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Property and inflation

Research Report

April 2011

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This programme supports the IPF's wider goals of enhancing the knowledge, understanding and efficiency of property as an investment class. The initiative provides the UK property investment market with the ability to deliver substantial, objective and high quality analysis on a structured basis. It will enable the whole industry to engage with other financial markets, the wider business community and government on a range of complementary issues.

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EXECUTIVE SUMMARY

1. While UK property delivers positive long-run real returns, it is not, in most cases, a hedge against inflation, where a 'hedge' is defined strictly as moving at the same time as inflation, or reacting to it, rather than merely keeping pace with it over time. This may depend upon the underlying economic conditions and type of inflation.
2. Equities tend to be a far better hedge against inflation.
3. Property does hedge against economic growth and, consequently, is useful for matching future assets to liabilities where future liabilities are nominal GDP related ie wages.
4. The three key factors in terms of investment performance are position in the cycle at purchase, GDP growth and inflation, in that order. Inflation is an important driver of nominal returns but not the dominant one.
5. As income provides all of the real total returns over most years and sub-periods, looking at returns in real terms emphasises the need to maintain and protect income.
6. The importance of the cycle points to 'average cost pricing'. By investing regular sums for long-term investors, through different stages of the market, an investor effectively purchases more when prices are lower.
7. Total returns to the different sectors and to alternative assets, and their relative volatility, behave differently in the face of changes to inflation and GDP growth.
8. The best scenario for property is the High Growth-Low Inflation associated with the non-inflationary constant expansion (NICE) era.
9. The High Inflation-Low Growth (stagflation) scenario is particularly bad for property. This implies that cost-push inflation, such as when commodity prices are rising faster than retail inflation, is not favourable.
10. High GDP growth is generally beneficial for property allocations, unless high growth is also accompanied by high inflation. This means that the 'Demand-Pull' scenario combination (when strong economic growth causes competition for resources and rising prices) does not imply a higher property allocation, except for investors prepared to take on high risk.
11. Property should be preferred to equities when low inflation is expected, except for the Low Inflation-Low Growth combination, when equities should be preferred.
12. For very cautious investors, inflation becomes more important than GDP as a driver of property allocations. But for funds prepared to take on more risk, GDP growth is the key driver.
13. In most economic environments, if an investor wants to take on more risk, the property allocation should increase. However, the exception is the Low Inflation–Low Growth situation, where the property allocation is higher for the lower risk portfolios. In other words, in this environment, property becomes a safe haven, relative to equities.
14. Within the property sector, office and industrial are better hedges against inflation than retail and should be preferred if there is thought to be a risk of high inflation.
15. The allocation to office depends on the amount of risk an investor is prepared to incur, while the economic environment tends to influence the allocation of retail and industrial.
16. Retail and industrial property tend to be substitutes for one another, with retail being preferred when inflation is low, and industrial (which is a better hedge) when inflation is high.

1. INTRODUCTION

Property practitioners often claim that real estate investment 'acts as a hedge against inflation'. In current markets, it may also be important to consider the effect of deflation.

The purpose of this project is to explore the inflation-hedging qualities of real estate investments, both within the UK and in an international context. The research extends prior work, examines different sectors of the market and considers the inter-relationship of inflation, economic growth and asset returns.

Specific objectives and outputs include:

- A critical review of the existing literature (both academic and international) on the inflation-hedging characteristics of real estate;
- Creation of an international database of real estate returns, inflation and other relevant macro-economic and financial variables;
- Consideration of the impact of different lease terms in different countries;
- Analysis of the relationship between measures of different types of inflation and real estate returns over different time periods, holding periods and with, where possible, separate analyses by main sectors (industrial, office, residential, retail);
- Consideration of the actual and potential impacts of deflation and testing for the existence of asymmetric behaviour or the existence of 'inflation regimes';
- Comparative analysis of the inflation-hedging behaviour of other asset classes;
- Consideration of other measures of inflation (for example, wages or earnings);
- Consideration of the implications of the findings for portfolio strategy, investment targets and performance measurement.

The analysis assumes that property investment is financed from investors' own resources or by long-term commercial fixed rate mortgages. This means that changes in interest rates driven by fluctuations in inflation do not affect finance costs. Analysis of leveraged investments, where loan periods are relatively short, could produce very different results as high inflation, for example, forces up financing costs as well as potentially impacting on real returns. This is an important consideration but beyond the scope of this report.

2. REVIEW OF PREVIOUS WORK

2.1 Summary

Over the last 30 years or so there has been an extensive body of work looking at the inflation hedging characteristics of various assets. The origin of much of this work was Fama and Schwert (1977) which found that US equities were surprisingly a 'perverse' hedge on inflation ie equity returns were negatively linked to inflation. This was deemed to be a surprise because equities are thought to be a 'real' asset and so, in theory, should offer a hedge against the impact of inflation in eroding real returns. Since this original work, a multiplicity of studies improved upon the original empirical work and extended it to other markets and assets, including property. The original assumption was that property, like equities, is a real asset and so should offer a hedge against inflation. However, it will be seen that, in practice, there is still considerable debate as to whether this proposition holds. This section of the report makes a critical appraisal of this previous work, looking in particular at the methodology used and the key findings. It highlights any problems with previous methodologies and issues that remain unresolved.

2.2 Returns to property and other assets

The return on an asset is the amount by which the capital invested in an asset appreciates or depreciates over time plus any income received from that asset, with the relative contribution of each varying between assets and across time.

In the 1930s, Irving Fisher originally postulated that interest rates comprise a combination of a real interest rate and an expected inflation rate. Consequently, providing that the real rate remains unchanged, the total nominal interest rate will vary with changes in inflation. This analysis can be extended to argue that the return to all assets will be a combination of a real return and an inflation rate. Moreover, it can be further argued that providing the drivers of real return remains unchanged by inflation then the nominal return to an asset should vary in line with inflation (or, more accurately, expected inflation) in order to keep the real return constant. The assumption that the drivers of real returns are not linked to inflation is, however, questionable and we will return to this issue later.

As was stated previously, returns are normally a combination of income returns plus changes in capital value. In the case of bonds, the income is the coupon (or interest rate) payment on the bond and the capacity for changes in the capital value of the bond is normally limited by the fact that most bonds are issued with a fixed maturity date, at which point they are redeemable at their par value. As both the coupon and the par value on a standard bond are fixed in nominal terms, a rise in inflation means that bond prices have to fall in order to offer investors a higher nominal return to compensate them for the rise in inflation.

In contrast, the returns on both equities and property are potentially more flexible, offering the possibility both that income may adjust to offset the rise in inflation and that capital values may change. The income of an equity is its dividend payment, which, in turn, is linked to the profits of the company. Changes in profits should be linked to changes in real activity so, providing that real activity is not affected by an inflation change, nominal profits, and so nominal dividends, should change in line with inflation. As a result, equity returns should, in theory, rise in line with inflation. However, there are two caveats to this. First, dividends are normally only paid out twice a year and so, potentially, can take time to react to a change in inflation. This is less likely to be a problem providing that the inflation is anticipated but it could be more of a problem if the inflation is unanticipated. This gives rise to the proposition that, while equities may offer a hedge against anticipated inflation, they may not offer one against unanticipated inflation. Second, it may be wrong to assume that the inflation shock has no impact upon the real economy and so upon real returns. Depending upon the causes of the inflation shock, this may not hold.

Consequently, the real dividend may fall during an inflation shock if the real economy is expected to be negatively affected, and the capital value of the asset may also be eroded by the real shock. For either or both of these reasons, equity returns may not offer a hedge against inflation.

Property, in theory, has similar characteristics to equities, which, again, should allow it to offer at least a partial hedge against inflation. The income payment to property comes in the form of a rent. This rent should, in theory, change in line with inflation but two caveats should be attached to this. First, rental agreements are often of quite long durations and (in the UK) are usually only reviewed every five years, so only about 20% of rents would be reviewed in any one year. Rents, therefore, will not adjust quickly to any unexpected inflation shocks. Second, the UK market tends to operate on the basis that rents can only be adjusted upwards. Consequently, property income flows will, at best, only offer a partial hedge against inflation. As with the case of equities, the capital value of a property portfolio may be eroded by an inflation shock if this shock also implies some changes to real returns.

2.3 Methodological issues in previous studies

Tests of the inflation-hedging hypothesis have taken a number of forms. Some work has looked at correlation tests or examination of the data in graphical form. However, the vast majority of published work has concentrated on building on the econometric framework first introduced in Fama and Schwert (1977). This paper tests the following relationship:

$$R = \beta_0 + \beta_1 EINF + \beta_2 UNINF + e$$

where:

R is the asset return in period t

EINF is expected inflation in period t

UNINF is unexpected inflation in period t

e is an error term

The hypothesis to be tested was that the asset would offer a complete hedge against inflation if both β_1 and β_2 are equal to one.

Subsequent work has built on this framework in a number of ways:

- It is hypothesised that the observed relationship between inflation and asset returns may be spurious due to missing variables, such as measures of real economic activity or measures of monetary shocks. Subsequent work, therefore, has attempted to incorporate various measures of these variables into the explanatory equation;
- The original Fama and Schwertz empirical work was criticised for concentrating purely on the short term relationship between inflation and returns and, accordingly subsequent work has attempted to introduce a long run relationship;
- Various data issues are a key factor in calling into question the robustness of results from previous empirical work. In particular, the distinction between expected and unexpected inflation is unobservable and so has to be measured in some way. Also, it has frequently been questioned whether the historic return data for property, which is usually based upon appraisals, is an accurate measure of actual market conditions.

A good example of recent attempts to solve these methodological issues is Hoesli et al (2008).

This paper uses an Error Correction Model to investigate the relationship between returns for various assets (including both real estate and real estate securities). This methodology follows a two stage modelling process. First, a long run relationship is established by regressing the level of returns upon a set of explanatory variables. Second, the residuals from this equation are then used in an equation that looks at the change in returns versus changes in the explanatory variables. The reasoning behind this approach is that the levels of return equation represents the long run equilibrium between returns and the explanatory variables. However, in the short run, this relationship may have moved away from equilibrium and so the difference equation represents the dynamics of the attempt to move back to this long run relationship.

Hoesli et al include a range of real and monetary variables in their explanatory variables. These include GDP, industrial production and money supply. This allows them to explore the hypothesis about whether the previously observed surprising relationship between returns and inflation was due to missing variables. One avenue for future empirical work is to look at whether other measures of real activity may be more appropriate for the property market.

A number of studies have also tested the direction of causality between changes in inflation and changes in property prices using the Granger causality test. The purpose of this work is not to test the hypothesis that property returns offer a hedge against inflation but, instead, to see which of property prices and inflation moves first. As such, it can be seen as a complement to the other work already mentioned and has typically been done in junction with it. Examples of such studies include Glascock et al (2002). These studies have usually concluded that changes in inflation cause movement in property returns but not vice versa.

2.4 Results of previous studies

Numerous studies have now been undertaken across a range of countries looking at the impact of inflation on returns to equities, direct property investment and real estate securities. Most work has been undertaken on the UK and US markets, but recent papers have covered a number of other European markets along with China, Hong Kong and Singapore. Ironically, despite all this work, the most striking conclusion must be that it still remains unclear as to what extent real estate returns do act as a hedge against inflation, or even whether real estate is a superior hedge to equities. Most studies would reject the hypothesis that real estate acts as a complete hedge against all inflation or even that it offers a complete hedge against anticipated inflation but, that apart, there is no widespread agreement. (Table 2.1 summarises the results from a range of recent studies).

Despite using very similar methodologies, recent papers come up with surprisingly differing conclusions for the impact of inflation on returns in different markets. For example, Ganesan and Chiang (1998) conclude that real assets in general are not a good hedge against inflation in Hong Kong and that real estate is not a good hedge. Similar conclusions are reached by Chu and Sing (2004) for China and by Stevenson and Murray (1999) for Ireland. However, in contrast, Sing and Low (2000) find that real estate does provide a good hedge in Singapore.

More worrying than the conflicting results for other markets is that studies of the same market have come up with differing conclusions. The most frequently researched markets are the US and the UK, and studies here have again come up with differing results while, seemingly, employing similar methodologies. In the case of the UK, most recent studies suggest that property offers, at best, only a weak hedge against inflation, but conclusions differ on whether or not property offers a better hedge than equities.

2. REVIEW OF PREVIOUS WORK

Strikingly, Hoesli et al (2008) find significantly different results when they estimate their equations over different time periods. This might be because property experiences quite long and quite marked cycles, and, potentially, means that any analysis is very sensitive to the choice of time period. This suggests that at least some of the differences in recent studies might be explained by researchers looking at differing time periods. This begs the question whether the relationship between inflation and asset returns varies over time because of one or more structural breaks in the data or, alternatively, whether equations are still missing variables that help explain the relationship.

Table 2.1: A summary of previous studies

Study	Country	Sectors	Period tested	Methodology	Conclusions
Barber, Robertson and Scott (1977)	UK	Commercial Property and Equities	1967 to 1994	Uses the unobserved components model.	Property is an inflation hedge but only a weak one. It is better against unanticipated inflation than anticipated inflation. Industrial sector is the best hedge and the office sector the worst. Equities offer a better hedge against shocks to the price level but not against core inflation.
Hoesli et al (1997)	UK	Bonds, Equities and Real Estate	1963 to 1993	Uses the Fama and Schwertz methodology. Has separate equations for income and capital value. Uses Chow tests to test for structural breaks.	Real estate has poorer hedging characteristics than equities but better than bonds.
Liu, Hartzell and Hoesli (1997)	Australia, France, Japan, South Africa, Switzerland, UK and US	Real Estate Equities and Equities	1980 to 1991	Uses the Fama and Schwertz methodology and that of Geske and Roll.	Both real estate equities and common stocks are perverse hedges to inflation. Real estate stocks provide a worse hedge.
Ganesan and Chiang (1998)	Hong Kong	Real Estate and Equities	1984 to 1994	Estimates a cointegrated version of the original Fama and Schwertz equation and includes 'real variables'	Strong indications that in general real estate is not a good hedge against inflation.
Sing and Low (2000)	Singapore	Real Estate, Real Estate Equities and Equities	1978 to 1998	Uses the Fama and Schwertz methodology.	Real estate offers a better hedge than equities and real estate stocks. Different types of property have different hedging characteristic. Results vary across different types of inflation regime.
Glascock, Lu and So (2002)	US	Real Estate REITs	1972 to 1995	Uses a vector error correction model and also runs causality tests.	Negative relationship between inflation and REIT returns is spurious and is explained by the interaction of monetary policy and inflation.
Adrangi, Chatrath and Rafflee (2004)	US	Equity and Mortgage REITs	1972 to 1999	Estimates a cointegrated version of the original Fama and Schwertz equation and includes “real variables”. Chow test run to test for stability. Also includes two interesting methodologies for estimating expected and unexpected inflation based upon the Hodrick-Prescott filter and an ARIMA model.	The real REIT returns are negatively correlated with inflation. Results are robust for the longer run. Weaker evidence of mortgage REITs decoupling from equities for at least one short period.
Chu and Sing (2004)	China	Real Estate	1996 to 2002	Uses the Fama and Schwertz methodology.	Shows no evidence of long term hedging ability. However, causality test does show unidirectional causality from inflation to real estate returns.
Chen and Sing (2006)	Hong Kong, Tokyo Singapore, Taipei and London	Residential Property	Various periods between 1971 to 2003	Uses the unobserved components model.	Hedging characteristics of property vary. Works best in Singapore in the short term and Taipei in longer term.
Hoesli, Lizieri and MacGregor (2008)	UK and US	Equities, Real Estate and Real Estate REITs	1977 to 2003	Uses the Fama and Schwertz methodology.	In the long run, once real and monetary variables are included, returns are positively linked to inflation. However, adjustment process is long and gradual. Real estate returns have differing characteristics from equity returns.

2.5 Issues and problems with existing work

The seeming failure of a consensus to emerge from past work suggests that there is room for further study in this area. In particular, it highlights the need for a new model that encompasses previous analysis and explains the reasons that past studies appear to have come up with seemingly different results. We highlight three areas of research that are potentially worth pursuing:

The first of these is resolving data issues. It would be useful to establish whether different types of property are affected in the same way. In particular, is prime property any different from market averages?

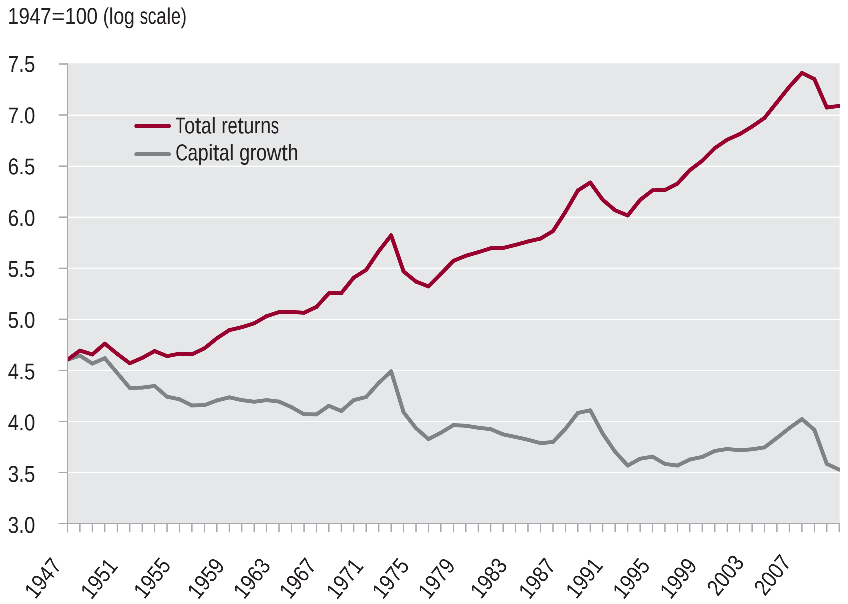
Second, does the choice of data period make a significant difference to the results and, if so, why?

Third, what are the inflation characteristics of alternative assets and different property sectors when estimated in a consistent way? Consequently, what do the differences in hedging characteristics imply for investment strategy under different inflation regimes?

3.1 Long-run real returns

Figure 3.1 shows real returns to UK property investment and real capital growth in the UK since 1947. It is benchmarked to 1947=100 (or ln(100) in the chart) and is based on the IPD All Property Index deflated by the ONS' consumer spending deflator. What it shows, for returns, is the hypothetical value of an investment of £100 in 1947 with all returns re-invested year-by-year, expressed in 1947 prices. For capital values, it shows the hypothetical value, implied by the IPD capital growth series, of an investment made in 1947, again expressed in 1947 prices. The gap between the two lines is attributable to the contribution of income and re-invested income to real total returns.

Figure 3.1: UK property – real returns and capital values



Source: IPD, ONS, Oxford Economics

Figure 3.1 exhibits a number of very marked features:

- There is a strong upward trend in real total returns but …
- … a number of very pronounced booms and busts produced some major fluctuations with peaks in 1973, 1989 and 2006;
- Taking the period from 1947 as a whole, all of the real returns came from income or re-invested income rather than capital growth and …
- ... all of the volatility came from capital growth. Income returns were by no means constant but they were very stable when compared with capital growth.

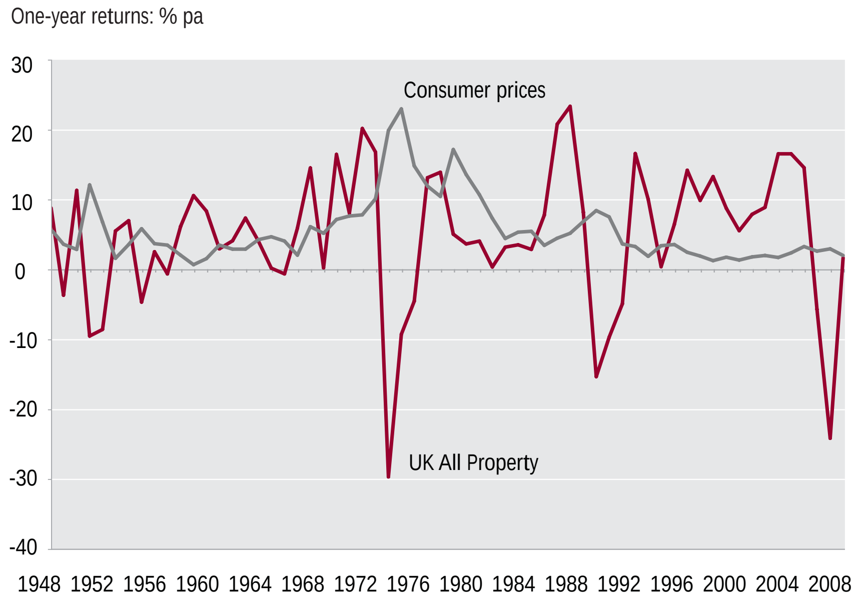
Apart from the recent sharp peak and retrenchment, the negative impact of capital growth has levelled off in recent years. Taking broadly comparable points in the cycle as benchmarks, real capital growth fell at an average annual rate of 1.7% per annum between 1957 and 1992 but only by 0.2% per annum between 1992 and 2009. Although we do not yet know the final shape of the current cycle, there does appear to have been an improvement across the most recent one. This has also shown up in real total returns, which have increased from an annual average of 4% per annum between 1957 and 1992 to 6.4% per annum between 1992 and 2009, with most of the improvement being driven by the slowdown in the rate of real capital decline.

Although real capital growth has been negative, with real returns increasing by 4.1% per annum between 1947 and 2009, it is clear, in the naïve sense, that property has easily outstripped consumer prices[1] over a long time period. It is also clear, however, that the size of the fluctuation means that positive real returns have by no means been guaranteed in the short-to-medium term. An investment made in 1973 would not have shown a real profit until 1986; and an investment made in 1989 would not have shown a real profit until 1997.

Positive long-run real returns, at least since the mid-70s, are a feature that property shares with other investments such as equities, along with a number of other features such as volatility (even more marked in equities but much less noticeable for gilts) and the relative smoothness of income returns. Note, however, that real capital growth has been higher for equities than for property and higher for property than for gilts, with the relative income returns being the other way around (see Appendix 1).

The observation of positive long-run real returns is not, however, sufficient evidence to be able to say that property investment acts as a hedge against inflation. As the literature shows, if property acts as a hedge against inflation, we would expect that nominal total returns, all other things being equal, would move broadly in line with inflation and that real returns would be invariant to inflation in the long-run.

Figure 3.2: UK real property returns versus inflation



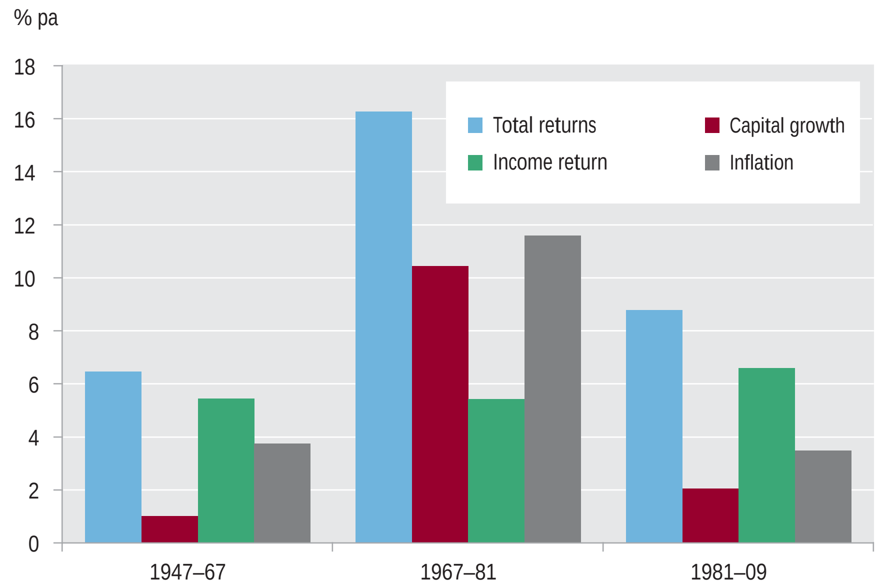
Source: IPD, ONS, Oxford Economics

[1] Nominal property returns also outstripped nominal wage growth for the short 1973 to 2009 period for which there is consistent wages data, although the gap with wages growth was 1.9% per annum compared to an excess of nominal property returns over consumer price inflation of 3.6% pa.

Figure 3.2 plots annual real total returns (ie after removing inflation) for the IPD All Property index against consumer price inflation. The coincidence of sharply negative real property returns and spikes in inflation in 1974 and 1990 stand out clearly, but year-to-year fluctuations mask the relationship for much of the rest of the period.

Figure 3.3 attempts to iron out short-term variation by showing the nominal rates of return between various benchmark years (which approximate to low/high/low inflation years) together with the average annual rate of consumer price inflation between the same years.

Figure 3.3: Nominal rates of return and consumer price inflation



Source: IPD, ONS, Oxford Economics

If property was a perfect hedge against inflation then nominal total returns should move up and down exactly in line with inflation (or real rates of return should be invariant to inflation). Looking at the sub-divisions of the 1947 to 2009 period shown in Figure 3.3, this appears to be possible. Relatively low nominal total returns during a relatively low inflation period between 1947 and 1967 are followed by higher returns during the high inflation period between 1967 and 1981, followed by lower nominal total returns when inflation fell back again in the period after 1981. Statistical analysis (see below) indicates that this relationship might not be quite as good as that suggested, but a feature of Figure 3.3 that stands out, and which is also statistically significant, is that there is a clear positive relationship between capital growth and inflation and no obvious relationship between income returns and inflation. Further, a relationship is also apparent between real capital growth and inflation. Real capital growth is negative in every sub-period but it was less negative between 1967 and 1981 than it was in the other two sub-periods. Leaving aside the booms and busts and looking at the sub-periods as a whole, inflation appears to be good for real capital growth.

Given the positive relationship between real capital growth and inflation, an obvious conclusion is that whatever drives inflation in consumer prices also drives inflation in property values. One possible link is the path of real interest rates. Using a simple definition of real interest rates as long-term government bond yields less actual consumer price inflation, rates were, on average, positive between 1947 and 1967, negative between 1967 and 1981 and then positive again between 1981 and 2009. The link is obvious but the precise causality is complex. The main reason that real interest rates were negative on average between 1967 and 1981 was that governments attempted to combat emerging stagflation by keeping real interest rates low, although they only succeeded in pushing inflation up further without necessarily boosting growth. Monetary policy has experienced a step change since 1981[2] and that may have been associated with weaker real capital growth (although it certainly did not stop further large fluctuations in real capital values).

Real income returns exhibited the opposite phenomenon – they fell when inflation rose and vice versa. Real income returns do not appear to have a very close relationship with GDP, but there is a strong and negative link with inflation, whether we look over long periods, as in Figure 3.3, or if we look at annual changes. An obvious conclusion is that the income return in the UK fails to keep up with unusually high bouts of inflation because of the UK's long lease structure. This would be consistent with the findings of earlier research that property returns, as a whole, hedge against expected inflation but not against unforeseen inflation.

All of this analysis, of course, is abstract and ignores the real world conditions of changing demand and, especially, supply conditions. There is also the danger that it identifies the impact of specific historical episodes which cannot justifiably be extrapolated into the future. Nonetheless, it is a useful exercise in establishing the broad features that characterised the evolution of real long-run UK property returns.

3.2 Initial statistical results

Appendix 2 shows the results of an analysis of the relationship between IPD total returns and inflation over the full 1947 to 2009 period. The first equation (Equation A2:1) shows that if we fit a simple model with nominal total returns for All Property as the dependent variables and GDP growth, inflation and a constant as the explanatory variables we appear to get a significant negative relationship with inflation, as well as the significant positive relationship with UK GDP that usually comes through strongly in property returns analysis. If property was a perfect hedge against inflation, we would expect a coefficient on inflation that was not significantly different from one[3]. In the case of Equation A2:1, the estimated coefficient on inflation is 0.43 and it is significantly lower than one (t=2.12). If we accept this at face value, it means that property is not a hedge against inflation. Equation A2:2 takes this further by splitting inflation into its expected and unexpected component parts, using a crude proxy for expected inflation[4]. In line with previous research, this shows that all of the negative impact of inflation on real total returns is coming from the unexpected inflation component. The estimated coefficient on expected inflation is not significantly different from one, while that on unexpected inflation is close to zero (and statistically different from one, t=2.49), implying that total returns completely fail as a hedge against unexpected inflation. This is in line with the findings of previously published research.

Equations A2:3 and A2:4 apply the same methodology to nominal capital growth. Equation A2:3 shows an inflation coefficient in the capital growth equation which is also less than one but not statistically different from one (though the t-statistic is marginal at 1.82). Equation A2:4, however, shows that capital growth, like total returns, fails to react to unexpected inflation.

[2] Or slightly earlier to be precise. Though the tightening of monetary policy in the UK is associated with the election of the Conservative government in 1979, there had been moves towards tighter policy in the latter days of the previous administration. There have been other changes in UK monetary policy since 1947, and 1981 was only singled out because of movements in the property data, although it did coincide with a sharp increase in real bond yields in the UK. It was also the start of a run of positive real bond yields (defined here as the nominal yield less the current rate of inflation) that has continued to the present day.

[3] If the dependent variable is nominal property returns, then a coefficient of one indicates that nominal property returns move exactly in line with inflation (i.e that it is a hedge and that real property returns are invariant to inflation). If the dependent variable is real property returns, a zero coefficient on inflation is required for property to be a hedge against inflation, ie for real propertyv returns to be invariant to inflation)

[4] It assumes that expected inflation was equal to 0.92 multiplied by actual inflation in the previous year. This is based on the average relationship over the sample period. Alternative measures of estimating expected inflation are not available as sufficiently long time series are available for neither index linked gilts nor the necessary survey data. Experiments with more recent data, however, show that this is a not unreasonable proxy.

Equations A2:5 and A2:6 look at the relationship between income and inflation. Note that income is defined here as the difference between total returns and capital growth so as to make total returns additive. This means that real total returns can be expressed as real capital growth plus real income. Income shows no link whatsoever to inflation.

Equations A2:7 and A2:8 look at returns over five years rather than a single year and concentrate on the period since 1976[5]. Five-year returns and capital growth are considered because five years is, typically, the minimum holding period for physical investments in building because of transactions costs. A further reason to look at five-year returns is that practically all variations in inflation over five years are likely to be unexpected. Note that Equations A2:7 and A2:8 use total returns and capital growth specified in real rather than nominal terms, so a statistically significant negative term on inflation is evidence that either total returns or capital growth are not perfect hedges against inflation. Using five-year averages induces a moving average process in the error term of the equations, so this is corrected for by estimating with a moving average term (MA(1)). The results show a significant estimated negative coefficient on inflation for real five-year total returns and a negative but not statistically significant estimated negative coefficient on real five-year capital growth. Five-year income (equation not shown), like one-year income, has little relationship with inflation.

Another feature of Equations A2:7 and A2:8 is the presence of significant and negative dependent variables (ie five-year real returns or five-year real capital growth lagged five years). This feature is not picked up in the one-year return equations but it appears to be a major feature of five-year total returns and capital growth. A variation on Equation A2:7 is shown in Appendix 4. Equation A4:1 shows the equation variables used in the investment implications analysis (see Chapter 5). This includes a real interest rate term as well as five-year GDP growth and inflation. In this case, the statistical evidence that UK property is not a good hedge against inflation is even stronger. The results of equation A2:7 are summarised below:

Equation 3.1: UK IPD returns estimated over 1976–2009

Five-year real total returns = -0.45* five-year real total returns, lagged five years

(-3.83)

+ 1.91*GDP growth over five years – 0.49*Inflation over five years + 0.28

(3.10) (-3.15)

$R^2 = 0.85$

This points to a number of interesting observations. The main one is that although returns on UK property have historically outperformed inflation, at least in the medium–long term, property does not match the technical definition of being a hedge against inflation. This means that, for a given level of GDP growth in the future, higher inflation is likely to lead to lower real returns and vice-versa.

Second, although total returns fail all of the tests for being a hedge against inflation, capital growth is more borderline, passing some tests and failing others. The implication, backed up by the results of Equations A2:5 and A2:6, is that income offers even less protection against inflation.

[5] It was not possible to specify equations using five-year returns that did not exhibit substantial serial correlation with longer runs of data.

The five-year analysis (Equation A2:7, reproduced above) implies that the one-year returns analysis might not reject decisively enough the hypothesis that property is a perfect hedge against inflation. The t-statistic for the difference between one and the estimated coefficient on inflation in the nominal one-year returns equation (A2:1) is 2.12 while the absolute value of the equivalent t-statistic in the five-year real returns equation (A2:7) is 3.15.

A third observation is a by-product of equations A2:7 and 2:8. There is a significant negative coefficient on the dependent variable lagged five years. In technical terms, this indicates that some element of real total returns has a large mean reversion tendency. In this case it is the capital growth component, and mean reversion indicates that several positive years are likely to be followed by negative years. One cause of this is likely to be the development cycle in property, which lags behind demand growth. Increased demand growth initially pushes up real capital values and real total returns but new developments eventually bring real capital values back down again.

An unavoidable conclusion from the analysis is that different time periods produce different results. This is clearly illustrated in Table 3.1. Estimating the relationship between real five-year total returns, lagged five-year returns, GDP growth and inflation gives different results for different estimation periods. GDP growth always shows up as important and significant and lagged returns are less important with shorter time periods. The key point, however, is that the inflation term is significantly less than zero (which indicates that property is not a perfect hedge against inflation, as this is a real returns example) for all time periods considered except 1980 to 2009.

Table 3.1: All property real five-year total returns

Estimation period:	1970–2009	1975–2009	1980–2009	1985–2009	1970–2003
LDV (-5)					
Estimated coefficient	-0.42	-0.45	-0.31	-0.05	-0.50
t-statistic	-3.58	-3.37	-1.82	-0.25	-4.78
Inflation					
Estimated coefficient	-0.44	-0.48	-0.28	-0.90	-0.33
t-statistic	-3.22	-3.37	**-0.90**	-2.45	-2.48
GPD					
Estimated coefficient	2.36	1.96	2.17	3.19	2.46
t-statistic	3.96	3.12	2.77	4.08	4.08
Constant	4.80	5.86	3.80	15.51	3.73
R^2	0.83	0.85	0.78	0.85	0.87
Serial correlation - Chi^2 (2)	5.23	4.14	4.87	1.86	2.52

This must be kept in mind when considering the results for other markets and for prime property shown below and in the next chapter.

3.3 International comparisons

It could be that the inability of UK property to act as a hedge against inflation, apparent in the long-run statistical results discussed above, is largely a function of UK lease structures. There are, unfortunately, no long-run IPD data elsewhere comparable with that available for the UK. The longest series available are for Australia, Ireland and Canada and these are summarised in Table 3.2.

The model used is similar to that used for the UK above. Nominal total returns is the dependent variable and the equations include GDP growth as well as inflation as explanatory variables.

The key statistics[7] to look for are the estimated coefficient on inflation and the t-statistic for the difference between the estimated coefficient on inflation and one (the critical value at the 5% level is 2.06 for equations spanning the full 1984 to 2009 time period. For the long-run UK equation the critical value is 1.96)[6]. If property is a perfect hedge against inflation then the estimated coefficient on inflation should be one. Although the estimated coefficient on inflation is below one for Ireland, Canada, Sweden and the UK (shorter sample), in no one instance is the difference from one statistically significant. This is even the case for Sweden, where the estimated coefficient on inflation is actually negative. In Australia and the Netherlands, the estimated coefficient is greater than one. There are problems with serial correlation in some of the equations (Canada, Sweden and the UK shorter sample) but they appear to show a more promising case for property investment's ability to act as a hedge against inflation in a number of countries. To be precise, we cannot reject the hypothesis that the coefficient on inflation is equal to one in any of the countries shown in Table 3.2, except for in the UK for the full 1948-2009 sample. The shorter-sample UK estimates actually give a negative coefficient on inflation (another indicator of the sensitivity of the results to the time period chosen) but this is still not significantly different from one.

Table 3.2: Nominal IPD All Property one-year returns and inflation – international comparisons

LS dependent variable = nominal All Property returns							
Country:	**Australia**	**Ireland**	**Canada**	**Netherlands**	**Sweden**	**UK**	**UK**
Estimation period:	**1986–2009**	**1984–2009**	**1986–2009**	**1995–2009**	**1997–2009**	**1984–2009**	**1948–2009**
GPD							
Estimated coefficient	4.13	2.91	1.90	1.18	1.02	2.81	2.42
t-statistic	4.92	5.82	3.19	5.12	1.48	3.18	4.19
Inflation							
Estimated coefficient	1.64	0.57	0.68	1.12	-5.14	-0.59	0.43
t-statistic (difference from 1)	-1.14	0.50	0.34	-0.26	0.08	1.62	2.12
Constant	-0.10	-0.07	0.02	-0.01	0.08	0.04	0.01
R^2	0.58	0.62	0.32	0.82	0.58	0.33	0.23
Serial correlation - Chi^2 (2)	5.43	1.29	12.26	1.56	6.38	6.49	1.89

Table 3.2 is ambiguous as regards the impact of rent escalation clauses on the ability of property to act as a hedge against inflation[7]. UK rents show the biggest evidence of property returns not responding adequately to inflation, even though the coefficient on inflation estimated over the 1984 to 2009 period is not statistically different from one. Australia and the Netherlands show the strongest evidence in support of property as a hedge against inflation but Ireland, with a similar lease structure to the UK, also supports the hypothesis.

The major drawback in interpreting the results shown in Table 3.2 is the relatively short time period examined. Apart from the UK, the longest available time series date from the mid-1980s. This is a particular problem as it misses out the earlier periods of higher inflation. In the case of Australia, for example, inflation averaged 9.5% between 1973 and 1996 but only 3.2% between 1986 and 2009. This pattern is repeated for all of the other countries, although higher inflation in the earlier years is much less marked in the Netherlands.

[6] The critical value, or the point at which the t-statistic becomes significant, varies with the sample size. Hence, it is lower for the long-run UK equation than for the others.

[7] Neither Australia nor Canada have been characterised by short leases but in both countries annual escalation clauses based on inflation or movements in market rents are often common. Rents in the Netherlands are indexed annually to consumer price inflation, while in Sweden they are negotiable but usually indexed annually in line with consumer price inflation.

3.4 UK total returns and inflation: property sectors and alternative assets

Tables 3.3 and 3.4 show a set of estimation results for nominal total returns estimated for UK property sectors, all property, equities and gilts. Table 3.3 shows the results for returns over one year estimated over the 1971 to 2009 period while Table 3.4 shows the results for five-year returns estimated over 1980 to 2009. The five-year returns equations also include lagged dependent variable lagged five-years and a real interest rate term (which is important for five-year total returns on offices and gilts). The five-year returns equation also included a moving average (MA(1)) error term.

The estimated equation for All Property one-year returns gives an estimated coefficient on inflation of 0.42. This is not significantly different from one, indicating that All Property was possibly a hedge against inflation over this period. Indeed, of all the equations for one-year returns for assets and sectors, only retail shows up as not being a good inflation hedge. Interestingly, in the five-year returns equations, all of the assets and sectors have coefficients on (five-year) inflation that are very close to one indicating that measured over five years all of them are inflation hedges.

The five-year result for All Property in Table 3.4 is obviously at odds with the results shown in Equation 1 and A2:7. The main difference between the two is the estimation period and this highlights the importance of the period being analysed. Inflation was substantial higher and property returns were much weaker in the early 70s and this appears to have a material impact on the results.

Table 3.3: Estimation results for nominal total one-year returns on property sectors and alternative assets

LS one-year: 1971 to 2009						
Nominal	**Office**	**Retail**	**Industrial**	**All Property**	**Equities**	**Gift**
GDP						
Estimated coefficient	3.07	2.53	2.24	2.79	-0.96	-0.49
t-statistic	3.93	3.34	3.11	0.74	-0.48	-0.52
Inflation						
Estimated coefficient	0.70	0.22	0.64	0.42	0.37	0.18
t-statistic (difference from 1)	0.87	2.28	1.10	1.75	0.70	1.93
Constant	-0.01	0.04	0.03	0.02	0.12	0.10
R^2	0.31	0.24	0.23	0.29	0.02	0.02
Serial correlation - Chi^2 (2)	4.37	3.98	3.93	4.10	1.42	0.99

Appendix 3 (Equations A9–A2:11) also shows a version of Table 3.3 for property sectors which uses real total returns (which is used for the portfolio analysis in Chapter 5). The results and implications are similar to those shown in Table 3.3.

Table 3.4: Estimation results for nominal total five-year returns on IPD property sectors and alternative assets

LS five-year: 1980 to 2009						
Nominal	**Office**	**Retail**	**Industrial**	**All Property**	**Equities**	**Gilts**
Dependent variable (-5)						
Estimated coefficient	-0.06	-0.23	-0.50	-0.13	-0.42	-0.15
t-statistic	-0.46	-1.23	-3.23	-0.83	-2.80	-1.05
GDP						
Estimated coefficient	4.35	2.57	2.02	3.39	0.27	-0.70
t-statistic	5.49	3.34	2.60	4.80	0.25	-1.74
Inflation						
Estimated coefficient	1.28	0.96	1.14	1.01	2.46	1.04
t-statistic (difference from 1)	-0.05	0.01	-0.03	0.00	-0.21	0.00
Real Interest Rates						
Estimated coefficient	-0.09	-0.02	-0.03	-0.06	0.23	0.10
t-statistic	-3.14	-0.64	-0.95	-2.32	5.06	5.39
Constant	0.05	0.23	0.00	0.18	-0.54	0.00
R^2	0.89	0.78	0.86	0.85	0.79	0.00
Serial correlation - Chi^2 (2)	1.02	2.04	0.25	0.21	0.71	0.00

On the basis of Table 3.4, however, the conclusion is that we cannot reject the hypothesis that property and other UK assets do hedge against inflation when the analysis is carried out using five-year returns and over the period since 1980.

Analysis of five-year returns (Appendix 4) confirmed that gilts fail to hedge against inflation (indirectly through the impact of inflation on real interest rates and the impact of real interest rates on gilt returns) and that real UK equity returns are invariant with respect to both UK GDP growth and UK inflation (in other words, UK equities do hedge against inflation). The All Property results estimated over the 1976 to 2009 period (Equation 1 and Table A2:7), however, muddy the conclusions and make us wary about applying the conclusions of Table 3.4 to all periods, especially when, as in the early 70s, they included high inflation and volatile returns.

3.5 Summary of Chapter 3

1. The returns to property investment have easily outstripped inflation, taking the past 60 or so years as a whole.
2. Income returns rather than capital growth have been the main driver of real total returns in the UK since 1947.
3. The main exception to this was the high inflation 1967 to 1981 period, when real income returns were flat and capital growth was the main driver of real total returns, even though it experienced substantial volatility.
4. Capital growth also has a strong mean reversion tendency – good years tend to be followed by bad.
5. GDP growth is a major driver of property returns.
6. Analysis of various phases in the long-run data (back to 1947) for UK property as a whole indicates that real capital growth may be positively correlated with inflation and, hence, a good hedge against inflation. There is a possibility, however, that this is just picking up a period of negative real interest rates in the 1970s rather than a genuine relationship with inflation.

7. Analysis of IPD data for a number of countries all show the hypothesis that property is a perfect hedge against inflation, after having allowed for GDP growth, cannot be rejected. This contrasts with the longer-run analysis of UK IPD data.
8. Analysis over different periods gives different conclusions. Analysis over more recent time periods tends to show that property investment is a hedge against inflation, while analysis over a longer period implies that it might not be.
9. Even though analysis of shorter time periods shows the hypothesis, that property is a perfect hedge against inflation, after having allowed for GDP growth, cannot be rejected, this is not the same as saying we can prove property is a perfect inflation hedge.
10. The importance of GDP growth means that even where the statistics imply that property is a technical hedge against inflation, it does not necessarily mean that an increase in inflation will be met by an increase in nominal returns. That will depend on what happens to GDP growth.
11. Gilts do not appear to hedge against inflation but UK equities do.

The analysis is complicated by having to look at different relationships between different variables over different time periods. The preferred All Property equation (Equation 1) for example, can only be estimated for All Property and not for the individual sectors. Chapter 4 investigates the ability of prime data, where longer data runs are often available, to shed further light on the inflation-returns link.

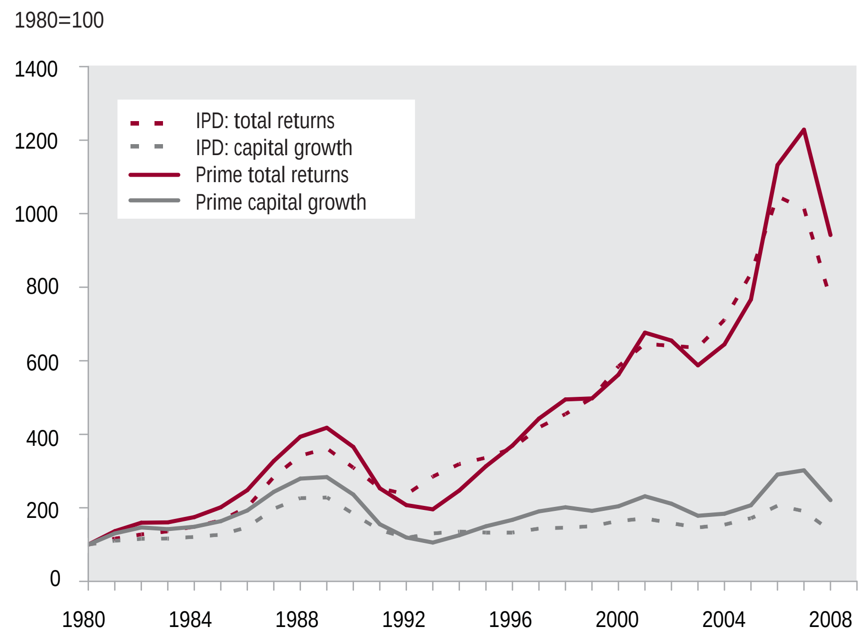
4.1 Why look at prime data?

IPD data have the advantage of a more comprehensive definition (eg it takes proper account of depreciation) and are based on actual data on income received (taking into account vacancies as well as any variations from the headline rent). The main drawback with IPD data, however, is the length of the time series available. UK data are available by broad sector back to 1971 and have been extended further back for all property in other studies but time series for other countries are generally much shorter. Within the UK, key centre data is also more limited. IPD indices are generally available back to 1981, while the prime series used here is available back to 1974 and, hence, covers a key high inflationary episode in the UK.

One of the main drawbacks with prime series is that the data are abstract, being based on judgement and, strictly speaking, only apply to a single high value location. On the other hand, the simplifying assumptions behind the calculations of prime returns, particularly that the building is newly let from day one, means that it is easier to work out the ramifications of different lease structures and rent escalation clauses. This, together with the longer time series on offer, makes the analysis of prime data quite attractive. None of this would matter, however, if prime returns behaved in a completely different way to the average properties measured by IPD. Fortunately, although there are some obvious differences, there are also major similarities in the movement of IPD and prime returns over time.

4.2 Prime and IPD returns compared: the City offices example

Figure 4.1: Nominal returns – London city offices



Source: Oxford Economics/Haver Analytics

Table 4.1 shows real total returns and the decomposition of real total returns into real capital growth and real income for offices in the city of London, using both prime and IPD definitions (prime is also shown as solid lines and IPD as dashed lines in the Figure 4.1). As with the analysis in Chapter 3, real income has been defined as the difference between real total returns and real capital growth.

Table 4.1: Real returns (% pa): 1980 to 2009

	IPD	Prime
Total returns	3.3	4.1
Capital growth	-2.4	-0.9
Income return	5.8	4.9

A number of similarities and differences are immediately observed:

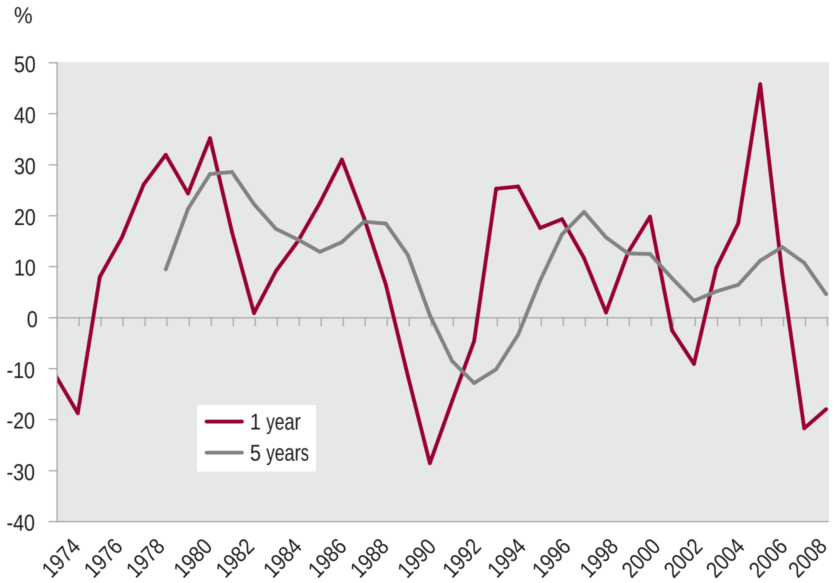
- Total returns for prime outstrip IPD, at least over the period considered;
- The contribution of real capital growth is negative for both prime and IPD but prime is substantially less negative than IPD;
- Real income is lower for prime than for IPD, presumably as a consequence of yields on prime properties being lower;
- In both cases, more than 100% of the real total return comes from income rather than capital growth. In other words, income compensates for a real capital loss in both cases.

With the similarities, and differences, between prime and IPD identified, attention can now turn to the relationship between prime total returns and inflation. The core of this analysis is on total returns over five years rather than over a single year. The rationale behind this is that transaction costs dictate that five years is usually the minimum economic period that a building needs to be held before it is sold and that, in practice, investors' holding periods tend to be much longer.

4.3 Movement in real prime total returns: City offices

Figure 4.2 shows the relationship between one- and five-year (nominal) total returns for City offices. The five-year returns series illustrates the total returns over the five years to the date stated (eg the value for 2009 is the total return achieved between 2005 and 2009). The one-year returns series is the conventionally defined total returns series. No assumptions are made about the re-investment of the income so, if anything, true income and total returns are understated. Apart from lagging behind the one-year total returns series, the five-year series also smoothes out many of the year-to-year fluctuations.

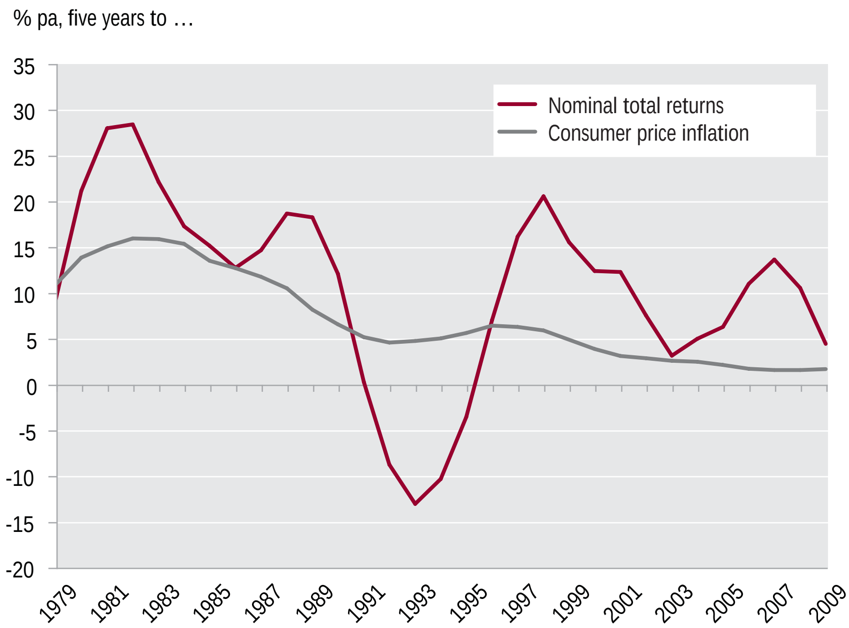
Figure 4.2: City offices – nominal total returns



Source: Oxford Economics

Figure 4.3 shows the five-year total returns for City offices alongside consumer price inflation. The main observations are that nominal total returns for prime City offices are generally higher and more volatile than inflation. They easily outstrip inflation for most periods. Consequently, there is a long-run positive real rate of return, as was found for the UK IPD indices.

Figure 4.3: City offices – total returns (five years) and consumer prices

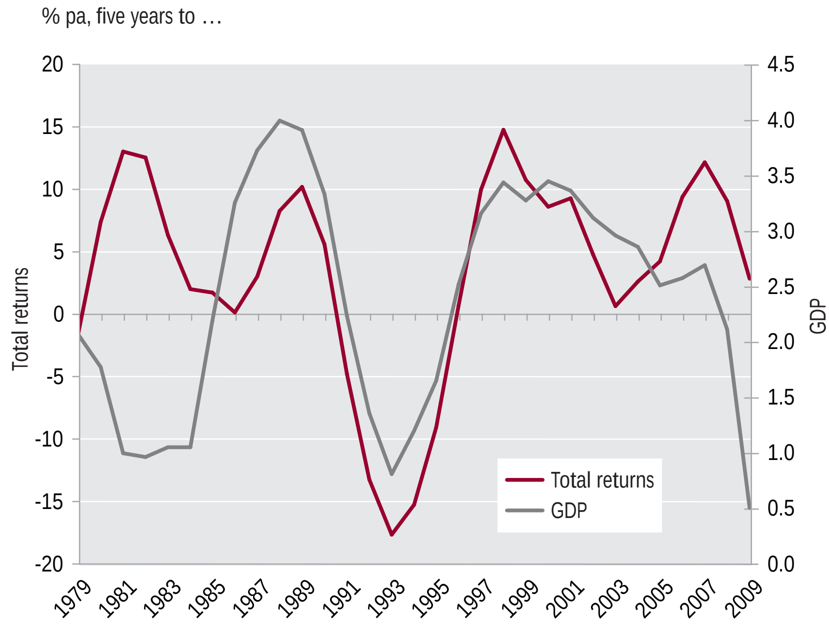


Source: Oxford Economics/ONS

The main exception to positive real total returns was the 1991 to 1995 period. Over this period nominal returns fell as a result of the early 90s recession, largely as a result of falling capital values as inflation increased. The result was several years when investors who had held properties for five years would have made a substantial loss had they sold. Investors holding for a longer period, however, could still have made positive total returns. Five-year returns subsequently recovered and then fell back again, hitting a low in 2003 – but they remained positive.

Looking at Figure 4.4, a very marked feature of real five-year total returns is the link with UK GDP growth over a similar five-year period, especially for the period from the late 1980s onwards. The UK GDP/real total returns relationship for prime City offices is even stronger than the UK GDP/IPD UK offices relationship. This is perhaps surprising, given that the City economy does not always move in line with UK GDP (a City GDP estimate would give an even stronger relationship). However, it is due to the importance of GDP growth to capital growth and the fact that prime City offices capital growth is a more significant component of its total return.

Figure 4.4: City offices – real total returns and UK GDP



Source: Oxford Economics/ONS

4.4 The relationship between prime City offices and inflation

Appendix 3, Table A3:1 presents estimation results for the relationship between nominal and real total five-year returns for prime City offices and inflation and UK GDP (also measured over five years). The first column of figures shows a simple equation that has nominal five-year returns as the dependent variable and which only has five-year inflation, five-year GDP growth and a constant as explanatory variables. As with the analysis of IPD data, in an equation with nominal returns as the dependent variable, the coefficient on inflation should equal one if the investment was a perfect inflation hedge. The estimated coefficient on inflation is positive and not significantly different from one. On the basis of this equation, the hypothesis that prime City offices is a perfect inflation hedge cannot be rejected. There is, however, a problem with serial correlation, as encountered with many models that look at overlapping multi-year returns.

The second column of figures in Table A3:1 adds in a number of variables in an attempt to reduce the serial correlation problem and, therefore, make the estimated impact of inflation more robust. The variables are a dependent variable lagged five years and two step dummies for observed changes in real total returns that cannot be explained by any of the other variables.

The final column of figures in Table A3:1 shows the results when real rather than nominal total returns are the dependent variable. In this case, the test for inflation hedging is that the coefficient on inflation should not be significantly less than zero. As can be seen, the results of the real terms estimation are similar to, although not exactly the same as, the nominal returns results.

The results of this exercise show:

1. The coefficient on inflation is not significantly different from one. In other words, the data indicate that prime City offices might be a hedge against inflation. Note, however, the estimation period is 1984 to 2009 and the caveats around analysis for this period, noted in the discussion of Table 3.1 in the previous chapter.
2. There is a very positive, very significant relationship with UK GDP growth.
3. There is a strong mean reversion effect (similar to that found in the analysis of IPD data). The negative coefficient on the lagged dependent variable means that several years of above average real total returns tend to be followed by several years of below average returns.

The results imply, in the case of City offices, that prime property might be a hedge against inflation (in the technical sense). This compares with the findings that average properties measured by the IPD All Properties Index and analysed over a longer time period (Equation 1) are not.

A reason for this is that the prime estimates may not be taking full account of depreciation and maintenance costs, which might be linked to inflation. A cursory glance at the differences between the prime and IPD estimates, however, indicates that most of the differences are cyclical rather than related to costs (missing from the prime data) that are linked to inflation. We can only conclude, therefore, that there is evidence that prime City offices do appear to provide a better hedge against inflation than the IPD average for City offices.

4.5 International analysis

Appendix 3, Tables A3:2 to A3:4 repeat the prime City offices five-year returns example for a number of sectors in a number of cities. The best time series available in almost every case is for offices but for Hong Kong and Warsaw the series is still quite short and the lagged dependent variable term has been omitted in order to give a more meaningful time series. The results are also summarised in Table 4.2.

Table 4.2: Prime data – responsiveness of real total returns

	Estimation period	Inflation co-efficient	GDP growth coefficient	Mean reversion coefficient
Offices				
Amsterdam	1981	-0.53	4.74	-0.19
Frankfurt	1983	-0.03	7.77	-0.49
London City	1984	-0.37	8.80	-0.30
London West End	1984	4.50	10.43	-0.30
Paris	1983	-0.78	14.22	-0.32
Sydney	1991	-0.78	14.22	-0.32
Tokyo	1990	0.48	4.81	-0.57
Retail				
Amsterdam	1990	-0.78	1.04	-0.31
Frankfurt	1990	5.47	1.70	-0.43
London	1990	-1.14	4.51	-0.27
Paris	1990	0.35	5.73	-0.39
Industrial				
Amsterdam	1990	-1.34	1.95	-0.09
Frankfurt	1990	5.28	2.63	-0.73
London	1990	1.29	5.08	-0.01
Paris	1990	2.60	6.02	-0.42

The detailed results indicate that in most cases there is little evidence prime offices (Table A3:2) is a hedge against inflation. London West End offices appears to be a super-hedge against inflation, in that an increase in inflation produces a statistically significant increase in returns that more than offsets it. All of the prime office centres considered also display the mean reversion tendency and the importance of GDP growth observed in City offices.

The prime retail equations are generally estimated over a shorter period and give mixed results. The mean reversion tendency is still present but retail does not act as an inflation hedge in all of the centres. The two centres where it fails – Hong Kong and Sydney – are estimated over a very short period and these results should not be given too much weight. There is also one super-hedge in the shape of Frankfurt where an increase in inflation brings about a greater increase in nominal returns.

The prime industrials equations also suffer from short time periods. In this case, three of the four locations are actually super-hedges. Prime Amsterdam industrial by contrast fails to hedge against inflation. Once again, the short time periods should make us wary of reading too much into some of these results.

This international prime analysis indicates:

- Most markets show a negative link between inflation and real returns (ie property fails to hedge against inflation) but there are some notable exceptions, particularly West End offices and retail and industrial in Frankfurt, which appear to act as 'super-hedges' against inflation;
- In all markets there appears to be a positive correlation with economic growth;

- Three of the four industrial markets considered show incidences of being a hedge against inflation;
- The mean reversion tendency is apparent everywhere except in London industrial;
- Although all incomes used have been adjusted for the lease terms for each market (where there is inflation indexation to the next break point this is calculated), there is no obvious pattern to suggest it changes the results, one city versus another.

The reason why West End offices appear to act as a super-hedge against inflation is that the West End is a prime location with a very limited capacity for speedy supply adjustment. The same might also apply to Paris offices, which also hedge inflation. A the dynamics between the property values (capital and rental) and land value, as a proportion of total value, may vary from one city to another. Frankfurt retail and industrial appear to be a hedge against inflation, unlike the office market, but this may be due to the shorter time period.

Overall, the prime analysis tends to show property in a slightly more favourable light than the IPD analysis. In many, the inflation coefficients (or responses) are negative but not significantly different from zero, and some centres even show up as super-hedges. Some of this, no doubt, is due to the greater importance of capital growth to total returns when compared with the IPD data, and some may be still be due to the period analysed.

5.1 Lessons from Modern Portfolio Theory

Previous sections in this report have focussed on the returns to property investment and alternative assets and how they respond to fluctuations in inflation (ie their hedging properties). The results indicate that UK property on the whole looks to be a potential hedge against inflation when analysed over more recent periods, while it appears to fall short when analysed over a longer period. Equities are an inflation hedge but gilts are not. In addition, real property returns have been found to be positively related and gilts to be negatively related to real GDP growth (see Appendix 4, Table A4:1 for a summary of the long-run estimation results for alternative assets). This chapter uses the long-run estimates, which show that property is not a perfect hedge, in order to magnify the differences between alternative assets and to illustrate the implications for investment strategy.

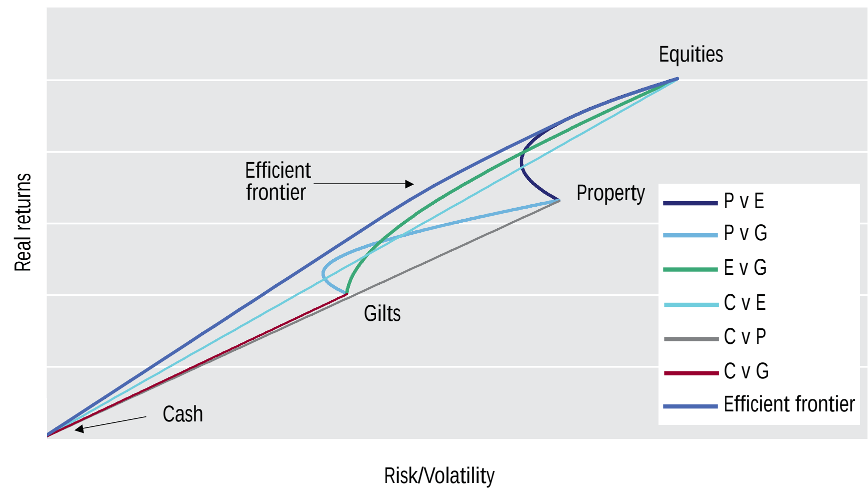
Investment strategy, however, has to take account of factors other than the expected return on alternative assets. The optimal mix of assets in a multi-asset portfolio depends on the aim of the investor, the nature and duration of their liabilities and the risks the investor is prepared to take. Modern Portfolio Theory suggests that, by looking at the asset mix, we can suggest combinations of assets (cash, gilts, property and equities) that might be 'efficient', in the sense of having the least volatility, for a given return or the maximum return for a given exposure to volatility (Markowitz, 1952, 1959).

Using estimated returns (real returns are used here) and defining volatility as the (standard) deviation from a cash-only portfolio[8], and assuming that future real returns and real volatility will be similar to that experienced in the past, we can estimate the risk-return trade-off between alternative assets. These assumptions can critically change the portfolio mix, which depends on cross-correlation between asset classes and risk. However, the emphasis is not on the precise outcomes in terms of portfolio mix (that is a matter for further study and a huge project all of its own) but, rather, the focus is on the impact of different economic environments on strategy.

Figure 5.1 shows the cross-correlations for the four asset classes – cash, gilts, property and equities-based upon historical relationships and the assumptions detailed above. In Figure 5.1 the lines joining the origin (0,0) with the points marked gilts, property and equity show the mix of expected returns and risk from combining them with risk free, zero real return cash. The curves combining equities and property, equities and gilts and property and gilts show the expected returns and risk from different mixes of each pair of assets. We can use these relationships to construct the efficient frontier, representing portfolios for which there is the lowest risk for a given level of expected return, as shown by the blue line in Figure 5.1.

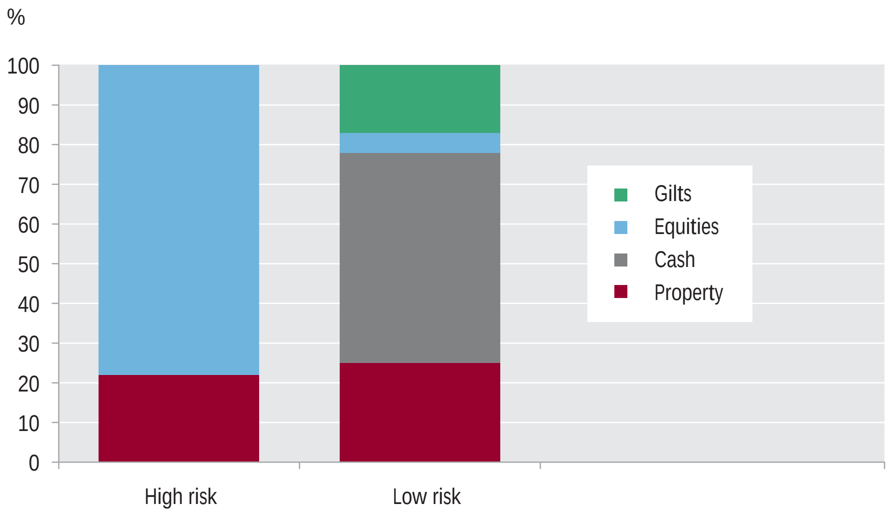
[8] It is recognised that cash itself carries risk (e.g. of not keeping up with inflation) but it carries minimal risk in terms of capital loss, especially as cash returns have typically varied positively with inflation.

Figure 5.1: Cross-correlations of risk and real returns between asset classes – base case



Using this framework, an investor who is happy to accept an elevated level of risk (for example, three-quarters of the way along the risk axis) as a trade off for higher expected real returns would heavily bias their portfolio towards equities and, to a lesser extent, property, while having little or no cash or gilts. Conversely, the portfolio of a relatively risk-averse investor (for example, a quarter of the way along the risk axis) would have a high cash component, with smaller shares of property and gilts and very little in the way of equities. Figure 5.2 shows how the portfolios of these two notional investors would vary.

Figure 5.2: Indicative portfolio allocations for high and low risk investors



Source: Oxford Economics

5. IMPLICATIONS FOR INVESTMENT STRATEGY

As inflationary conditions and GDP growth can have an impact on both real return and real volatility, different inflation and growth regimes will have implications for optimal asset allocation.

Chapter 3 showed that different assets display different abilities to hedge against inflation and perform differently in times of strong or weak economic growth. This suggests that the efficient frontier will shift, depending upon the prevailing economic conditions, which, in turn, suggests different asset allocations.

5.2 Real returns volatility under different economic regimes

Chapter 3 has established the link between inflation, economic growth and real returns on alternative assets. In order to make use of Modern Portfolio Theory a view is also required on the link, if any, between real volatility and inflation and growth. This is, potentially, a major subject in itself and is not the main subject of this report. Nonetheless, we offer some tentative findings that can be used to derive asset allocation implications.

The approach taken is to look at the relationship between five-year rolling real volatility estimates and five-year GDP growth and inflation results. Lagged dependent variables are included and statistically insignificant variables excluded. The estimated relationships are set out in Appendix 4.

For each of the alternative assets, the lagged dependent variable had a large coefficient, which was highly significant. This indicates a high persistence in real volatility over time.

No relationship between inflation and volatility was found for property or gilts, although there was a significant and positive relationship between GDP growth and the volatility of real returns for property and a negative relationship with the volatility of real total returns for gilts. The positive relationship between GDP growth and property volatility is likely to be related to the mean reversion tendency of real capital growth (ie periods of boom followed by slumps). The reason for the negative link between GDP growth volatility in real gilts returns is not obvious, although it is very apparent in the data, with the periods of high growth in the late eighties (especially) and 1998 to 2007 being associated with low volatility. There is a question of whether low gilts volatility promoted GDP growth or the other way around. Causality tests, however, indicate that it was GDP growth that was the instigator. The reason for the link appears to be that the change in interest rates, which drives the capital growth for gilts, is more volatile when growth is weak. This is related to sharp falls in interest rates in the early stage of a recession and a sharp increase towards its end.

For GDP growth, no relationship was found in relation to the volatility of real equity returns, but a negative link was found with inflation and a positive link with inflation volatility. This raises the possibility of a link between inflation and inflation volatility. Specifically, is inflation more volatile at higher rates of inflation? The results in the final column of Table 4:2 Appendix 4 appear to confirm this.

The presence of lagged dependent variables in the specification of the volatility equations complicates the evaluation of the growth and inflation effects (as an increase in inflation or growth will change volatility and this will be magnified in subsequent periods). As the emphasis here is on returns over five years, the inflation/growth impacts on volatility have been evaluated over a five-year period. In the case of equities, this has been adjusted for the feedback from inflation volatility. The estimated equation implies that an increase in inflation will lead to a fall in the volatility of real equity returns. An increase in inflation, however, will also increase inflation volatility (Joyce, 1997) and this will reduce volatility, partly or wholly offsetting the direct impact of higher inflation. The approach taken is to substitute the inflation impact on inflation volatility (from the final column of Table 4:2 in Appendix 4) into the equities volatility equation to derive a single inflation impact on equities volatility.

The result is to reduce, but not eliminate, the negative impact of inflation on the volatility of real equity returns. This is a crucial result as it means that equities is the only asset class where the volatility of real returns is sensitive to inflation. Further, the relation is negative. This means that high inflation reduces equities' volatility and makes equities more attractive to investors, all other things being equal.

The findings from the econometric investigation into the relationship between inflation and growth on volatility, together with their impact on real returns (taken from Chapter 3 and Appendix 4) are shown in Table 5.1. To summarise, inflation has a negative impact on real returns for property and gilts and a negative impact on volatility for equities, whilst GDP growth has a positive relationship with both real returns and volatility in property but a negative relationship with gilts returns.

Table 5.1: The impact of inflation and growth on the volatilities of alternative UK asset classes

Responsiveness of real total returns		
	Inflation	**GDP growth**
Property	-0.44	1.93
Equities	0.00	0.00
Gilts	-0.66	-1.03

Responsiveness of real volatility		
	Inflation	**GDP growth**
Property	0.00	4.43
Equities	-2.46	0.00
Gilts	0.00	-5.52

Note that the estimated impact of inflation on real property returns is actually more negative than the -0.44 shown in Table 5.1 but this is offset by the impact of inflation on real interest rates (Appendix 4, Tables 4:1 and 4:3).

5.3 Scenario analysis

5.3.1 Defining the scenarios

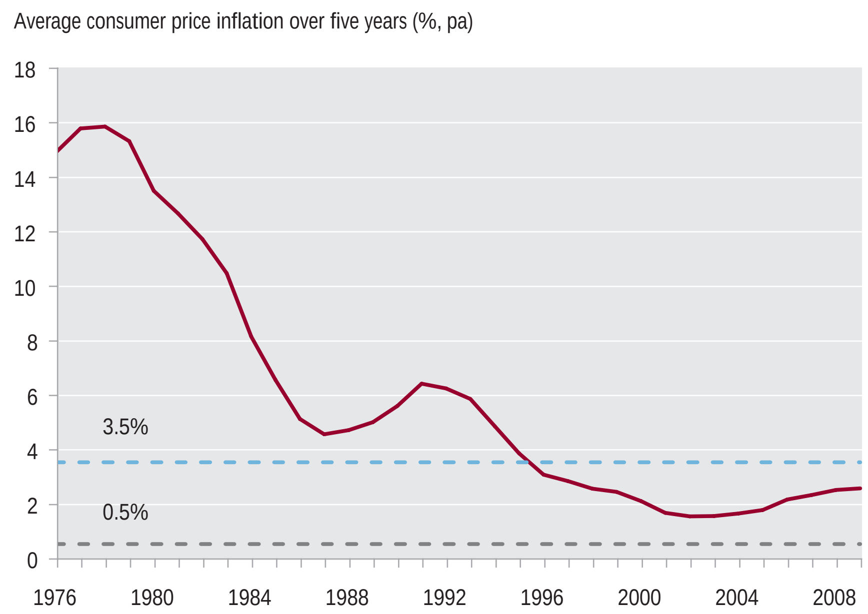
The observations on Modern Portfolio Theory for asset allocation at the beginning of this chapter, together with the results shown in Table 5.1, imply that variations in the inflation/GDP growth mix have implications for optimal portfolio composition. The rest of this chapter looks at a number of scenarios that aim to illustrate these effects. Specifically, six scenarios are considered (as shown in Table 5.2).

Table 5.2: Inflation and growth combinations in the scenarios

Scenario	Inflation	GDP growth
	(Differences from base)	
High Inflation/Base GDP	+1.5	0.0
High Inflation/High GDP	+1.5	+0.5
High Inflation/Low GDP	+1.5	-0.5
Low Inflation/Base GDP	-1.5	0.0
Low Inflation/High GDP	-1.5	+0.5
Low Inflation/Low GDP	-1.5	-0.5

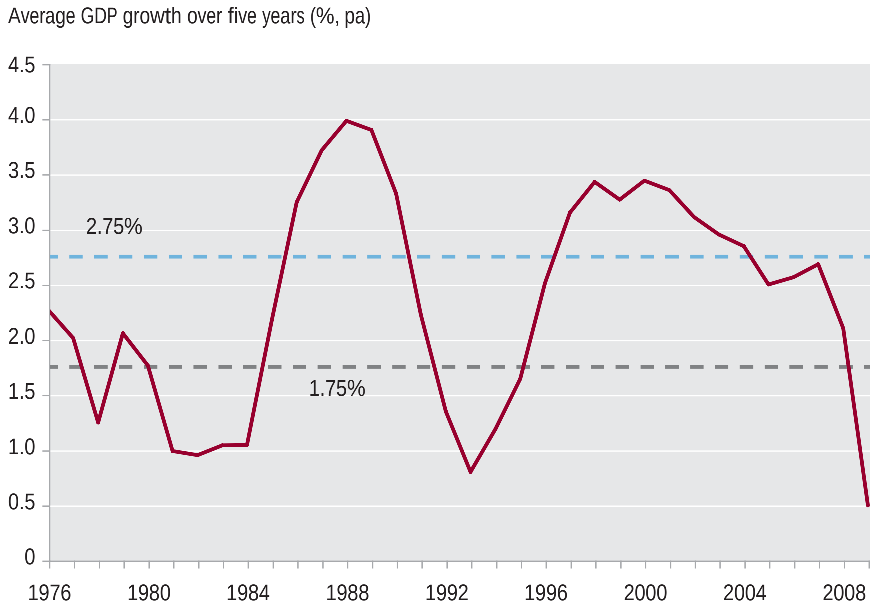
The scenarios are all expressed relative to the base, where the base is a broad consensus view of sustainable growth and inflation outcomes of around 2.25% per annum for GDP growth and 2.0% per annum for inflation over a five year period. The precise values do not matter, as the point of this chapter is to analyse variations around the base; however, the baseline GDP/inflation combination should be broadly consistent with the baseline real returns and volatility assumptions (see below). Comparisons of the scenario values for inflation and GDP growth are shown in Figures 5.3 and 5.4 below.

Figure 5.3: UK inflation – history and scenarios



Source: Oxford Economics, ONS

Figure 5.4: UK GDP growth – history and scenarios



Source: Oxford Economics, ONS

With a baseline view of inflation of 2%, the inflation scenarios range from 0.5% to 3.5% per annum. We could characterise the High Inflation/Low GDP Growth scenario as a stagflation scenario. Note, however, that the High Inflation scenarios are not particularly high in a long-run historical context but they are high relative to anything that has been seen since the mid-1990s. The Low Inflation/High Growth scenario is the NICE scenario[9].

The Low Inflation scenarios still have positive inflation. Nonetheless, the rate envisaged would be very low for the UK. It would not be too misleading to describe Low Inflation/Low Growth as the 'Deflation' scenario. Another scenario that can easily be given a name is High Inflation/High Growth, which can be called a 'Demand-Pull' inflation scenario. Note that both High Inflation/Base Growth and High Inflation/Low Growth could be described as 'Supply' or 'Cost-Push' inflation scenarios.

5.3.2 Asset allocations: the base case

The baseline assumptions for future real returns and volatility are shown in Table 5.3. These are based on long-run historical experience with the exception of the volatility of property returns. This is based on the IPD series but it has been both 'unsmoothed', to allow for the smoothing process inherent in valuation-based data, and further amplified, to reflect the possible additional volatility caused by property being a much less liquid asset than the alternatives considered. The overall result is a base case volatility estimate which is 1.8 times higher than the historical IPD data.

Table 5.3: Base case assumptions

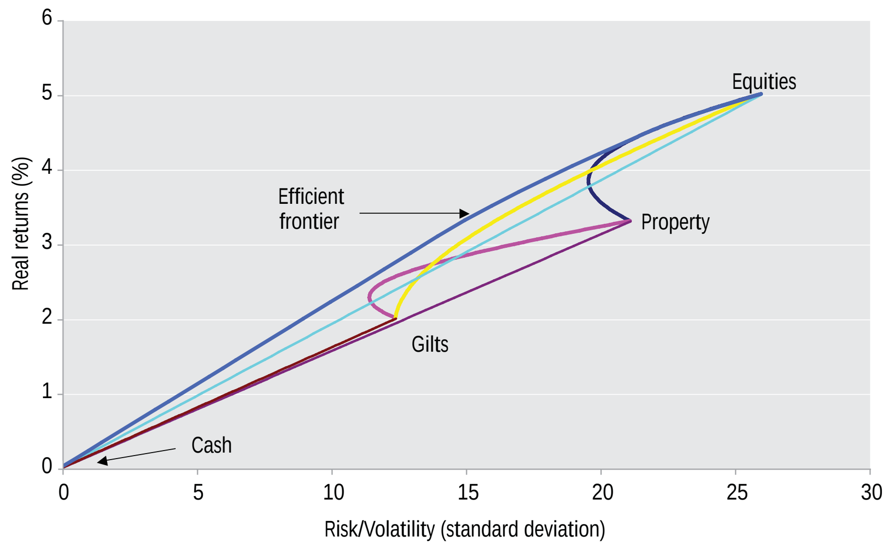
	Real return	Volitality
	(Differences from base)	
Property*	3.8	20.9*
Cash	0.5	3.5
Equities	5.5	25.1
Gilts	2.5	12.3

* Unsmoothed series, with 'amplification', giving volatility of 1.8 x original IPD series

[9] Non-inflationary, constant expansion

Using these baseline assumptions and the cross correlations observed in the past, the stylistic representation of the efficient frontier shown in Figure 5.1 can be estimated to give the base case shown in Figure 5.5 (where the results are shown relative to holding cash)[10].

Figure 5.5: The efficient frontier – the base case



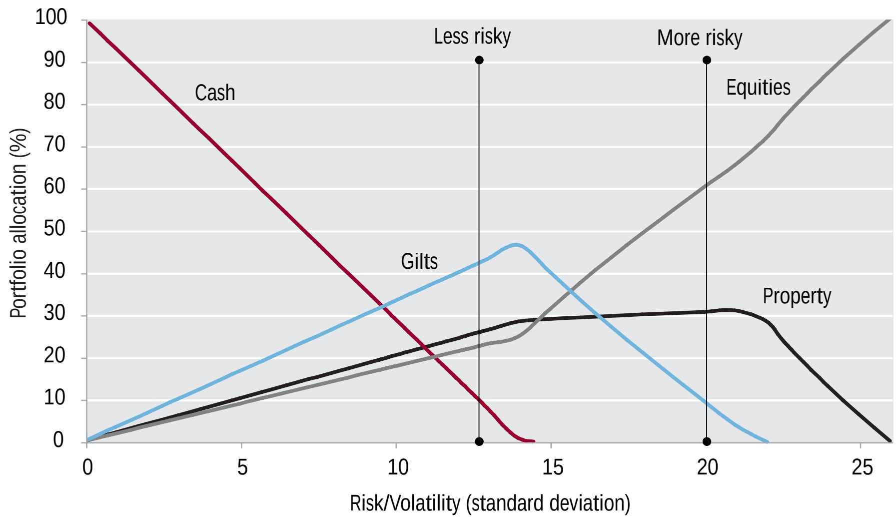
Source: Oxford Economics, ONS

Investors willing to accept maximum risk would hold 100% equities which would provide an expected return of 5.5% per annum (on the chart this is 5% plus the 0.5% available on cash). At the other extreme, completely risk-averse investors would only hold cash. At all other points between these two extremes, investors would hold a combination of two, three or four of the alternative assets, depending on the level of risk that they are prepared to accept.

[10] Optimisation and derivation of efficient frontier from a bespoke method devised and created by Real Estate Forecasting.

Figure 5.6 shows the combination of assets at different levels of risk that produce the real returns on the efficiency frontier.

Figure 5.6: Asset allocation – the base case



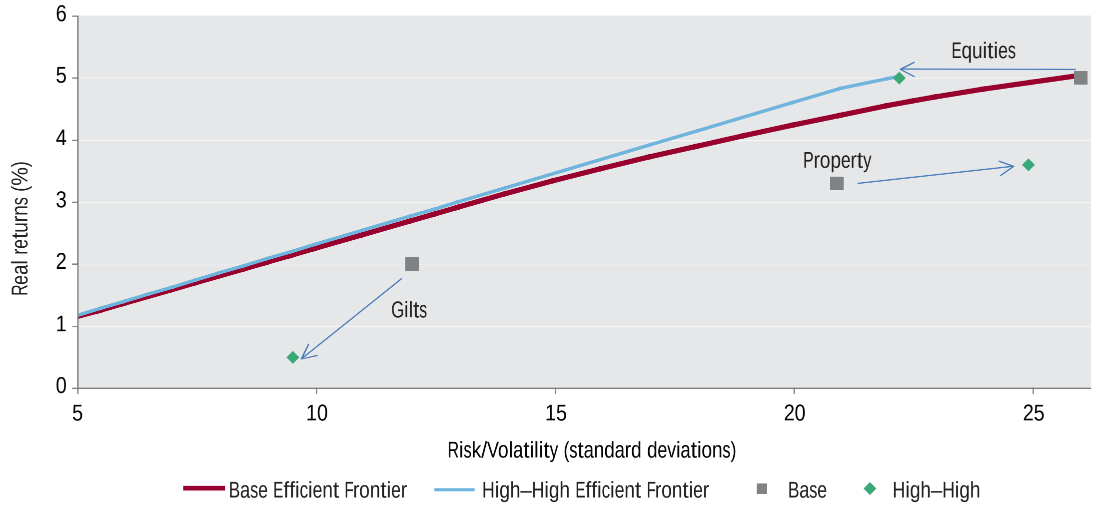
In the base case, a less risky investor, content with volatility of 12.5 standard deviations, would opt for a mix of 25% property, 22% equities, 41% gilts and 11% cash, whereas the more adventurous investor, content to accept volatility of 20 standard deviations, would opt for 31% property, 60% equities, 9% gilts and no cash.

It must be emphasised that these do not represent any actual portfolios nor attempt to model actual behaviour. Rather, they show what can be considered optimal under certain assumptions. The advantage of this approach is that it clearly shows why balancing risk and return means that portfolios should contain a mixture of assets. It also provides a framework for exploring what happens when the relative rates of return and risk change when the inflation/GDP growth regimes alter.

5.3.3 Asset allocation under alternative scenarios

As real rates of return and volatility are sensitive to the levels of inflation and GDP growth, the shape and position of the curves shown in Figures 5.6 and 5.7 will differ under each of the alternative scenarios. For example, the grey squares in Figure 5.7 show the relative risk/return positions of the alternative assets in the base case. In the High Inflation/High GDP Growth scenario, the returns and volatility alter and the position of the three assets moves in the direction of the arrows to the position marked by the green diamonds. This can have a considerable effect on both the efficiency frontier and optimal asset allocation.

Figure 5.7: Risk and return – base case vs the high/high scenario



In the High Inflation/High GDP Growth example illustrated in Figure 5.7, the efficient frontier is steeper than in the base. Equities become more attractive to investors in the High Inflation/High GDP Growth example, as they offer less volatility for no reduction in expected returns when compared with the base case. Property, by contrast, offers a higher expected return but at the cost of extra risk (the movement upwards and to the right in Figure 5.7). This results in a lower allocation for property in both the 'Low Risk' and 'High Risk' portfolios described in Table 5.4.

Table 5.4: Asset allocation under alternative scenarios

Low risk portfolio				
	Property	Cash	Equities	Gilts
Base	25%	11%	22%	41%
High Inflation/Base GDP	6%	41%	53%	0%
High Inflation/High GDP	11%	40%	50%	0%
High Inflation/Low GDP	0%	44%	56%	0%
Low Inflation/Base GDP	33%	0%	7%	60%
Low Inflation/High GDP	33%	0%	9%	59%
Low Inflation/Low GDP	37%	0%	2%	61%

High risk portfolio				
	Property	Cash	Equities	Gilts
Base	31%	0%	60%	9%
High Inflation/Base GDP	9%	5%	85%	0%
High Inflation/High GDP	17%	4%	79%	0%
High Inflation/Low GDP	0%	10%	90%	0%
Low Inflation/Base GDP	46%	0%	44%	10%
Low Inflation/High GDP	55%	0%	30%	15%
Low Inflation/Low GDP	0%	0%	50%	50%

Table 5.4 shows the implied optimal asset allocations in each of the scenarios considered. These vary considerably for property from scenario to scenario. In addition, the characteristic of property, whereby both expected real returns and volatility vary with GDP growth, means that the implications of the different scenarios for property are different for the 'Low Risk' and 'High Risk' portfolio examples considered.

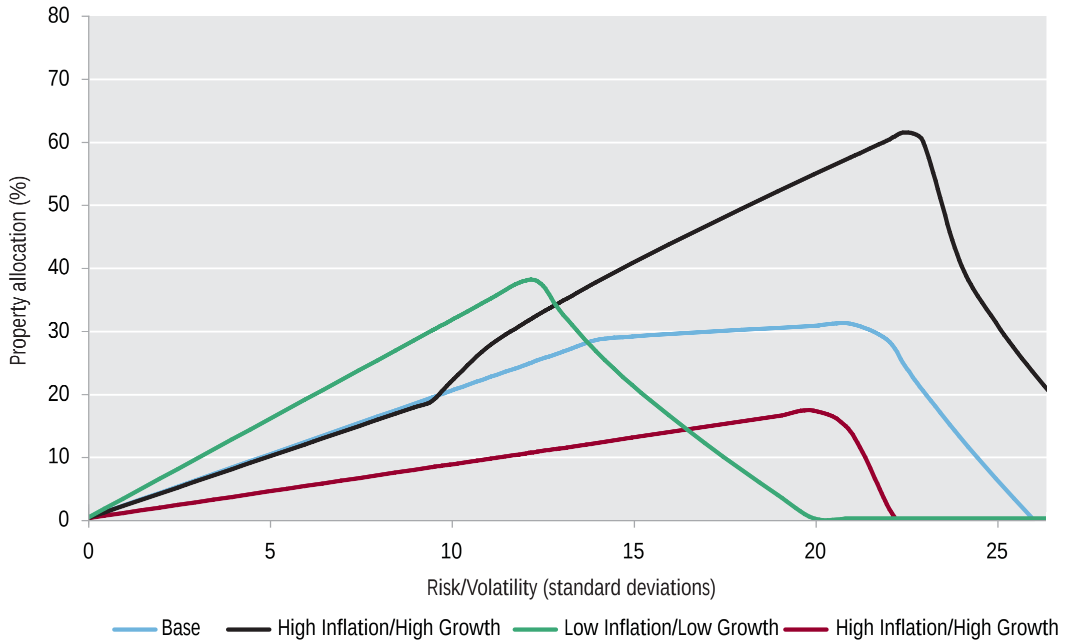
The main conclusion from Table 5.4 is that the base case is quite good for property but any combination of GDP growth rates with high inflation leads to a lower property allocation. This reflects both property's weak hedging (against inflation) properties and the negative correlation between inflation and equities volatility (see Table 5.1). The High Inflation/Low Growth (stagflation) scenario is particularly bad for property, with the model indicating a zero allocation for both the Low and High Risk portfolios. This is because expected returns from property in the stagflation scenario are low and, although volatility is lower, the volatility of equities falls further still. Gilts also do badly in this scenario, due to a combination of lower returns and higher volatility.

High GDP growth is generally beneficial for property allocations unless high growth is accompanied by high inflation. This means that the 'Demand-Pull' scenario combination of high inflation and high GDP does not imply a higher property allocation than the base case, even though the expected real returns for property are higher (Table 5.1). This is interesting because this is the environment typically associated with higher property returns, and commonly thought to be 'good for property'. The reason for this is that high GDP growth increases the volatility of real property returns. The gap between the volatility of equities and property is then further narrowed by the negative relationship between inflation volatility and the volatility of real equity returns. As might be expected, equities are the major winner in terms of predicted allocation in the 'Demand-Pull' inflation scenario.

Property tends to do quite well in low inflation scenarios. Interestingly, for the 'Low Risk' portfolio it does particularly well in the Low Inflation/Low Growth or Deflation scenario despite the importance of GDP growth for real property returns. The property allocation in the Deflation scenario for the 'High Risk' portfolio is nil. The reason for this discrepancy between the scenarios is that low volatility makes property an attractive asset for the "Low Risk" portfolio, but low real returns make it unattractive for the 'High Risk' portfolio. As a result, property receives its highest allocation in the 'Low Risk' portfolio under the Deflation scenario but gets its (joint) lowest allocation in the 'High Risk' portfolio.

Figure 5.8 illustrates the importance of the level of acceptable risk for property allocation under the base case and three of the six scenarios. The Low Inflation/High Growth or NICE scenario gives an allocation for property that is close to the base case for lower levels of required volatility, but then starts to give much higher allocations with a peak of over 50% for portfolios willing to accept volatility of around 22.5 standard deviations. The Deflation scenario, by contrast, gives a higher property allocation for low levels of risk than either the base or NICE scenarios. Property allocations in the Deflation scenario then peak at a relatively low risk level of around 12 standard deviations and fall away to zero by around 20 standard deviations. The NICE scenario gives a higher allocation for property from around 13 standard deviations upwards. The High Inflation/High Growth or 'Demand-Pull' scenario generally suggests lower property allocations than the other cases illustrated in Figure 5.8.

Figure 5.8: **Property allocations under different scenarios**



5.4 Implications for sectors

The analysis so far has focussed on the implication of different inflation and GDP growth combinations for property and alternative asset class allocations in portfolios of varying riskiness. In principle, this analysis can also be applied to the allocation of investments in different property sectors either within an overall portfolio containing alternative assets or within a wholly property portfolio (ie taking the overall size of the property investment as given). This section considers the latter.

There is one issue with the data, in that the IPD sector data is not available as far back as the All Property Index, which would mean that freely estimated results would not be consistent with the All Property analysis given above. Given the inability to use a longer time series and to avoid using the early 80s onwards period that has been found to overstate property's ability to hedge against inflation (see Chapter 3), the sector analysis uses one- rather than five-year returns, with no lagged dependent variable. This permits the use of the longest possible estimation period and, as Table 5.5 shows, the weighted sum of the sector results are not dissimilar from the All Property coefficients used earlier. They imply that the weakness of property as a hedge against inflation is concentrated in retail and that the real return for offices is much more sensitive to fluctuations in GDP growth than either retail or industrials. On the risk side, the volatility of real returns for offices appear to be much more sensitive to different levels of GDP growth than the volatility of real returns for retail or industrials.

Table 5.5: The impact of inflation and growth on the volatilities of different UK property sectors

Responsiveness of real total returns		
	Inflation	GDP growth
Office	-0.35	2.52
Retail	-0.75	2.14
Industrial	-0.40	1.75
Weighted total	-0.49	2.21
All Property	-0.44	1.93

Responsiveness of real volatility		
	Inflation	GDP growth
Office	0.00	5.33
Retail	0.00	3.66
Industrial	0.00	3.44
Weighted total	0.00	4.36
All Property	0.00	4.43

These assumptions give the following sector allocations for the base case and the scenarios:

Table 5.6: Sector allocation under alternative scenarios

Low risk portfolio			
	Office	Retail	Industrial
Base	27%	48%	25%
High Inflation/Base GDP	21%	24%	55%
High Inflation/High GDP	28%	26%	46%
High Inflation/Low GDP	8%	36%	56%
Low Inflation/Base GDP	21%	79%	0%
Low Inflation/High GDP	25%	75%	0%
Low Inflation/Low GDP	5%	86%	9%

High risk portfolio			
	Office	Retail	Industrial
Base	50%	38%	12%
High Inflation/Base GDP	43%	4%	53%
High Inflation/High GDP	72%	0%	28%
High Inflation/Low GDP	47%	0%	53%
Low Inflation/Base GDP	49%	51%	0%
Low Inflation/High GDP	75%	25%	0%
Low Inflation/Low GDP	58%	42%	0%

Office weightings vary by the amount of risk taken on by the portfolio but the weightings do not change much under the different inflation scenarios (for a given rate of GDP Growth). The Low Inflation/Low GDP growth scenario results in a big reduction in the office weighting in the Low Risk portfolio but not in the High Risk.

Retail is much more sensitive to inflation. High inflation results in much lower weightings in all portfolios and low inflation results in much higher weightings, especially down the lower risk part of the spectrum.

Industrial is the converse of retail (ie these are trading off against each other). High inflation results in much higher weights in all portfolios. Low inflation results in much lower weights, going to zero quite low down the risk spectrum.

This runs contrary to the usual argument, which is often stated as: 'Invest in industrial in a low inflation environment as it gives good income'; 'Invest in retail in high inflation, as goods' prices rise and retail rents rise', but it does make sense if we accept that industrial is a better hedge than retail, as indicated in Tables 3.3 and 5.5.

5.5 Interpretation of the results

The results presented above, particularly for alternative asset allocations, give some interesting conclusions, essentially regarding the advantages of the Deflation over the NICE scenario for the allocation of property in low risk portfolios. Some caution, however, must be exercised in interpreting the results for two main reasons.

The first is the usual set of caveats that apply to the use of Modern Portfolio Theory (MPT). The model depends on variables being jointly normally distributed, which is not always the case; it is based on the efficient market hypothesis, with all of its restrictive assumptions, and it assumes that correlations between assets are fixed in the future.

MPT does not really model the market. The risk, return and correlation measures used by MPT are based on expected values based on past data. There is not usually an attempt to model the future but the analysis presented here is much more explicitly forward looking, in that it looks at alternative outcomes for the macroeconomic drivers.

The second reason concerns the sensitivity of the results to the estimated responsiveness of real returns and real volatility of alternative asset classes to different combinations of inflation and GDP growth. The existence of these relationships is at the heart of the analysis, but it is fair to say that, although there has been a considerable body of work on the inflation-hedging and growth sensitivity of alternative asset classes, there has been relatively little work on the relationship between inflation, growth and the volatility of returns. This does not invalidate the conclusions, but it should make readers particularly aware of the sensitivity of the results to the estimated sensitivities. Of particular issue here is the estimated negative relationship between the volatility of real returns for equities and inflation. A positive relationship was also found between equity volatility and inflation volatility, which, in turn, has a positive relationship with inflation. The findings were that, even after the inflation-inflation volatility link is taken into account, there is still a negative relationship between inflation and equity volatility but the numerous inter-linkages demonstrate the complexity of the subject and the need for caution in interpreting the results.

Rather than considering the asset split directly, a typical approach of many mixed asset portfolios is to consider the desired split between nominal assets (cash and gilts) and growth assets (equities and property), depending on the level of risk investors are prepared to take. Only then will they go on to consider their allocation between equities and property (for growth assets) and gilts and cash (for nominal assets). What this does is to take the split between growth and nominal assets as a fixed input (for the level of risk) and goes on to determine the allocation within these broader classes. This is an important distinction, as it differs from reading off a fixed (and arbitrary) point on a chart of optimal allocations. This method, therefore, takes into account the practical constraints of the decision-making process, rather than considering the optimal theoretical outcomes. It is, effectively, defining risk in a slightly different way.

With that in mind, and the need to incorporate (as identified earlier in the report) GDP as an important factor as well as inflation, we have broken down the analysis into low and high risk funds. This leads to the following analysis, which considers appropriate weights under different scenarios:

Table 5.7: Low risk

	High Inflation High Growth	High Inflation Low Growth	Low Inflation High Growth	Low Inflation Low Growth
Growth assets	50%	50%	50%	50%
Nominal assets	50%	50%	50%	50%
Split of growth assets:				
Property	10%	0%	35%	5%
Equities	40%	50%	15%	45%

Table 5.8: High risk

	High Inflation High Growth	High Inflation Low Growth	Low Inflation High Growth	Low Inflation Low Growth
Growth assets	80%	80%	80%	80%
Nominal assets	20%	50%	50%	20%
Split of growth assets:				
Property	15%	0%	50%	0%
Equities	65%	80%	30%	80%

The conclusions for a high risk fund, prepared to commit as much as 80% of its portfolio to growth assets, are as follows:

The Low Inflation/High Growth scenario remains (as in the previous analysis) the ideal economic environment. However, where GDP growth is low, little or no weighting would be given to property. High inflation and high growth would lead to a moderate investment in property. Therefore, good GDP growth becomes crucial, and is (in fact) a prerequisite to property investment in a mixed asset portfolio.

The conclusions for a low risk fund, only prepared to commit 50% of its portfolio to growth assets, are as follows:

The Low Inflation/High Growth scenario remains the ideal economic environment, and High Inflation/Low Growth remains an environment where little or no weighting would be given to property. For ranges of outcomes in between these extremes, it appears that property is more sensitive to GDP growth than inflation.

In particular, using this analysis would suggest that a High Inflation/High GDP Growth scenario would be preferable to a Low Inflation–Low Growth scenario. This was not evident from previous analysis, where (for a low risk portfolio) the Low Inflation/Low GDP Growth scenario looked attractive. This is due to the fact that, as the equities weighting is so low at low risk, the growth assets do not reach a 50% weighting. For ultra low risk portfolios this remains the most attractive economic scenario for property.

Table 5.9: Ultra low risk

	High Inflation High Growth	High Inflation Low Growth	Low Inflation High Growth	Low Inflation Low Growth
Growth assets	30%	30%	30%	30%
Nominal assets	70%	70%	70%	70%
Split of growth assets:				
Property	5%	0%	30%	30%
Equities	25%	30%	0%	0%

For ultra low risk funds, therefore, it is low inflation and not high GDP that is a key driver for property allocations. High inflation favours equities and low inflation favours property.

Figure 5.9: Property weightings for different portfolio types

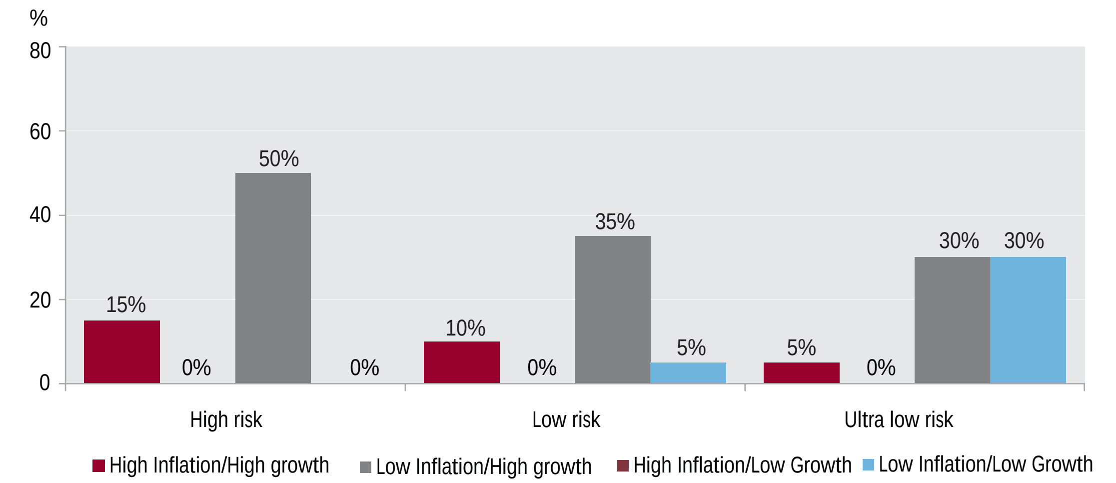
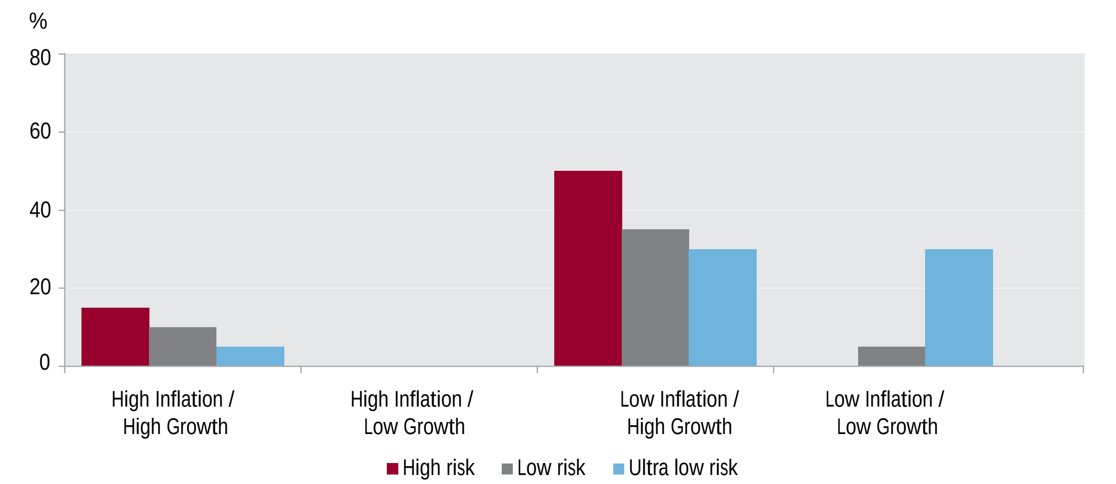


Figure 5.10: Property weightings in different economic scenarios



5.6 Implications for sectors

By using similar methods, we are able to analyse the appropriate splits between sectors, within commercial property. In this case, there is no risk-free asset and the analysis is carried out using absolute (real) returns and deviations. By choosing different weightings in portfolios (see example below) depending on whether inflation is high or low, one can either generate the same return (broadly) for a significantly reduced risk or an increased return with no additional risk. Either selection is more efficient than the IPD weightings.

Table 5.10: Low risk portfolio

	Low inflation	High inflation
Retail	75%	30%
Office	20%	20%
Industrial	5%	50%

Table 5.11: High risk portfolio

	Low inflation	High inflation
Retail	45%	5%
Office	50%	50%
Industrial	5%	45%

The analysis shows that, given the assumptions used, the appropriate office weighting depends on the tolerance to risk, the appropriate industrial weighting depends on inflation and the appropriate retail weighting depends on both inflation and risk tolerance.

While it might perhaps seem surprising that the retail weighting falls and the industrial weighting rises with higher inflation, this is a direct result of the fact that industrial property is a better hedge against inflation than retail. The fact that retail is such a poor hedge against inflation may be partly due to the data, being all retail and, as such, includes retail warehousing and shopping centres. A more detailed breakdown is outside the scope of this report, but further analysis in this area may be appropriate.

Analysis by GDP growth did not, in the sector case, yield very different allocations. This is due, in part, to the fact that, although office returns benefit more than other sectors from high GDP growth, the volatility also increases, leaving the allocation broadly unaltered. It is also influenced by the definition of risk and the point on the efficient frontier along which high or low risk is identified.

5.7 Implications for benchmarks

Benchmarks and performance targets are usually, although not exclusively, selected based on IPD indices: either IPD or IPD +1%, or some comparable benchmark for small/large funds. It may be that these benchmarks focus on the 'norm', rather than the efficient, and it might be appropriate in future for funds to consider efficient benchmarks, rather than the 'herd'.

One possibility is for benchmarks to be set depending on the levels of risk tolerance of the fund. Another might be to vary benchmarks, depending on economic conditions. The issue of benchmarking deserves a far more detailed airing than can be achieved here and there is further work to be done in this area.

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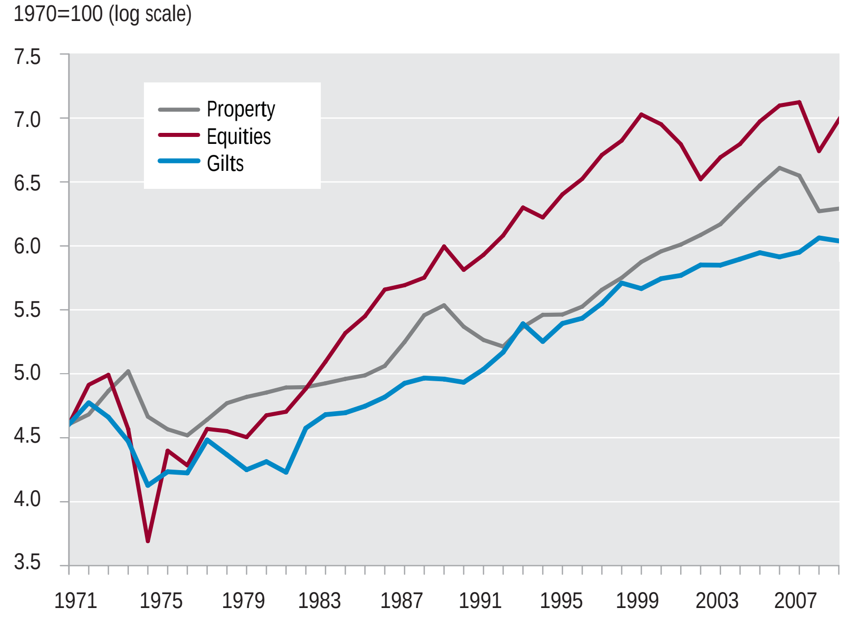
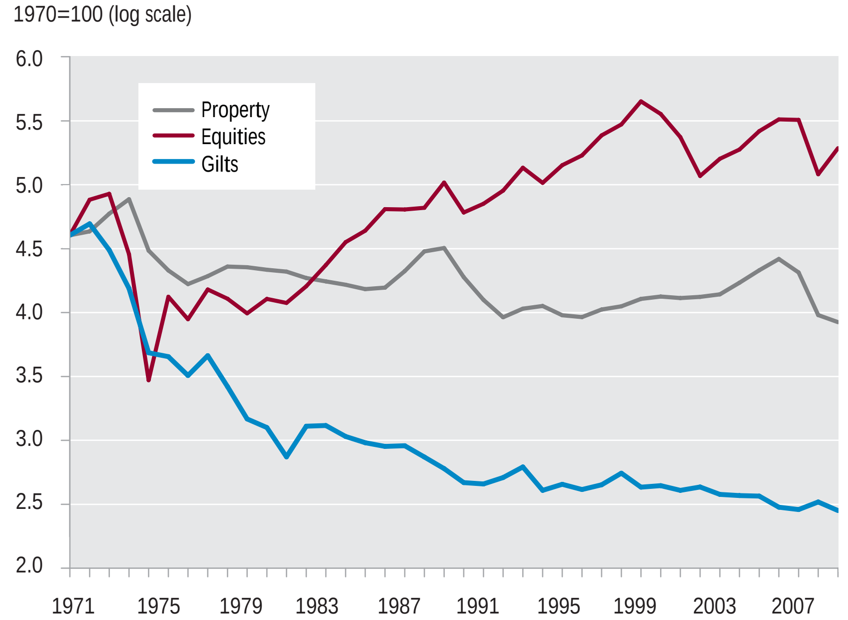
APPENDIX 1. LONG-RUN REAL RETURNS: PROPERTY VS ALTERNATIVE ASSETS BASED ON IPD DATA

Appendix 1 – Figure 1: UK real return on alternative assets



Appendix 1 – Figure 2: Real capital index for alternative assets



APPENDIX 2. LONG-RUN ESTIMATION RESULTS USING IPD UK ALL PROPERTY DATA

Equation A2:1–A2:6: IPD nominal total returns and capital growth – one year

LS one year: 1949–2009	A2:1	A2:2	A2:3	A2:4	A2:5	A2:6
Nominal	Total returns	Total returns	Capital growth	Capital growth	income	income
Dependent variable(-1)						
Estimated coefficient					0.67	0.67
t-statistic					6.73	6.91
GDP						
Estimated coefficient	2.42	2.60	2.57	2.73		
t-statistic	4.19	4.40	4.47	4.65		
Inflation						
Estimated coefficient	0.43		0.51		-0.01	
t-statistic (difference from 1)	2.12		1.82		43.40	
Expected inflation						
Estimated coefficient		0.64		0.71		0.01
t-statistic (difference from 1)		1.18		0.95		
Unexpected inflation						
Estimated coefficient		-0.09		0.02		-0.07
t-statistic (difference from 1)		2.49		2.25		
Constant						
Estimated coefficient	0.01	0.00	-0.05	-0.07	2.13	2.02
R^2	0.23	0.26	0.26	0.28	0.46	0.49
Serial correlation LM(2)	1.89	1.32	2.01	1.55	0.55	1.72

Log linear equations except for income which is linear.

eg

$\ln(TRN_t) = \beta_0 + \beta_1 \Delta \ln(PC_t) + \beta_2 \Delta \ln(GDP_t)$

$INC_t = \beta_0 + \beta_1 100*(PC_{t\,/}PC_{t-1} - 1) + r_t$

Where:

TRN is total returns over one year (%)

GDP Gross domestic product

PC Consumer price deflator

INC Income contribution to total returns = total returns – capital growth

APPENDIX 2. LONG-RUN ESTIMATION RESULTS USING IPD UK ALL PROPERTY DATA

Equation A2:7–A2:8: IPD real total returns and capital growth – five year

LS five year: 1976–2009	A2:7	A2:8
	Total returns	Capital growth
Dependent variable (-5)		
Estimated coefficient	-0.45	-0.45
t-statistic	-3.83	-3.56
GDP		
Estimated coefficient	1.91	1.89
t-statistic	3.10	2.83
Inflation		
Estimated coefficient	-0.49	-0.31
t-statistic	-3.15	-1.86
Constant	0.28	-0.21
MA(1)		
Estimated coefficient	0.76	0.79
t-statistic	6.51	6.93
R^2	0.85	0.82
Serial correlation LM(2)	2.79	5.42

Equation A2:9–A2:11: IPD real total returns by sector – one year

LS 39 years: 1971–2009	A2:9	A2:10	A2:11
	Office	Retail	Industrial
GDP			
Estimated coefficient	2.52	2.14	1.75
t-statistic	2.81	2.48	2.06
Inflation			
Estimated coefficient	-0.35	-0.75	-0.40
t-statistic	-0.90	-2.08	-1.08
Constant	1.35	5.63	5.07
MA(1)			
Estimated coefficient	0.37	0.31	0.33
t-statistic	1.91	1.56	1.80
R^2	0.41	0.44	0.34
Serial correlation LM(2)	1.81	3.11	1.78

APPENDIX 3. LONG-RUN ESTIMATION RESULTS USING PRIME PROPERTY ESTIMATES

Table A3:1: Initial prime estimation results for London city offices

Prime London city offices - five year returns			
Nominal total returns	**Nominal**	**Nominal**	**Real**
Sample	**1979–2009**	**1984–2009**	**1987–2009**
Dependent variable(-5)			
Estimated coefficient	-	-0.27	-0.30
t-statistic	-	-3.91	-4.84
GPD			
Estimated coefficient	5.26	9.25	8.80
t-statistic	2.97	11.06	11.77
Inflation			
Estimated coefficient	1.59	0.89	-0.37
t-statistic (difference from 1)	-1.26	0.20	-0.79*
Constant	-10.22	-1.20	-2.41
Step dummies used		1986, 2005	1986, 2005
R^2	0.33	0.89	0.92
Serial correlation LM(2)	18.90	1.29	0.40

* difference from zero

Nominal:

Nominal five-year returns = β_1.Nominal five-year returns(t-5) + β_2.five-year GDP growth + β_3.five-year inflation + β_0 + dummies + r

and

Real:

Nominal five-year returns - five-year inflation = β_1.Nominal five-year returns(t-5) + β_2.five-year GDP growth + β_3.five-year inflation + β_0 + dummies + r

APPENDIX 3. LONG-RUN ESTIMATION RESULTS USING PRIME PROPERTY ESTIMATES

Table A3:2: Estimations results for real five-year returns on prime office

Real five-year total returns	Amsterdam	Frankfurt	Hong Kong	London City	London West End	New York	Paris	Sydney	Tokyo	Warsaw
Sample	**1981**	**1983**	**1997**	**1984**	**1984**	**1993**	**1983**	**1991**	**1990**	**1997**
Dependent variable (-5)										
Estimated coefficient	-0.19	-0.49	-0.13	-0.30	-0.30	-0.12	-0.23	-0.32	-0.57	-
t-statistic	-3.60	-8.10	-1.37	-4.84	-4.56	-1.12	4.92	-3.87	-6.57	-
GPD										
Estimated coefficient	4.74	7.77	5.67	8.80	10.43	4.23	6.54	14.22	4.81	7.93
t-statistic	14.91	14.20	10.76	11.77	13.81	3.33	4.92	7.14	7.85	4.54
Inflation										
Estimated coefficient	-0.53	-0.03	-0.02	-0.37	4.50	-4.81	0.35	-0.78	0.48	-0.09
t-statistic	-1.78	-0.08	-0.09	-0.79	6.75	-1.68	0.89	-0.65	0.34	-0.02
Constant	7.51	1.47	-16.99	-2.41	-45.50	2.28	3.55	-37.21	1.58	-18.11
Step dummies used	1983, 1989	1992		1986, 2005	1988, 2000, 2005	1998	1992, 2001		2005, 2006	
Spike dummies used			2002, 2005			2007, 2008			1990, 2005	
R^2	0.95	0.95	0.99	0.92	0.92	0.94	0.92	0.91	0.95	0.68
Serial correlation LM(2)	6.11	2.30	8.63	0.40	0.22	6.74	2.78	3.42	4.25	1.45

Table A3:3: Results for real-year returns on prime retail

Real total returns	Amsterdam	Frankfurt	Hong Kong		London	New York	Paris	Sydney		Warsaw
Sample	**1990**	**1990**	**2005**		**1990**	**1996**	**1990**	**2004**		**2000**
Dependent variable (-5)										
Estimated coefficient	-0.31	-0.43	-		-0.27	-	-0.39	-		-
t-statistic	-2.60	-5.31	-		-2.29	-	-3.29	-		-
GPD										
Estimated coefficient	1.04	1.70	5.65		4.51	-4.41	5.73	26.36		-0.32
t-statistic	0.88	2.70	3.69		3.55	-2.01	4.58	3.28		-0.23
Inflation										
Estimated coefficient	-0.78	5.47	-3.05		-1.14	7.99	0.35	-23.33		8.15
t-statistic	-0.71	8.20	-2.43		-1.93	0.94	0.18	-3.05		1.90
Constant	8.87	0.15	-5.56		1.47	9.21	7.36	-8.58		3.14
Step dummies used	1999	1992			2005					
R^2	0.86	0.87	0.89		0.89	0.40	0.87	0.88		0.36
Serial correlation LM(2)	4.15	0.00	n.a.		2.02	4.81	3.06	0.00		-1.66

APPENDIX 3. LONG-RUN ESTIMATION RESULTS USING PRIME PROPERTY ESTIMATES

Table A3:4: Results for real-year returns on prime industrial

Real total returns	Amsterdam	Frankfurt			London		Paris	Sydney		Warsaw
Sample	**1990**	**1990**			**1990**		**1990**	**1993**		**2000**
Dependent variable(-5)										
Estimated coefficient	-0.09	-0.73			-0.01		-0.42	-		-
t-statistic	-2.48	-7.18			-0.06		-2.48	-		-
GPD										
Estimated coefficient	1.95	2.63			5.08		6.02	11.05		2.25
t-statistic	4.87	2.72			6.54		3.40	7.19		1.31
Inflation										
Estimated coefficient	-1.34	5.28			1.29		2.60	-1.76		6.41
t-statistic	-2.48	4.65			3.11		2.42	-0.91		1.25
Constant	7.88	-1.40			-6.20		-2.19	-26.50		-8.25
Step dummies used	1998, 2008						2005	2006		
R^2	0.94	0.90			0.82		0.87	0.88		0.29
Serial correlation LM(2)	1.94	2.17			0.51		4.20	0.49		2.51

APPENDIX 4. FIVE-YEAR REAL RESULTS FOR ALTERNATIVE ASSETS

Appendix 4:1 Results for nominal-year returns on prime industrial*

LS estimation period	1976–2009	
	Property**	Gilts
Dependent lagged five years		
Estimated coefficient	-0.56	
t-statistic	-4.87	
Five-year GPD		
Estimated coefficient	1.93	
t-statistic	3.08	
Five-year GDP lagged one year		
Estimated coefficient		-1.03
t-statistic		-3.27
Five-year inflation		
Estimated coefficient	-0.85	
t-statistic	-3.92	
Real interest rates		
Estimated coefficient	0.86	1.41
t-statistic	-2.21	10.50
STEP1977		
Estimated coefficient		8.05
t-statistic		4.43
MA(1)		
Estimated coefficient	0.84	
t-statistic	7.20	
Constant		
Estimated coefficient	11.34	-5.01
R^2	0.87	0.87
Serial correlation LM(2)	1.55	0.05

Impact of inflation	-0.86	0.00
Via real interest rates***	0.40	-0.66
Total	-0.46	-0.66

*No equation is shown for equities as no statistically significant relationship was found between real equity returns and either real (UK) GDP or inflation. This implies that equities are a hedge against inflation.

**Estimated with a MA(1) term which inflates the value of the R2

***After five years

Appendix 4:2: **Five-year real volatility equations**

LS estimation period	1976–2009			
	Property	Equities	Gilts	Inflation*
Lagged dependent variable				
Estimated coefficient	0.88	0.85	0.77	
t-statistic	11.00	10.40	9.98	
Five-year Inflation(-1)				
Estimated coefficient		-1.67		0.21
t-statistic		-3.52		6.02
Five-year GDP				
Estimated coefficient			-1.73	
t-statistic			-3.44	
Five-year GDP(-1)				
Estimated coefficient	1.32			
t-statistic	2.57			
Inflation volitality				
Estimated coefficient		4.25		
t-statistic		3.22		
STEP1980				
Estimated coefficient				-2.32
t-statistic				
Constant				
Estimated coefficient	-2.22	4.22	6.30	2.66
R^2	0.80	0.88	0.83	0.94
Serial correlation LM(2)	3.07	3.40	4.46	2.37

*Estimated with a MA(1) term which inflates the value of the R2

APPENDIX 4. RESULTS FOR FIVE-YEAR REAL RETURNS ON ALTERNATIVE ASSETS

Appendix 4:3: Five-year real interest rates equation

LS estimation period	1976–2009
	Property
Dependent variable lagged one year	
Estimated coefficient	0.90
t-statistic	66.00
Change in five-year inflation	
Estimated coefficient	-0.71
t-statistic	-16.27
Constant	
Estimated coefficient	
R^2	0.99
Serial correlation LM(2)	0.05
Impact of inflation*	-0.47

*after five years

Real interest rates are defines as the five-year moving average of long-term interest rates less the five-year average inflation rate.

Property and alternative asset data

IPD data are supplemented by estimates from Scott et al to take the series back to 1947.

The primate property returns estimates are hybrid estimates, based on information on rents and yields supplied by Aberdeen Asset Management, Jones Lang Lasalle and King Sturge. Complete time series were not available from all three organisations for the full time period so the indices are chain-linked to allow for varying composition over time.

Estimates of five-year prime returns assume that the yield gives the income return in the first year and, in subsequent years, that income depends on the lease structures prevalent in the countries concerned (ie there is no change for five years in the UK and some element of indexation in a number of other countries).

Estimates of returns for gilts and equities are taken from the IPD Annual Digest.

Economic data (GDP and the consumer price deflator) are taken from individual country national accounts estimates. Note that the consumer price deflator is equal to current price consumer spending divided by constant price consumer spending. It was chosen as a measure of inflation as it provides the longest consistent consumer price estimates in most countries.

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