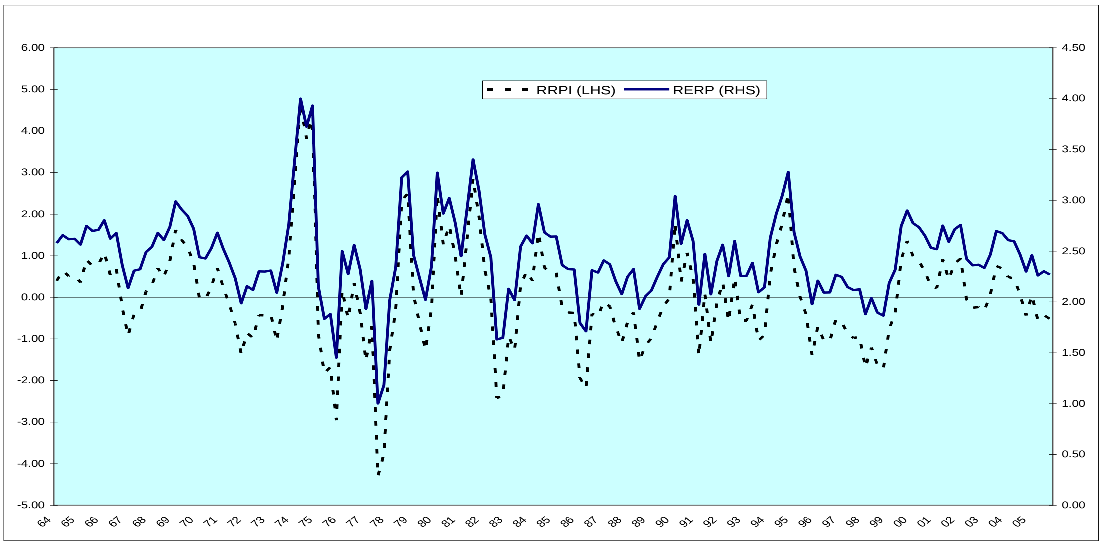
More precisely, a “Realistic Risk Premium Indicator (RRPI)” was monitored for the 1963-2005 period. The RRPI at any point was defined to be the combined impact on the UK equity market dividend yield over the previous 12 month period from changes in real interest rates, the required inflation risk premium and real dividend growth expectations. The RRPI reached a maximum of 4.6% in June 1974 (note from Table B, Appendix 2, a rise in real rates and the inflation risk premium over this period together with a fall of growth expectations) and a minimum of -4.3% in September 1977 (caused by a combination of falling real rates of interest and rising growth expectations).

The RRPI was transformed into a “Realistic Equity Risk Premium (RERP)” range of 1% to 4% using the transformation function:

$$RERP = 0.3359 + 2.4448*RRPI$$

The results are illustrated in Figure 6.9. Thus the maximum RRPI value of 4.63% observed for June 1974 is transformed to a RERP of 4% and the minimum RRPI value of -4.4% observed for September 1977 is transformed to a RERP value of 1%.

Figure 6.9 Realistic equity risk premium



The computations described in 6.3.6. were repeated for this third scenario. In this case, of course, equity yields at any point would additionally have been influenced by changes in the assumed equity risk premium requirement.

Table 6.13 Return decomposition (Realistic risk premium simulation)

	Annual average (%)	Associated volatility (%)
Expected return	**11.4**	**3.4**
<u>Contibutions from:</u>		
Unexpected dividend growth	1.5	6.3
Change in real rates of interest	4.7	21.0
Change in real growth expectations	-0.3	10.0
Change in inflation risk premium	1.5	18.2
Change in equity risk premium	1.4	17.2
Actual return	**20.2**	**39.5**
Unanticipated return	**8.8**	
<u>less</u> Unanticipated bond return	**1.9**	
Unanticipated equity risk premium	**6.9**	

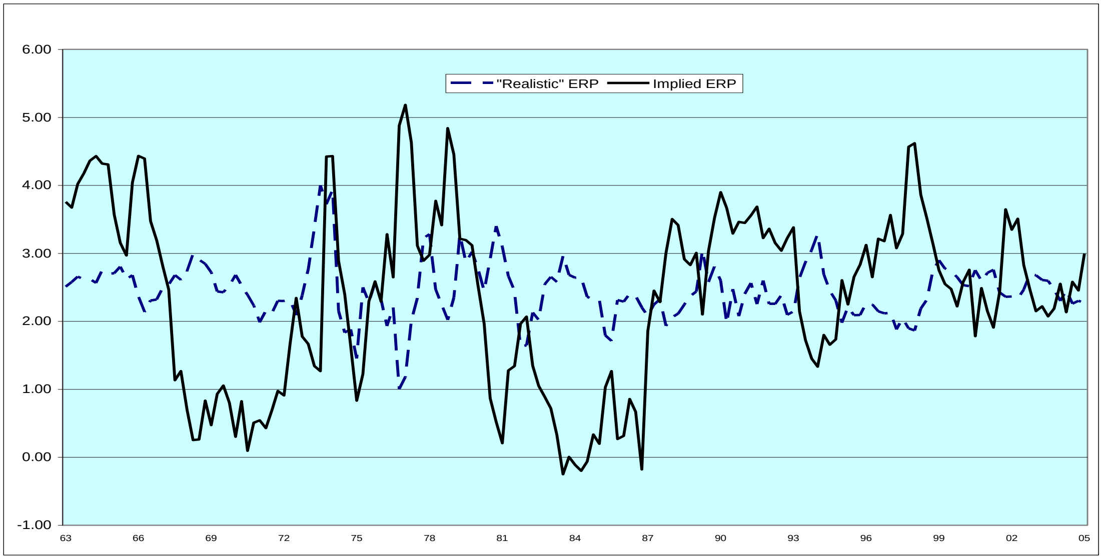
As before, the simulated returns were decomposed to examine the impact of each of the influences. As Table 6.13 shows, the overall volatility of the market would have been higher than actually observed but well below that observed for the fixed risk premium simulation. The key difference in comparison with actual observed equity market volatility is that it is assumed that there is a positive correlation between the impact of changes in the risk premium requirement and the impact of changes in other variables. As discussed previously, the first analysis showed that, over the period of observation, there is a negative correlation between the implied equity risk premium effects and other effects which had the effect of reducing overall volatility.

The main reasons why the second simulation – which assumed the fixed risk premium – produced such a high market volatility was that there were no benefits from such a negative correlation effect, but also because of the geared effect on returns that a constant risk premium assumption produces. For example, during 1977 there appeared to be a very significant decline in real interest rates – long bond yields fell by 4 percentage points against a marginal improvement in the inflation environment. While the equity market received some benefit from this, equity yields fell little more than one percentage point. The initial analysis – which estimates the implied equity risk premium at any point – interpreted this phenomenon as implying that there had been a significant rise in the equity risk premium available. The second analysis however – which assumed a constant 2.5% risk premium assumption – simulated the equity dividend yield as falling from 7.27% to 3.13%, an implied capital gain of 132%.

6.3.9 Over-reaction or under-reaction?

It has been demonstrated that changes in economic fundamentals and expectations can produce significant changes in current asset values, thereby creating significant volatility. The question then arises as to how much of this volatility is "rational" and how much is "irrational". It has also been shown that there appears to be a negative correlation between movements in the implied equity risk premium and movements in other fundamental influences. As a result, a simulation of market behaviour assuming rational changes in risk premium requirements (the third simulation discussed above) suggests that greater volatility would result than is actually observed. One explanation proposed for the negative correlation between the implied risk premium and other factors is not that investors behave counter-intuitively (e.g. they lower risk premium requirements at times of deteriorating conditions) but that there are periods of disequilibrium between the equity market and other financial markets.

Figure 6.10 "Realistic ERP" –v- Implied ERP



In the third scenario described above, the "rational" equity risk premium was confined to a band of 1% to 4%, a lower band than that of the implied equity risk premium. A comparison is presented in Figure 6.10. Whilst there are occasions when the two measures move in the same direction – rising significantly during the 1972-74 bear market, for example - there are many occasions when the two measures move in opposite directions. Indeed, there is a significant negative correlation between the two measures. Assuming that investors are risk-averse, this suggests that much of the movement in the implied risk premium results from the under-reaction by the equity market to changes in the economic environment which, in turn, results in market disequilibrium. In other words, pricing can be irrational

6.3.10 Rational or irrational pricing?

This final analysis examines the predictive ability of the two risk premium measures calculated, the "implied" ex-ante risk premium and the "realistic" risk premium.

The results in the tables 6.14 and 6.15 indicate the predictive ability of each of the measures. The excess returns ([1+equity return]/[1+bond return]-1) earned from equities over subsequent 3, 6 12 and 24 month periods were regressed on each of the measures in turn. Quarterly overlapping observations for the period 1963-2005 were input.

The results indicate:

- There is a positive, statistically significant relationship between the implied equity risk premium and subsequent excess equity returns. The strongest relationships are observed for subsequent 6 and 12 month periods.

- The relationship between the realistic equity risk premium and excess equity returns is largely insignificant and, surprisingly, negative for subsequent periods up to 12 months.

Table 6.14 Excess equity returns (EER)–v- Implied equity risk premium (IERP)

3 months	3m EER = -1.246 + 1.017*IERP (t-stat = 1.94)	R2 = 0.022
6 months	6m EER = -2.470 + 2.023*IERP (t-stat = 2.64)	R2 = 0.040
12 months	12m EER = -2.654 + 2.997*IERP (t-stat = 2.66)	R2 = 0.042
24 months	24m EER = 2.731 + 2.323*IERP (t-stat = 1.54)	R2 = 0.015

Note: Excess equity returns = ((1 + equity return)/(1 + bond return) -1)
Implied equity risk premium is the risk premium derived in the main analysis (See Appendix 2A)

This analysis is extended to analyse performances subsequent to peaks and troughs in each of these indicators. The results are shown in Tables 6.16 and 6.17

Table 6.15 Excess equity returns –v- Realistic equity risk premium (RERP)

3 months	3m EER = 4.611 - 1.415*RERP (t-stat = -0.86)	R2 = 0.001
6 months	6m EER = 9.012 - 2.746*RERP (t-stat = -1.13)	R2 = 0.008
12 months	12m EER = 6.863 - 1.009*RERP (t-stat = -0.28)	R2 = 0.001
24 months	24m EER = 0.955 + 2.956*RERP (t-stat = 0.63)	R2 = 0.002

Note: Excess equity returns = ((1 + equity return)/(1 + bond return) -1)
Realistic risk premium (constrained to the range 1% to 4%) is inversely proportional to the change in equity dividend yield experienced over trailing 12 months which arises through the combined impact of changes in real rates, the inflation risk premium and growth expectations.

Tables 6.16 and 6.17 indicate:

- Exceptional, positive excess equity returns subsequent to the "implied ERP" indicator reaching exceptionally high levels. Equally, very poor excess returns are obtained subsequent to exceptionally low levels of the indicator. Prime examples of these phenomena are the periods following the trough in the 1973-4 bear market in December 1974 and the Crash experienced from Black Monday onwards in October 1987.

- The "realistic ERP" indicator appears to be a very poor predictor of subsequent excess performance, even at its extreme levels. Indeed, the results are counter-intuitive, suggesting that there are leads and/or lags in the process that have not been identified or that the model used to construct the "realistic ERP" is flawed.

Table 6.16 Excess returns following peaks/troughs in "Implied ERP"

Date	Implied ERP	3 months	6months	12 months	24 months
		……..Subsequent excess returns……….			
Q4/66	4.43	-0.1	14.8	34.2	109.1
Q2/71	0.09	0.5	4.9	19.5	16.2
Q4/74	4.43	38.2	52.2	80.7	57.2
Q4/75	0.83	-2.5	-11.4	-13.1	-16.1
Q4/77	5.18	2.2	11.9	12.4	6.4
Q3/87	-0.18	-32.4	-34.8	-30.9	-15.6
Q4/88	3.51	12.3	20.8	32.3	16.2
Q4/94	1.33	-2.7	2.4	1.9	9.1
Q4/98	4.62	14.7	19.7	31.2	11.1
Q2/01	1.78	-18.6	-12.5	-22.5	-38.1
Q1/03	3.51	13.6	21.3	24.2	35.3
Average (following peaks)		**13.5**	**23.5**	**35.8**	**39.2**
Average (following troughs)		**-11.1**	**-10.3**	**-9.0**	**-8.9**

Note: Excess equity returns = ((1 + equity return)/(1 + bond return) -1)

Implied equity risk premium is the risk premium derived in the main analysis

6.4 RETURN DECOMPOSITION: SOME CONCLUDING REMARKS

The aim of this analysis has been to model the ex-ante equity risk premium evident in the UK equity market. The results indicate that, over the period analysed, the ex-ante risk premium averaged some three percentage points less than the premium subsequently experienced. This unexpected premium has been analysed and attributed to changes in a number of economic variables.

Unexpected changes in fundamental driving variables have also resulted in high volatility of returns. Likewise, contributions to this increased volatility have been analysed and attributed.

Perhaps the most significant and intriguing element of the analysis, however, is the suggestion of a negative correlation between the "implied" equity risk premium and other driving variables. This finding raises the question as to whether the "implied

ERP" being measured reflects not only changes in the risk aversion of investors but also captures irrational pricing.

Table 6.17 Excess equity returns following peaks/troughs in "Realistic ERP"

Date	"Realistic" ERP	……..Subsequent excess returns………. 3 months	6months	12 months	24 months
Q1/69	2.99	-9.8	-15.5	-17.7	-17.8
Q4/71	1.99	13.9	13.9	22.4	-0.5
Q2/74	4.00	-27.2	-30.0	6.5	12.1
Q4/75	1.45	-2.5	-11.4	-13.1	-16.1
Q3/76	2.50	6.3	6.1	10.6	21.6
Q3/77	1.00	-7.2	-5.1	10.0	-0.2
Q4/78	3.28	3.6	0.7	-5.3	16.5
Q3/82	1.63	-0.6	5.2	9.7	25.2
Q1/90	3.04	-3.3	-16.8	-9.5	-17.5
Q1/91	1.97	-1.5	-1.4	-8.9	-12.4
Q4/94	3.28	-2.7	2.4	1.9	9.1
Q4/98	1.87	14.7	19.7	31.2	11.1
Average (following peaks)		**-5.5**	**-8.9**	**-2.3**	**4.0**
Average (following troughs)		**2.8**	**3.5**	**8.6**	**1.2**

Note: Excess equity returns = ((1 + equity return)/(1 + bond return) -1)
Realistic risk premium (constrained to the range 1% to 4%) is inversely proportional to the change in equity dividend yield experienced over trailing 12 months which arises through the combined impact of changes in real rates, the inflation risk premium and growth expectations.

CHAPTER 7 - CONCLUSIONS

7.1 A VARYING RISK PREMIUM

Investors accept that there is uncertainty, or risk, associated with equity investment returns. On average, over the long-term, equities are expected to provide a premium over and above the returns available on risk-free assets. Moreover, long histories of returns provide evidence that such a premium is achieved.

Equity returns, however, are cyclical. There can be long periods when equity returns greatly exceed risk–free returns; there can be long periods when the premium disappears altogether.

This thesis has explored the influences and driving forces in equity markets, with a particular emphasis on the UK equity market. Both rational and irrational influences have been examined and discussed. It is certainly not the author's contention that many of the puzzles that have confronted equity market researchers over recent decades have now been resolved. It is to be hoped, however, that a further, useful platform has been built from which further investigation and analysis can be taken forward.

7.2 GENERAL REVIEW

Chapter 2 of the thesis explored previous work related to the broad issues under investigation. In so doing, the spotlight inevitably fell on the concepts of information efficiency and valuation rationality, concepts that have been keenly debated by both academics and practitioners over the past forty years.

7.2.1 Challenges to the Efficient Market Hypothesis

Testing of the weak and semi-strong forms of the Efficient Market Hypothesis (EMH) has shown that it is difficult to earn abnormal stock market returns consistently by using publicly available information. Indeed, studies show that even expert, professional investors, on average, underperform stock market benchmarks. Tests of the strong form of the EMH are more difficult to interpret in view of legal and regulatory constraints on practitioners but the evidence suggests that stock markets are not efficient in the strong form.

Challenges to the Efficient Market Hypothesis have been mounted over the past three decades, however, following the identification of anomalies that appeared to suggest that prices do not always follow a random walk. Indeed, claims emerged that prices are mean-reverting and that returns could be predicted by using, for example, dividend yield as a simple predictor variable or by employing shorter-term momentum strategies.

Further questioning of the EMH arrived in the 1970s and early 1980s in the form of variance testing and variance bounds analysis. The claim was that security prices appear to be far more volatile than is justified by the volatility of underlying earnings and dividends, suggesting that investors behave irrationally. Shiller (1981) was at the forefront in such attacks and his arguments are presented in Chapter 2 in the form of a simulation of the volatility witnessed in the UK equity market.

The concept of “rationality”, therefore, has become a focus of the challenge to the EMH. And behavioural finance has drawn on the work of cognitive psychologists, such as Taversky and Kahneman (1974, 1981, 1986) in identifying and explaining investors’ beliefs, preferences and expectations. A number of factors are evident, behavioural finance suggests, which indicate that investors do not always behave rationally. Indeed, it could be argued that, in today’s competitive environment, the “rational” or “least risky” investment strategy to pursue might well be that being pursued by the majority of competitors, whether or not one believes that the majority’s course of action is fundamentally justified.

The 1995-2000 period, which witnessed the phenomenon of the dot-com bubble, could be identified as one period when such behaviour was evident. Anecdotal evidence suggests that it was a widely held view amongst professional managers at that time that stocks in the dot-com sector were being priced irrationally. Moreover, that apparent mis-pricing was exacerbated by the buying demand from private investors. To be underweight significantly in the sector, however, would have, and did, present considerable risks. Even long-term funds, such as pension funds, have their performance measured – both in absolute terms and in relation to their peer group – every three months!

Another plank of the efficient market hypothesis – that arbitragers will ensure that deviations from "true" fundamental analysis - has also from time to time been sorely tested, none more so than at present as a result of the "credit crunch" within the banking system. In such an environment, where there is no guarantee that highly-leveraged positions will be financed indefinitely – even if they represent supposedly perfect arbitrage opportunities – there will be occasions when pricing anomalies are sustained for significant periods.

7.2.2 The equity risk premium

Chapter 2 also introduced a discussion of the equity risk premium, the annual return earned on ordinary shares over and above the risk-free rate. The assumed level of the premium is important in many financial assessments including the cost of equity capital and long-term actuarial assumptions.

For many years, following the initial studies of Ibbotson and Sinquefield (1976) in the US and Dimson and Brealey (1978) in the UK, academics and practitioners were advised to assume that the equity premium is of the order of 6% - 9% per annum.

Since those initial studies, many researchers have questioned the "equity risk premium puzzle" – why the historical premium was so high. More importantly, the justification for using ex-post assessments of the premium has also been questioned, particularly in view of the forward-looking nature of the applications in which the premium is used. All the analyses that have attempted to measure historical ex-ante measures of the risk premium have concluded that ex-ante estimates are significantly lower than ex-post measures. Thus, it is dangerous to base future expectations of the equity risk premium on historical, achieved experiences.

7.2.3 Important implications

Chapter 2 concluded with three important observations**:**

(a) It is dangerous to extrapolate from past experiences. Financial markets are driven by expectations.

(b) Expected equity returns, as well as achieved outcomes, can vary significantly over time.

(c) Small changes in expected equity returns can result in significant short-term variation in equity values.

These three observations formed key considerations in the empirical studies that were undertaken and presented in Chapters 3 to 6 of the thesis.

7.3 THE MACRO APPROACH

The first of the empirical studies undertaken, as described in Chapter 3, examined the relationship between equity markets and underlying macro-economic variables.

If it is assumed that equity prices reflect the present value of all future, expected dividends – and this assumption is adopted throughout the thesis – then we should expect equity returns to reflect changes in both growth expectations and required discount rates.

It is surprising that, given this fundamental relationship, research into the nature of the systematic factors driving the market has been relatively limited. Historical studies tend to agree, however, that there is a negative correlation between expected equity returns and anticipated business conditions. In particular, yields rise and default terms widen in anticipation of deteriorating conditions; yields fall and default terms narrow ahead of improving conditions.

The greatest methodological problem, recognised by most researchers in this area, is that, in the main, any analyses are dependent on ex-post macro-economic data, rather than expectational data. However, some studies, notably Lovatt and Parikh (2000), did duplicate analyses that had previously been carried out using ex-post data by making use of historical forecasts. The relationships between equity returns and changes in the historical forecasts tended to be less significant than those found using the ex-post variable data.

7.3.1 A new analysis of UK equity market returns, 1963-2003

Chapter 3 presented a new analysis of UK equity market returns using the approach adopted by Fama (1990) for his analysis of the US equity market. Unlike previous studies of UK market returns – notably that of Lovatt and Parikh (2000) – the period analysed was not confined to one of relative calm under a single government, but embraced diverse cyclical swings in economic and market conditions. The range of market and macro-economic indicators was also extended. Some of these additional indicators were found to be statistically meaningful; the inclusion of long interest rates, in particular, was found to be very significant.

The indicators were broken down into three categories: standard predictors of return variation such as dividend yield; shocks to the discounting process, such as unexpected changes in interest rates; and shocks to future expected cash flows, such as unexpected changes in economic activity. Quarterly, annual non-overlapping and annual overlapping variations in equity returns were analysed.

Changes in dividend yield, shocks to long-interest rates and shocks to levels of industrial production were found to be the best indicators of variation in equity returns. In the case of anticipated levels of economic activity, the equity market tended to lead by a full year. Multi-factor combinations of the indicators were found to explain approximately 50% to 70% of return variation.

These are re-assuring results which confirm that, in the main, the equity market is driven by expectations for the macroeconomic environment. They also fit neatly with Gordon's equity discount model, which provides the framework for the analyses presented in Chapters 5 and 6. Rises in risk premium requirements and interest rates, for example, can by viewed as rises in the discount rate, which would push equity prices down and dividend yields up. Subsequent returns will be above-average if and when premium requirements return to normal. Equally, a lowering of expectations regarding future economic activity can be viewed as a negative influence on the numerator in the discounting process.

This analysis of the linkages between the equity market and macro-economic factors benefited from the use of ex-post data. Thus, it was assumed that investors had perfect foresight. It is likely that less of the variation in returns would have been explained if relevant ex-ante data had been available and used.

7.4 MARKET VOLATILITY

Chapter 4 explored the nature of equity market volatility and its predictive capabilities. Past studies have shown that, although statistical measures of volatility are important elements in financial market modelling – in option pricing, for example - such measures are not reliable indicators of future expected returns. Furthermore, no significant correlation has been found between stock market volatility and macro-economic variability.

Studies of stock market volatility in the UK are limited in number and scope compared with those in the US. This thesis therefore contributes a wide-ranging investigation into key aspects of UK stock market volatility over a relatively long period.

An analysis of UK equity market volatility over the period 1963-2003 has been presented. Clustering in return volatility is a well-documented feature in many financial markets and the analysis shows that the UK equity market is no exception. It is for this reason that ARCH and GARCH models have become popular tools for use in studies of this type. Indeed, a GARCH (1,1) model was found to provide a sound description of historic trends in UK equity market volatility over the period in question.

Standard finance assumes a positive relationship between expected return and risk, where risk is commonly represented by standard deviation or variance. A range of predictors, which incorporated historic measures of volatility, was tested, therefore, for ability to predict subsequent excess returns. No predictor achieved results that were statistically significant. A significant, negative relationship was found, however, between contemporaneous measures of volatility and excess returns. The GARCH model established further that the key element of this contemporaneous relationship was a strong linkage between excess returns and unanticipated volatility.

The relationship between market volatility and the volatility of macro-economic variables was also examined. Only limited relationships of statistical significance were found.

Expected returns must be judged against prospective volatility. But what the analysis described here demonstrates is that past volatility provides only a limited guide to future volatility and future returns. An important conclusion must be that we should continue to strive for better predictors of potential risk and rewards.

The following definition is attributed to Elroy Dimson of the London Business School (cited in Maginn et al, 2007, p xiv): *"Risk means more things can happen than will happen"*. In other words, it is often very difficult to assess the range and nature of possible outcomes. But a failure to do so could have very damaging consequences. Recent experiences in financial markets suggest that many of our traditional measures of risk, such as standard deviation, and our assumptions regarding the distribution of potential equity returns, are only of limited use.

7.5 A PARTIAL DECOMPOSITION OF EXPECTED RETURNS

Chapter 5 presented an investigation into the argument raised by Shiller (1981), in particular, that the volatility of equity markets is "excessive" and not justified by the "fundamentals".

The same conclusions can be reached if a similar approach to Shiller's is applied to the UK equity market. That is, the equity market should display only limited volatility if it is assumed that investors have perfect foresight of future earnings and dividends since the long-term trend in earnings and dividends is reasonably smooth.

The weakness in Shiller's original methodology, however, was the assumption that perfect-forecast dividends could be discounted at a constant rate. This was, of course, unrealistic. Subsequent attempts to relax the constant discount rate assumption produced mixed results.

The analysis presented in Chapter 5 shows that, even if perfect foresight of future dividends is assumed, equity markets will still show considerable volatility, mainly because of variation in the return available on alternative, risk-free assets. That is, such variation introduces considerable volatility through the dividend discounting process. Indeed, by using a variable discount rate comprised of the prevailing risk-free bond yield and a constant equity risk premium it was shown that changes in the discount rate could account for approximately three-quarters of the "excessive" volatility displayed by the equity market. A constant discount rate assumption resulted in volatility of less than 1% p.a. compared to a volatility of over 21% p.a. in the actual index. However, introducing a variable discount rate, as described, resulted in volatility of over 16% pa.

The remainder of Chapter 5 presented a possible explanation for the volatility not explained by discount rate variation, namely variation in the required equity risk premium. The important conclusion reached was that, whatever the cause, there appear to be significant swings in the risk premium over time.

7.6 A FULL DECOMPOSITION OF RETURNS

The final empirical analysis presented in this thesis attempts to explain fully the variation in equity returns over time and why ex-post returns vary substantially from ex-ante returns. A supplementary analysis of bond returns is also provided as a spin-off from the main investigation.

To the best of the author's knowledge, no detailed analysis of the type presented here has been previously undertaken. Certainly, analyses of expected equity returns and equity risk premia from an ex-ante perspective have been attempted previously, and these analyses are summarised in Chapter 6. Vivian (2007), for example, applied the Fama & French (2002) methodology to the UK stock market. But such studies only analyse long-term trends, they do not – as is the case here – measure and dissect returns from year to year and, indeed, from quarter to quarter.

The analysis presented here utilises the history of real, long-term interest rates now available for the UK market in decomposing expected equity returns, an approach not taken elsewhere. Another feature of the analysis is the recognition given to the "inflation risk premium" and the attempt to simulate the variation in this return element over the period examined.

The key findings of the analysis are as follows:

- Ex-post equity returns in the UK over the period from end-1963 to end-2005 were estimated to have been 4.9% p.a. higher than ex-ante returns. At 29.1%, the annualised standard deviation in ex-post returns was considerably higher than the equivalent, estimated measure for ex-ante returns (3.2%). The ex-post estimate of the equity risk premium, at 5.5%, was found to be substantially higher than the ex-ante estimate of 2.5% pa.

- The main analysis, in which the implied equity risk premium is the residual element of returns after all other elements have been estimated, produced some counter-intuitive results. In particular, the results suggested that the required premium has tended to rise in expectation of improved economic conditions and has tended to fall when conditions are expected to deteriorate. The implication – tested using a fixed risk-premium model – is that the volatility of the equity market would be even higher if the negative correlation between the risk premium and other return elements did not exist. Several interpretations were offered for this phenomenon, including the suggestion that there are periods during which equity and bond markets are in disequilibrium. A third return model, which incorporates a "realistic risk premium", suggested that such anomalies do periodically exist.

7.7 FUTURE RESEARCH

This thesis attempts to explain why a high variation in equity returns is experienced over time. To different degrees, all the empirical analyses presented suggested that there are rational explanations for high variation such as the variability in risk-free returns, as reflected in long-term interest rates.

With the benefit of hindsight, however, it would appear that there are periods, such as 1974 and late 1987, when equity valuations are forced to extremes and when investors appear to be either overly-pessimistic or overly-optimistic. Some commentators might suggest that such extremes do not prove that these represent periods of irrationality. Economic conditions arise, they might argue, when such risk premium levels are justified. Behavioural theorists are more likely to provide emotive descriptions for such extreme instances.

Today's researchers can only simulate from past data available what expectations might have been historically. And simulations, as presented herein, require assumptions to be made that can always be open to challenge. A useful area for future research would be to record the long-term expectations of investors regarding a range of market and economic variables at regular intervals. One benefit would be a greater understanding of the movements in long-term financial markets.

The full decomposition of equity and bond returns, presented in Chapter 6, is a unique analysis of UK financial markets. Some of the key results, such as the significant difference between ex-ante and ex-post equity risk premia, were not unexpected. However, no previous analysis has attempted to explain the difference in such detail. Perhaps the most intriguing conclusion of the study is the fact that there appear to be periods of disequilibrium between the bond and equity markets during which the "implied risk premium" can deviate significantly from the "realistic risk premium". Ex-post analysis suggests that these periods of disequilibrium provide opportunities for investors to earn superior excess returns. Further research could usefully be undertaken to establish:

(a) whether such disequilibrium is apparent in other mature markets

(b) whether the "implied risk premium" could be divided more precisely into "rational" and "irrational" elements.

Finally, recognition also has to be given to changes in market environments over time. The introduction of modern derivative instruments and the acceleration in information flows through improved technology, for example, will have influenced the formation of prices during the period investigated in this thesis. Performance pressures are also considerably greater than several decades ago. Arguably, this leads to greater short-termism and herding. Additionally, hedge funds now have a substantial influence. It could be argued that this has a positive influence on the efficiency of markets through the continual eradication of pricing anomalies; the negative argument is that, by their very nature, certain hedge fund strategies can create major instabilities in markets.

Whilst many theories may remain core ingredients of our understanding of market pricing for many decades to come, future researchers should always bear in mind that any models built on past experience might have only a limited life expectancy in terms of their future usefulness.

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APPENDICES

APPENDIX 1a – SIMULATED INDICES

Date	All-Share Index	All-share Yield	Notional Dividend	Simulated Index (Note A)	Variable discount rate (%) (Note B)	Simulated Index (Note C)
31/12/1962	95	4.35	4.11	95	9.8	181
29/03/1963	98	4.27	4.19	98	10.0	176
28/06/1963	99	4.32	4.28	94	9.6	197
30/09/1963	104	4.14	4.30	96	9.6	199
31/12/1963	109	4.08	4.43	98	10.0	185
31/03/1964	105	4.29	4.49	100	10.1	185
30/06/1964	107	4.49	4.82	102	10.3	180
30/09/1964	109	4.50	4.92	104	10.3	184
31/12/1964	97	5.18	5.03	106	10.5	177
31/03/1965	98	5.36	5.26	108	10.6	177
30/06/1965	93	5.69	5.32	110	10.9	170
30/09/1965	100	5.40	5.38	112	10.4	191
31/12/1965	104	5.23	5.42	114	10.7	183
31/03/1966	105	5.24	5.50	116	10.9	179
30/06/1966	111	4.94	5.49	119	11.1	174
30/09/1966	94	5.84	5.47	121	11.2	173
30/12/1966	94	5.79	5.44	123	10.9	190
31/03/1967	98	5.48	5.36	126	10.6	204
30/06/1967	106	5.00	5.32	129	11.0	191
29/09/1967	114	4.65	5.30	131	11.1	193
29/12/1967	121	4.38	5.31	134	11.3	189
29/03/1968	137	3.92	5.38	137	11.4	188
28/06/1968	155	3.47	5.38	140	12.0	172
30/09/1968	164	3.31	5.43	143	11.7	185
31/12/1968	174	3.24	5.63	146	12.2	171
31/03/1969	164	3.44	5.64	149	12.9	153
30/06/1969	142	4.02	5.71	152	14.1	128
30/09/1969	140	4.09	5.71	155	13.1	156
31/12/1969	147	3.85	5.67	159	13.1	159
31/03/1970	144	4.07	5.86	162	12.8	171
30/06/1970	126	4.72	5.93	166	13.4	157
30/09/1970	139	4.31	5.98	170	13.6	157
31/12/1970	136	4.39	5.98	173	14.1	148
31/03/1971	143	4.20	5.99	177	13.3	172
30/06/1971	168	3.64	6.11	181	13.4	171
30/09/1971	181	3.40	6.16	186	12.9	191
31/12/1971	193	3.25	6.29	190	12.8	197
31/03/1972	218	2.96	6.44	194	13.1	194
30/06/1972	206	3.22	6.65	198	13.7	180
29/09/1972	199	3.40	6.77	203	13.9	178
29/12/1972	218	3.15	6.87	208	14.2	175
30/03/1973	190	3.69	6.99	212	14.6	169
29/06/1973	192	3.67	7.04	217	14.8	168
28/09/1973	181	3.93	7.13	222	15.8	150
31/12/1973	150	4.77	7.14	227	16.9	134
29/03/1974	118	6.17	7.30	233	18.8	111
28/06/1974	105	7.31	7.70	238	20.1	101
30/09/1974	77	10.15	7.81	243	20.3	102
31/12/1974	67	11.71	7.83	249	22.2	88

Date	All-Share Index	All-share Yield	Notional Dividend	Simulated Index (Note A)	Variable discount rate (Note B)	Simulated Index (Note C)
31/03/1975	118	6.70	7.93	255	18.5	128
30/06/1975	128	6.51	8.35	261	19.1	124
30/09/1975	145	5.91	8.55	267	19.1	128
31/12/1975	158	5.47	8.65	273	19.2	130
31/03/1976	165	5.35	8.81	279	18.5	142
30/06/1976	155	5.91	9.18	285	18.3	150
30/09/1976	135	7.12	9.61	292	19.5	137
31/12/1976	152	6.42	9.76	299	18.9	148
31/03/1977	177	5.69	10.04	305	17.1	185
30/06/1977	191	5.53	10.55	312	17.4	183
30/09/1977	224	4.89	10.98	319	15.1	244
30/12/1977	215	5.28	11.33	327	14.9	256
31/03/1978	205	5.64	11.58	334	15.8	235
30/06/1978	211	5.65	11.90	341	16.8	215
29/09/1978	228	5.43	12.40	349	16.7	223
29/12/1978	220	5.79	12.75	356	16.7	228
30/03/1979	266	4.94	13.15	364	15.1	282
29/06/1979	248	5.32	13.19	372	15.8	267
28/09/1979	255	5.96	15.18	380	15.0	298
31/12/1979	230	6.87	15.79	388	16.2	266
31/03/1980	240	6.91	16.61	396	17.0	267
30/06/1980	270	6.40	17.25	404	16.4	273
30/09/1980	290	6.12	17.76	412	16.0	291
31/12/1980	292	6.10	17.83	421	16.5	282
31/03/1981	310	5.78	17.90	429	16.5	288
30/06/1981	321	5.66	18.14	438	17.5	246
30/09/1981	278	6.57	18.30	447	18.8	240
31/12/1981	313	5.89	18.44	457	18.3	258
31/03/1982	327	5.80	18.94	466	17.0	301
30/06/1982	323	6.09	19.66	476	17.0	309
30/09/1982	362	5.50	19.90	486	15.1	407
31/12/1982	382	5.26	20.10	496	14.6	418
31/03/1983	412	4.94	20.35	506	14.5	428
30/06/1983	459	4.56	20.93	517	14.2	453
30/09/1983	446	4.80	21.39	528	14.4	452
30/12/1983	471	4.62	21.74	539	14.2	475
30/03/1984	524	4.38	22.96	550	14.2	486
29/06/1984	488	4.87	23.75	561	15.0	456
28/09/1984	536	4.68	25.08	572	14.5	491
31/12/1984	593	4.42	26.21	583	14.3	509
29/03/1985	616	4.47	27.54	595	14.5	509
28/06/1985	596	4.80	28.59	606	14.6	514
30/09/1985	626	4.63	28.99	618	14.2	549
31/12/1985	683	4.34	29.64	630	14.2	556
31/03/1986	810	3.69	29.91	642	13.0	651
30/06/1986	816	3.87	31.57	654	13.1	652
30/09/1986	769	4.17	32.06	666	14.5	573
31/12/1986	835	3.98	33.25	679	14.5	589
31/03/1987	1004	3.41	34.24	691	13.4	666
30/06/1987	1153	3.08	35.52	704	13.4	684
30/09/1987	1209	3.03	36.63	717	14.2	641
31/12/1987	870	4.33	37.68	730	13.7	686

Date	All-Share Index	All-share Yield	Notional Dividend	Simulated Index (Note A)	Variable discount rate (Note B)	Simulated Index (Note C)
31/03/1988	897	4.31	38.65	743	13.2	734
30/06/1988	963	4.22	40.64	756	13.6	719
30/09/1988	946	4.47	42.30	769	13.5	741
30/12/1988	927	4.69	43.46	782	13.4	761
31/03/1989	1076	4.19	45.09	795	13.2	759
30/06/1989	1102	4.20	46.27	809	13.7	759
29/09/1989	1170	4.07	47.60	822	13.8	767
29/12/1989	1205	4.19	50.48	835	14.0	764
30/03/1990	1115	4.74	52.85	848	15.6	674
29/06/1990	1171	4.67	54.70	861	14.9	731
28/09/1990	962	5.76	55.42	874	15.5	702
31/12/1990	1032	5.46	56.36	887	14.9	756
29/03/1991	1193	4.77	56.92	900	14.4	800
28/06/1991	1161	5.00	58.06	914	14.7	794
30/09/1991	1266	4.62	58.49	928	13.9	860
31/12/1991	1188	4.93	58.55	942	14.2	855
31/03/1992	1172	5.04	59.05	957	14.2	871
30/06/1992	1217	4.81	58.52	972	13.5	937
30/09/1992	1206	4.88	58.86	987	13.7	933
31/12/1992	1364	4.31	58.78	1004	12.7	1034
31/03/1993	1408	4.13	58.15	1020	12.5	1070
30/06/1993	1432	4.06	58.15	1038	12.2	1119
30/09/1993	1507	3.87	58.30	1055	11.5	1208
31/12/1993	1682	3.46	58.20	1074	10.7	1304
31/03/1994	1562	3.76	58.73	1093	12.2	1175
30/06/1994	1463	4.09	59.85	1112	13.0	1116
30/09/1994	1511	4.00	60.44	1131	12.8	1152
30/12/1994	1521	4.02	61.16	1151	12.9	1169
31/03/1995	1539	4.15	63.85	1171	12.6	1211
30/06/1995	1624	4.04	65.59	1192	12.7	1225
29/09/1995	1734	3.85	66.75	1212	12.6	1257
29/12/1995	1803	3.82	68.88	1233	12.0	1316
29/03/1996	1843	3.86	71.16	1253	12.6	1296
28/06/1996	1856	3.91	72.58	1274	12.4	1331
30/09/1996	1945	3.82	74.30	1295	12.2	1372
31/12/1996	2014	3.76	75.71	1317	12.0	1418
31/03/1997	2100	3.64	76.43	1339	12.2	1421
30/06/1997	2185	3.55	77.55	1361	11.4	1518
30/09/1997	2455	3.17	77.82	1384	11.0	1582
31/12/1997	2411	3.23	77.88	1408	10.7	1638
31/03/1998	2782	2.36	65.65	1436	10.2	1711
30/06/1998	2743	2.41	66.12	1464	10.0	1758
30/09/1998	2345	2.84	66.59	1493	9.1	1878
31/12/1998	2674	2.50	66.85	1523	8.7	1949
31/03/1999	2895	2.34	67.74	1553	9.0	1940
30/06/1999	2946	2.26	66.58	1585	9.2	1950
30/09/1999	2826	2.41	68.11	1618	9.4	1949
31/12/1999	3242	2.12	68.73	1651	9.2	1998
31/03/2000	3111	2.11	65.63	1686	9.1	2033
30/06/2000	3030	2.16	65.44	1722	9.1	2063
29/09/2000	3029	2.17	65.74	1760	9.3	2077
29/12/2000	2984	2.23	66.54	1798	8.9	2139

Date	All-Share Index	All-share Yield	Notional Dividend	Simulated Index (Note A)	Variable discount rate (Note B)	Simulated Index (Note C)
30/03/2001	2711	2.53	68.60	1837	9.1	2137
29/06/2001	2728	2.42	66.02	1878	9.6	2143
28/09/2001	2340	2.87	67.17	1919	9.3	2196
31/12/2001	2524	2.63	66.38	1963	9.4	2228
29/03/2002	2557	2.66	68.03	2007	9.7	2238
28/06/2002	2263	2.98	67.44	2053	9.4	2295
30/09/2002	1801	3.73	67.20	2100	8.9	2365
31/12/2002	1894	3.55	67.23	2149	8.9	2395
31/03/2003	1736	3.87	67.17	2199	9.0	2426
30/06/2003	1971	3.43	67.61	2251	9.0	2461
30/09/2003	2028	3.36	68.13	2304	9.2	2488
31/12/2003	2207	3.10	68.43	2359	9.2	2520
30/03/2004	2197	3.10	68.11	2415	8.9	2575
29/06/2004	2229	3.20	71.32	2473	9.1	2607
28/09/2004	2272	3.20	72.69	2532	8.9	2652
31/12/2004	2412	3.00	72.37	2593	8.7	2695
29/03/2005	2458	3.10	76.19	2654	9.0	2728
28/06/2005	2560	3.10	79.37	2717	8.6	2773
30/09/2005	2746	3.00	82.37	2782	8.6	2810
31/12/2005	2847	3.00	85.41	2847	8.3	2847

Notes

A Present value of the end 2005 index and all expected dividends to end 2005 discounted at a constant rate of 13.08% per annum.

B Prevailing rate of return on $2^1/_2$% Consols + 4.2% constant equity risk premium

C Present value of the end 2005 index and all expected dividends to end 2005 discounted at the prevailing rate of return on $2^1/_2$% Consols + 4.2% constant equity risk premium.

APPENDIX 1b – IMPLIED EQUITY RISK PREMIA

Date	All-Share Index	Notional dividend	Internal rate of return (%) (Note A)	Consols yield	Implied equity risk premium (%) (Note B)
31/12/1962	95	4.11	12.85	5.59	7.3
29/03/1963	98	4.19	12.76	5.79	7.0
28/06/1963	99	4.28	12.81	5.39	7.4
30/09/1963	104	4.30	12.66	5.43	7.2
31/12/1963	109	4.43	12.53	5.81	6.7
31/03/1964	105	4.49	12.83	5.88	7.0
30/06/1964	107	4.82	12.80	6.07	6.7
30/09/1964	109	4.92	12.80	6.05	6.8
31/12/1964	97	5.03	13.58	6.31	7.3
31/03/1965	98	5.26	13.62	6.39	7.2
30/06/1965	93	5.32	14.04	6.66	7.4
30/09/1965	100	5.38	13.77	6.21	7.6
31/12/1965	104	5.42	13.64	6.48	7.2
31/03/1966	105	5.50	13.68	6.68	7.0
30/06/1966	111	5.49	13.45	6.89	6.6
30/09/1966	94	5.47	14.62	7.01	7.6
30/12/1966	94	5.44	14.73	6.66	8.1
31/03/1967	98	5.36	14.61	6.41	8.2
30/06/1967	106	5.32	14.21	6.80	7.4
29/09/1967	114	5.30	13.91	6.85	7.1
29/12/1967	121	5.31	13.67	7.06	6.6
29/03/1968	137	5.38	13.06	7.16	5.9
28/06/1968	155	5.38	12.50	7.75	4.7
30/09/1968	164	5.43	12.29	7.46	4.8
31/12/1968	174	5.63	12.10	7.99	4.1
31/03/1969	164	5.64	12.53	8.71	3.8
30/06/1969	142	5.71	13.49	9.91	3.6
30/09/1969	140	5.71	13.73	8.87	4.9
31/12/1969	147	5.67	13.53	8.87	4.7
31/03/1970	144	5.86	13.81	8.56	5.2
30/06/1970	126	5.93	14.84	9.19	5.6
30/09/1970	139	5.98	14.33	9.37	5.0
31/12/1970	136	5.98	14.60	9.87	4.7
31/03/1971	143	5.99	14.45	9.07	5.4
30/06/1971	168	6.11	13.55	9.24	4.3
30/09/1971	181	6.16	13.22	8.71	4.5
31/12/1971	193	6.29	12.96	8.64	4.3
31/03/1972	218	6.44	12.39	8.87	3.5
30/06/1972	206	6.65	12.84	9.50	3.3
29/09/1972	199	6.77	13.20	9.73	3.5
29/12/1972	218	6.87	12.77	9.97	2.8
30/03/1973	190	6.99	13.81	10.39	3.4
29/06/1973	192	7.04	13.88	10.61	3.3
28/09/1973	181	7.13	14.42	11.59	2.8
31/12/1973	150	7.14	16.02	12.70	3.3
29/03/1974	118	7.30	18.24	14.65	3.6
28/06/1974	105	7.70	19.63	15.87	3.8
30/09/1974	77	7.81	23.63	16.06	7.6
31/12/1974	67	7.83	26.07	18.01	8.1

Date	All-Share Index	Notional dividend	Internal rate of return (%)	Consols yield	Implied equity risk premium (%)
31/03/1975	118	7.93	19.28	14.33	4.9
30/06/1975	128	8.35	18.75	14.87	3.9
30/09/1975	145	8.55	17.85	14.86	3.0
31/12/1975	158	8.65	17.29	14.98	2.3
31/03/1976	165	8.81	17.16	14.33	2.8
30/06/1976	155	9.18	17.93	14.08	3.9
30/09/1976	135	9.61	19.61	15.26	4.3
31/12/1976	152	9.76	18.67	14.70	4.0
31/03/1977	177	10.04	17.48	12.86	4.6
30/06/1977	191	10.55	17.00	13.20	3.8
30/09/1977	224	10.98	15.80	10.90	4.9
30/12/1977	215	11.33	16.40	10.72	5.7
31/03/1978	205	11.58	17.02	11.63	5.4
30/06/1978	211	11.90	17.02	12.62	4.4
29/09/1978	228	12.40	16.51	12.54	4.0
29/12/1978	220	12.75	17.07	12.54	4.5
30/03/1979	266	13.15	15.58	10.90	4.7
29/06/1979	248	13.19	16.43	11.56	4.9
28/09/1979	255	15.18	16.40	10.81	5.6
31/12/1979	230	15.79	17.60	12.01	5.6
31/03/1980	240	16.61	17.38	12.82	4.6
30/06/1980	270	17.25	16.50	12.19	4.3
30/09/1980	290	17.76	16.02	11.80	4.2
31/12/1980	292	17.83	16.16	12.30	3.9
31/03/1981	310	17.90	15.83	12.31	3.5
30/06/1981	321	18.14	15.72	13.29	2.4
30/09/1981	278	18.30	17.30	14.65	2.6
31/12/1981	313	18.44	16.38	14.13	2.2
31/03/1982	327	18.94	16.19	12.78	3.4
30/06/1982	323	19.66	16.53	12.78	3.8
30/09/1982	362	19.90	15.66	10.90	4.8
31/12/1982	382	20.10	15.36	10.39	5.0
31/03/1983	412	20.35	14.87	10.33	4.5
30/06/1983	459	20.93	14.10	10.02	4.1
30/09/1983	446	21.39	14.56	10.23	4.3
30/12/1983	471	21.74	14.27	9.97	4.3
30/03/1984	524	22.96	13.49	9.97	3.5
29/06/1984	488	23.75	14.33	10.75	3.6
28/09/1984	536	25.08	13.66	10.25	3.4
31/12/1984	593	26.21	12.94	10.12	2.8
29/03/1985	616	27.54	12.77	10.31	2.5
28/06/1985	596	28.59	13.24	10.41	2.8
30/09/1985	626	28.99	12.95	9.97	3.0
31/12/1985	683	29.64	12.35	10.05	2.3
31/03/1986	810	29.91	11.03	8.75	2.3
30/06/1986	816	31.57	11.12	8.91	2.2
30/09/1986	769	32.06	11.78	10.33	1.4
31/12/1986	835	33.25	11.20	10.25	0.9
31/03/1987	1004	34.24	9.77	9.24	0.5
30/06/1987	1153	35.52	8.74	9.16	-0.4
30/09/1987	1209	36.63	8.47	9.99	-1.5
31/12/1987	870	37.68	11.41	9.50	1.9

Date	All-Share Index	Notional dividend	Internal rate of return (%)	Consols yield	Implied equity risk premium (%)
31/03/1988	897	38.65	11.29	9.00	2.3
30/06/1988	963	40.64	10.78	9.39	1.4
30/09/1988	946	42.30	11.08	9.26	1.8
30/12/1988	927	43.46	11.42	9.16	2.3
31/03/1989	1076	45.09	10.16	8.97	1.2
30/06/1989	1102	46.27	10.06	9.54	0.5
29/09/1989	1170	47.60	9.63	9.61	0.0
29/12/1989	1205	50.48	9.48	9.83	-0.4
30/03/1990	1115	52.85	10.32	11.43	-1.1
29/06/1990	1171	54.70	9.96	10.68	-0.7
28/09/1990	962	55.42	12.06	11.33	0.7
31/12/1990	1032	56.36	11.48	10.66	0.8
29/03/1991	1193	56.92	10.14	10.20	-0.1
28/06/1991	1161	58.06	10.54	10.47	0.1
30/09/1991	1266	58.49	9.79	9.73	0.1
31/12/1991	1188	58.55	10.57	9.99	0.6
31/03/1992	1172	59.05	10.85	9.96	0.9
30/06/1992	1217	58.52	10.59	9.30	1.3
30/09/1992	1206	58.86	10.83	9.54	1.3
31/12/1992	1364	58.78	9.65	8.53	1.1
31/03/1993	1408	58.15	9.44	8.32	1.1
30/06/1993	1432	58.15	9.39	7.98	1.4
30/09/1993	1507	58.30	8.97	7.27	1.7
31/12/1993	1682	58.20	7.88	6.55	1.3
31/03/1994	1562	58.73	8.83	7.98	0.8
30/06/1994	1463	59.85	9.72	8.83	0.9
30/09/1994	1511	60.44	9.50	8.65	0.8
30/12/1994	1521	61.16	9.57	8.68	0.9
31/03/1995	1539	63.85	9.58	8.44	1.1
30/06/1995	1624	65.59	9.07	8.51	0.6
29/09/1995	1734	66.75	8.38	8.38	0.0
29/12/1995	1803	68.88	8.02	7.78	0.2
29/03/1996	1843	71.16	7.85	8.40	-0.5
28/06/1996	1856	72.58	7.88	8.25	-0.4
30/09/1996	1945	74.30	7.38	8.04	-0.7
31/12/1996	2014	75.71	7.02	7.78	-0.8
31/03/1997	2100	76.43	6.55	7.98	-1.4
30/06/1997	2185	77.55	6.08	7.19	-1.1
30/09/1997	2455	77.82	4.51	6.78	-2.3
31/12/1997	2411	77.88	4.82	6.45	-1.6
31/03/1998	2782	65.65	2.79	5.99	-3.2
30/06/1998	2743	66.12	3.01	5.80	-2.8
30/09/1998	2345	66.59	5.50	4.93	0.6
31/12/1998	2674	66.85	3.46	4.51	-1.0
31/03/1999	2895	67.74	2.20	4.81	-2.6
30/06/1999	2946	66.58	1.89	4.96	-3.1
30/09/1999	2826	68.11	2.60	5.23	-2.6
31/12/1999	3242	68.73	0.14	5.01	-4.9
31/03/2000	3111	65.63	0.82	4.93	-4.1
30/06/2000	3030	65.44	1.27	4.92	-3.7
29/09/2000	3029	65.74	1.22	5.08	-3.9
29/12/2000	2984	66.54	1.49	4.74	-3.2

Date	All-Share Index	Notional dividend	Internal rate of return (%)	Consols yield	Implied equity risk premium (%)
30/03/2001	2711	68.6	3.63	4.94	-1.3
29/06/2001	2728	66.02	3.55	5.39	-1.8
28/09/2001	2340	67.17	7.62	5.14	2.5
31/12/2001	2524	66.38	5.83	5.16	0.7
29/03/2002	2557	68.03	5.66	5.47	0.2
28/06/2002	2263	67.44	9.82	5.16	4.7
30/09/2002	1801	67.2	18.8	4.65	14.2
31/12/2002	1894	67.23	18.15	4.71	13.4
31/03/2003	1736	67.17	23.65	4.76	18.9
30/06/2003	1971	67.61	19.45	4.78	14.7
30/09/2003	2028	68.13	19.88	4.98	14.9
31/12/2003	2207	68.43	16.98	5.02	12
30/03/2004	2197	68.11	19.51	4.72	14.8
29/06/2004	2229	71.32	21.34	4.9	16.4
28/09/2004	2272	72.69	23.47	4.69	18.8
31/12/2004	2412	72.37	21.62	4.52	17.1
29/03/2005	2458	76.19	25.4	4.81	20.6
28/06/2005	2560	79.37	27.44	4.36	23.1
30/09/2005	2746	82.37	19.08	4.36	14.7
31/12/2005	2847	85.41	-	4.1	-

Notes

A The annual internal rate of return that equates the All-Share index level at that date with the end 2005 index level and dividends to be received up until end 2005

B The annual internal rate of return minus the prevailing consols yield

APPENDIX 2

APPENDIX 2a - Analysis of calendar year returns

APPENDIX 2b – Analysis of 12 month returns measured quarterly

TABLE A	Shows historical yields and 12-month total returns for UK equities and undated bonds together with implied ex-post equity risk premia. Historical 12-month dividend growth and inflation values are also shown.
TABLE B	Shows the input data for simulations of historical long-term inflation and real dividend growth expectations together with the simulated values.
TABLE C	Shows simulated ex-ante equity risk premium values as the difference between simulated expected equity returns and quoted bond returns.
TABLE D	Shows how changes in the real interest rate environment together with changes in real dividend growth expectations and inflation risk premia "explain" changes in the simulated ex-ante equity risk premium values.
TABLE E	Analyses why equity returns over any 12-month period have varied from expectations.
TABLE F	Analyses why bond returns over any 12-month period have varied from expectations.
TABLE G	Analyses how and why the achieved equity risk premium over any 12-month period has varied from expectations.

Table Definitions

Table A

(1) Historic dividend yield for FTSE All-Share Index (FTSE 500 Index prior to 1993). Gross prior to 1998.

(2) Yield on undated $2^1/_2$% UK government consols.

(3) Implied dividend growth for the FTSE All-Share Index constituents. Derived from movement in implied dividend (Index x [dividend yield]/100). Adjusted to allow for change in yield presentation in 1998.

(4) Total return from a portfolio indexed to the FTSE All-Share Index over the previous 12 months. Total return = Capital performance + (dividend yield 12 months ago x [1 + dividend growth over previous 12 months]).

(5) Total return on $2^1/_2$% UK government consols over previous 12 months. Income yield + capital performance.

(6) Column 4 – column 5.

(7) Percentage change in Retail Prices over previous 12 months.

Table B

(1) Average annual inflation over 5 year window which includes 3 years historic and 2 years still to be reported (i.e. assumes perfect foresight.)

(2) Average inflation over previous 20 years.

(3) Derived as a function of the two variables shown in (1) and (2). [see main text]
End 2005: Inflation gap = 0.6869*2.7 + 0.2555*3.6 = 2.8

(4) 80% of value derived in (3).

(5) 20% of value derived in (3) up until 1981.
Value used from 1981 onwards is:

Actual observed inflation gap – simulated long-term inflation

(6) Simulated real rates of interest. Actual real rates on benchmark long-dated index-linked gilts used for 1981 – 2005. Prior to 1981, derived from:

Consols yield – simulated inflation gap.

End 1963: Simulated real rate = 5.8 – 3.4 = 2.4

(7) Average real annual dividend growth over previous 15 years.

(8) Average real annual dividend growth over subsequent 10 years.

(9) Derived as a function of the two variables shown in (7) and (8).
End 2005: Simulation long-term expectation = 0.7*1.5 + 0.3*2.6 = 1.8

Table C

(1) Column 1, Table A.

(2) Expected inflation (column 4, Table B) + Expected real growth (column 9, Table B).
End 2005: 2.2 + 1.8 = 4.0%

(3) Dividend yield expected in first year :
= Historic yield x (1 + expected nominal dividend growth) -1
End 2005: (2.95 x 1.04) – 1 = 3.07%

(4) Expected first year yield (column 3) + expected nominal dividend growth (column 2)
End 2005: 3.1 + 4.0 = 7.1%

(5) Yield on $2^1/_2$% consols.

(6) Column 4 – column 5.

Table D

(1) Column 3. Table C

(2) Column 6, Table B.

(3) Column 4, Table B.

(4) Column 3, Table B.

(5) Column 1 + column 2 - column 3 – column 4.
End 2005: 3.07 + 1.82 -1.30 -0.60 = 2.99

Table E

(1) Actual return – expected return (at end of previous year)
End 2005: 21.6 – 7.1 = 14.5

(2) Unexpected capital performance + unexpected yield (see text)
End 2005: (14.3 – 3.9) + 0.0305*(14.3 – 3.9) = 10.7

(3) (1 + actual dividend growth)*(start yield/end yield – 1)
End 2005: (1.143)*(3.05/2.95 -1) = 3.8

(4) Performance attributable to change in real rate (see text for discussion)
End 2005: -0.1554/-0.1000*3.7915 = 5.9

(5) Performance attributable to change in real growth expectation
End 2005: -0.1921/-0.1000*3.7915 = 7.3

(6) Performance attributable to change in inflation risk premium
End 2005: -0.1754/-0.1000*3.7915 = 6.7

(7) Performance attributable to change in equity risk premium
End 2005: 0.4229/-0.1000*3.7915 = -16.0
Note: (3) = (4) + (5) + (6) + (7)

Table F

(1) Column 5, Table A.

(2) Expected return (yield) 12 months previously as in column 2, Table A.

(3) Column 1 – column 2.

(4)-
(6) Percentage changes due to changes in yield components.
Returns should be chain-linked.
End 2005: Unexpected bond return = (1.037)*(1.019)*(1.044) -1 = 10.3%

Table G

(1) From column 6, Table C.

(2) Column 1, Table E.

(3) Column 2, Table E.

(4) Column 3, Table E.

(5) Column 3. Table F.

(6) Column 4, Table A – column 5, Table A.

(7) Column 6 – column 1.

APPENDIX 2A

Table A - Historical market/economic data

	(1) **Historic Equity Yield**	(2) **Undated Bond Yield**	(3) **12 Month Dividend Growth**	(4) **12 Month Equity Return**	(5) **12 Month Bond Return**	(6) **Ex-post Equity risk Premium**	(7) **12 Month Inflation (RPI)**
1963	4.08	5.81	7.2	18.9	1.8	17.1	1.9
1964	5.18	6.31	18.1	-2.1	-2.1	0.0	4.8
1965	5.23	6.48	7.8	12.3	3.7	8.6	4.5
1966	5.79	6.66	0.4	-4.1	3.8	-7.8	3.7
1967	4.38	7.06	-2.4	34.6	1.0	33.6	2.5
1968	3.24	7.99	6.0	48.0	-4.6	52.6	5.9
1969	3.85	8.87	0.8	-11.9	-1.9	-10.0	4.7
1970	4.39	9.87	5.5	-3.5	-1.3	-2.1	7.9
1971	3.25	8.64	5.1	46.5	24.2	22.3	9.0
1972	3.15	9.97	9.3	16.4	-4.8	21.1	7.7
1973	4.77	12.70	3.9	-28.1	-11.5	-16.6	10.6
1974	11.71	18.01	9.6	-50.1	-16.8	-33.3	19.1
1975	5.47	14.98	10.4	149.3	38.3	111.0	24.9
1976	6.42	14.70	12.8	2.3	16.8	-14.5	15.1
1977	5.28	10.72	16.1	48.6	51.8	-3.2	12.1
1978	5.79	12.54	12.6	8.6	-3.7	12.3	8.4
1979	6.87	12.01	23.8	11.5	16.9	-5.4	17.2
1980	6.10	12.30	12.9	34.9	9.6	25.3	15.1
1981	5.89	14.13	3.5	13.5	-0.6	14.1	12.0
1982	5.26	10.39	9.0	28.5	50.2	-21.7	5.4
1983	4.62	9.97	8.1	28.8	14.5	14.2	5.3
1984	4.42	10.12	13.8	31.6	8.5	23.1	4.6
1985	4.34	10.05	13.1	20.2	10.9	9.3	5.7
1986	3.98	10.25	12.2	27.2	8.0	19.2	3.7
1987	4.33	9.50	13.3	8.7	18.2	-9.5	3.7
1988	4.69	9.16	15.3	11.5	13.2	-1.7	6.8
1989	4.19	9.83	16.2	35.5	2.4	33.1	7.7
1990	5.46	10.66	11.7	-9.6	2.0	-11.6	9.3
1991	4.93	9.99	3.9	20.7	17.5	3.3	4.5
1992	4.31	8.53	0.4	19.8	27.1	-7.3	2.6
1993	3.46	6.55	-1.0	27.6	38.8	-11.2	1.9
1994	4.02	8.68	5.1	-5.9	-18.0	12.1	2.9
1995	3.82	7.78	12.6	23.0	20.2	2.9	3.2
1996	3.76	7.78	9.9	15.9	7.8	8.1	2.5
1997	3.23	6.45	2.9	23.6	28.4	-4.8	3.6
1998	2.50	4.51	4.7	14.3	49.5	-35.2	2.7
1999	2.12	5.01	2.8	23.8	-5.5	29.3	1.8
2000	2.23	4.74	-3.2	-5.9	10.8	-16.7	2.9
2001	2.63	5.16	-0.2	-13.2	-3.4	-9.8	0.7
2002	3.55	4.71	1.3	-22.3	14.7	-37.0	2.9
2003	3.10	5.02	1.8	20.2	-1.5	21.7	2.8
2004	3.05	4.54	7.5	12.5	15.5	-3.0	3.5
2005	2.95	4.12	14.3	21.6	14.8	6.8	2.2

Table B - Long-term Simulations

	(1) 5 Year Inflation Window	(2) 20 Year Trailing Inflation	(3) Sim Inf Gap	(4) Sim L-T Inf. Exp.	(5) Sim Inflation RP	(6) Sim real rates (Prior to '81)	(7) 15 year Trailing RG	(8) 10yr F/C Real Growth	(9) Sim L-T Exp.
1963	2.3	3.9	3.4	2.7	0.7	2.4	4.2	-1.1	2.6
1964	3.1	3.9	3.3	2.7	0.7	3.0	4.8	-2.7	2.6
1965	3.4	3.9	3.4	2.7	0.7	3.1	4.5	-4.2	1.9
1966	4.3	3.8	3.9	3.1	0.8	2.8	4.4	-4.1	1.9
1967	4.2	3.7	3.9	3.1	0.8	3.2	4.5	-3.3	2.2
1968	4.9	3.8	4.3	3.5	0.9	3.6	3.8	-2.9	1.8
1969	6.0	3.9	5.1	4.1	1.0	3.8	2.6	-2.0	1.2
1970	7.0	3.8	5.8	4.6	1.2	4.1	2.1	-2.0	0.9
1971	7.9	3.8	6.4	5.2	1.3	2.2	1.9	-2.4	0.6
1972	10.8	4.1	8.4	6.8	1.7	1.5	2.0	-2.2	0.7
1973	14.1	4.5	10.8	8.7	2.2	1.9	1.3	-1.4	0.5
1974	15.3	5.2	11.8	9.5	2.4	6.2	-0.2	0.9	0.1
1975	16.3	6.1	12.7	10.2	2.5	2.3	-1.7	2.8	-0.4
1976	15.8	6.7	12.5	10.0	2.5	2.2	-1.8	3.8	-0.1
1977	15.4	7.1	12.4	9.9	2.5	-1.7	-1.6	4.4	0.2
1978	13.5	7.5	11.2	9.0	2.2	1.3	-1.8	4.8	0.2
1979	12.9	8.3	11.0	8.8	2.2	1.0	-1.9	5.0	0.2
1980	11.6	8.9	10.2	8.2	2.0	2.1	-2.3	5.5	0.1
1981	10.9	9.3	9.9	7.9	3.0	3.2	-2.6	6.2	0.1
1982	8.4	9.5	8.2	6.6	0.9	3.0	-2.0	5.7	0.3
1983	6.6	9.6	7.0	5.6	0.9	3.5	-1.9	5.1	0.2
1984	4.9	9.6	5.9	4.7	2.3	3.1	-0.7	3.8	0.7
1985	4.6	9.7	5.6	4.5	1.9	3.6	-0.1	4.0	1.1
1986	4.9	9.7	5.8	4.7	1.9	3.7	0.7	3.9	1.7
1987	5.5	9.8	6.3	5.0	0.6	3.9	1.2	2.9	1.7
1988	6.2	9.8	6.8	5.4	0.0	3.8	2.1	2.3	2.2
1989	6.4	10.0	6.9	5.5	0.7	3.6	3.2	1.7	2.7
1990	6.1	10.0	6.8	5.4	1.2	4.1	4.2	0.8	3.2
1991	5.2	9.8	6.1	4.8	0.7	4.4	4.3	0.8	3.3
1992	4.2	9.5	5.3	4.3	0.3	3.9	3.9	0.8	3.0
1993	3.0	9.1	4.4	3.5	-0.9	3.9	3.5	1.0	2.7
1994	2.6	8.3	3.9	3.1	1.7	3.9	3.2	1.2	2.6
1995	2.8	7.3	3.8	3.0	1.2	3.6	4.0	1.7	3.3
1996	3.0	6.7	3.8	3.0	1.2	3.6	5.0	1.2	3.9
1997	2.8	6.2	3.5	2.8	0.6	3.0	4.7	1.6	3.8
1998	2.7	5.9	3.4	2.7	-0.2	2.0	4.7	1.7	3.8
1999	2.3	5.2	2.9	2.4	0.9	1.8	3.8	1.8	3.2
2000	2.2	4.6	2.7	2.2	0.8	1.8	2.9	2.7	2.8
2001	2.2	4.1	2.6	2.1	0.9	2.2	2.3	3.1	2.5
2002	2.6	3.9	2.8	2.2	0.3	2.2	1.5	3.5	2.1
2003	2.4	3.8	2.6	2.1	1.0	1.9	1.0	3.9	1.8
2004	2.8	3.8	2.9	2.3	0.8	1.5	0.7	3.8	1.6
2005	2.7	3.6	2.8	2.2	0.6	1.3	1.5	2.6	1.8

Table C - Simulated equity risk premium

	(1) Historic Equity Yield	(2) Long-term Exp div growth (nominal)	(3) 1st Year Expected Yield	(4) Expected 12 month equity return	-	(5) Expected Bond Return	=	(6) Ex-ante Equity risk Premium
1963	4.08	5.3	4.30	9.6		5.8		3.8
1964	5.18	5.2	5.45	10.7		6.3		4.4
1965	5.23	4.6	5.47	10.0		6.5		3.6
1966	5.79	5.0	6.08	11.1		6.7		4.4
1967	4.38	5.3	4.61	9.9		7.1		2.8
1968	3.24	5.3	3.41	8.7		8.0		0.7
1969	3.85	5.3	4.05	9.3		8.9		0.5
1970	4.39	5.5	4.63	10.2		9.9		0.3
1971	3.25	5.7	3.44	9.2		8.6		0.5
1972	3.15	7.5	3.39	10.9		10.0		0.9
1973	4.77	9.2	5.21	14.4		12.7		1.7
1974	11.71	9.6	12.83	22.4		18.0		4.4
1975	5.47	9.8	6.01	15.8		15.0		0.8
1976	6.42	9.9	7.06	17.0		14.7		2.3
1977	5.28	10.1	5.81	15.9		10.7		5.2
1978	5.79	9.2	6.32	15.5		12.5		3.0
1979	6.87	9.0	7.49	16.5		12.0		4.5
1980	6.10	8.2	6.60	14.8		12.3		2.5
1981	5.89	8.0	6.36	14.3		14.1		0.2
1982	5.26	6.8	5.62	12.5		10.4		2.1
1983	4.62	5.8	4.89	10.7		10.0		0.7
1984	4.42	5.4	4.66	10.0		10.1		-0.1
1985	4.34	5.7	4.59	10.2		10.0		0.2
1986	3.98	6.3	4.23	10.6		10.3		0.3
1987	4.33	6.7	4.62	11.4		9.5		1.9
1988	4.69	7.6	5.05	12.7		9.2		3.5
1989	4.19	8.3	4.54	12.8		9.8		3.0
1990	5.46	8.6	5.93	14.6		10.7		3.9
1991	4.93	8.1	5.33	13.4		10.0		3.4
1992	4.31	7.3	4.62	11.9		8.5		3.4
1993	3.46	6.3	3.68	9.9		6.5		3.4
1994	4.02	5.8	4.25	10.0		8.7		1.3
1995	3.82	6.3	4.06	10.4		7.8		2.6
1996	3.76	6.9	4.02	10.9		7.8		3.1
1997	3.23	6.6	3.44	10.0		6.5		3.6
1998	2.50	6.5	2.66	9.1		4.5		4.6
1999	2.12	5.5	2.24	7.8		5.0		2.8
2000	2.23	5.0	2.34	7.3		4.7		2.6
2001	2.63	4.6	2.75	7.3		5.2		2.1
2002	3.55	4.4	3.70	8.1		4.7		3.3
2003	3.10	3.9	3.22	7.2		5.0		2.1
2004	3.05	3.9	3.17	7.1		4.5		2.6
2005	2.95	4.0	3.07	7.1		4.1		3.0
Average	**4.5**	**6.6**	**4.8**	**11.4**		**8.9**		**2.5**

Table D - Analysis of the ex-ante equity risk premium

	(1) First year Expected div yield	+	(2) Simulated Long-term real Dividend growth	-	(3) Simulated Real rates (actual from '81)	-	(4) Simulated Inflation Risk Premium	=	(5) Ex-ante Equity risk Premium
1963	4.30		2.6		2.4		0.7		3.8
1964	5.45		2.6		3.0		0.7		4.4
1965	5.47		1.9		3.1		0.7		3.6
1966	6.08		1.9		2.8		0.8		4.4
1967	4.61		2.2		3.2		0.8		2.8
1968	3.41		1.8		3.6		0.9		0.7
1969	4.05		1.2		3.8		1.0		0.5
1970	4.63		0.9		4.1		1.2		0.3
1971	3.44		0.6		2.2		1.3		0.5
1972	3.39		0.7		1.5		1.7		0.9
1973	5.21		0.5		1.9		2.2		1.7
1974	12.83		0.1		6.2		2.4		4.4
1975	6.01		-0.4		2.3		2.5		0.8
1976	7.06		-0.1		2.2		2.5		2.3
1977	5.81		0.2		-1.7		2.5		5.2
1978	6.32		0.2		1.3		2.2		3.0
1979	7.49		0.2		1.0		2.2		4.5
1980	6.60		0.1		2.1		2.0		2.5
1981	6.36		0.1		3.2		3.0		0.2
1982	5.62		0.3		3.0		0.9		2.1
1983	4.89		0.2		3.5		0.9		0.7
1984	4.66		0.7		3.1		2.3		-0.1
1985	4.59		1.1		3.6		1.9		0.2
1986	4.23		1.7		3.7		1.9		0.3
1987	4.62		1.7		3.9		0.6		1.9
1988	5.05		2.2		3.8		0.0		3.5
1989	4.54		2.7		3.6		0.7		3.0
1990	5.93		3.2		4.1		1.2		3.9
1991	5.33		3.3		4.4		0.7		3.4
1992	4.62		3.0		3.9		0.3		3.4
1993	3.68		2.7		3.9		-0.9		3.4
1994	4.25		2.6		3.9		1.7		1.3
1995	4.06		3.3		3.6		1.2		2.6
1996	4.02		3.9		3.6		1.2		3.1
1997	3.44		3.8		3.0		0.6		3.6
1998	2.66		3.8		2.0		-0.2		4.6
1999	2.24		3.2		1.8		0.9		2.8
2000	2.34		2.8		1.8		0.8		2.6
2001	2.75		2.5		2.2		0.9		2.1
2002	3.70		2.1		2.2		0.3		3.3
2003	3.22		1.8		1.9		1.0		2.1
2004	3.17		1.6		1.5		0.8		2.6
2005	3.07		1.8		1.3		0.6		3.0

Table E - Analysis of equity returns

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Unexpected	**Unexpected return due to:**		**……......Contributions to 12m re-rating……**			
	Equity	**Unexpected**	**Unexpected**	**Change in**	**Change in**	**Change in**	**Change in**
	Return	**div growth**	**re-rating**	**Real rates**	**Real growth**	**IRP**	**ERP**
1963	9.1	2.0	7.1	-6.3	0.9	0.2	12.2
1964	-11.7	13.4	-25.1	-12.1	-0.1	0.2	-13.2
1965	1.6	2.7	-1.0	-2.6	-13.3	-0.3	15.1
1966	-14.1	-4.4	-9.7	6.1	0.0	-1.7	-14.1
1967	23.5	-7.9	31.4	-9.5	6.1	0.3	34.5
1968	38.1	0.8	37.3	-13.6	-11.9	-3.1	65.9
1969	-20.6	-4.6	-16.0	-3.0	-14.8	-3.8	5.6
1970	-12.8	0.2	-13.0	-6.9	-6.9	-3.1	3.9
1971	36.4	-0.5	36.9	57.8	-9.7	-3.9	-7.3
1972	7.2	3.7	3.5	22.6	4.7	-12.2	-11.6
1973	-39.0	-3.7	-35.3	-6.4	-5.1	-9.0	-14.8
1974	-64.5	0.5	-65.0	-36.7	-3.1	-1.7	-23.6
1975	126.8	0.9	125.9	72.2	-9.4	-3.2	66.3
1976	-13.5	3.2	-16.7	1.7	4.3	0.6	-23.3
1977	31.6	6.6	25.1	76.7	5.5	0.6	-57.7
1978	-7.3	2.6	-9.9	-53.0	0.8	3.8	38.5
1979	-4.0	15.5	-19.5	5.3	-0.8	0.6	-24.5
1980	18.5	4.2	14.3	-19.0	-1.7	2.5	32.5
1981	-1.4	-5.1	3.7	-17.8	0.3	-16.4	37.6
1982	14.2	1.1	13.1	3.4	3.9	41.9	-36.2
1983	16.3	1.3	15.0	-12.8	-1.3	-0.4	29.4
1984	20.9	15.4	5.5	9.7	11.6	-37.2	21.3
1985	10.2	8.1	2.1	-11.9	11.8	9.8	-7.7
1986	17.0	6.8	10.1	-1.2	13.5	0.9	-3.0
1987	-1.9	7.3	-9.2	-4.8	1.0	32.5	-37.8
1988	0.1	9.0	-8.9	4.2	10.6	13.6	-37.3
1989	22.8	8.9	13.9	4.7	14.0	-18.1	13.3
1990	-22.5	3.5	-26.0	-8.8	8.3	-8.8	-16.6
1991	6.2	-5.0	11.2	-7.2	1.4	8.5	8.4
1992	6.3	-8.1	14.4	9.9	-5.0	8.3	1.3
1993	15.7	-8.6	24.3	-1.0	-6.4	33.2	-1.4
1994	-15.8	-1.2	-14.6	1.3	-2.4	-63.7	50.2
1995	13.0	7.1	5.9	8.6	18.0	14.4	-35.1
1996	5.5	3.7	1.8	-0.6	15.8	0.2	-13.7
1997	12.7	-4.2	16.9	17.6	-2.6	15.4	-13.5
1998	4.3	-2.0	6.2	8.0	-0.1	6.8	-8.5
1999	14.7	-3.7	18.4	11.1	-25.8	-50.9	84.0
2000	-13.7	-8.9	-4.8	-2.9	-14.0	5.5	6.5
2001	-20.5	-5.3	-15.2	-15.9	-10.9	-3.7	15.3
2002	-29.6	-3.4	-26.2	0.7	-9.9	15.9	-32.9
2003	12.1	-2.7	14.8	8.9	-9.2	-22.3	37.4
2004	5.4	3.6	1.8	15.6	-7.3	7.1	-13.6
2005	14.5	10.7	3.8	5.9	7.3	6.7	-16.0
Average	**4.9**	**1.5**	**3.4**	**2.3**	**-0.7**	**-0.8**	**2.7**

Table F - Analysis of bond returns

	(1) Bond total return	-	(2) Expected bond return (12 m ago)	=	(3) Unexpected bond return	(4) ……Unexpected bond return due to… Change in RRR	(5) Change in Inflation	(6) Change in IRP
1963	1.8		5.6		-3.8	-4.3	0.4	0.1
1964	-2.1		5.8		-7.9	-8.7	0.7	0.2
1965	3.7		6.3		-2.6	-1.7	-0.7	-0.2
1966	3.8		6.5		-2.7	5.8	-6.5	-1.6
1967	1.0		6.7		-5.7	-6.4	0.6	0.2
1968	-4.6		7.1		-11.6	-5.8	-5.0	-1.2
1969	-1.9		8.0		-9.9	-1.5	-7.0	-1.7
1970	-1.3		8.9		-10.2	-3.4	-5.7	-1.4
1971	24.2		9.9		14.3	23.6	-6.1	-1.5
1972	-4.8		8.6		-13.4	8.3	-16.7	-4.0
1973	-11.5		10.0		-21.4	-3.3	-15.6	-3.7
1974	-16.8		12.7		-29.5	-25.3	-4.6	-1.1
1975	38.3		18.0		20.3	27.8	-4.8	-1.2
1976	16.8		15.0		1.9	0.7	0.9	0.2
1977	51.8		14.7		37.1	35.3	1.1	0.3
1978	-3.7		10.7		-14.5	-21.8	7.4	1.9
1979	16.9		12.5		4.4	2.7	1.3	0.3
1980	9.6		12.0		-2.4	-8.4	5.2	1.3
1981	-0.6		12.3		-12.9	-8.1	2.1	-7.1
1982	50.2		14.1		36.0	1.5	10.7	21.1
1983	14.5		10.4		4.2	-5.0	9.8	-0.1
1984	8.5		10.0		-1.5	4.1	10.4	-14.2
1985	10.9		10.1		0.8	-4.6	1.7	3.9
1986	8.0		10.0		-2.0	-0.7	-1.5	0.2
1987	18.2		10.3		7.9	-2.0	-3.3	13.9
1988	13.2		9.5		3.7	1.6	-4.1	6.5
1989	2.4		9.2		-6.8	1.8	-1.3	-7.2
1990	2.0		9.8		-7.9	-4.7	1.1	-4.4
1991	17.5		10.7		6.8	-3.2	5.6	4.4
1992	27.1		10.0		17.1	5.2	6.5	4.5
1993	38.8		8.5		30.3	0.0	9.6	18.8
1994	-18.0		6.5		-24.5	1.1	6.3	-29.8
1995	20.2		8.7		11.5	3.5	1.2	6.5
1996	7.8		7.8		0.0	-0.5	0.5	0.0
1997	28.4		7.8		20.6	8.4	3.0	8.0
1998	49.5		6.5		43.0	18.3	1.7	18.9
1999	-5.5		4.5		-10.0	6.1	8.9	-22.1
2000	10.8		5.0		5.8	-1.2	4.0	2.9
2001	-3.4		4.7		-8.2	-8.3	2.1	-1.9
2002	14.7		5.2		9.6	0.6	-3.1	12.4
2003	-1.5		4.7		-6.2	6.6	2.5	-14.1
2004	15.5		5.0		10.5	10.1	-4.0	4.6
2005	14.8		4.5		10.3	3.7	1.9	4.4
Average	**10.8**		**8.9**		**1.9**	**1.1**	**0.4**	**0.4**

Table G - Ex-post -v- ex-ante risk premia

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Ex-ante ERP (12M ago)	**Unexpected Equity return (Last 12M)**	**……Due to…. Unexpected Dividend growth**	**Unexpected Re-rating**	**Unexpected Bond return (Last 12M)**	**Ex-post ERP (Last 12M)**	**Unexpected Risk premium (Last 12M)**
1963	4.2	9.1	2.0	7.1	-3.8	17.1	12.9
1964	3.8	-11.7	13.4	-25.1	-7.9	0.0	-3.8
1965	4.4	1.6	2.7	-1.0	-2.6	8.6	4.3
1966	3.6	-14.1	-4.4	-9.7	-2.7	-7.8	-11.4
1967	4.4	23.5	-7.9	31.4	-5.7	33.6	29.2
1968	2.8	38.1	0.8	37.3	-11.6	52.6	49.8
1969	0.7	-20.6	-4.6	-16.0	-9.9	-10.0	-10.7
1970	0.5	-12.8	0.2	-13.0	-10.2	-2.1	-2.6
1971	0.3	36.4	-0.5	36.9	14.3	22.3	22.0
1972	0.5	7.2	3.7	3.5	-13.4	21.1	20.6
1973	0.9	-39.0	-3.7	-35.3	-21.4	-16.6	-17.5
1974	1.7	-64.5	0.5	-65.0	-29.5	-33.3	-35.0
1975	4.4	126.8	0.9	125.9	20.3	111.0	106.6
1976	0.8	-13.5	3.2	-16.7	1.9	-14.5	-15.4
1977	2.3	31.6	6.6	25.1	37.1	-3.2	-5.5
1978	5.2	-7.3	2.6	-9.9	-14.5	12.3	7.2
1979	3.0	-4.0	15.5	-19.5	4.4	-5.4	-8.4
1980	4.5	18.5	4.2	14.3	-2.4	25.3	20.9
1981	2.5	-1.4	-5.1	3.7	-12.9	14.1	11.6
1982	0.2	14.2	1.1	13.1	36.0	-21.7	-21.9
1983	2.1	16.3	1.3	15.0	4.2	14.2	12.2
1984	0.7	20.9	15.4	5.5	-1.5	23.1	22.4
1985	-0.1	10.2	8.1	2.1	0.8	9.3	9.4
1986	0.2	17.0	6.8	10.1	-2.0	19.2	19.0
1987	0.3	-1.9	7.3	-9.2	7.9	-9.5	-9.9
1988	1.9	0.1	9.0	-8.9	3.7	-1.7	-3.6
1989	3.5	22.8	8.9	13.9	-6.8	33.1	29.6
1990	3.0	-22.5	3.5	-26.0	-7.9	-11.6	-14.6
1991	3.9	6.2	-5.0	11.2	6.8	3.3	-0.6
1992	3.4	6.3	-8.1	14.4	17.1	-7.3	-10.8
1993	3.4	15.7	-8.6	24.3	30.3	-11.2	-14.5
1994	3.4	-15.8	-1.2	-14.6	-24.5	12.1	8.7
1995	1.3	13.0	7.1	5.9	11.5	2.9	1.5
1996	2.6	5.5	3.7	1.8	0.0	8.1	5.5
1997	3.1	12.7	-4.2	16.9	20.6	-4.8	-7.9
1998	3.6	4.3	-2.0	6.2	43.0	-35.2	-38.8
1999	4.6	14.7	-3.7	18.4	-10.0	29.3	24.7
2000	2.8	-13.7	-8.9	-4.8	5.8	-16.7	-19.5
2001	2.6	-20.5	-5.3	-15.2	-8.2	-9.8	-12.4
2002	2.1	-29.6	-3.4	-26.2	9.6	-37.0	-39.2
2003	3.3	12.1	-2.7	14.8	-6.2	21.7	18.3
2004	2.1	5.4	3.6	1.8	10.5	-3.0	-5.1
2005	2.6	14.5	10.7	3.8	10.3	6.8	4.2
Ave	**2.5**	**4.9**	**1.5**	**3.4**	**1.9**	**5.5**	**3.0**

APPENDIX 2b

Table A - Historical market/economic data

		(1) Historic Equity Yield	(2) Undated Bond Yield	(3) 12 Month Dividend Growth	(4) 12 Month Equity Return	(5) 12 Month Bond Return	(6) Ex-post Equity risk Premium	(7) 12 Month Inflation (RPI)
1963	Q4	4.08	5.81	7.2	18.9	1.8	17.1	1.9
1964	Q1	4.29	5.88	15.4	19.7	4.3	15.5	1.4
	Q2	4.49	6.07	12.5	13.1	-5.8	19.0	3.4
	Q3	4.50	6.05	19.8	15.2	-4.8	20.0	4.4
	Q4	5.18	6.31	18.1	-2.1	-2.1	0.0	4.8
1965	Q1	5.36	6.39	17.1	-1.3	-2.1	0.8	4.5
	Q2	5.69	6.66	10.4	-8.0	-2.8	-5.2	4.9
	Q3	5.40	6.21	9.3	-4.0	3.5	-7.4	4.8
	Q4	5.23	6.48	7.8	12.3	3.7	8.6	4.5
1966	Q1	5.24	6.68	4.4	12.4	2.0	10.3	4.3
	Q2	4.94	6.89	3.3	24.9	3.3	21.6	3.9
	Q3	5.84	7.01	1.8	-0.3	-5.2	4.9	3.6
	Q4	5.79	6.66	0.4	-4.1	3.8	-7.8	3.7
1967	Q1	5.48	6.41	-2.5	-1.7	10.9	-12.6	3.5
	Q2	5.00	6.80	-3.2	0.4	8.2	-7.8	2.4
	Q3	4.65	6.85	-3.1	27.3	9.3	18.0	1.5
	Q4	4.38	7.06	-2.4	34.6	1.0	33.6	2.5
1968	Q1	3.92	7.16	0.4	45.8	-4.1	49.9	3.4
	Q2	3.47	7.75	1.2	50.8	-5.5	56.3	4.6
	Q3	3.31	7.46	2.5	48.7	-1.3	50.1	5.9
	Q4	3.24	7.99	6.0	48.0	-4.6	52.6	5.9
1969	Q1	3.44	8.71	4.9	23.7	-10.7	34.4	6.3
	Q2	4.02	9.19	6.1	-4.7	-8.0	3.3	5.3
	Q3	4.09	8.87	5.0	-11.6	-8.4	-3.1	5.1
	Q4	3.85	8.87	0.8	-11.9	-1.9	-10.0	4.7
1970	Q1	4.07	8.56	3.9	-8.6	10.5	-19.1	5.1
	Q2	4.72	9.19	3.9	-7.3	9.2	-16.5	5.9
	Q3	4.31	9.37	4.8	3.7	3.6	0.2	7.0
	Q4	4.39	9.87	5.5	-3.5	-1.3	-2.1	7.9
1971	Q1	4.20	9.07	2.2	3.2	3.0	0.2	8.8
	Q2	3.64	9.24	3.1	38.5	8.7	29.8	10.3
	Q3	3.40	8.71	3.1	35.1	16.9	18.3	9.9
	Q4	3.25	8.64	5.1	46.5	24.2	22.3	9.0
1972	Q1	2.96	8.87	7.5	57.1	11.3	45.7	7.6
	Q2	3.22	9.50	8.7	26.9	6.5	20.4	6.1
	Q3	3.40	9.73	9.8	13.5	-1.7	15.3	7.0
	Q4	3.15	9.97	9.3	16.4	-4.8	21.1	7.7
1973	Q1	3.69	10.39	8.6	-9.7	-5.8	-3.9	8.2
	Q2	3.67	10.61	6.0	-3.6	-1.0	-2.6	9.3
	Q3	3.93	11.59	5.4	-5.2	-6.3	1.1	9.3
	Q4	4.77	12.70	3.9	-28.1	-11.5	-16.6	10.6

		Historic Equity Yield	Undated Bond Yield	12 Month Dividend Growth	12 Month Equity Return	12 Month Bond Return	Ex-post Equity risk Premium	12 Month Inflation (RPI)
1974	Q1	6.17	14.65	4.4	-33.7	-18.7	-15.0	13.5
	Q2	7.31	15.87	9.3	-41.1	-22.5	-18.6	16.5
	Q3	10.15	16.06	9.5	-53.3	-16.2	-37.1	17.1
	Q4	11.71	18.01	9.6	-50.1	-16.8	-33.3	19.1
1975	Q1	6.70	14.33	8.6	6.7	16.8	-10.1	21.2
	Q2	6.51	14.87	8.4	29.6	22.6	7.0	26.1
	Q3	5.91	14.86	9.5	99.2	24.1	75.1	26.6
	Q4	5.47	14.98	10.4	149.3	38.3	111.0	24.9
1976	Q1	5.35	14.33	11.1	46.6	14.3	32.2	21.2
	Q2	5.91	14.08	10.0	28.4	20.4	7.9	13.8
	Q3	7.12	15.26	12.4	0.0	12.3	-12.3	14.3
	Q4	6.42	14.70	12.8	2.3	16.8	-14.5	15.1
1977	Q1	5.69	12.86	14.0	13.3	25.8	-12.5	16.7
	Q2	5.53	13.20	14.8	29.5	20.8	8.7	17.7
	Q3	4.89	10.90	14.2	74.4	55.3	19.1	15.6
	Q4	5.28	10.72	16.1	48.6	51.8	-3.2	12.1
1978	Q1	5.64	11.63	15.3	22.9	23.5	-0.6	9.1
	Q2	5.65	12.62	12.9	16.7	17.8	-1.1	7.4
	Q3	5.43	12.54	13.0	7.3	-2.2	9.4	7.8
	Q4	5.79	12.54	12.6	8.6	-3.7	12.3	8.4
1979	Q1	4.94	10.90	13.6	36.1	18.3	17.8	9.8
	Q2	5.32	11.56	10.8	23.9	21.8	2.2	11.4
	Q3	5.96	10.81	22.4	18.2	28.5	-10.3	16.5
	Q4	6.87	12.01	23.8	11.5	16.9	-5.4	17.2
1980	Q1	6.91	12.82	26.3	-3.5	-4.1	0.6	19.8
	Q2	6.40	12.19	30.8	15.7	6.4	9.3	21.0
	Q3	6.12	11.80	17.0	20.9	2.4	18.5	15.9
	Q4	6.10	12.30	12.9	34.9	9.6	25.3	15.1
1981	Q1	5.78	12.31	7.8	36.3	17.0	19.3	12.6
	Q2	5.66	13.29	5.2	25.7	4.0	21.7	11.3
	Q3	6.57	14.65	3.0	2.2	-7.7	9.9	11.4
	Q4	5.89	14.13	3.5	13.5	-0.6	14.1	12.0
1982	Q1	5.80	12.78	5.8	11.6	8.6	2.9	10.4
	Q2	6.09	12.78	8.3	6.8	17.3	-10.4	9.2
	Q3	5.50	10.90	8.8	37.1	49.1	-12.0	7.3
	Q4	5.26	10.39	9.0	28.5	50.2	-21.7	5.4
1983	Q1	4.94	10.33	7.4	32.4	36.4	-4.0	4.6
	Q2	4.56	10.02	6.5	48.7	40.2	8.4	3.7
	Q3	4.80	10.23	7.5	29.0	17.4	11.6	5.1
	Q4	4.62	9.97	8.1	28.8	14.5	14.2	5.3
1984	Q1	4.38	9.97	12.8	32.8	14.0	18.9	5.2
	Q2	4.87	10.75	13.5	11.5	3.3	8.2	5.1
	Q3	4.68	10.25	17.3	25.9	10.0	15.9	4.7
	Q4	4.42	10.12	20.6	31.6	8.5	23.1	4.6
1985	Q1	4.47	10.31	20.0	22.8	6.7	16.1	6.1
	Q2	4.80	10.41	20.3	28.0	14.0	14.0	7.0
	Q3	4.63	9.97	15.6	22.3	13.1	9.2	5.9
	Q4	4.34	10.05	13.1	20.2	10.9	9.3	5.7

		Historic Equity Yield	Undated Bond Yield	12 Month Dividend Growth	12 Month Equity Return	12 Month Bond Return	Ex-post Equity risk Premium	12 Month Inflation (RPI)
1986	Q1	3.69	8.75	8.6	36.4	28.1	8.3	4.2
	Q2	3.87	8.91	10.4	42.3	27.3	14.9	2.5
	Q3	4.17	10.33	10.6	27.9	6.5	21.4	3.0
	Q4	3.98	10.25	12.2	27.2	8.0	19.2	3.7
1987	Q1	3.41	9.24	14.5	28.1	3.5	24.6	4.0
	Q2	3.08	9.16	12.5	45.7	6.1	39.6	4.2
	Q3	3.03	9.99	14.3	62.0	13.8	48.2	4.2
	Q4	4.33	9.50	13.3	8.7	18.2	-9.5	3.7
1988	Q1	4.31	9.00	12.9	-6.8	11.9	-18.7	3.5
	Q2	4.22	9.39	14.4	-13.0	6.8	-19.7	4.6
	Q3	4.47	9.26	15.5	-18.2	17.8	-36.1	5.9
	Q4	4.69	9.16	15.3	11.5	13.2	-1.7	6.8
1989	Q1	4.19	8.97	16.7	25.0	9.3	15.7	7.9
	Q2	4.20	9.54	13.9	19.2	7.7	11.5	8.3
	Q3	4.07	9.61	12.5	28.6	5.6	23.1	7.6
	Q4	4.19	9.83	16.2	35.5	2.4	33.1	7.7
1990	Q1	4.74	11.43	17.2	8.5	-12.6	21.1	8.1
	Q2	4.67	10.68	18.2	11.3	-1.1	12.4	9.8
	Q3	5.76	11.33	16.4	-13.0	-5.5	-7.5	10.9
	Q4	5.46	10.66	11.7	-9.6	2.0	-11.6	9.3
1991	Q1	4.77	10.20	7.7	12.1	23.4	-11.3	8.2
	Q2	5.00	10.47	6.1	4.1	12.7	-8.6	5.8
	Q3	4.62	9.73	5.5	37.7	27.8	9.9	4.1
	Q4	4.93	9.99	3.9	20.7	17.5	3.3	4.5
1992	Q1	5.04	9.96	3.7	3.1	12.6	-9.5	4.0
	Q2	4.81	9.30	0.8	9.8	23.0	-13.2	3.9
	Q3	4.88	9.54	0.6	-0.1	11.7	-11.8	3.6
	Q4	4.31	8.53	0.4	19.8	27.1	-7.3	2.6
1993	Q1	4.13	8.32	-1.5	25.1	29.8	-4.6	1.9
	Q2	4.06	7.98	-0.6	22.5	25.8	-3.3	1.2
	Q3	3.87	7.27	-0.9	29.7	40.8	-11.1	1.8
	Q4	3.46	6.55	-1.0	27.6	38.8	-11.2	1.9
1994	Q1	3.76	7.98	1.0	15.1	12.5	2.6	2.3
	Q2	4.09	8.83	2.9	6.3	-1.6	7.9	2.6
	Q3	4.00	8.65	3.7	4.3	-8.6	12.9	2.2
	Q4	4.02	8.68	5.1	-5.9	-18.0	12.1	2.9
1995	Q1	4.15	8.44	8.7	2.6	2.6	0.0	3.5
	Q2	4.04	8.51	9.6	15.4	12.6	2.8	3.5
	Q3	3.85	8.38	10.4	19.2	11.8	7.4	3.9
	Q4	3.82	7.78	12.6	23.0	20.2	2.9	3.2

		Historic Equity Yield	Undated Bond Yield	12 Month Dividend Growth	12 Month Equity Return	12 Month Bond Return	Ex-post Equity risk Premium	12 Month Inflation (RPI)
1996	Q1	3.86	8.40	11.4	24.4	8.9	15.6	2.7
	Q2	3.91	8.25	10.7	18.8	11.7	7.1	2.1
	Q3	3.82	8.04	11.3	16.5	12.7	3.8	2.1
	Q4	3.76	7.78	9.9	15.9	7.8	8.1	2.5
1997	Q1	3.64	7.98	7.4	18.0	13.8	4.3	2.6
	Q2	3.55	7.19	6.8	21.9	22.9	-1.0	2.9
	Q3	3.17	6.78	4.7	30.2	26.5	3.7	3.6
	Q4	3.23	6.45	2.9	23.6	28.4	-4.8	3.6
1998	Q1	2.36	5.99	4.7	36.3	41.0	-4.7	3.5
	Q2	2.41	5.80	4.0	29.3	31.3	-2.0	3.7
	Q3	2.84	4.93	4.4	-1.2	44.5	-45.6	3.2
	Q4	2.50	4.51	4.7	14.3	49.5	-35.2	2.7
1999	Q1	2.34	4.81	3.2	6.5	30.6	-24.1	2.1
	Q2	2.26	4.96	0.7	9.8	22.6	-12.7	1.3
	Q3	2.41	5.23	2.3	23.4	-0.9	24.3	1.1
	Q4	2.12	5.01	2.8	23.8	-5.5	29.3	1.8
2000	Q1	2.11	4.93	-3.1	9.7	2.3	7.4	2.6
	Q2	2.16	4.92	-1.7	5.1	5.9	-0.8	3.3
	Q3	2.17	5.09	-3.5	9.5	8.1	1.4	3.3
	Q4	2.23	4.74	-3.2	-5.9	10.8	-16.7	2.9
2001	Q1	2.53	4.94	4.5	-10.6	4.8	-15.4	2.3
	Q2	2.42	5.39	0.9	-7.8	-3.9	-3.9	1.9
	Q3	2.87	5.14	2.2	-20.5	4.0	-24.5	1.7
	Q4	2.63	5.16	-0.2	-13.2	-3.4	-9.8	0.7
2002	Q1	2.66	5.47	-0.8	-3.2	-4.7	1.5	1.3
	Q2	2.98	5.16	2.2	-14.6	9.9	-24.5	1.0
	Q3	3.73	4.65	0.0	-20.2	15.7	-35.9	1.7
	Q4	3.55	4.71	1.3	-22.3	14.7	-37.0	2.9
2003	Q1	3.87	4.76	-1.3	-29.5	20.2	-49.7	3.1
	Q2	3.43	4.78	0.3	-9.9	13.1	-23.0	2.9
	Q3	3.36	4.98	1.4	16.3	-2.0	18.3	2.8
	Q4	3.10	5.02	1.8	20.2	-1.5	21.7	2.8
2004	Q1	3.13	4.75	2.4	30.5	5.1	25.5	2.6
	Q2	3.16	4.91	4.2	16.6	2.1	14.5	3.0
	Q3	3.16	4.74	5.4	15.6	10.1	5.5	3.1
	Q4	3.05	4.54	7.5	12.5	15.5	-3.0	3.5
2005	Q1	3.09	4.70	10.4	15.3	5.8	9.5	3.2
	Q2	3.10	4.34	12.7	18.4	18.0	0.4	2.9
	Q3	2.99	4.38	14.4	24.5	13.0	11.5	2.7
	Q4	2.95	4.12	14.3	21.6	14.8	6.8	2.2

Table B - Long-term Simulations

		(1) 5 Year Inflation Window	(2) 20 Year Trailing Inflation	(3) Sim Inf Gap	(4) Sim L-T Inf. Exp.	(5) Sim Inflation RP	(6) Sim real rates (Prior to '81)	(7) 15 year Trailing RG	(8) 10yr F/C Real Growth	(9) Sim L-T Exp.
1963	Q4	2.3	3.9	3.4	2.7	0.7	2.4	4.2	-1.1	2.6
1964	Q1	2.3	3.9	3.1	2.5	0.6	2.8	4.2	-1.4	2.5
	Q2	2.6	3.9	3.4	2.7	0.7	2.6	4.5	-1.8	2.6
	Q3	2.7	4.0	3.5	2.8	0.7	2.5	4.7	-2.1	2.7
	Q4	3.1	3.9	3.3	2.7	0.7	3.0	4.8	-2.7	2.6
1965	Q1	3.2	3.8	3.3	2.7	0.7	3.1	5.1	-3.6	2.5
	Q2	3.4	3.9	3.5	2.8	0.7	3.2	4.8	-3.9	2.2
	Q3	3.1	4.0	3.4	2.8	0.7	2.8	4.7	-4.0	2.1
	Q4	3.4	3.9	3.4	2.7	0.7	3.1	4.5	-4.2	1.9
1966	Q1	3.4	3.8	3.3	2.6	0.7	3.4	4.4	-4.4	1.7
	Q2	3.8	3.9	3.6	2.9	0.7	3.3	4.3	-4.2	1.8
	Q3	4.0	3.9	3.8	3.0	0.8	3.3	4.4	-4.0	1.9
	Q4	4.3	3.8	3.9	3.1	0.8	2.8	4.4	-4.1	1.9
1967	Q1	4.4	3.7	3.9	3.2	0.8	2.5	4.5	-4.1	1.9
	Q2	4.2	3.7	3.9	3.1	0.8	2.9	4.4	-3.8	1.9
	Q3	4.2	3.7	3.8	3.0	0.8	3.0	4.6	-3.6	2.1
	Q4	4.2	3.7	3.9	3.1	0.8	3.2	4.5	-3.3	2.2
1968	Q1	4.5	3.7	4.0	3.2	0.8	3.1	4.6	-3.3	2.3
	Q2	4.4	3.8	4.0	3.2	0.8	3.7	4.2	-3.0	2.0
	Q3	4.6	3.8	4.1	3.3	0.8	3.3	4.0	-2.9	1.9
	Q4	4.9	3.8	4.3	3.5	0.9	3.6	3.8	-2.9	1.8
1969	Q1	5.4	3.9	4.7	3.8	0.9	4.0	3.5	-2.8	1.6
	Q2	5.7	3.9	4.9	3.9	1.0	4.3	3.2	-3.2	1.3
	Q3	5.8	4.0	5.0	4.0	1.0	3.8	3.0	-2.4	1.4
	Q4	6.0	3.9	5.1	4.1	1.0	3.8	2.6	-2.0	1.2
1970	Q1	6.2	3.6	5.2	4.2	1.0	3.4	2.4	-2.2	1.1
	Q2	6.4	3.7	5.4	4.3	1.1	3.8	2.4	-2.2	1.0
	Q3	7.0	3.8	5.8	4.6	1.2	3.6	2.3	-2.1	1.0
	Q4	7.0	3.8	5.8	4.6	1.2	4.1	2.1	-2.0	0.9
1971	Q1	7.2	3.6	5.9	4.7	1.2	3.2	2.0	-2.0	0.8
	Q2	7.4	3.8	6.0	4.8	1.2	3.2	1.9	-2.1	0.7
	Q3	7.6	3.9	6.2	5.0	1.2	2.5	1.9	-2.2	0.6
	Q4	7.9	3.8	6.4	5.2	1.3	2.2	1.9	-2.4	0.6
1972	Q1	8.6	3.8	6.9	5.5	1.4	2.0	1.9	-2.4	0.6
	Q2	9.6	3.9	7.6	6.1	1.5	1.9	2.0	-2.4	0.7
	Q3	10.0	4.1	7.9	6.3	1.6	1.8	2.1	-2.3	0.7
	Q4	10.8	4.1	8.4	6.8	1.7	1.5	2.0	-2.2	0.7
1973	Q1	11.7	4.2	9.1	7.3	1.8	1.3	2.0	-2.2	0.8
	Q2	13.5	4.3	10.4	8.3	2.1	0.3	1.8	-1.9	0.7
	Q3	13.8	4.5	10.6	8.5	2.1	1.0	1.6	-1.8	0.6
	Q4	14.1	4.5	10.8	8.7	2.2	1.9	1.3	-1.4	0.5

		5 Year Inflation Window	20 Year Trailing Inflation	Sim Inf Gap	Sim L-T Inf. Exp.	Sim Inflation RP	Sim real rates (Prior to '81)	15 year Trailing RG	10yr F/C Real Growth	Sim L-T Exp.
1974	Q1	14.2	4.6	10.9	8.7	2.2	3.7	1.0	-0.7	0.5
	Q2	14.2	4.9	11.0	8.8	2.2	4.9	0.7	-0.5	0.4
	Q3	14.6	5.0	11.3	9.1	2.3	4.7	0.4	0.0	0.3
	Q4	15.3	5.2	11.8	9.5	2.4	6.2	-0.2	0.9	0.1
1975	Q1	16.0	5.3	12.4	9.9	2.5	1.9	-0.8	1.7	0.0
	Q2	16.6	5.9	12.9	10.3	2.6	2.0	-1.2	2.2	-0.2
	Q3	16.4	6.0	12.8	10.3	2.6	2.0	-1.4	2.4	-0.3
	Q4	16.3	6.1	12.7	10.2	2.5	2.3	-1.7	2.8	-0.4
1976	Q1	16.2	6.2	12.7	10.2	2.5	1.6	-2.0	3.0	-0.5
	Q2	16.2	6.4	12.7	10.2	2.5	1.4	-1.9	3.3	-0.3
	Q3	16.1	6.5	12.8	10.2	2.6	2.5	-1.7	3.3	-0.2
	Q4	15.8	6.7	12.5	10.0	2.5	2.2	-1.8	3.8	-0.1
1977	Q1	15.5	6.8	12.4	9.9	2.5	0.5	-1.8	4.2	0.0
	Q2	15.1	7.0	12.2	9.7	2.4	1.0	-1.8	4.4	0.0
	Q3	16.0	7.1	12.8	10.3	2.6	-1.9	-1.7	4.4	0.1
	Q4	15.4	7.1	12.4	9.9	2.5	-1.7	-1.6	4.4	0.2
1978	Q1	15.2	7.3	12.3	9.8	2.5	-0.7	-1.7	4.5	0.2
	Q2	14.1	7.4	11.6	9.3	2.3	1.0	-1.7	4.8	0.2
	Q3	14.0	7.5	11.5	9.2	2.3	1.0	-1.7	4.8	0.3
	Q4	13.5	7.5	11.2	9.0	2.2	1.3	-1.8	4.8	0.2
1979	Q1	13.5	7.7	11.3	9.0	2.3	-0.4	-1.8	5.0	0.3
	Q2	13.7	8.0	11.4	9.1	2.3	0.1	-2.3	5.4	0.0
	Q3	13.4	8.3	11.3	9.1	2.3	-0.5	-1.9	4.7	0.1
	Q4	12.9	8.3	11.0	8.8	2.2	1.0	-1.9	5.0	0.2
1980	Q1	12.3	8.5	10.6	8.5	2.1	2.2	-2.2	5.3	0.1
	Q2	12.0	8.8	10.5	8.4	2.1	1.7	-2.2	5.4	0.1
	Q3	11.7	8.9	10.3	8.3	2.1	1.5	-2.2	5.2	0.0
	Q4	11.6	8.9	10.2	8.2	2.0	2.1	-2.3	5.5	0.1
1981	Q1	11.3	8.9	10.1	8.1	2.0	2.2	-2.5	5.7	0.0
	Q2	11.2	9.1	10.0	8.0	3.0	2.3	-2.5	6.0	0.0
	Q3	11.1	9.3	10.0	8.0	3.5	3.1	-2.6	6.1	0.0
	Q4	10.9	9.3	9.9	7.9	3.0	3.2	-2.6	6.2	0.1
1982	Q1	10.4	9.4	9.5	7.6	2.3	2.9	-2.4	6.1	0.2
	Q2	9.9	9.5	9.2	7.4	2.2	3.2	-2.2	5.8	0.2
	Q3	8.8	9.6	8.5	6.8	0.9	3.2	-2.2	5.7	0.2
	Q4	8.4	9.5	8.2	6.6	0.9	3.0	-2.0	5.7	0.3
1983	Q1	7.7	9.4	7.7	6.2	1.4	2.8	-2.0	5.5	0.2
	Q2	7.2	9.5	7.4	5.9	0.6	3.5	-1.8	5.3	0.3
	Q3	6.9	9.6	7.2	5.7	1.1	3.4	-1.8	5.2	0.3
	Q4	6.6	9.6	7.0	5.6	0.9	3.5	-1.9	5.1	0.2
1984	Q1	6.1	9.6	6.6	5.3	1.0	3.7	-1.5	4.6	0.4
	Q2	5.5	9.6	6.2	5.0	1.7	4.1	-1.4	4.5	0.4
	Q3	5.2	9.7	6.0	4.8	2.0	3.4	-1.1	4.1	0.5
	Q4	4.9	9.6	5.9	4.7	2.3	3.1	-0.7	3.8	0.7

		5 Year Inflation Window	20 Year Trailing Inflation	Sim Inf Gap	Sim L-T Inf. Exp.	Sim Inflation RP	Sim real rates (Prior to '81)	15 year Trailing RG	10yr F/C Real Growth	Sim L-T Exp.
1985	Q1	4.8	9.7	5.8	4.6	2.5	3.2	-0.6	3.8	0.7
	Q2	4.5	9.7	5.6	4.5	2.5	3.4	-0.5	3.9	0.8
	Q3	4.6	9.7	5.6	4.5	2.1	3.4	-0.3	3.8	0.9
	Q4	4.6	9.7	5.6	4.5	1.9	3.6	-0.1	4.0	1.1
1986	Q1	4.6	9.7	5.7	4.5	0.6	3.6	0.1	4.3	1.4
	Q2	4.7	9.7	5.7	4.5	1.0	3.3	0.5	3.9	1.5
	Q3	4.7	9.7	5.7	4.6	3.0	2.7	0.6	4.0	1.6
	Q4	4.9	9.7	5.8	4.7	1.9	3.7	0.7	3.9	1.7
1987	Q1	5.1	9.7	6.0	4.8	1.2	3.3	0.8	3.7	1.7
	Q2	5.3	9.8	6.1	4.9	0.6	3.7	0.8	3.5	1.6
	Q3	5.3	9.8	6.2	4.9	1.1	4.0	1.0	3.2	1.7
	Q4	5.5	9.8	6.3	5.0	0.6	3.9	1.2	2.9	1.7
1988	Q1	5.5	9.7	6.3	5.0	0.1	3.8	1.3	3.0	1.8
	Q2	5.8	9.8	6.5	5.2	0.3	3.9	1.7	2.6	1.9
	Q3	6.3	9.8	6.8	5.5	-0.1	3.9	1.8	2.4	2.0
	Q4	6.2	9.8	6.8	5.4	0.0	3.8	2.1	2.3	2.2
1989	Q1	6.3	9.8	6.9	5.5	0.0	3.5	2.4	2.3	2.4
	Q2	6.5	9.9	7.0	5.6	0.3	3.7	2.4	2.0	2.3
	Q3	6.5	10.0	7.0	5.6	0.4	3.6	2.6	2.0	2.4
	Q4	6.4	10.0	6.9	5.5	0.7	3.6	3.2	1.7	2.7
1990	Q1	6.3	10.0	6.9	5.5	1.8	4.1	3.7	0.9	2.9
	Q2	6.5	10.1	7.0	5.6	1.0	4.1	4.0	0.8	3.0
	Q3	6.4	10.2	7.0	5.6	1.5	4.3	3.9	0.9	3.0
	Q4	6.1	10.0	6.8	5.4	1.2	4.1	4.2	0.8	3.2
1991	Q1	6.0	10.0	6.7	5.3	0.7	4.2	4.3	1.2	3.3
	Q2	5.8	9.9	6.5	5.2	0.9	4.4	4.2	0.6	3.2
	Q3	5.5	9.9	6.3	5.1	0.5	4.2	4.1	0.8	3.1
	Q4	5.2	9.8	6.1	4.8	0.7	4.4	4.3	0.8	3.3
1992	Q1	4.9	9.8	5.9	4.7	0.7	4.5	4.4	1.0	3.4
	Q2	4.6	9.8	5.7	4.5	0.5	4.2	4.2	1.1	3.3
	Q3	4.5	9.7	5.5	4.4	1.0	4.1	4.0	0.9	3.1
	Q4	4.2	9.5	5.3	4.3	0.3	3.9	3.9	0.8	3.0
1993	Q1	4.0	9.4	5.1	4.1	0.6	3.6	3.8	0.9	2.9
	Q2	3.4	9.3	4.7	3.8	0.5	3.7	3.7	1.0	2.9
	Q3	3.1	9.3	4.5	3.6	0.4	3.2	3.5	1.0	2.8
	Q4	3.0	9.1	4.4	3.5	-0.9	3.9	3.5	1.0	2.7
1994	Q1	2.9	8.9	4.3	3.4	1.1	3.5	3.5	1.0	2.7
	Q2	2.7	8.6	4.0	3.2	1.6	3.9	3.8	1.1	3.0
	Q3	2.7	8.5	4.0	3.2	1.6	3.9	3.3	1.1	2.6
	Q4	2.6	8.3	3.9	3.1	1.7	3.9	3.2	1.2	2.6
1995	Q1	2.6	8.0	3.8	3.1	1.5	3.9	3.5	1.2	2.8
	Q2	2.5	7.6	3.6	2.9	1.8	3.8	3.6	1.4	3.0
	Q3	2.7	7.5	3.8	3.0	1.7	3.7	3.6	1.6	3.0
	Q4	2.8	7.3	3.8	3.0	1.2	3.6	4.0	1.7	3.3

		5 Year Inflation Window	20 Year Trailing Inflation	Sim Inf Gap	Sim L-T Inf. Exp.	Sim Inflation RP	Sim real rates (Prior to '81)	15 year Trailing RG	10yr F/C Real Growth	Sim L-T Exp.
1996	Q1	2.9	7.1	3.8	3.1	1.5	3.8	4.3	1.5	3.5
	Q2	3.0	7.0	3.8	3.1	1.3	3.8	4.6	1.5	3.6
	Q3	3.0	6.9	3.8	3.0	1.3	3.7	4.8	1.3	3.7
	Q4	3.0	6.7	3.8	3.0	1.2	3.6	5.0	1.2	3.9
1997	Q1	2.9	6.4	3.6	2.9	1.4	3.7	4.9	1.3	3.8
	Q2	2.7	6.3	3.5	2.8	0.8	3.6	4.9	1.3	3.8
	Q3	2.8	6.3	3.5	2.8	0.6	3.3	4.8	1.5	3.8
	Q4	2.8	6.2	3.5	2.8	0.6	3.0	4.7	1.6	3.8
1998	Q1	2.7	6.2	3.4	2.7	0.4	2.9	4.8	1.4	3.8
	Q2	2.7	6.1	3.4	2.7	0.5	2.6	4.7	1.6	3.8
	Q3	2.7	6.1	3.4	2.7	-0.3	2.5	4.7	1.6	3.8
	Q4	2.7	5.9	3.4	2.7	-0.2	2.0	4.7	1.7	3.8
1999	Q1	2.6	5.8	3.3	2.6	0.4	1.8	4.4	1.6	3.6
	Q2	2.7	5.6	3.3	2.6	0.4	2.0	4.2	1.9	3.5
	Q3	2.6	5.3	3.1	2.5	0.6	2.1	4.0	1.8	3.3
	Q4	2.3	5.2	2.9	2.4	0.9	1.8	3.8	1.8	3.2
2000	Q1	2.3	5.0	2.9	2.3	0.9	1.8	3.2	2.4	3.0
	Q2	2.3	4.8	2.8	2.2	1.0	1.7	3.0	2.7	2.9
	Q3	2.2	4.7	2.7	2.2	1.0	1.9	2.9	2.7	2.9
	Q4	2.2	4.6	2.7	2.2	0.8	1.8	2.9	2.7	2.8
2001	Q1	2.3	4.5	2.7	2.2	0.6	2.1	3.1	2.5	2.9
	Q2	2.1	4.3	2.5	2.0	1.0	2.3	2.4	3.1	2.6
	Q3	2.1	4.2	2.5	2.0	0.8	2.4	2.5	3.0	2.6
	Q4	2.2	4.1	2.6	2.1	0.9	2.2	2.3	3.1	2.5
2002	Q1	2.4	4.0	2.7	2.1	1.0	2.3	2.3	3.0	2.5
	Q2	2.4	3.9	2.7	2.1	0.9	2.2	2.0	3.2	2.3
	Q3	2.5	3.9	2.7	2.2	0.4	2.1	1.7	3.4	2.2
	Q4	2.6	3.9	2.8	2.2	0.3	2.2	1.5	3.5	2.1
2003	Q1	2.5	3.9	2.7	2.2	0.6	2.0	1.4	3.7	2.1
	Q2	2.4	3.9	2.6	2.1	0.7	2.0	1.2	3.7	2.0
	Q3	2.4	3.8	2.6	2.1	0.9	2.0	1.0	3.8	1.9
	Q4	2.4	3.8	2.6	2.1	1.0	1.9	1.0	3.9	1.8
2004	Q1	2.5	3.8	2.4	2.0	1.2	1.6	0.8	4.0	1.8
	Q2	2.4	3.8	2.4	1.9	1.3	1.8	0.9	3.9	1.8
	Q3	2.5	3.7	2.4	1.9	1.2	1.6	0.9	3.8	1.8
	Q4	2.8	3.8	2.9	2.3	0.8	1.5	0.7	3.8	1.6
2005	Q1	2.8	3.7	2.6	2.1	1.0	1.7	0.7	3.5	1.6
	Q2	2.7	3.6	2.5	2.0	0.9	1.4	1.0	3.2	1.7
	Q3	2.7	3.6	2.4	1.9	1.2	1.3	1.3	3.0	1.8
	Q4	2.7	3.6	2.8	2.2	0.6	1.3	1.5	2.6	1.8

Table C - Simulated equity risk premium

		(1) Historic Equity Yield	(2) Long-term Exp div growth (nominal)	(3) 1st Year Expected Yield	(4) Expected 12 month equity return	-	(5) Expected Bond Return	=	(6) Ex-ante Equity risk Premium
1963	Q4	4.08	5.3	4.30	9.6		5.8		3.8
1964	Q1	4.29	5.0	4.51	9.6		5.9		3.7
	Q2	4.49	5.4	4.73	10.1		6.1		4.0
	Q3	4.50	5.5	4.75	10.2		6.1		4.2
	Q4	5.18	5.2	5.45	10.7		6.3		4.4
1965	Q1	5.36	5.2	5.64	10.8		6.4		4.4
	Q2	5.69	5.0	5.97	11.0		6.7		4.3
	Q3	5.40	4.9	5.66	10.5		6.2		4.3
	Q4	5.23	4.6	5.47	10.0		6.5		3.6
1966	Q1	5.24	4.4	5.47	9.8		6.7		3.2
	Q2	4.94	4.7	5.17	9.9		6.9		3.0
	Q3	5.84	4.9	6.13	11.1		7.0		4.0
	Q4	5.79	5.0	6.08	11.1		6.7		4.4
1967	Q1	5.48	5.0	5.76	10.8		6.4		4.4
	Q2	5.00	5.0	5.25	10.3		6.8		3.5
	Q3	4.65	5.1	4.89	10.0		6.9		3.2
	Q4	4.38	5.3	4.61	9.9		7.1		2.8
1968	Q1	3.92	5.5	4.14	9.6		7.2		2.5
	Q2	3.47	5.2	3.65	8.9		7.8		1.1
	Q3	3.31	5.2	3.48	8.7		7.5		1.3
	Q4	3.24	5.3	3.41	8.7		8.0		0.7
1969	Q1	3.44	5.3	3.62	9.0		8.7		0.3
	Q2	4.02	5.2	4.23	9.5		9.2		0.3
	Q3	4.09	5.4	4.31	9.7		8.9		0.8
	Q4	3.85	5.3	4.05	9.3		8.9		0.5
1970	Q1	4.07	5.2	4.28	9.5		8.6		0.9
	Q2	4.72	5.3	4.97	10.2		9.2		1.1
	Q3	4.31	5.6	4.55	10.2		9.4		0.8
	Q4	4.39	5.5	4.63	10.2		9.9		0.3
1971	Q1	4.20	5.5	4.43	9.9		9.1		0.8
	Q2	3.64	5.5	3.84	9.3		9.2		0.1
	Q3	3.40	5.6	3.59	9.2		8.7		0.5
	Q4	3.25	5.7	3.44	9.2		8.6		0.5
1972	Q1	2.96	6.2	3.14	9.3		8.9		0.4
	Q2	3.22	6.8	3.44	10.2		9.5		0.7
	Q3	3.40	7.1	3.64	10.7		9.7		1.0
	Q4	3.15	7.5	3.39	10.9		10.0		0.9
1973	Q1	3.69	8.1	3.99	12.0		10.4		1.7
	Q2	3.67	9.0	4.00	13.0		10.6		2.3
	Q3	3.93	9.1	4.29	13.4		11.6		1.8
	Q4	4.77	9.2	5.21	14.4		12.7		1.7

		Historic Equity Yield	Long-term Exp div growth (nominal)	1st Year Expected Yield	Expected 12 month equity return	-	Expected Bond Return	=	Ex-ante Equity risk Premium
1974	Q1	6.17	9.2	6.74	16.0		14.6		1.3
	Q2	7.31	9.2	7.98	17.1		15.9		1.3
	Q3	10.15	9.4	11.10	20.5		16.1		4.4
	Q4	11.71	9.6	12.83	22.4		18.0		4.4
1975	Q1	6.70	9.9	7.36	17.2		14.3		2.9
	Q2	6.51	10.1	7.17	17.3		14.9		2.4
	Q3	5.91	10.0	6.50	16.5		14.9		1.6
	Q4	5.47	9.8	6.01	15.8		15.0		0.8
1976	Q1	5.35	9.7	5.87	15.6		14.3		1.2
	Q2	5.91	9.9	6.49	16.4		14.1		2.3
	Q3	7.12	10.0	7.83	17.8		15.3		2.6
	Q4	6.42	9.9	7.06	17.0		14.7		2.3
1977	Q1	5.69	9.9	6.25	16.1		12.9		3.3
	Q2	5.53	9.8	6.07	15.8		13.2		2.6
	Q3	4.89	10.4	5.40	15.8		10.9		4.9
	Q4	5.28	10.1	5.81	15.9		10.7		5.2
1978	Q1	5.64	10.0	6.21	16.3		11.6		4.6
	Q2	5.65	9.5	6.19	15.7		12.6		3.1
	Q3	5.43	9.5	5.94	15.4		12.5		2.9
	Q4	5.79	9.2	6.32	15.5		12.5		3.0
1979	Q1	4.94	9.3	5.40	14.7		10.9		3.8
	Q2	5.32	9.2	5.81	15.0		11.6		3.4
	Q3	5.96	9.1	6.51	15.7		10.8		4.8
	Q4	6.87	9.0	7.49	16.5		12.0		4.5
1980	Q1	6.91	8.5	7.50	16.0		12.8		3.2
	Q2	6.40	8.4	6.94	15.4		12.2		3.2
	Q3	6.12	8.3	6.63	14.9		11.8		3.1
	Q4	6.10	8.2	6.60	14.8		12.3		2.5
1981	Q1	5.78	8.0	6.24	14.3		12.3		2.0
	Q2	5.66	8.0	6.12	14.2		13.3		0.9
	Q3	6.57	8.1	7.10	15.2		14.6		0.5
	Q4	5.89	8.0	6.36	14.3		14.1		0.2
1982	Q1	5.80	7.8	6.25	14.1		12.8		1.3
	Q2	6.09	7.6	6.55	14.1		12.8		1.3
	Q3	5.50	7.0	5.88	12.9		10.9		2.0
	Q4	5.26	6.8	5.62	12.5		10.4		2.1
1983	Q1	4.94	6.4	5.26	11.7		10.3		1.3
	Q2	4.56	6.2	4.84	11.1		10.0		1.1
	Q3	4.80	6.0	5.09	11.1		10.2		0.9
	Q4	4.62	5.8	4.89	10.7		10.0		0.7
1984	Q1	4.38	5.7	4.63	10.3		10.0		0.3
	Q2	4.87	5.4	5.13	10.5		10.8		-0.3
	Q3	4.68	5.3	4.93	10.3		10.3		0.0
	Q4	4.42	5.4	4.66	10.0		10.1		-0.1

		Historic Equity Yield	Long-term Exp div growth (nominal)	1st Year Expected Yield	Expected 12 month equity return	-	Expected Bond Return	=	Ex-ante Equity risk Premium
1985	Q1	4.47	5.4	4.71	10.1		10.3		-0.2
	Q2	4.80	5.3	5.05	10.4		10.4		-0.1
	Q3	4.63	5.4	4.88	10.3		10.0		0.3
	Q4	4.34	5.7	4.59	10.2		10.0		0.2
1986	Q1	3.69	5.9	3.91	9.8		8.8		1.0
	Q2	3.87	6.1	4.10	10.2		8.9		1.3
	Q3	4.17	6.2	4.43	10.6		10.3		0.3
	Q4	3.98	6.3	4.23	10.6		10.3		0.3
1987	Q1	3.41	6.5	3.63	10.1		9.2		0.9
	Q2	3.08	6.5	3.28	9.8		9.2		0.7
	Q3	3.03	6.6	3.23	9.8		10.0		-0.2
	Q4	4.33	6.7	4.62	11.4		9.5		1.9
1988	Q1	4.31	6.8	4.60	11.4		9.0		2.5
	Q2	4.22	7.1	4.52	11.7		9.4		2.3
	Q3	4.47	7.5	4.80	12.3		9.3		3.0
	Q4	4.69	7.6	5.05	12.7		9.2		3.5
1989	Q1	4.19	7.9	4.52	12.4		9.0		3.4
	Q2	4.20	7.9	4.53	12.5		9.5		2.9
	Q3	4.07	8.0	4.40	12.4		9.6		2.8
	Q4	4.19	8.3	4.54	12.8		9.8		3.0
1990	Q1	4.74	8.4	5.14	13.5		11.4		2.1
	Q2	4.67	8.6	5.07	13.7		10.7		3.0
	Q3	5.76	8.6	6.25	14.8		11.3		3.5
	Q4	5.46	8.6	5.93	14.6		10.7		3.9
1991	Q1	4.77	8.7	5.18	13.9		10.2		3.7
	Q2	5.00	8.3	5.42	13.8		10.5		3.3
	Q3	4.62	8.2	5.00	13.2		9.7		3.5
	Q4	4.93	8.1	5.33	13.4		10.0		3.4
1992	Q1	5.04	8.1	5.45	13.5		10.0		3.6
	Q2	4.81	7.8	5.19	13.0		9.3		3.7
	Q3	4.88	7.5	5.25	12.8		9.5		3.2
	Q4	4.31	7.3	4.62	11.9		8.5		3.4
1993	Q1	4.13	7.0	4.42	11.5		8.3		3.2
	Q2	4.06	6.7	4.33	11.0		8.0		3.0
	Q3	3.87	6.4	4.12	10.5		7.3		3.2
	Q4	3.46	6.3	3.68	9.9		6.5		3.4
1994	Q1	3.76	6.1	3.99	10.1		8.0		2.1
	Q2	4.09	6.2	4.34	10.6		8.8		1.7
	Q3	4.00	5.9	4.23	10.1		8.6		1.5
	Q4	4.02	5.8	4.25	10.0		8.7		1.3
1995	Q1	4.15	5.8	4.39	10.2		8.4		1.8
	Q2	4.04	5.9	4.28	10.2		8.5		1.7
	Q3	3.85	6.0	4.08	10.1		8.4		1.7
	Q4	3.82	6.3	4.06	10.4		7.8		2.6

		Historic Equity Yield	Long-term Exp div growth (nominal)	1st Year Expected Yield	Expected 12 month equity return	-	Expected Bond Return	=	Ex-ante Equity risk Premium
1996	Q1	3.86	6.5	4.11	10.7		8.4		2.2
	Q2	3.91	6.7	4.17	10.9		8.2		2.7
	Q3	3.82	6.8	4.08	10.9		8.0		2.8
	Q4	3.76	6.9	4.02	10.9		7.8		3.1
1997	Q1	3.64	6.7	3.89	10.6		8.0		2.6
	Q2	3.55	6.6	3.79	10.4		7.2		3.2
	Q3	3.17	6.6	3.38	10.0		6.8		3.2
	Q4	3.23	6.6	3.44	10.0		6.5		3.6
1998	Q1	2.36	6.6	2.51	9.1		6.0		3.1
	Q2	2.41	6.5	2.57	9.1		5.8		3.3
	Q3	2.84	6.5	3.02	9.5		4.9		4.6
	Q4	2.50	6.5	2.66	9.1		4.5		4.6
1999	Q1	2.34	6.2	2.48	8.7		4.8		3.9
	Q2	2.26	6.1	2.40	8.5		5.0		3.5
	Q3	2.41	5.8	2.55	8.4		5.2		3.1
	Q4	2.12	5.5	2.24	7.8		5.0		2.8
2000	Q1	2.11	5.3	2.22	7.5		4.9		2.6
	Q2	2.16	5.1	2.27	7.4		4.9		2.5
	Q3	2.17	5.0	2.28	7.3		5.1		2.2
	Q4	2.23	5.0	2.34	7.3		4.7		2.6
2001	Q1	2.53	5.0	2.66	7.7		4.9		2.8
	Q2	2.42	4.6	2.53	7.2		5.4		1.8
	Q3	2.87	4.6	3.00	7.6		5.1		2.5
	Q4	2.63	4.6	2.75	7.3		5.2		2.1
2002	Q1	2.66	4.6	2.78	7.4		5.5		1.9
	Q2	2.98	4.5	3.11	7.6		5.2		2.4
	Q3	3.73	4.4	3.89	8.3		4.7		3.6
	Q4	3.55	4.4	3.70	8.1		4.7		3.3
2003	Q1	3.87	4.2	4.03	8.3		4.8		3.5
	Q2	3.43	4.0	3.57	7.6		4.8		2.8
	Q3	3.36	4.0	3.49	7.4		5.0		2.5
	Q4	3.10	3.9	3.22	7.2		5.0		2.1
2004	Q1	3.13	3.7	3.25	7.0		4.7		2.2
	Q2	3.16	3.7	3.28	7.0		4.9		2.1
	Q3	3.16	3.7	3.28	6.9		4.7		2.2
	Q4	3.05	3.9	3.17	7.1		4.5		2.6
2005	Q1	3.09	3.6	3.20	6.8		4.7		2.1
	Q2	3.10	3.7	3.22	6.9		4.3		2.6
	Q3	2.99	3.7	3.10	6.8		4.4		2.5
	Q4	2.95	4.0	3.07	7.1		4.1		3.0

Table D - Analysis of the ex-ante equity risk premium

		(1) First year Expected div yield	+	(2) Simulated Long-term real Dividend growth	-	(3) Simulated Real rates (actual from '81)	-	(4) Simulated Inflation Risk Premium	=	(5) Ex-ante Equity risk Premium
1963	Q4	4.30		2.6		2.4		0.7		3.8
1964	Q1	4.51		2.5		2.8		0.6		3.7
	Q2	4.73		2.6		2.6		0.7		4.0
	Q3	4.75		2.7		2.5		0.7		4.2
	Q4	5.45		2.6		3.0		0.7		4.4
1965	Q1	5.64		2.5		3.1		0.7		4.4
	Q2	5.97		2.2		3.2		0.7		4.3
	Q3	5.66		2.1		2.8		0.7		4.3
	Q4	5.47		1.9		3.1		0.7		3.6
1966	Q1	5.47		1.7		3.4		0.7		3.2
	Q2	5.17		1.8		3.3		0.7		3.0
	Q3	6.13		1.9		3.3		0.8		4.0
	Q4	6.08		1.9		2.8		0.8		4.4
1967	Q1	5.76		1.9		2.5		0.8		4.4
	Q2	5.25		1.9		2.9		0.8		3.5
	Q3	4.89		2.1		3.0		0.8		3.2
	Q4	4.61		2.2		3.2		0.8		2.8
1968	Q1	4.14		2.3		3.1		0.8		2.5
	Q2	3.65		2.0		3.7		0.8		1.1
	Q3	3.48		1.9		3.3		0.8		1.3
	Q4	3.41		1.8		3.6		0.9		0.7
1969	Q1	3.62		1.6		4.0		0.9		0.3
	Q2	4.23		1.3		4.3		1.0		0.3
	Q3	4.31		1.4		3.8		1.0		0.8
	Q4	4.05		1.2		3.8		1.0		0.5
1970	Q1	4.28		1.1		3.4		1.0		0.9
	Q2	4.97		1.0		3.8		1.1		1.1
	Q3	4.55		1.0		3.6		1.2		0.8
	Q4	4.63		0.9		4.1		1.2		0.3
1971	Q1	4.43		0.8		3.2		1.2		0.8
	Q2	3.84		0.7		3.2		1.2		0.1
	Q3	3.59		0.6		2.5		1.2		0.5
	Q4	3.44		0.6		2.2		1.3		0.5
1972	Q1	3.14		0.6		2.0		1.4		0.4
	Q2	3.44		0.7		1.9		1.5		0.7
	Q3	3.64		0.7		1.8		1.6		1.0
	Q4	3.39		0.7		1.5		1.7		0.9
1973	Q1	3.99		0.8		1.3		1.8		1.7
	Q2	4.00		0.7		0.3		2.1		2.3
	Q3	4.29		0.6		1.0		2.1		1.8
	Q4	5.21		0.5		1.9		2.2		1.7

		First year Expected div yield	+	Simulated Long-term real Dividend growth	-	Simulated Real rates (actual from '81)	-	Simulated Inflation Risk Premium	=	Implied Equity risk Premium
1974	Q1	6.74		0.5		3.7		2.2		1.3
	Q2	7.98		0.4		4.9		2.2		1.3
	Q3	11.10		0.3		4.7		2.3		4.4
	Q4	12.83		0.1		6.2		2.4		4.4
1975	Q1	7.36		0.0		1.9		2.5		2.9
	Q2	7.17		-0.2		2.0		2.6		2.4
	Q3	6.50		-0.3		2.0		2.6		1.6
	Q4	6.01		-0.4		2.3		2.5		0.8
1976	Q1	5.87		-0.5		1.6		2.5		1.2
	Q2	6.49		-0.3		1.4		2.5		2.3
	Q3	7.83		-0.2		2.5		2.6		2.6
	Q4	7.06		-0.1		2.2		2.5		2.3
1977	Q1	6.25		0.0		0.5		2.5		3.3
	Q2	6.07		0.0		1.0		2.4		2.6
	Q3	5.40		0.1		-1.9		2.6		4.9
	Q4	5.81		0.2		-1.7		2.5		5.2
1978	Q1	6.21		0.2		-0.7		2.5		4.6
	Q2	6.19		0.2		1.0		2.3		3.1
	Q3	5.94		0.3		1.0		2.3		2.9
	Q4	6.32		0.2		1.3		2.2		3.0
1979	Q1	5.40		0.3		-0.4		2.3		3.8
	Q2	5.81		0.0		0.1		2.3		3.4
	Q3	6.51		0.1		-0.5		2.3		4.8
	Q4	7.49		0.2		1.0		2.2		4.5
1980	Q1	7.50		0.1		2.2		2.1		3.2
	Q2	6.94		0.1		1.7		2.1		3.2
	Q3	6.63		0.0		1.5		2.1		3.1
	Q4	6.60		0.1		2.1		2.0		2.5
1981	Q1	6.24		0.0		2.2		2.0		2.0
	Q2	6.12		0.0		2.3		3.0		0.9
	Q3	7.10		0.0		3.1		3.5		0.5
	Q4	6.36		0.1		3.2		3.0		0.2
1982	Q1	6.25		0.2		2.9		2.3		1.3
	Q2	6.55		0.2		3.2		2.2		1.3
	Q3	5.88		0.2		3.2		0.9		2.0
	Q4	5.62		0.3		3.0		0.9		2.1
1983	Q1	5.26		0.2		2.8		1.4		1.3
	Q2	4.84		0.3		3.5		0.6		1.1
	Q3	5.09		0.3		3.4		1.1		0.9
	Q4	4.89		0.2		3.5		0.9		0.7
1984	Q1	4.63		0.4		3.7		1.0		0.3
	Q2	5.13		0.4		4.1		1.7		-0.3
	Q3	4.93		0.5		3.4		2.0		0.0
	Q4	4.66		0.7		3.1		2.3		-0.1
1985	Q1	4.71		0.7		3.2		2.5		-0.2
	Q2	5.05		0.8		3.4		2.5		-0.1
	Q3	4.88		0.9		3.4		2.1		0.3
	Q4	4.59		1.1		3.6		1.9		0.2

		First year Expected div yield	+	Simulated Long-term real Dividend growth	-	Simulated Real rates (actual from '81)	-	Simulated Inflation Risk Premium	=	Implied Equity risk Premium
1986	Q1	3.91		1.4		3.6		0.6		1.0
	Q2	4.10		1.5		3.3		1.0		1.3
	Q3	4.43		1.6		2.7		3.0		0.3
	Q4	4.23		1.7		3.7		1.9		0.3
1987	Q1	3.63		1.7		3.3		1.2		0.9
	Q2	3.28		1.6		3.7		0.6		0.7
	Q3	3.23		1.7		4.0		1.1		-0.2
	Q4	4.62		1.7		3.9		0.6		1.9
1988	Q1	4.60		1.8		3.8		0.1		2.5
	Q2	4.52		1.9		3.9		0.3		2.3
	Q3	4.80		2.0		3.9		-0.1		3.0
	Q4	5.05		2.2		3.8		0.0		3.5
1989	Q1	4.52		2.4		3.5		0.0		3.4
	Q2	4.53		2.3		3.7		0.3		2.9
	Q3	4.40		2.4		3.6		0.4		2.8
	Q4	4.54		2.7		3.6		0.7		3.0
1990	Q1	5.14		2.9		4.1		1.8		2.1
	Q2	5.07		3.0		4.1		1.0		3.0
	Q3	6.25		3.0		4.3		1.5		3.5
	Q4	5.93		3.2		4.1		1.2		3.9
1991	Q1	5.18		3.3		4.2		0.7		3.7
	Q2	5.42		3.2		4.4		0.9		3.3
	Q3	5.00		3.1		4.2		0.5		3.5
	Q4	5.33		3.3		4.4		0.7		3.4
1992	Q1	5.45		3.4		4.5		0.7		3.6
	Q2	5.19		3.3		4.2		0.5		3.7
	Q3	5.25		3.1		4.1		1.0		3.2
	Q4	4.62		3.0		3.9		0.3		3.4
1993	Q1	4.42		2.9		3.6		0.6		3.2
	Q2	4.33		2.9		3.7		0.5		3.0
	Q3	4.12		2.8		3.2		0.4		3.2
	Q4	3.68		2.7		3.9		-0.9		3.4
1994	Q1	3.99		2.7		3.5		1.1		2.1
	Q2	4.34		3.0		3.9		1.6		1.7
	Q3	4.23		2.6		3.9		1.6		1.5
	Q4	4.25		2.6		3.9		1.7		1.3
1995	Q1	4.39		2.8		3.9		1.5		1.8
	Q2	4.28		3.0		3.8		1.8		1.7
	Q3	4.08		3.0		3.7		1.7		1.7
	Q4	4.06		3.3		3.6		1.2		2.6

		First year Expected div yield	+	Simulated Long-term real Dividend growth	-	Simulated Real rates (actual from '81)	-	Simulated Inflation Risk Premium	=	Implied Equity risk Premium
1996	Q1	4.11		3.5		3.8		1.5		2.2
	Q2	4.17		3.6		3.8		1.3		2.7
	Q3	4.08		3.7		3.7		1.3		2.8
	Q4	4.02		3.9		3.6		1.2		3.1
1997	Q1	3.89		3.8		3.7		1.4		2.6
	Q2	3.79		3.8		3.6		0.8		3.2
	Q3	3.38		3.8		3.3		0.6		3.2
	Q4	3.44		3.8		3.0		0.6		3.6
1998	Q1	2.51		3.8		2.9		0.4		3.1
	Q2	2.57		3.8		2.6		0.5		3.3
	Q3	3.02		3.8		2.5		-0.3		4.6
	Q4	2.66		3.8		2.0		-0.2		4.6
1999	Q1	2.48		3.6		1.8		0.4		3.9
	Q2	2.40		3.5		2.0		0.4		3.5
	Q3	2.55		3.3		2.1		0.6		3.1
	Q4	2.24		3.2		1.8		0.9		2.8
2000	Q1	2.22		3.0		1.8		0.9		2.6
	Q2	2.27		2.9		1.7		1.0		2.5
	Q3	2.28		2.9		1.9		1.0		2.2
	Q4	2.34		2.8		1.8		0.8		2.6
2001	Q1	2.66		2.9		2.1		0.6		2.8
	Q2	2.53		2.6		2.3		1.0		1.8
	Q3	3.00		2.6		2.4		0.8		2.5
	Q4	2.75		2.5		2.2		0.9		2.1
2002	Q1	2.78		2.5		2.3		1.0		1.9
	Q2	3.11		2.3		2.2		0.9		2.4
	Q3	3.89		2.2		2.1		0.4		3.6
	Q4	3.70		2.1		2.2		0.3		3.3
2003	Q1	4.03		2.1		2.0		0.6		3.5
	Q2	3.57		2.0		2.0		0.7		2.8
	Q3	3.49		1.9		2.0		0.9		2.5
	Q4	3.22		1.8		1.9		1.0		2.1
2004	Q1	3.25		1.8		1.6		1.2		2.2
	Q2	3.28		1.8		1.8		1.3		2.1
	Q3	3.28		1.8		1.6		1.2		2.2
	Q4	3.17		1.6		1.5		0.8		2.6
2005	Q1	3.20		1.6		1.7		1.0		2.1
	Q2	3.22		1.7		1.4		0.9		2.6
	Q3	3.10		1.8		1.3		1.2		2.5
	Q4	3.07		1.8		1.3		0.6		3.0

Table E- Analysis of equity returns

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Unexpected	**Unexpected return due to:**		**…...Contributions to 12m re-rating…………**			
		Equity Return	**Unexpected div growth**	**Unexpected re-rating**	**Change in Real rates**	**Change in Real growth**	**Change in IRP**	**Change in ERP**
1963	Q4	9.1	2.0	7.1	-6.3	0.9	0.2	12.2
1964	Q1	9.9	10.4	-0.5	-12.1	-0.4	1.9	10.1
	Q2	3.2	7.5	-4.3	-17.9	1.7	0.3	11.6
	Q3	5.4	15.0	-9.6	-15.0	1.5	-0.1	4.0
	Q4	-11.7	13.4	-25.1	-12.1	-0.1	0.2	-13.2
1965	Q1	-10.8	12.6	-23.4	-6.3	-0.6	-0.8	-15.6
	Q2	-18.1	5.2	-23.3	-10.0	-7.2	-0.2	-5.8
	Q3	-14.2	4.0	-18.2	-4.9	-10.6	0.2	-3.0
	Q4	1.6	2.7	-1.0	-2.6	-13.3	-0.3	15.1
1966	Q1	1.6	-0.8	2.4	-6.4	-14.8	0.0	23.7
	Q2	13.9	-1.8	15.7	-2.0	-8.5	-0.6	26.8
	Q3	-10.9	-3.2	-7.7	-8.1	-3.0	-1.0	4.4
	Q4	-14.1	-4.4	-9.7	6.1	0.0	-1.7	-14.1
1967	Q1	-11.5	-7.3	-4.3	15.8	2.6	-2.1	-20.6
	Q2	-9.5	-8.3	-1.2	6.1	2.6	-0.8	-9.1
	Q3	16.3	-8.5	24.8	4.3	3.6	-0.2	17.1
	Q4	23.5	-7.9	31.4	-9.5	6.1	0.3	34.5
1968	Q1	35.0	-4.9	39.9	-15.7	8.8	-0.4	47.2
	Q2	40.6	-4.0	44.6	-22.1	2.5	-0.8	65.0
	Q3	38.7	-2.8	41.5	-8.1	-5.0	-1.9	56.5
	Q4	38.1	0.8	37.3	-13.6	-11.9	-3.1	65.9
1969	Q1	14.1	-0.6	14.6	-26.1	-19.4	-3.8	64.0
	Q2	-13.6	0.9	-14.5	-13.7	-18.2	-4.5	21.9
	Q3	-20.3	-0.3	-20.0	-12.7	-13.7	-4.3	10.6
	Q4	-20.6	-4.6	-16.0	-3.0	-14.8	-3.8	5.6
1970	Q1	-17.6	-1.5	-16.1	15.6	-12.8	-2.4	-16.5
	Q2	-16.8	-1.4	-15.4	9.7	-6.6	-1.9	-16.6
	Q3	-6.0	-0.6	-5.3	5.7	-8.5	-3.4	0.7
	Q4	-12.8	0.2	-13.0	-6.9	-6.9	-3.1	3.9
1971	Q1	-6.3	-3.1	-3.2	4.1	-6.7	-3.1	2.5
	Q2	28.3	-2.3	30.6	17.1	-8.8	-3.6	25.8
	Q3	25.0	-2.6	27.6	32.7	-10.7	-2.8	8.4
	Q4	36.4	-0.5	36.9	57.8	-9.7	-3.9	-7.3
1972	Q1	47.2	2.2	45.0	42.7	-4.6	-6.8	13.7
	Q2	17.5	3.4	14.2	41.6	0.7	-9.3	-18.8
	Q3	4.3	4.3	0.0	0.0	0.0	0.0	0.0
	Q4	7.2	3.7	3.5	22.6	4.7	-12.2	-11.6
1973	Q1	-19.0	2.5	-21.5	20.4	3.0	-11.5	-33.4
	Q2	-13.8	-0.8	-13.0	45.3	-1.0	-13.9	-43.4
	Q3	-16.0	-1.7	-14.2	20.9	-3.5	-12.4	-19.2
	Q4	-39.0	-3.7	-35.3	-6.4	-5.1	-9.0	-14.8

		Unexpected	Unexpected return due to:		…....Contributions to 12m re-rating…………			
		Equity	Unexpected	Unexpected	Change in	Change in	Change in	Change in
		Return	div growth	re-rating	Real rates	Real growth	IRP	ERP
1974	Q1	-45.8	-3.8	-41.9	-38.2	-3.8	-5.2	5.2
	Q2	-54.1	0.4	-54.4	-63.5	-4.1	-1.7	14.8
	Q3	-66.7	0.4	-67.1	-36.5	-3.1	-1.4	-26.1
	Q4	-64.5	0.5	-65.0	-36.7	-3.1	-1.7	-23.6
1975	Q1	-9.3	-0.7	-8.6	26.9	-8.5	-4.2	-22.7
	Q2	12.5	-0.8	13.3	44.4	-8.7	-5.4	-16.9
	Q3	78.7	0.2	78.6	45.6	-9.6	-4.8	47.5
	Q4	126.8	0.9	125.9	72.2	-9.4	-3.2	66.3
1976	Q1	29.3	1.3	28.0	6.6	-8.6	-1.4	31.4
	Q2	11.1	-0.1	11.2	10.7	-1.7	0.4	1.7
	Q3	-16.5	2.6	-19.1	-6.8	1.2	0.2	-13.7
	Q4	-13.5	3.2	-16.7	1.7	4.3	0.6	-23.3
1977	Q1	-2.2	4.6	-6.8	20.4	8.9	1.4	-37.4
	Q2	13.1	5.2	7.9	6.4	6.3	2.0	-6.8
	Q3	56.5	4.5	52.1	94.0	6.5	-0.1	-48.3
	Q4	31.6	6.6	25.1	76.7	5.5	0.6	-57.7
1978	Q1	6.7	5.7	1.0	21.6	4.1	0.3	-25.0
	Q2	0.9	3.3	-2.4	0.3	3.9	2.0	-8.6
	Q3	-8.5	2.7	-11.2	-55.6	2.8	4.5	37.0
	Q4	-7.3	2.6	-9.9	-53.0	0.8	3.8	38.5
1979	Q1	19.9	3.8	16.1	-6.2	1.0	4.0	17.3
	Q2	8.2	1.3	6.9	16.3	-4.0	0.6	-6.0
	Q3	2.8	13.7	-10.9	28.7	-3.3	0.6	-36.9
	Q4	-4.0	15.5	-19.5	5.3	-0.8	0.6	-24.5
1980	Q1	-18.2	17.8	-36.0	-43.6	-3.3	2.0	9.0
	Q2	0.7	22.8	-22.1	-29.9	0.8	3.3	3.7
	Q3	5.3	8.3	-3.1	-35.1	-0.9	3.2	29.8
	Q4	18.5	4.2	14.3	-19.0	-1.7	2.5	32.5
1981	Q1	20.3	-0.8	21.1	-0.6	-1.4	1.7	21.4
	Q2	10.3	-3.5	13.8	-10.2	-0.8	-15.0	39.8
	Q3	-12.7	-5.6	-7.1	-24.1	0.2	-20.7	37.6
	Q4	-1.4	-5.1	3.7	-17.8	0.3	-16.4	37.6
1982	Q1	-2.7	-2.3	-0.4	-10.7	3.5	-4.6	11.5
	Q2	-7.3	0.3	-7.6	-13.9	2.5	11.6	-7.9
	Q3	21.9	0.7	21.2	-1.5	2.6	46.8	-26.7
	Q4	14.2	1.1	13.1	3.4	3.9	41.9	-36.2
1983	Q1	18.3	-0.4	18.7	1.1	1.3	18.1	-1.8
	Q2	34.5	-1.2	35.7	-7.9	2.9	34.7	6.0
	Q3	16.2	0.5	15.7	-4.6	2.0	-4.1	22.4
	Q4	16.3	1.3	15.0	-12.8	-1.3	-0.4	29.4
1984	Q1	21.1	6.7	14.4	-22.9	2.9	9.9	24.6
	Q2	0.4	7.6	-7.2	-14.6	1.9	-23.2	28.6
	Q3	14.8	11.8	3.0	-1.7	5.1	-21.0	20.6
	Q4	20.9	15.4	5.5	9.7	11.6	-37.2	21.3
1985	Q1	12.5	14.9	-2.4	12.9	10.2	-39.1	13.6
	Q2	17.5	15.7	1.8	16.6	10.9	-21.0	-4.6
	Q3	12.0	10.8	1.2	1.8	10.2	-2.7	-7.9
	Q4	10.2	8.1	2.1	-11.9	11.8	9.8	-7.7

		Unexpected	Unexpected return due to:		…....Contributions to 12m re-rating…………			
		Equity	**Unexpected**	**Unexpected**	**Change in**	**Change in**	**Change in**	**Change in**
		Return	**div growth**	**re-rating**	**Real rates**	**Real growth**	**IRP**	**ERP**
1986	Q1	26.3	3.3	23.0	-11.5	16.7	52.0	-34.2
	Q2	31.9	5.4	26.5	3.1	18.2	41.1	-35.8
	Q3	17.6	5.4	12.2	16.1	16.8	-22.3	1.7
	Q4	17.0	6.8	10.1	-1.2	13.5	0.9	-3.0
1987	Q1	18.3	8.9	9.4	12.3	9.1	-17.7	5.7
	Q2	35.5	6.7	28.9	-11.1	4.0	15.3	20.7
	Q3	51.4	8.4	43.0	-43.2	2.0	68.3	15.9
	Q4	-1.9	7.3	-9.2	-4.8	1.0	32.5	-37.8
1988	Q1	-16.9	6.6	-23.6	-13.7	3.8	25.3	-39.0
	Q2	-22.8	8.1	-30.9	-5.0	7.3	7.6	-40.8
	Q3	-28.0	9.2	-37.2	2.7	8.0	28.6	-76.6
	Q4	0.1	9.0	-8.9	4.2	10.6	13.6	-37.3
1989	Q1	13.6	10.2	3.3	9.5	14.1	4.0	-24.3
	Q2	7.5	7.0	0.5	6.0	9.0	1.0	-15.4
	Q3	16.4	5.3	11.1	8.0	10.8	-12.7	5.0
	Q4	22.8	8.9	13.9	4.7	14.0	-18.1	13.3
1990	Q1	-3.9	9.7	-13.6	-12.6	11.0	-42.3	30.3
	Q2	-1.2	10.7	-11.9	-8.5	16.2	-17.2	-2.3
	Q3	-25.4	8.7	-34.2	-11.8	10.5	-20.3	-12.6
	Q4	-22.5	3.5	-26.0	-8.8	8.3	-8.8	-16.6
1991	Q1	-1.4	-0.7	-0.7	-1.6	9.8	23.6	-32.4
	Q2	-9.6	-2.6	-7.0	-5.7	2.8	1.1	-5.2
	Q3	22.8	-3.2	26.0	0.3	2.8	22.1	0.9
	Q4	6.2	-5.0	11.2	-7.2	1.4	8.5	8.4
1992	Q1	-10.7	-5.2	-5.6	-7.9	1.2	-0.5	1.6
	Q2	-3.9	-7.9	4.0	2.1	2.2	7.6	-8.0
	Q3	-13.3	-7.9	-5.4	1.6	-0.4	-10.7	4.1
	Q4	6.3	-8.1	14.4	9.9	-5.0	8.3	1.3
1993	Q1	11.6	-10.1	21.7	19.5	-9.5	3.4	8.3
	Q2	9.5	-8.8	18.4	12.1	-7.3	-0.4	14.0
	Q3	17.0	-8.9	25.9	20.1	-6.8	13.4	-0.8
	Q4	15.7	-8.6	24.3	-1.0	-6.4	33.2	-1.4
1994	Q1	3.6	-6.3	9.9	2.0	-4.3	-12.5	24.8
	Q2	-4.7	-3.9	-0.8	-7.3	1.8	-26.1	30.8
	Q3	-6.2	-2.8	-3.4	-15.8	-3.3	-27.3	43.1
	Q4	-15.8	-1.2	-14.6	1.3	-2.4	-63.7	50.2
1995	Q1	-7.5	2.7	-10.2	-8.7	1.1	-11.2	8.5
	Q2	4.9	3.5	1.4	3.8	0.3	-4.3	1.6
	Q3	9.1	4.8	4.3	4.2	10.5	-2.8	-7.6
	Q4	13.0	7.1	5.9	8.6	18.0	14.4	-35.1

		Unexpected	Unexpected return due to:		…....Contributions to 12m re-rating…………			
		Equity	Unexpected	Unexpected	Change in	Change in	Change in	Change in
		Return	div growth	re-rating	Real rates	Real growth	IRP	ERP
1996	Q1	14.2	5.8	8.4	2.0	18.6	-0.4	-11.9
	Q2	8.6	5.0	3.7	-0.8	17.4	13.2	-26.1
	Q3	6.4	5.5	0.9	2.1	19.2	9.2	-29.7
	Q4	5.5	3.7	1.8	-0.6	15.8	0.2	-13.7
1997	Q1	7.4	0.9	6.5	4.3	10.0	3.1	-11.0
	Q2	11.0	0.1	10.8	5.8	5.3	15.6	-15.9
	Q3	19.3	-2.1	21.5	10.0	1.2	21.1	-10.9
	Q4	12.7	-4.2	16.9	17.6	-2.6	15.4	-13.5
1998	Q1	25.7	-2.1	27.7	15.7	-0.4	21.2	-8.8
	Q2	18.9	-2.7	21.6	18.4	-0.8	5.3	-1.3
	Q3	-11.1	-2.3	-8.8	-20.0	0.1	-23.9	35.0
	Q4	4.3	-2.0	6.2	8.0	-0.1	6.8	-8.5
1999	Q1	-2.6	-3.5	0.9	42.8	-9.4	0.6	-33.0
	Q2	0.7	-6.0	6.7	26.4	-12.2	2.7	-10.3
	Q3	13.9	-4.3	18.2	15.8	-17.2	-36.6	56.2
	Q4	14.7	-3.7	18.4	11.1	-25.8	-50.9	84.0
2000	Q1	1.0	-9.5	10.6	2.8	-25.6	-22.3	55.7
	Q2	-3.4	-8.0	4.6	8.3	-23.7	-23.8	43.7
	Q3	1.2	-9.5	10.7	9.1	-18.6	-17.7	37.8
	Q4	-13.7	-8.9	-4.8	-2.9	-14.0	5.5	6.5
2001	Q1	-18.1	-0.8	-17.4	-15.5	-2.8	9.3	-8.3
	Q2	-15.2	-4.3	-10.8	-23.4	-11.2	-3.4	27.2
	Q3	-27.8	-2.9	-24.9	-16.2	-8.2	8.9	-9.4
	Q4	-20.5	-5.3	-15.2	-15.9	-10.9	-3.7	15.3
2002	Q1	-10.9	-6.0	-4.8	-6.7	-14.4	-13.5	29.8
	Q2	-21.7	-2.6	-19.2	5.1	-8.6	5.7	-21.4
	Q3	-27.8	-4.7	-23.1	7.3	-9.8	9.3	-29.9
	Q4	-29.6	-3.4	-26.2	0.7	-9.9	15.9	-32.9
2003	Q1	-36.9	-6.0	-30.9	7.1	-9.7	10.9	-39.3
	Q2	-17.5	-4.3	-13.2	3.1	-10.6	5.7	-11.4
	Q3	8.0	-3.1	11.2	1.2	-10.0	-13.9	33.8
	Q4	12.1	-2.7	14.8	8.9	-9.2	-22.3	37.4
2004	Q1	22.3	-1.9	24.2	11.7	-8.9	-18.6	40.1
	Q2	9.0	0.1	8.9	8.7	-4.2	-19.2	23.7
	Q3	8.1	1.5	6.7	12.0	-2.9	-11.2	8.7
	Q4	5.4	3.6	1.8	15.6	-7.3	7.1	-13.6
2005	Q1	8.4	6.9	1.4	-1.4	-6.6	6.6	2.8
	Q2	11.5	9.3	2.2	11.6	-4.3	12.7	-17.8
	Q3	17.6	11.1	6.5	13.3	0.9	2.1	-9.8
	Q4	14.5	10.7	3.8	5.9	7.3	6.7	-16.0

Table F - Analysis of bond returns

		(1) Bond total return	-	(2) Expected bond return (12 m ago)	=	(3) Unexpected bond return	(4) …...Unexpected bond return due to… Change in RRR	(5) Change in Inflation	(6) Change in IRP
1963	Q4	1.8		5.6		-3.8	-4.3	0.4	0.1
1964	Q1	4.3		5.8		-1.5	-7.5	5.1	1.3
	Q2	-5.8		5.4		-11.2	-12.2	0.9	0.2
	Q3	-4.8		5.4		-10.2	-9.9	-0.3	-0.1
	Q4	-2.1		5.8		-7.9	-8.7	0.7	0.2
1965	Q1	-2.1		5.9		-8.0	-5.0	-2.5	-0.6
	Q2	-2.8		6.1		-8.9	-8.1	-0.7	-0.2
	Q3	3.5		6.1		-2.6	-3.8	1.0	0.2
	Q4	3.7		6.3		-2.6	-1.7	-0.7	-0.2
1966	Q1	2.0		6.4		-4.3	-4.7	0.3	0.1
	Q2	3.3		6.7		-3.3	-1.4	-1.6	-0.4
	Q3	-5.2		6.2		-11.4	-7.3	-3.6	-0.9
	Q4	3.8		6.5		-2.7	5.8	-6.5	-1.6
1967	Q1	10.9		6.7		4.2	15.8	-8.2	-2.0
	Q2	8.2		6.9		1.3	4.9	-2.8	-0.7
	Q3	9.3		7.0		2.3	3.1	-0.6	-0.1
	Q4	1.0		6.7		-5.7	-6.4	0.6	0.2
1968	Q1	-4.1		6.4		-10.5	-9.3	-1.0	-0.3
	Q2	-5.5		6.8		-12.3	-10.6	-1.5	-0.4
	Q3	-1.3		6.9		-8.2	-3.9	-3.6	-0.9
	Q4	-4.6		7.1		-11.6	-5.8	-5.0	-1.2
1969	Q1	-10.7		7.2		-17.8	-11.1	-6.1	-1.5
	Q2	-8.0		7.8		-15.7	-6.6	-8.0	-2.0
	Q3	-8.4		7.5		-15.9	-6.6	-8.1	-2.0
	Q4	-1.9		8.0		-9.9	-1.5	-7.0	-1.7
1970	Q1	10.5		8.7		1.7	8.0	-4.7	-1.2
	Q2	9.2		9.2		0.0	5.3	-4.1	-1.0
	Q3	3.6		8.9		-5.3	2.8	-6.4	-1.6
	Q4	-1.3		8.9		-10.2	-3.4	-5.7	-1.4
1971	Q1	3.0		8.6		-5.6	2.0	-6.0	-1.5
	Q2	8.7		9.2		-0.5	7.4	-5.9	-1.5
	Q3	16.9		9.4		7.5	13.8	-4.5	-1.1
	Q4	24.2		9.9		14.3	23.6	-6.1	-1.5
1972	Q1	11.3		9.1		2.3	15.6	-9.5	-2.3
	Q2	6.5		9.2		-2.8	16.0	-13.4	-3.2
	Q3	-1.7		8.7		-10.5	8.0	-14.2	-3.4
	Q4	-4.8		8.6		-13.4	8.3	-16.7	-4.0
1973	Q1	-5.8		8.9		-14.6	8.7	-18.0	-4.3
	Q2	-1.0		9.5		-10.5	21.3	-22.1	-5.2
	Q3	-6.3		9.7		-16.1	9.2	-19.4	-4.6
	Q4	-11.5		10.0		-21.4	-3.3	-15.6	-3.7

	Bond total return	-	Expected bond return (12 m ago)	=	Unexpected bond return	......Unexpected bond return due to... Change in RRR	Change in Inflation	Change in IRP
1974 Q1	-18.7		10.4		-29.1	-19.3	-9.9	-2.4
Q2	-22.5		10.6		-33.1	-30.4	-3.2	-0.8
Q3	-16.2		11.6		-27.8	-24.2	-3.8	-0.9
Q4	-16.8		12.7		-29.5	-25.3	-4.6	-1.1
1975 Q1	16.8		14.6		2.2	14.0	-8.5	-2.1
Q2	22.6		15.9		6.7	22.3	-10.5	-2.5
Q3	24.1		16.1		8.0	20.0	-8.1	-2.0
Q4	38.3		18.0		20.3	27.8	-4.8	-1.2
1976 Q1	14.3		14.3		0.0	2.5	-2.0	-0.5
Q2	20.4		14.9		5.6	4.5	0.8	0.2
Q3	12.3		14.9		-2.6	-3.1	0.4	0.1
Q4	16.8		15.0		1.9	0.7	0.9	0.2
1977 Q1	25.8		14.3		11.5	8.4	2.2	0.6
Q2	20.8		14.1		6.7	2.5	3.3	0.8
Q3	55.3		15.3		40.1	40.9	-0.5	-0.1
Q4	51.8		14.7		37.1	35.3	1.1	0.3
1978 Q1	23.5		12.9		10.6	9.9	0.5	0.1
Q2	17.8		13.2		4.6	0.1	3.5	0.9
Q3	-2.2		10.9		-13.1	-21.2	8.1	2.1
Q4	-3.7		10.7		-14.5	-21.8	7.4	1.9
1979 Q1	18.3		11.6		6.7	-2.5	7.4	1.9
Q2	21.8		12.6		9.1	7.3	1.4	0.3
Q3	28.5		12.5		16.0	13.9	1.5	0.4
Q4	16.9		12.5		4.4	2.7	1.3	0.3
1980 Q1	-4.1		10.9		-15.0	-19.2	4.2	1.1
Q2	6.4		11.6		-5.2	-12.1	6.2	1.6
Q3	2.4		10.8		-8.4	-15.6	6.7	1.7
Q4	9.6		12.0		-2.4	-8.4	5.2	1.3
1981 Q1	17.0		12.8		4.2	-0.2	3.4	0.9
Q2	4.0		12.2		-8.2	-4.6	2.9	-6.5
Q3	-7.7		11.8		-19.5	-12.3	1.8	-9.7
Q4	-0.6		12.3		-12.9	-8.1	2.1	-7.1
1982 Q1	8.6		12.3		-3.7	-4.9	3.4	-2.1
Q2	17.3		13.3		4.0	-5.9	4.6	5.6
Q3	49.1		14.6		34.4	-0.3	9.1	23.6
Q4	50.2		14.1		36.0	1.5	10.7	21.1
1983 Q1	36.4		12.8		23.6	0.7	12.8	8.8
Q2	40.2		12.8		27.5	-2.4	12.6	16.0
Q3	17.4		10.9		6.5	-1.7	10.4	-1.8
Q4	14.5		10.4		4.2	-5.0	9.8	-0.1
1984 Q1	14.0		10.3		3.6	-8.2	8.3	4.2
Q2	3.3		10.0		-6.8	-5.9	9.8	-9.7
Q3	10.0		10.2		-0.3	-0.5	9.7	-8.6
Q4	8.5		10.0		-1.5	4.1	10.4	-14.2
1985 Q1	6.7		10.0		-3.2	5.4	7.6	-14.7
Q2	14.0		10.8		3.2	6.8	5.4	-8.2
Q3	13.1		10.3		2.8	0.7	3.3	-1.2
Q4	10.9		10.1		0.8	-4.6	1.7	3.9

		Bond total return	-	Expected bond return (12 m ago)	=	Unexpected bond return	......Unexpected bond return due to... Change in RRR	Change in Inflation	Change in IRP
1986	Q1	28.1		10.3		17.8	-4.0	1.2	21.2
	Q2	27.3		10.4		16.9	0.9	-0.9	16.9
	Q3	6.5		10.0		-3.5	6.6	-0.8	-8.8
	Q4	8.0		10.0		-2.0	-0.7	-1.5	0.2
1987	Q1	3.5		8.8		-5.3	4.4	-3.3	-6.1
	Q2	6.1		8.9		-2.8	-3.7	-3.7	4.8
	Q3	13.8		10.3		3.5	-10.6	-2.9	19.2
	Q4	18.2		10.3		7.9	-2.0	-3.3	13.9
1988	Q1	11.9		9.2		2.7	-5.8	-2.2	11.4
	Q2	6.8		9.2		-2.4	-2.3	-3.1	3.2
	Q3	17.8		10.0		7.9	0.8	-5.1	12.8
	Q4	13.2		9.5		3.7	1.6	-4.1	6.5
1989	Q1	9.3		9.0		0.3	3.8	-5.0	1.7
	Q2	7.7		9.4		-1.6	2.3	-4.2	0.4
	Q3	5.6		9.3		-3.7	3.2	-1.6	-5.2
	Q4	2.4		9.2		-6.8	1.8	-1.3	-7.2
1990	Q1	-12.6		9.0		-21.5	-6.0	-0.4	-16.2
	Q2	-1.1		9.5		-10.6	-3.9	0.0	-6.9
	Q3	-5.5		9.6		-15.1	-6.3	0.3	-9.7
	Q4	2.0		9.8		-7.9	-4.7	1.1	-4.4
1991	Q1	23.4		11.4		12.0	-0.8	1.6	11.1
	Q2	12.7		10.7		2.0	-2.6	4.1	0.6
	Q3	27.8		11.3		16.4	0.3	4.8	10.8
	Q4	17.5		10.7		6.8	-3.2	5.6	4.4
1992	Q1	12.6		10.2		2.4	-3.7	6.6	-0.2
	Q2	23.0		10.5		12.6	1.3	6.6	4.3
	Q3	11.7		9.7		1.9	1.1	7.0	-5.8
	Q4	27.1		10.0		17.1	5.2	6.5	4.5
1993	Q1	29.8		10.0		19.8	10.2	6.7	1.9
	Q2	25.8		9.3		16.5	6.5	9.5	-0.1
	Q3	40.8		9.5		31.3	10.2	10.5	7.8
	Q4	38.8		8.5		30.3	0.0	9.6	18.8
1994	Q1	12.5		8.3		4.2	1.3	9.5	-6.1
	Q2	-1.6		8.0		-9.6	-3.5	7.1	-12.5
	Q3	-8.6		7.3		-15.9	-8.0	4.9	-12.9
	Q4	-18.0		6.5		-24.5	1.1	6.3	-29.8
1995	Q1	2.6		8.0		-5.4	-4.1	4.2	-5.3
	Q2	12.6		8.8		3.7	1.8	3.8	-1.9
	Q3	11.8		8.6		3.1	1.8	2.6	-1.3
	Q4	20.2		8.7		11.5	3.5	1.2	6.5

	Bond total return	-	Expected bond return (12 m ago)	=	Unexpected bond return	……Unexpected bond return due to… Change in RRR	Change in Inflation	Change in IRP
1996 Q1	8.9		8.4		0.4	0.6	0.1	-0.3
Q2	11.7		8.5		3.2	-0.7	-1.8	5.9
Q3	12.7		8.4		4.3	0.6	-0.4	4.1
Q4	7.8		7.8		0.0	-0.5	0.5	0.0
1997 Q1	13.8		8.4		5.4	1.8	2.1	1.4
Q2	22.9		8.2		14.6	2.6	3.7	7.7
Q3	26.5		8.0		18.5	4.3	3.2	10.1
Q4	28.4		7.8		20.6	8.4	3.0	8.0
1998 Q1	41.0		8.0		33.0	10.8	2.2	17.4
Q2	31.3		7.2		24.1	16.9	1.0	5.1
Q3	44.5		6.8		37.7	13.4	1.8	19.3
Q4	49.5		6.5		43.0	18.3	1.7	18.9
1999 Q1	30.6		6.0		24.6	21.0	2.7	0.3
Q2	22.6		5.8		16.8	12.4	2.5	1.4
Q3	-0.9		4.9		-5.8	9.1	4.7	-17.5
Q4	-5.5		4.5		-10.0	6.1	8.9	-22.1
2000 Q1	2.3		4.8		-2.5	1.7	6.9	-10.3
Q2	5.9		5.0		0.9	4.4	8.7	-11.1
Q3	8.1		5.2		2.8	4.6	7.0	-8.1
Q4	10.8		5.0		5.8	-1.2	4.0	2.9
2001 Q1	4.8		4.9		-0.1	-7.3	2.8	4.8
Q2	-3.9		4.9		-8.8	-10.5	3.5	-1.5
Q3	4.0		5.1		-1.1	-8.5	2.7	5.2
Q4	-3.4		4.7		-8.2	-8.3	2.1	-1.9
2002 Q1	-4.7		4.9		-9.6	-3.5	0.6	-6.9
Q2	9.9		5.4		4.5	3.1	-1.9	3.4
Q3	15.7		5.1		10.6	6.0	-3.2	7.8
Q4	14.7		5.2		9.6	0.6	-3.1	12.4
2003 Q1	20.2		5.5		14.8	5.8	-0.9	9.5
Q2	13.1		5.2		8.0	2.4	1.1	4.3
Q3	-2.0		4.7		-6.6	1.1	2.1	-9.5
Q4	-1.5		4.7		-6.2	6.6	2.5	-14.1
2004 Q1	5.1		4.8		0.3	8.7	5.4	-12.4
Q2	2.1		4.8		-2.7	6.2	4.4	-12.3
Q3	10.1		5.0		5.1	8.3	4.7	-7.3
Q4	15.5		5.0		10.5	10.1	-4.0	4.6
2005 Q1	5.8		4.7		1.1	-0.8	-2.1	4.1
Q2	18.0		4.9		13.1	7.2	-2.6	8.4
Q3	13.0		4.7		8.2	8.2	-1.3	1.3
Q4	14.8		4.5		10.3	3.7	1.9	4.4

Table G - Ex-post -v- ex-ante risk premia

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Ex-ante ERP (12M ago)	**Unexpected Equity return (Last 12M)**	**…....Due to..... Unexp DG**	**Unexp RR**	**Unexpected Bond return (Last 12M)**	**Ex-post ERP (Last 12M)**	**Unexpected Risk premium (Last 12M)**
1963	Q4	4.2	9.1	2.0	7.1	-3.8	17.1	12.9
1964	Q1	4.1	9.9	10.4	-0.5	-1.5	15.5	11.4
	Q2	4.5	3.2	7.5	-4.3	-11.2	19.0	14.4
	Q3	4.3	5.4	15.0	-9.6	-10.2	20.0	15.6
	Q4	3.8	-11.7	13.4	-25.1	-7.9	0.0	-3.8
1965	Q1	3.7	-10.8	12.6	-23.4	-8.0	0.8	-2.8
	Q2	4.0	-18.1	5.2	-23.3	-8.9	-5.2	-9.2
	Q3	4.2	-14.2	4.0	-18.2	-2.6	-7.4	-11.6
	Q4	4.4	1.6	2.7	-1.0	-2.6	8.6	4.3
1966	Q1	4.4	1.6	-0.8	2.4	-4.3	10.3	5.9
	Q2	4.3	13.9	-1.8	15.7	-3.3	21.6	17.3
	Q3	4.3	-10.9	-3.2	-7.7	-11.4	4.9	0.6
	Q4	3.6	-14.1	-4.4	-9.7	-2.7	-7.8	-11.4
1967	Q1	3.2	-11.5	-7.3	-4.3	4.2	-12.6	-15.7
	Q2	3.0	-9.5	-8.3	-1.2	1.3	-7.8	-10.8
	Q3	4.0	16.3	-8.5	24.8	2.3	18.0	13.9
	Q4	4.4	23.5	-7.9	31.4	-5.7	33.6	29.2
1968	Q1	4.4	35.0	-4.9	39.9	-10.5	49.9	45.5
	Q2	3.5	40.6	-4.0	44.6	-12.3	56.3	52.8
	Q3	3.2	38.7	-2.8	41.5	-8.2	50.1	46.9
	Q4	2.8	38.1	0.8	37.3	-11.6	52.6	49.8
1969	Q1	2.5	14.1	-0.6	14.6	-17.8	34.4	31.9
	Q2	1.1	-13.6	0.9	-14.5	-15.7	3.3	2.1
	Q3	1.3	-20.3	-0.3	-20.0	-15.9	-3.1	-4.4
	Q4	0.7	-20.6	-4.6	-16.0	-9.9	-10.0	-10.7
1970	Q1	0.3	-17.6	-1.5	-16.1	1.7	-19.1	-19.3
	Q2	0.3	-16.8	-1.4	-15.4	0.0	-16.5	-16.8
	Q3	0.8	-6.0	-0.6	-5.3	-5.3	0.2	-0.7
	Q4	0.5	-12.8	0.2	-13.0	-10.2	-2.1	-2.6
1971	Q1	0.9	-6.3	-3.1	-3.2	-5.6	0.2	-0.7
	Q2	1.1	28.3	-2.3	30.6	-0.5	29.8	28.7
	Q3	0.8	25.0	-2.6	27.6	7.5	18.3	17.5
	Q4	0.3	36.4	-0.5	36.9	14.3	22.3	22.0
1972	Q1	0.8	47.2	2.2	45.0	2.3	45.7	44.9
	Q2	0.1	17.5	3.4	14.2	-2.8	20.4	20.3
	Q3	0.5	4.3	4.3	0.0	-10.5	15.3	14.8
	Q4	0.5	7.2	3.7	3.5	-13.4	21.1	20.6
1973	Q1	0.4	-19.0	2.5	-21.5	-14.6	-3.9	-4.4
	Q2	0.7	-13.8	-0.8	-13.0	-10.5	-2.6	-3.3
	Q3	1.0	-16.0	-1.7	-14.2	-16.1	1.1	0.1
	Q4	0.9	-39.0	-3.7	-35.3	-21.4	-16.6	-17.5

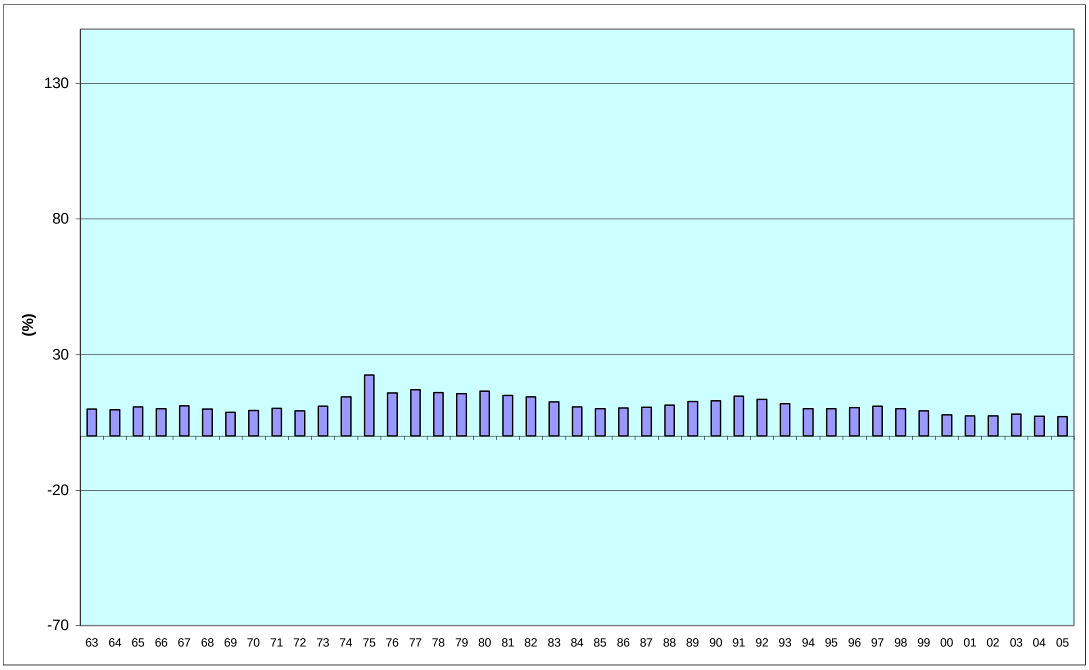
		Ex-ante ERP (12M ago)	Unexpected Equity return (Last 12M)	…....Due to..... Unexp DG	Unexp RR	Unexpected Bond return (Last 12M)	Ex-post ERP (Last 12M)	Unexpected Risk premium (Last 12M)
1974	Q1	1.7	-45.8	-3.8	-41.9	-29.1	-15.0	-16.7
	Q2	2.3	-54.1	0.4	-54.4	-33.1	-18.6	-20.9
	Q3	1.8	-66.7	0.4	-67.1	-27.8	-37.1	-38.9
	Q4	1.7	-64.5	0.5	-65.0	-29.5	-33.3	-35.0
1975	Q1	1.3	-9.3	-0.7	-8.6	2.2	-10.1	-11.5
	Q2	1.3	12.5	-0.8	13.3	6.7	7.0	5.7
	Q3	4.4	78.7	0.2	78.6	8.0	75.1	70.7
	Q4	4.4	126.8	0.9	125.9	20.3	111.0	106.6
1976	Q1	2.9	29.3	1.3	28.0	0.0	32.2	29.3
	Q2	2.4	11.1	-0.1	11.2	5.6	7.9	5.5
	Q3	1.6	-16.5	2.6	-19.1	-2.6	-12.3	-13.9
	Q4	0.8	-13.5	3.2	-16.7	1.9	-14.5	-15.4
1977	Q1	1.2	-2.2	4.6	-6.8	11.5	-12.5	-13.7
	Q2	2.3	13.1	5.2	7.9	6.7	8.7	6.4
	Q3	2.6	56.5	4.5	52.1	40.1	19.1	16.5
	Q4	2.3	31.6	6.6	25.1	37.1	-3.2	-5.5
1978	Q1	3.3	6.7	5.7	1.0	10.6	-0.6	-3.9
	Q2	2.6	0.9	3.3	-2.4	4.6	-1.1	-3.7
	Q3	4.9	-8.5	2.7	-11.2	-13.1	9.4	4.6
	Q4	5.2	-7.3	2.6	-9.9	-14.5	12.3	7.2
1979	Q1	4.6	19.9	3.8	16.1	6.7	17.8	13.2
	Q2	3.1	8.2	1.3	6.9	9.1	2.2	-0.9
	Q3	2.9	2.8	13.7	-10.9	16.0	-10.3	-13.2
	Q4	3.0	-4.0	15.5	-19.5	4.4	-5.4	-8.4
1980	Q1	3.8	-18.2	17.8	-36.0	-15.0	0.6	-3.2
	Q2	3.4	0.7	22.8	-22.1	-5.2	9.3	5.9
	Q3	4.8	5.3	8.3	-3.1	-8.4	18.5	13.6
	Q4	4.5	18.5	4.2	14.3	-2.4	25.3	20.9
1981	Q1	3.2	20.3	-0.8	21.1	4.2	19.3	16.1
	Q2	3.2	10.3	-3.5	13.8	-8.2	21.7	18.5
	Q3	3.1	-12.7	-5.6	-7.1	-19.5	9.9	6.8
	Q4	2.5	-1.4	-5.1	3.7	-12.9	14.1	11.6
1982	Q1	2.0	-2.7	-2.3	-0.4	-3.7	2.9	1.0
	Q2	0.9	-7.3	0.3	-7.6	4.0	-10.4	-11.3
	Q3	0.5	21.9	0.7	21.2	34.4	-12.0	-12.5
	Q4	0.2	14.2	1.1	13.1	36.0	-21.7	-21.9
1983	Q1	1.3	18.3	-0.4	18.7	23.6	-4.0	-5.3
	Q2	1.3	34.5	-1.2	35.7	27.5	8.4	7.1
	Q3	2.0	16.2	0.5	15.7	6.5	11.6	9.7
	Q4	2.1	16.3	1.3	15.0	4.2	14.2	12.2
1984	Q1	1.3	21.1	6.7	14.4	3.6	18.9	17.5
	Q2	1.1	0.4	7.6	-7.2	-6.8	8.2	7.1
	Q3	0.9	14.8	11.8	3.0	-0.3	15.9	15.0
	Q4	0.7	20.9	15.4	5.5	-1.5	23.1	22.4
1985	Q1	0.3	12.5	14.9	-2.4	-3.2	16.1	15.7
	Q2	-0.3	17.5	15.7	1.8	3.2	14.0	14.2
	Q3	0.0	12.0	10.8	1.2	2.8	9.2	9.2
	Q4	-0.1	10.2	8.1	2.1	0.8	9.3	9.4

		Ex-ante ERP (12M ago)	Unexpected Equity return (Last 12M)	…....Due to..... Unexp DG	Unexp RR	Unexpected Bond return (Last 12M)	Ex-post ERP (Last 12M)	Unexpected Risk premium (Last 12M)
1986	Q1	-0.2	26.3	3.3	23.0	17.8	8.3	8.5
	Q2	-0.1	31.9	5.4	26.5	16.9	14.9	15.0
	Q3	0.3	17.6	5.4	12.2	-3.5	21.4	21.1
	Q4	0.2	17.0	6.8	10.1	-2.0	19.2	19.0
1987	Q1	1.0	18.3	8.9	9.4	-5.3	24.6	23.6
	Q2	1.3	35.5	6.7	28.9	-2.8	39.6	38.3
	Q3	0.3	51.4	8.4	43.0	3.5	48.2	47.9
	Q4	0.3	-1.9	7.3	-9.2	7.9	-9.5	-9.9
1988	Q1	0.9	-16.9	6.6	-23.6	2.7	-18.7	-19.6
	Q2	0.7	-22.8	8.1	-30.9	-2.4	-19.7	-20.4
	Q3	-0.2	-28.0	9.2	-37.2	7.9	-36.1	-35.9
	Q4	1.9	0.1	9.0	-8.9	3.7	-1.7	-3.6
1989	Q1	2.5	13.6	10.2	3.3	0.3	15.7	13.3
	Q2	2.3	7.5	7.0	0.5	-1.6	11.5	9.2
	Q3	3.0	16.4	5.3	11.1	-3.7	23.1	20.1
	Q4	3.5	22.8	8.9	13.9	-6.8	33.1	29.6
1990	Q1	3.4	-3.9	9.7	-13.6	-21.5	21.1	17.7
	Q2	2.9	-1.2	10.7	-11.9	-10.6	12.4	9.4
	Q3	2.8	-25.4	8.7	-34.2	-15.1	-7.5	-10.3
	Q4	3.0	-22.5	3.5	-26.0	-7.9	-11.6	-14.6
1991	Q1	2.1	-1.4	-0.7	-0.7	12.0	-11.3	-13.4
	Q2	3.0	-9.6	-2.6	-7.0	2.0	-8.6	-11.6
	Q3	3.5	22.8	-3.2	26.0	16.4	9.9	6.4
	Q4	3.9	6.2	-5.0	11.2	6.8	3.3	-0.6
1992	Q1	3.7	-10.7	-5.2	-5.6	2.4	-9.5	-13.2
	Q2	3.3	-3.9	-7.9	4.0	12.6	-13.2	-16.5
	Q3	3.5	-13.3	-7.9	-5.4	1.9	-11.8	-15.2
	Q4	3.4	6.3	-8.1	14.4	17.1	-7.3	-10.8
1993	Q1	3.6	11.6	-10.1	21.7	19.8	-4.6	-8.2
	Q2	3.7	9.5	-8.8	18.4	16.5	-3.3	-7.0
	Q3	3.2	17.0	-8.9	25.9	31.3	-11.1	-14.3
	Q4	3.4	15.7	-8.6	24.3	30.3	-11.2	-14.5
1994	Q1	3.2	3.6	-6.3	9.9	4.2	2.6	-0.5
	Q2	3.0	-4.7	-3.9	-0.8	-9.6	7.9	4.9
	Q3	3.2	-6.2	-2.8	-3.4	-15.9	12.9	9.7
	Q4	3.4	-15.8	-1.2	-14.6	-24.5	12.1	8.7
1995	Q1	2.1	-7.5	2.7	-10.2	-5.4	0.0	-2.1
	Q2	1.7	4.9	3.5	1.4	3.7	2.8	1.1
	Q3	1.5	9.1	4.8	4.3	3.1	7.4	5.9
	Q4	1.3	13.0	7.1	5.9	11.5	2.9	1.5

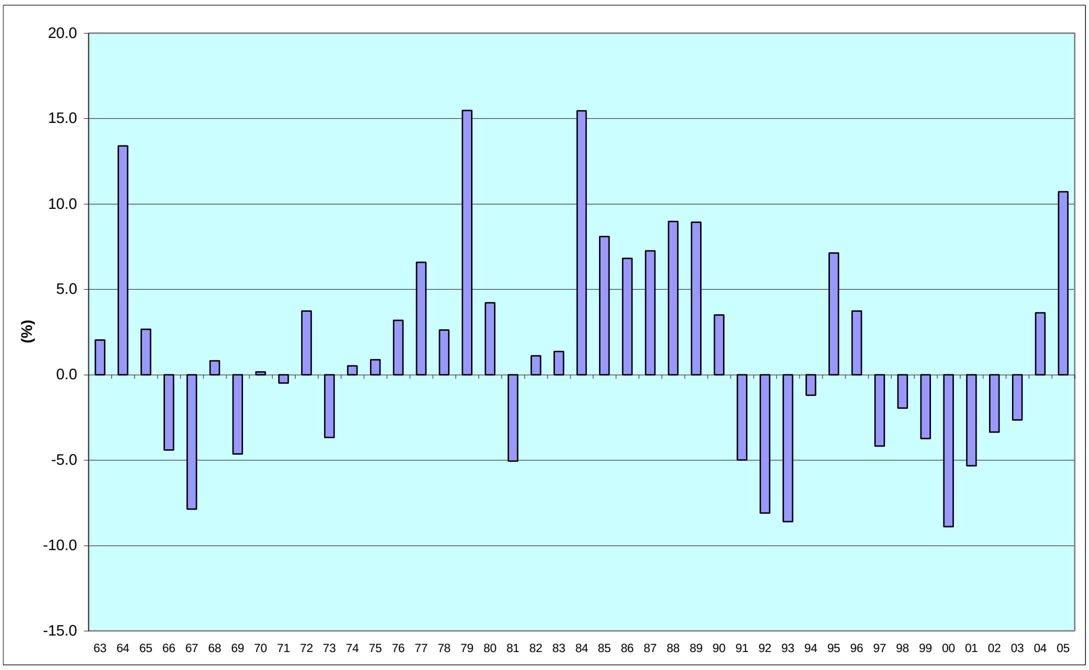
		Ex-ante ERP (12M ago)	Unexpected Equity return (Last 12M)	…....Due to..... Unexp DG	Unexp RR	Unexpected Bond return (Last 12M)	Ex-post ERP (Last 12M)	Unexpected Risk premium (Last 12M)
1996	Q1	1.8	14.2	5.8	8.4	0.4	15.6	13.8
	Q2	1.7	8.6	5.0	3.7	3.2	7.1	5.5
	Q3	1.7	6.4	5.5	0.9	4.3	3.8	2.1
	Q4	2.6	5.5	3.7	1.8	0.0	8.1	5.5
1997	Q1	2.2	7.4	0.9	6.5	5.4	4.3	2.0
	Q2	2.7	11.0	0.1	10.8	14.6	-1.0	-3.7
	Q3	2.8	19.3	-2.1	21.5	18.5	3.7	0.9
	Q4	3.1	12.7	-4.2	16.9	20.6	-4.8	-7.9
1998	Q1	2.6	25.7	-2.1	27.7	33.0	-4.7	-7.4
	Q2	3.2	18.9	-2.7	21.6	24.1	-2.0	-5.2
	Q3	3.2	-11.1	-2.3	-8.8	37.7	-45.6	-48.8
	Q4	3.6	4.3	-2.0	6.2	43.0	-35.2	-38.8
1999	Q1	3.1	-2.6	-3.5	0.9	24.6	-24.1	-27.2
	Q2	3.3	0.7	-6.0	6.7	16.8	-12.7	-16.0
	Q3	4.6	13.9	-4.3	18.2	-5.8	24.3	19.7
	Q4	4.6	14.7	-3.7	18.4	-10.0	29.3	24.7
2000	Q1	3.9	1.0	-9.5	10.6	-2.5	7.4	3.6
	Q2	3.5	-3.4	-8.0	4.6	0.9	-0.8	-4.3
	Q3	3.1	1.2	-9.5	10.7	2.8	1.4	-1.7
	Q4	2.8	-13.7	-8.9	-4.8	5.8	-16.7	-19.5
2001	Q1	2.6	-18.1	-0.8	-17.4	-0.1	-15.4	-18.0
	Q2	2.5	-15.2	-4.3	-10.8	-8.8	-3.9	-6.4
	Q3	2.2	-27.8	-2.9	-24.9	-1.1	-24.5	-26.7
	Q4	2.6	-20.5	-5.3	-15.2	-8.2	-9.8	-12.4
2002	Q1	2.8	-10.9	-6.0	-4.8	-9.6	1.5	-1.2
	Q2	1.8	-21.7	-2.6	-19.2	4.5	-24.5	-26.2
	Q3	2.5	-27.8	-4.7	-23.1	10.6	-35.9	-38.4
	Q4	2.1	-29.6	-3.4	-26.2	9.6	-37.0	-39.2
2003	Q1	1.9	-36.9	-6.0	-30.9	14.8	-49.7	-51.6
	Q2	2.4	-17.5	-4.3	-13.2	8.0	-23.0	-25.5
	Q3	3.6	8.0	-3.1	11.2	-6.6	18.3	14.7
	Q4	3.3	12.1	-2.7	14.8	-6.2	21.7	18.3
2004	Q1	3.5	22.3	-1.9	24.2	0.3	25.5	21.9
	Q2	2.8	9.0	0.1	8.9	-2.7	14.5	11.7
	Q3	2.5	8.1	1.5	6.7	5.1	5.5	3.0
	Q4	2.1	5.4	3.6	1.8	10.5	-3.0	-5.1
2005	Q1	2.2	8.4	6.9	1.4	1.1	9.5	7.3
	Q2	2.1	11.5	9.3	2.2	13.1	0.4	-1.7
	Q3	2.2	17.6	11.1	6.5	8.2	11.5	9.3
	Q4	2.6	14.5	10.7	3.8	10.3	6.8	4.2

APPENDIX 3 – CONTRIBUTIONS TO ANNUAL RETURNS

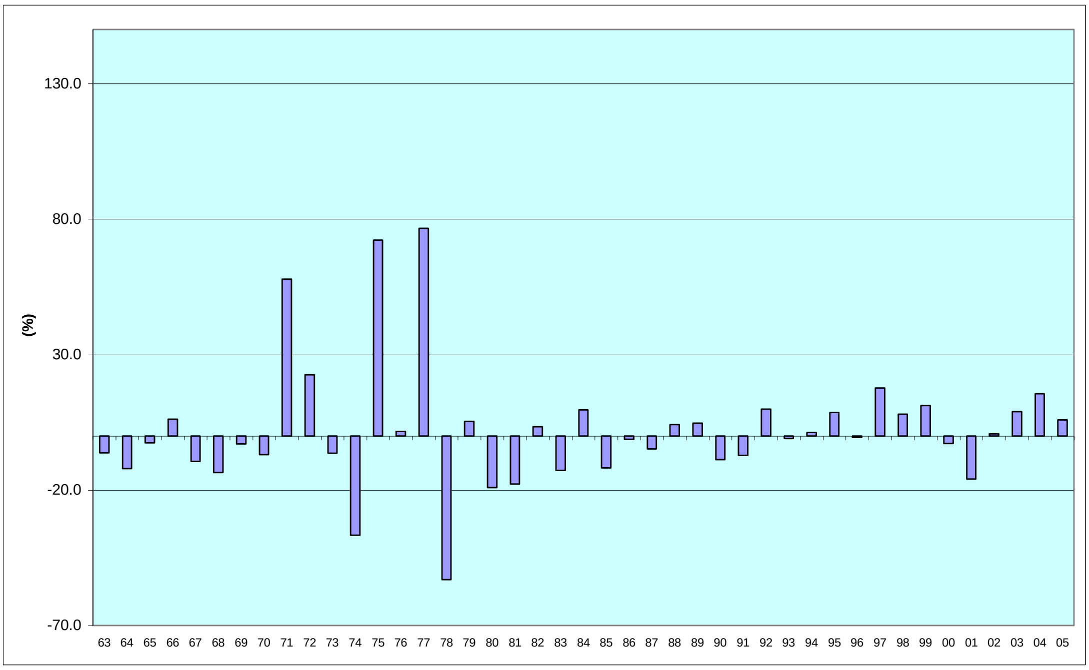
Expected (ex-ante) equity returns



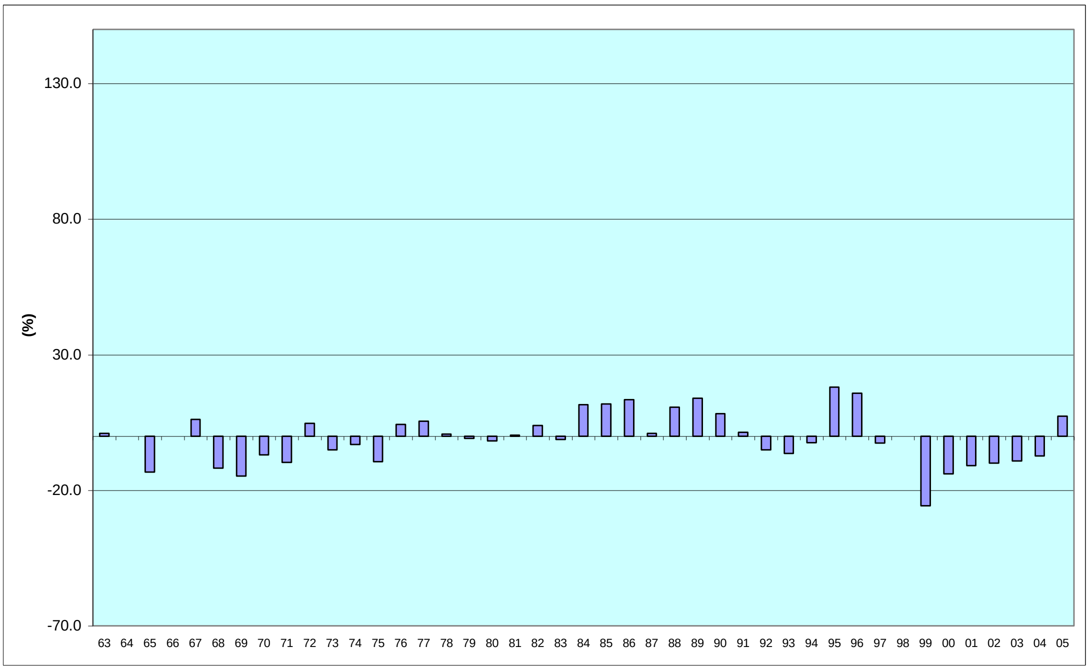
Contributions from unexpected dividend growth



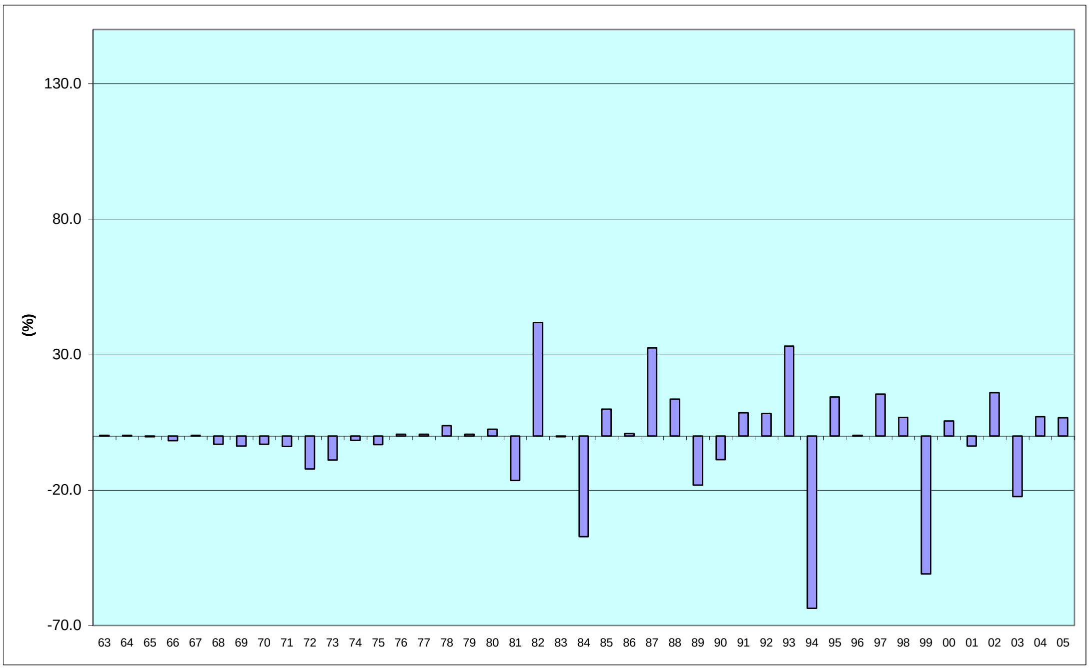
Contributions from changes in real rates of interest



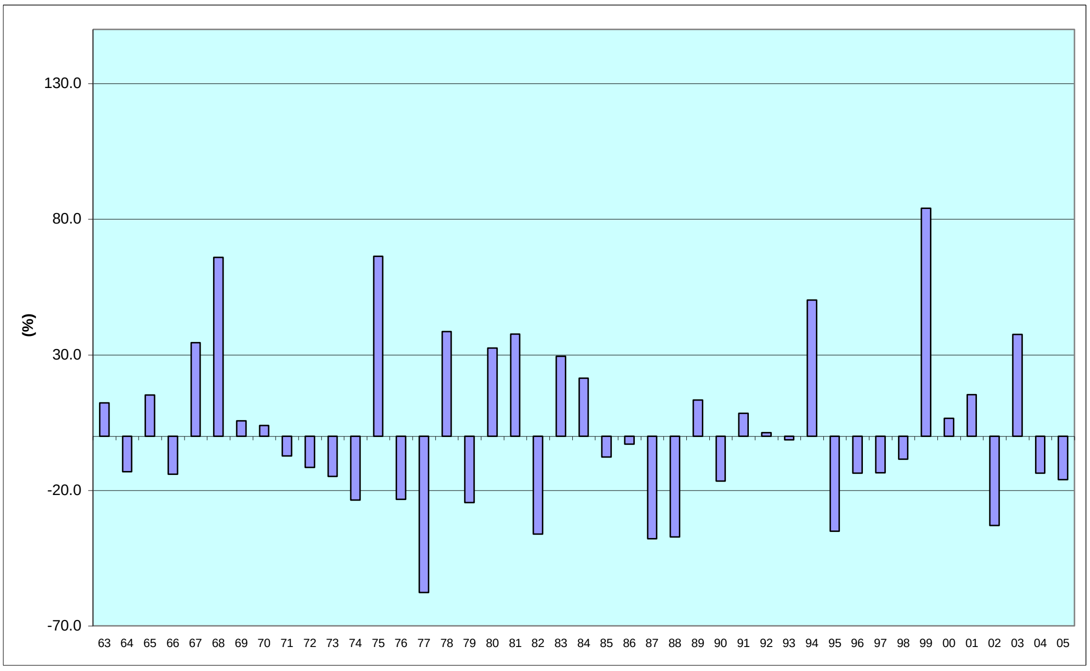
Contributions from changes in real growth expectations



Contributions from changes in inflation risk premia



Contributions from changes in equity risk premia



Actual (ex-post) equity returns