UK FINANCIAL MARKET RETURNS 1955-2000

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Abstract

We present and analyze new monthly index series for UK financial assets, covering equities, bonds, bills and inflation. The data are consistent with the CRSP/Ibbotson series for the US. We use our indices to estimate equity and bond premia, and to make international comparisons, especially with the US, Germany and Japan. We illustrate potential uses of the new series by investigating stock market seasonality, inflation-linked bonds, real dividend growth rates, and the small firm effect. While some of our findings resemble US results, we also report differences between UK and US stock market behavior.

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I. Introduction

Since the Fisher (1966), Fisher and Lorie (1968, 1970, 1977) and Ibbotson and Sinquefield (1976) studies, there has been growing interest in the long run return from major asset categories. Historical evidence on capital market returns is central to research in finance, and considerable effort has gone into developing improved data series for the United States and identifying new long term index series for other countries. This has led to a virtuous circle of academic research and practitioner usage. Researchers have used capital market returns data to develop grounded theory, test asset pricing models, and investigate cross-sectional and time series relationships between different asset class returns. Practitioners have focused on issues such as the cost of capital, rate of return regulation, asset allocation, pension strategy and financial analysis.

While many researchers utilise the CRSP/Ibbotson index series for the US, an increasing number of studies focus on other countries, providing valuable evidence on long-run historical returns in different economic and institutional environments. All too often, however, these studies utilise indices of price appreciation only. Jorion and Goetzmann (1999), for example, are able to identify only six non-US markets for which long-term total returns, including dividends, are available. **Table 1** summarises published studies for over a dozen countries. The annualised returns listed in Table 1 all include reinvested dividends measured after corporate tax but before personal tax, and are measured in local currency deflated by the local inflation index. Returns data for the four principal asset categories - stocks, bonds, bills and inflation - are available for almost every country listed, though long-run small stock indices are limited to the US, Canada, Germany and Japan. The primary source for each country is given on the right-hand side of Table 1, and supplementary sources are noted after each reference at the end of this paper. Note that although there are a growing number of published studies of financial market returns, the quality of the data varies considerably. Nevertheless, a broad pattern emerges from Table 1.

Consistent with Banz's (1981) original findings for the United States, the shares of smaller companies have provided high real returns, exceeding the performance of the entire equity market by several percentage points. On average, equities have given an annualised real return of some six percentage points (with a standard deviation that is generally over 20 percent). Government bonds have, on average, given an annualised real return of a couple of percentage points (with a standard deviation averaging nearly ten percent). Treasury bills, or the nearest equivalent, have given a real return of around one percentage point, while the inflation rate has averaged some five percent per year. Note, however, that the similarities mask appreciable differences in the long run returns from particular asset classes, reflecting differences in economic conditions, index coverage and sample period.

The annualised (geometric mean) returns in Table 1 are, of course, computed from just two numbers: a base value and the end-of-period index level. The standard deviations are calculated from annual returns. To make more meaningful comparisons between markets, and examine how relationships vary over time, the frequency of returns must be at least monthly. Unfortunately, about half the studies listed in Table 1 are based on annual estimates of return: a full series of monthly returns is available only for those countries printed in bold typeface. When such data are available, they can be used to study topics such as returns predictability, cross-asset and international market linkages, risk estimation and factor modelling, price formation and performance measurement. Hitherto, the long-run UK data sources have been largely inadequate for these purposes. We remedy this by providing a comprehensive record of UK financial market returns for a wide variety of asset classes.

Our paper is organised as follows. Section II outlines the data and methodology used to construct eight new index series for the UK, and draws comparisons with alternative sources of data. In Section III we review the attributes of the basic indices for each asset, and decompose the returns into a number of premia. Sections IV and V then focus on international comparisons. Section IV utilises the new database to present comparisons between the annual returns for the UK, US, Germany and Japan over the last 45 years. Section V then demonstrates how the availability of our new monthly index and dividend series enables researchers to investigate prior US findings using a novel database. We show how, in at least one case, it is possible to foreshadow future US research by analyzing a new US asset class whose UK counterpart has a longer history. We illustrate these potential uses of our new data using the examples of equity market seasonality and the size effect, analysis of inflation-linked bonds, the volatility of dividend growth rates, and the link between dividend growth and the size effect. We conclude with a brief summary in Section VI.

II. Research Procedure

Our research follows eight principles. First, we compile the longest possible history of monthly returns for the main asset categories, and our indices therefore commence at the 1955 start-date of London Business School's share price database (LSPD). Second, like CRSP, our indices are comprehensive in coverage: we include all listed equities after 1975, and a fully representative one-in-three random sample up to that date (see Dimson and Marsh (1983) for details). Third, our equity indices are consistent with the leading international indices, and are therefore market capitalization weighted with a coverage specified as a proportion of the value of all traded equities. Fourth, rather than estimate income as one-twelfth of the rolling dividend yield on the index, it is computed on a precise ex-dividend basis. Fifth, rather than approximating bond price changes from a series of bond yields, we base all estimates on actual prices. Sixth, we minimise bias from thin trading and rebalancing by following a buy-and-hold strategy that largely avoids intra-year reweighting, while year-end rebalancing is based on prices prior to the year-end. Seventh, the underlying data has been subjected to stringent quality checks. Finally, we have set up systems for updating the index series on a regular basis.

We generate comprehensive, appropriately weighted, arithmetic indices for nine asset categories. These series are summarised in **Table 2**. There are four equity and three bond series, plus treasury bills and inflation. The equity series are capitalization-weighted, whereas the bond indices are equally weighted. All index returns are calculated assuming zero taxes and transaction costs.

The four equity indices comprise a comprehensive, all-equities index, plus three component indices of high-, low- and micro-cap stocks (see Table 2). The all-equities index covers all sterling-denominated common stocks of UK registered companies traded on the London Stock Exchange (it is the counterpart of the CRSP NYSE index). The high-cap index comprises the largest 90 percent *by cumulative value* of all UK equities ranked by their market capitalizations. The low-cap index covers the next nine percent *by cumulative value*, while the micro-cap index covers all remaining equities, namely the smallest one percent *by cumulative value*. We estimate indices both including and excluding closed-end funds from the universe, but we limit this paper to indices that exclude closed-end funds. Since closed-end funds invest in other equities and other assets, exclusion helps avoid double counting, and ensures a purer measure of UK equity performance. Furthermore, since there is no relationship between the capitalization of a closed-end fund, and that of the stocks in which it invests, excluding closed-end funds from the size-based indices provides a better measure of size-based performance.

The bond indices are designed to measure returns to a tax-exempt investor and, as Schaefer (1981) notes, historically this has implied a high-coupon strategy. The long-maturity bond index has a maturity (at mid-year) that averages twenty years while the mid-maturity index has an average maturity of five years. Both indices are based on high coupon bonds, defined as those that fall within the top third of all coupons for the maturity range in question. The number of constituents in the long- and mid-maturity indexes averages four and two respectively. Index-linked bonds, whose value is tied to the level of retail prices, became freely available to all investors in 1981, and consequently the returns start in that year (see Woodward, 1990, and Brown-Schaefer, 1994). The index-linked series averages a mid-year maturity of twenty years and contains a mean of three constituents.

Our equity indices are based on deciles (and centiles) of total market value rather than number of stocks. This is consistent with the definitions adopted for the FTSE World smaller companies indices (defined as "*the bottom 10% by market capitalization of each market*") and for many local small-cap indices. In contrast, CRSP defines deciles in terms of number of stocks. Ibbotson's low-cap index is hence based on deciles 6 to 8, while their micro-cap index is based on the smallest two deciles, where each decile comprises *an equal number of companies*. By basing our index series on market capitalization deciles, we maximise their comparability with the international equity indices used in studies such as Roll (1992). We also avoid some of the measurement issues that are endemic to microscopically small companies, such as the decile of tiniest stocks (by number of companies) whose average market capitalization in 1955 was only £28,000, equivalent in real terms to around $0.7 million today.

Table 3 compares the definitions of our indices in terms of (A) size-deciles *by cumulative value*, as used in our study and (B) size-deciles *by number of companies*. Block A displays the number of companies falling within each market value decile MV1–MV10. The largest decile by value, MV1, contains only 0.15 percent of the number of listed companies (excluding closed-end funds). Our high-cap index covers the top nine deciles by market capitalization, MV1–MV9, while our low-cap and micro-cap index, taken together, cover the 85.78 percent of companies that make up the smallest decile by value, MV10. Block B shows the composition of size-deciles containing an equal number of companies. Decile no 1 contains 85.50 percent of the value of the market and, together with the largest 42 percent of the constituents of decile no 2, this is our high-cap index. The remainder of decile no 2, plus deciles no 3–5, plus the largest 20 percent of the constituents of decile no 6 add up to nine percent of the value of the market, and constitutes our low-cap index. The remainder of decile no 6 plus deciles no 7–10 add up to one percent of the market and constitutes our micro-cap index.

Our high-cap index corresponds to the CRSP "1-5" index, since it contains UK companies whose end-1999 market values are in the range $1.7-193 billion, as compared to $0.9-370 billion for CRSP "1-5" constituents as at end-September 1999 (see Ibbotson, 2000). Our low-cap index corresponds broadly to the CRSP "6-8" index, since it contains UK companies with values in the range $133-1700 million, as compared to $215-872 million for CRSP "6-8". Our micro-cap index contains UK companies capitalised at up to $133 million, somewhat below the CRSP "9-10" range of up to $215 million. The UK market is, of course, smaller than the US equity market and the market capitalizations of the stocks in our equity indices are on average smaller than their US counterparts. Our low-cap and micro-cap equity indices thus cover a larger proportion of the value of their equity market than their US equivalents, namely 9.00 percent (versus an historical average of 4.29 percent for the US low-cap) and 1.00 percent (versus 0.80 percent for the US micro-cap).

Compared to other UK data sources, our new indices are more comprehensive and accurate, and follow a consistent definition throughout the sample period. Foldes and Watson (1982) provide a quarterly UK equity return series for 1919-1970, but there are concerns over survivorship bias, and this index covers only 55-75 companies. The Financial Times-Stock Exchange (FTSE) UK equity index series have been published for many years, but these cover only part of the period. The (misleadingly named) FTSE All Share commenced life as a price index in 1962 and switched to total returns as recently as mid-1993, while the FTSE All Small index (which includes eligible stocks that fall outside the All Share) was not launched until start-1999. Barclays Capital (1999) publishes a return series that links in to the All Share in 1962, but which utilises a proprietary equity index prior to then which has been retrospectively back-calculated to 1919. This index, however, contains only 30 stocks, is calculated just once per year, and suffers from serious survivorship bias over the period 1919-35. Furthermore, Barclays Capital's companion bond index is based for much of its history on the price of a single, irredeemable government bond. Our new series are more similar to those of Ibbotson Associates (2000), and thus provide a superior basis for international comparisons of long-run rates of return.

Our basic index series are presented in both nominal and real terms. In addition, we compute seven derived series, as specified in **Table 4**. These component returns are calculated as both arithmetic differences between two returns, and as geometric differences. While component returns such as the equity risk premium are often presented as the arithmetic difference between equity and treasury bill returns, the geometric differencing procedure facilitates comparisons. In particular, geometric differencing gives rise to premia that can be compounded up to any chosen differencing interval, as well as generating premia that are independent of the choice of numeraire.

With geometric differencing, statistics such as the low-cap premium are invariant to the choice of annual versus monthly computation, nominal versus real returns, and dollar-denominated versus local-currency returns.

In the next section we provide summary statistics on the distributions of the basic and component returns, including geometric and arithmetic means, the standard deviations of continuously compounded returns, other measures of the range of returns, the serial correlation, coefficients of skewness and kurtosis, and cross-correlations between the index series. The 45-year history of annual returns is presented in Section III and is the basis for international comparisons in Section IV. Section V investigates the index series using monthly data to draw comparisons not only between countries but also over time.

III. The New Index Series: Capital Market Returns in the UK

A. Basic Returns

Summary statistics on the basic annual returns series from 1955 to 1999 are presented in **Table 5**. The upper panel is based on nominal returns, while the lower panel summarises the corresponding real returns. To conserve space, we do not present the actual returns series themselves; nor do we show detailed statistics on capital gains, other than to provide the geometric and arithmetic mean capital gains, shown in parentheses alongside the total returns. Note, however, that the availability of both capital gains and returns enables us to compute the dividends paid on the index, as in section V.C below. We are also able to compile returns on an after-tax basis for any tax bracket, as in Fisher and Lorie (1977), Siegel (1998) and Siegel and Montgomery (1995).

Table 5 shows that micro-cap equities have given the highest geometric and arithmetic mean returns, with low-cap equities also outperforming equities as a whole. The mean returns on long- and mid-maturity bonds and on treasury bills have been relatively similar (the index-linked bond figures relate to the post-1981 period only). In real terms, the various equity categories gave substantial mean returns, varying from an annualised 8.1 percent on high-cap equities to a geometric mean of 14.0 percent (and an arithmetic mean of 17.6 percent) on micro-cap stocks. The arithmetic-mean real return on high-cap equities of 10.9 percent is close to the 10.4 percent estimated for the UK by Goetzmann and Jorion (1995) over the period 1872-1992. The small capital loss experienced on long-maturity bonds suggests that investors' *ex ante* expectations may have been higher than the long bond returns actually realised. Ibbotson (2000) discusses the reasons for observing non-zero capital appreciation on the bond indices, emphasising the impact of bond portfolio convexity and bond substitution.

The standard deviations of annual returns are similar for the three equity series. The smaller capitalization indices have a larger residual risk, relative to equities as a whole, but (in the earlier years, at least) had a below-average beta. This contrasts with the US, where smaller companies have an above-average beta. The interplay between the ranking of returns and the ranking of volatilities is revealed in the Percent ≥ Zero column of Table 5. For a particular level of volatility, the higher the mean return, the larger should be the number of times the return is positive; and given a specified mean return that is above zero, then the higher the volatility, the lower should be the number of times the return is positive. In both panels of the table, these two effects are mutually offsetting. The proportion of nominal returns that is positive is strikingly similar for all risky asset categories, and with the exception of long bonds, the same effect is apparent for real returns.

The Percent Highest column of Table 5 shows the proportion of years in which each asset generated the largest return. In the majority of years, low-cap or micro-cap equities did best. Long- or mid-maturity bonds or treasury bills dominated equities in just one quarter of the years, whilst index-linked bonds have so far never been the best performing asset over a calendar year. Finally, the last three columns of Table 5 provide estimates of the serial correlation and coefficients of skewness and kurtosis for the annual returns series. For testing the significance of the serial correlation, relative to a null hypothesis of zero, the standard error is 0.15 (or, for index-linked bonds, 0.23). Apart from treasury bills and inflation, none of the serial correlation coefficients is significantly different from zero.

Table 6 shows the correlations between annual asset returns. The upper part of the table (bold typeface) shows the correlations between nominal returns, whilst the lower part (italic typeface) shows the correlations between real returns. In Section IV below, we compare selected correlations from this table with the US, Germany and Japan, and in Section V we use monthly data to provide additional insights for the UK and US.

B. Component Returns

Table 7 presents summary statistics on the component returns that were previously defined in Table 4. The upper panel contains statistics based on arithmetic differencing, whereby we subtract from each year's asset return the corresponding return on its benchmark. (This gives rise to definitions of, say, the equity risk premium that are consistent with standard finance textbooks such as Brealey and Myers, 1999) In the lower panel of Table 7 we provide component returns based on geometric differencing, again as defined in Table 4. The geometric difference between an asset return *a* and a benchmark return *b* is (1+*a*)/(1+*b*) – 1. For many of the resulting premia the means are similar, though in particular years there can be a substantial difference (see the columns headed Maximum Return and Minimum Return). For the micro-cap premium there is a marked difference between the geometric mean based on each of the two calculation methods. There is an easier interpretation for the arithmetic mean of the arithmetic premia and for the geometric mean of the geometric premia; the other means are simply summary statistics for the distribution of annual premia.

Following the definition used in Ibbotson (2000), the equity risk premium is the amount by which the annual return on high-cap equities has exceeded that on treasury bills. The upper panel of Table 7 shows that the arithmetic mean equity risk premium has averaged 9.6 percentage points over the last 45 years. (The corresponding figure for the excess return on *all* equities is an average of 9.9 percentage points). Though arithmetic differencing is the standard method for computing an historical risk premium that is to be added to the riskless interest rate, note that it is not independent of the choice of numeraire. If the UK equity and treasury bill returns were computed in dollars rather than pounds sterling, the result would deviate from the figure shown in the upper panel of Table 7. If we wish to make international comparisons, the geometric differencing procedure has distinct advantages.

In addition, the distribution of equity premia is closer to normal when geometric differencing is employed.

In the lower panel of Table 7 we estimate geometric premia that are not affected by the choice of real or nominal units, or by the choice of currency. Our estimate of the arithmetic mean equity risk premium is 9.0 percent, which is close to the figures estimated (over different periods) for the US by Ibbotson (2000) and for the UK by Barclays Capital (1999). The low-cap and micro-cap premia are larger than in the United States. The bond premia are low, and arguably below investors' *ex ante* expectations. The real term premium, defined as the reward for investing in index-linked bonds in preference to treasury bills, has been negative. This may partly reflect the fact that, over the period since index-linked securities were introduced to the UK market in early 1981, at least part of the subsequent increase in real interest rates was unanticipated. It may, however, also partly reflect the influence of tax clienteles, since index-linked bonds held by high-rate UK taxpayers have a favourable tax treatment, as compared to conventional bonds (see Brown and Schaefer, 1994).

All of the six risk and bond maturity premia have serial correlation coefficients that differ from zero by less than twice the standard error of 0.15 (or 0.24 for the real term premium), and are hence non-significant. Lastly, note that the coefficients of skewness and kurtosis in Table 7 are closer to the normal case in the lower panel, as compared to the arithmetic premia presented in the upper panel. This may be a further advantage to employing geometric premia in statistical work.

We conclude this section by presenting the correlations between the component returns (based on geometric differencing). In **Table 8** we display in the upper part of the matrix (in bold typeface) the correlations between annual component returns. As explained earlier, these figures are the same, whether the underlying returns are estimated in nominal or real terms. In italic typeface we record the correlations between monthly component returns. In general, the two measures are similar, but the monthly analysis is helpful when we wish to make comparisons between subperiods, especially when the series may be nonstationary. Furthermore, the standard error shrinks from .15 with annual data to .04 with monthly data (or from .23 to .07 for the real term premium). It can be seen that the majority of the monthly correlations are statistically different from zero. Note, for example, the significantly negative relationship between the equity risk premium and the monthly size premia, a topic we discuss in the following section.

IV. Comparisons of the UK, US, Germany and Japan Using Annual

Returns

Financial economists are sensibly cautious about extrapolating just from US capital market history (Welch, 1999), yet hitherto, there has been a dearth of reliable long-run returns data for other countries. Our new UK index series help to remedy this, and in this section, we compare our UK findings with both the US, and the two other major world markets, Germany and Japan, for which we can assemble comparable, high-quality series. For the United States, we utilise Ibbotson's (2000) data. For Japan we compile returns data covering the same period as our own research, by extending the Hamao (1991) and Hamao and Ibbotson (1994) data series. For Germany we extend the Stehle and Hartmond (1991) and Stehle (1992) data series, referring also to Braems and Haffner (1966). The results are summarised in **Table 9**. The table contains six panels. The first three display the geometric and arithmetic means and the standard deviation of the annual component returns. The lower three panels present the corresponding serial correlations and selected cross-correlations between the component series. The premia in Table 9 are not measured in currency units, and they are hence approximately equal to currency-hedged returns (Solnik, 1993). It is therefore appropriate to make transnational comparisons.

During this 45-year period covering most of the second half of the twentieth century, several of the premia are very similar across countries. This includes the much-quoted equity risk premium, which is in the region of 6-7 percent, ranging from 6.2 percent in the UK and US to 7.0 percent in Japan. There has been substantial year-to-year variation in the equity risk premia, however, as indicated by the annual standard deviation of some 16 percent for the US and around 22-23 percent for the other three countries. While all four equity markets have exhibited a positive size effect, this has been surprisingly modest, given the prominence the small firm premium continues to receive in the literature. Japan has the highest low-cap premium of 2.7 percent, while the annualised premium for the other three countries lies in the range of just 1-2 percent. Furthermore the adage "the smaller the better" has proved true only in the UK and Germany, since in both the US and Japan, the micro-cap premium was smaller than the low-cap premium, with the micro-cap premium in Japan actually being negative.

Over this interval, the annualised inflation rate was lowest and most stable in Germany, with a geometric mean of 3.0 percent and a standard deviation of 1.8 percent; and highest and most volatile in the UK, with a mean of 6.3 percent and standard deviation of 4.7 percent. In all four countries, long bonds provided a positive long-maturity premium over bills, but the premium was low in the UK and US (0.2 and 0.4 percent, respectively), and appreciably higher in Germany and Japan (1.9 and 2.7 percent, respectively).

This is consistent with the notion that over the second half of the century, the ex post long-maturity premium in the UK and US was below investors' ex ante expectations due to the rate of inflation proving higher than anticipated. At the same time, in Germany and Japan the bond maturity premium may well have exceeded ex ante expectations, reflecting the extent to which post-war hyperinflation came under firmer control than might have been anticipated in the aftermath of World War 2.

Not surprisingly, in all four countries there is a high level of serial dependence in the real rate of interest and in inflation. For the equity risk premium and long-bond premium, the signs of the serial correlation coefficients differ across countries, and are below twice the standard error of 0.15 (except for the long-bond premium in Japan). For the US, there is evidence of statistically significant positive serial dependence in the size premia. In contrast, for the UK and Germany, the serial correlations are positive, but not significant, while for Japan, they are negative and insignificant.

Turning to the penultimate panel, note that the large positive correlation between the UK equity risk and bond premia are not replicated overseas, where the correlations, while still positive, are much smaller. The lack of a positive linkage between the UK equity risk premium and the micro-cap and low-cap premia, however, appears not to be country specific: it is the US which is an outlier here, reflecting the higher beta of US small-caps as compared to other countries. Lastly, the final panel of Table 9 indicates that inflation has had a more neutral impact on component returns in the UK than elsewhere, where there has been a strong negative relationship between annual inflation and equity/bond premia. These topics merit further investigation, and the monthly frequency of our new indices makes this possible.

V. Comparisons of the UK and US Using Monthly Returns and Dividends

To make more meaningful comparisons between markets, the frequency of returns needs to be at least monthly, and for equities we also require reliable dividend series. Hitherto, the long-run UK data sources have failed to meet these requirements. In this section, we show how our new monthly data series facilitate comparison of US research findings with the UK. We also illustrate how one can foreshadow future US research by analyzing a British database with more substantial coverage than its American counterpart (see section V.B below).

A. Stock Market Seasonality

There has long been evidence of a January seasonal in US stock returns (Rozeff and Kinney, 1976) and around half of the “size effect” is attributable to January abnormal returns (Keim, 1983). The literature on stock market seasonality has sought to explain this through three hypotheses: risk seasonality (Rogalski and Tinic, 1986), tax loss selling (Roll, 1983, and Ritter, 1988) and portfolio rebalancing (Haugen and Lakonishok, 1988). The evidence does not support the risk seasonality explanation. The other two hypotheses remain open, with some studies supporting the tax loss selling story and others finding the January seasonal is unrelated to taxes (see Hawawini and Keim (2000) for a recent review). When applied across countries both hypotheses need adaptation, since the turn of the tax year and year-end "window dressing" can occur at different dates, depending on the fiscal and financial reporting systems. In the UK, for example, the tax year for individuals starts on April 6 and many firms report their results on an April-March cycle, though others work to an end-December tax and reporting year-end.

If there is a turn-of-the-year effect it should be observable in the UK during April as well as, or instead of, January. Gultekin and Gultekin (1983) and Reinganum and Shapiro (1987) suggest that the UK equity market may have both a January and April seasonal. Reinganum and Shapiro perceive April (but not January) tax loss selling, but do not control for size or for the fact that the UK tax system encourages selling winners as well as losers. Levis (1985) also looks at company size, finding a May (but not a January or April) size seasonal. These studies are limited, however, in the length of their research periods and the quality of their indices.

While a full investigation is beyond the scope of this paper, we present initial evidence based on the new indexes. **Table 10** shows arithmetic average monthly premia for 1955-99, the period for which we have monthly data for both the UK and US. The first two columns show the mean equity risk premium for the US and UK. The Kruskal-Wallis (KW) non-parametric test for seasonality, which tests the hypothesis that all months have identical means, is 13.8, and we are thus unable to reject the null that the US equity premium is time invariant. In contrast, the UK data reveal much larger differences between monthly risk premia than we observe for the US. For the UK the KW test statistic is 24.1, suggesting that we can reject the hypothesis that each month has the same mean. January has the highest mean of 2.8 percent; but if we exclude the January 1975 premium of 50 percent, the January mean falls to 1.8 percent, relegating it to third place behind April at 2.7 percent, and December at 1.9 percent. It is tempting to interpret the high April average as a turn-of-the-tax-year effect, and the high

January, and arguably December, average as being linked to turn-of-the-calendar-year reporting, or to co-movements with effects in other markets.

However, other studies, such as Gultekin and Gultekin (1983) and more recent papers summarised in Hawawini and Keim (2000), have noted that US capitalization-weighted, and hence large stock dominated, indexes do not exhibit seasonality, and that the US turn-of-the-year effect is almost exclusively a small stock phenomenon. This is confirmed by the last two columns of Table 10, which show the average monthly UK and US micro-cap premium over the 45-year period. The average US January premium is 5.8 percent, which is seven times higher than February, the next highest month, and which contrasts with the February-December mean of -0.4 percent. The KW test statistic rejects the null at the 99.9 percent level that US monthly micro-cap premia are time invariant. Since Keim's (1983) original analysis of the January size seasonal from 1963-79, the micro-cap premium has reversed, with an arithmetic mean of –3.3 percent, yet January has continued to be the best month with a mean premium of 3.4 percent.

The final column of Table 10 shows that in sharp contrast to the US, there is no evidence of a year-end size effect in the UK, regardless of whether we look at the calendar- or the tax-year-end. Of the twelve monthly premia, January, while positive at 0.6 percent ranks as only the fifth highest, while the April mean is actually negative at -0.3 percent, and ranks tenth. The KW statistic for the UK monthly micro-cap premia rejects the null that all months have the same mean, but the months with the highest premia are May, followed by February, July and then September. Furthermore, although May has the highest mean at 1.6 percent, this is not significantly different (at the 95 percent level) from the means for January, February, July, or September. These results suggest that if there are tax- or calendar-year-end seasonal effects in the UK, these relate to the overall market rather than to the relative performance of small versus large companies. This is the opposite of the US evidence.

Smaller companies have outperformed in the UK as in other countries (Hawawini and Keim, 2000). In the absence of a turn-of-the-year effect, we need to seek an alternative explanation. Previous US research may therefore have been somewhat misdirected, since it is now clear that turn-of-the-year seasonality has slim prospects of providing a validated explanation of the small firm effect. This raises the question of why the January/size effect appears to have been accepted by the academic community as a worldwide phenomenon. We conjecture that this is because stock market returns, including low-cap returns, have exhibited a January seasonal (Gultekin and Gultekin, 1983), at least on an *ex post* basis. The limited availability and quality of low-cap index series (see Table 1) has until now made it difficult to research the seasonality of the small firm premium other than in the US.

B. Inflation-Linked Bonds

An asset class that has considerable novelty is inflation-linked bonds. In the US, Treasury inflation-protected securities (TIPS) were introduced in January 1997, and while this asset category has attracted research interest (e.g., Campbell and Shiller, 1996), there is so far only a brief returns history. Other index-linked markets include Australia, Canada, New Zealand and Sweden. In the UK, however, index-linked government bonds were introduced as long ago as March 1981, and we therefore have a British returns history of 225 months. Though not identical, the structure of US TIPS is similar to their UK counterparts. British data may therefore provide important clues about how this asset may be expected to behave in the US.

Table 11 provides summary statistics on monthly bond returns and inflation over the period since April 1981 when index-linked bonds became widely available to UK investors. The top panel relates to the UK and the bottom panel refers to the United States. The top panel shows that, since their introduction in 1981, the mean real monthly return on UK index-linked bonds has been only 0.3 percent, which is lower even than the return on UK treasury bills. This negative real term premium is most likely attributable to the unanticipated increase in real interest rates during this period, and particularly in the early 1980s, although it may also partly reflect the influence of tax clienteles (see section III.B). The standard deviation of monthly real returns on UK index-linked bonds is 2.43 percent, as compared to 0.48, 1.83 and 2.98 percent for treasury bills, mid-maturity bonds and long-maturity bonds respectively. In terms of risk, UK index-linked bonds have behaved most like conventional long-bonds, and have been only marginally less volatile.

The correlations between monthly asset return are shown in the lower part of each panel. In the UK, correlations vary from –0.9 (bills versus inflation) to +0.9 (mid- versus long-maturity bonds). The pattern is similar in the US. The only statistic that appears significantly different between the two countries is the correlation between the real returns on treasury bills and inflation, which for the UK is –0.87, and for the US is –0.60. Since UK and US inflation statistics are released at different points in the month, this difference may be attributable to the timing of announcements in the two countries.

Given that both the coupon and maturity value of index-linked bonds are linked to retail price inflation, the top panel of Table 11 is informative for US investors. The similarity between the behavior of UK and US bonds and inflation suggests that, had US inflation-linked bonds existed over this period, they would have performed in a similar way to their UK counterparts. Note, first, the negative correlation (-0.22) between the real returns on index-linked bonds and the inflation rate; and second, the rather high correlation (0.55) between the returns on index-linked bonds and the real returns on conventional long-maturity bonds. It appears that, in terms of month-to-month price fluctuations, index-linked bonds behave more like conventional bonds than might have been expected. While this similarity is likely to carry over to the US, these relationships could clearly change in an environment where long-bond returns are driven more by changes in inflation and inflationary expectations than by changes in real interest rates.

C. Dividend Volatility

Cash dividends occupy a central role in stock valuation, and research in this area relies on the availability of accurate estimates of dividends paid on common stocks. The returns and capital gains series estimated in this paper are computed by reinvesting income on an ex-dividend basis using detailed, stock-level dividend data. The difference between monthly returns and capital gains can thus be used to obtain precise estimates of portfolio income in the form of a sequence of month-end cash dividends that have been reinvested back into the index. To examine the time path of dividends in more detail, we use this dividend series to compile a monthly income index covering all UK equities. To abstract for the impact of inflation, we also convert this index to real terms. For comparison we derive an equivalent monthly real dividend series for the US using Ibbotson's capital gains and returns series for the CRSP All-NYSE (deciles 1-10) index. We then compute monthly, quarterly and annual dividend growth rates for both markets.

The top two panels of **Table 12** provide summary statistics on real dividend growth for the UK and US. The monthly growth rates indicate that real dividend growth has been much higher in the UK than in the US (0.17 percent compounded monthly versus 0.09 percent). The UK also entered 1955 with a higher dividend yield than the US (4.96 versus 3.82 percent). Nevertheless, the superior dividends from UK equities do not carry forward into superior returns. We know from Section IV and Table 9 that the annualised real return on equities and the equity risk premium have been virtually identical in both countries. It seems likely, therefore, that lower US dividend growth rates reflect the fact that share buybacks were (and are expected to remain) an important supplement to dividends for US shareholders. This was not the case in the UK, and until the late 1990s share buybacks were negligible.

Monthly real dividend growth rates have a very high standard deviation, and are quite strongly negatively serially correlated. The top two panels of Table 12 show that these effects are even more marked in the US than the UK, reflecting the highly seasonal nature of dividends in both countries, especially the US. Most US dividends are paid quarterly, and ex-dividend dates cluster in February, May, August and November. Each of these four months accounts for 13-15 percent of overall annual dividends by value, and is preceded and followed by months that average just 5½ percent of annual dividends. This leads to the high volatility of month-to-month dividend changes, and the negative serial correlation. It also leads to a highly skewed distribution of monthly dividend changes, and hence a very high arithmetic mean. Given that these effects originate from the quarterly dividend seasonal, we would expect them to be greatly reduced for quarterly dividend changes, and Table 12 confirms that this is the case.

British companies typically pay dividends biannually, with ex-dividend dates clustering in March and April (each accounting for 13 percent of annual dividend value) and September (11 percent). This contrasts with the low ex-dividend months of January (4 percent), December (6 percent) and July (6 percent). But although this seasonal pattern is less marked than in the US, UK monthly dividends have been subject to additional noise arising from the system of stock exchange accounts that operated until recently. Under this system, stocks typically went ex-dividend on the first day of each two-week account. Some months thus had two ex-dividend clusters, while others had three. This, coupled with the occasional three-week account, added considerable noise to the already seasonal monthly dividend changes. Table 12 shows this resulted in a very high level of month-to-month variation in dividend growth rates (a standard deviation of 138 percent), and gave rise to a serial correlation coefficient of -0.23 in monthly real dividend growth rates. While high, these monthly dividend change figures are slightly less extreme than for the US. However, as Table 12 shows, quarterly UK dividend changes are more extreme than their US counterparts, since UK dividends do not follow a quarterly cycle.

The upper panel of Table 12 also provides summary statistics on annual real dividend growth rates. UK real dividend growth has experienced both a higher mean and a higher standard deviation than in the US. The annual standard deviation in the UK is 11 percent, indicating considerable variation over time, and even in the US, the standard deviation has been 4.6 percent. Annual dividend growth rates have shown surprisingly high levels of independence from one year to the next, with serial correlations (0.07 for the UK and 0.24 for the US) that are not statistically different from zero. The two countries' annual dividend growth rates exhibit a modest degree of co-movement, with a correlation coefficient of 0.40. By comparison, the correlation between the two countries' annual capital gains was 0.58.

Though dividend seasonality has long been understood by those who trade in stock index futures and options, UK index compilers underestimated its importance until mid-1993, when the Financial Times-Stock Exchange indexes were first computed on a total returns basis. Other UK indexes either omit dividends or estimate monthly income by adding one-twelfth of the rolling dividend yield to each month's capital gain. Some researchers, for example, Fama and French (1998), have also followed this procedure. The lower panel of Table 12 indicates that this is a poor approximation. The published FTSE All Share index has a lower dividend growth rate than the correct figure for all UK equities (see the top panel), but this may relate to its bias towards larger companies (see below). More seriously, however, the implicit smoothing gives rise to a spurious impression of dividend predictability. The strongly negative quarterly serial correlation and the near-zero annual serial correlation in the top panel of Table 12 are mis-represented in the lower panel as positive autocorrelations, with the annual figure of 0.42 (versus the correct figure of 0.07) appearing to be statistically significant.

In early examples of the excess volatility and speculative bubbles literatures, researchers either assumed that future dividends could proxy for investor expectations (see Shiller, 1981) or that investors might reasonably expect a constant growth rate of dividends to continue indefinitely (e.g., Barsky and DeLong, 1993). Table 12 indicates that these assumptions are unlikely to be appropriate, since year-on-year growth rates vary a great deal. With sophisticated forecasting methods applied to a broad dividend index, Donaldson and Kamstra (1996) show that it is possible to generate estimates of stock prices that are relatively accurate on an out-of-sample basis, even during abnormal market conditions. The new income indices for UK assets provide an opportunity to research issues that could not be addressed using existing index series.

D. The Small Firm Effect

The availability of high quality dividend data also allows us to shed light on other empirical questions, such as the size effect. The size effect is still generally regarded as synonymous with an expected premium from investing in small companies. However, although small- and micro-cap stocks outperformed high-cap stocks over the entire 1955-99 period (see Sections I, III, IV and V.A above), in both Britain and the US, the small firm premium went into reverse soon after its discovery. Our dividend series can provide pointers as to why this might have occurred.

The UK size effect first came to prominence with the launch some 13 years ago of a proprietary smaller companies index covering the bottom tenth by capitalization of the equity market. The index back-history revealed that from 1955-1986, smaller companies had outperformed the UK market by 6 percent per year (Dimson and Marsh, 1987). This research generated considerable interest in small-caps, and during 1987-8 there were over 200 follow-up articles in the UK press; at least 30 open- and closed-end fund IPO prospectuses reproduced extracts from the back-history; and numerous institutions developed a low-cap investment strategy. After the 1987/8 launch period, however, the UK size premium went into sharp reverse, and over the next decade the small-cap index underperformed by over 6 percent per annum.

The historical record and subsequent reversal were even more marked for micro-cap stocks, as shown in **Table 13**. In the UK, the geometric mean premium switched from +9.7 percent over 1955-88 (see the row in bold typeface in the top panel) to –6.8 percent over 1989-99 (see second panel). The negative micro-cap premium from 1989-99 would have been even larger had UK micro-cap stocks not enjoyed their best year on record during 1999 (see Table 7). The reversal of the UK size premium was a re-run of what had happened earlier in the US. Banz's (1981) and Reinganum's (1981) research on the US size premium generated great interest in low-caps, and led to the launch of new funds by Dimensional Fund Advisors and others

(Tully, 1998). As in the UK, the honeymoon lasted around two years, but starting at end-1983 the small firm premium went into reverse, with a stronger reversal for micro-caps. The mean US micro-cap premium was +5.5 percent over 1955-83, and –8.1 percent over 1984-99, as shown in the two rows in bold typeface in the lower two panels of Table 13.

Most of the size effect literature has sought to explain a premium in small stock returns (e.g., see Schwert, 1983; Dimson, 1988; and Hawawini and Keim, 2000). This search not only had limited success, but with hindsight was misdirected in its focus on a premium. For theories of the size effect to have real value, they should also help us understand the last decade's reversal by small-caps. This leads us to examine the underlying business performance of small, relative to large, companies. While fundamental performance can be measured in many ways, dividends provide the most direct measure of cash flow to shareholders. We therefore construct real dividend indices for our size-based indices, using the method outlined in section V.C above.

In 1955, the prospective dividend yield for the UK micro-cap index was 4.6 percent higher than for high-caps. As shown in the row in bold typeface in the top panel, from 1955-88 micro-cap dividends grew at an annualised rate that was 4.5 percent greater than for high-caps. The stock market gradually recognised the higher growth rate of these securities, and their price/dividend multiple increased at an annualised rate of 3.4 percent. Over this period, the micro-cap premium of 9.7 percent per annum was thus supported by three fundamental factors. These were a difference in initial income of 4.61 percent, subsequent dividend growth of 4.46 percent, and an increase in the price/dividend ratio of 3.36 percent. Taken together, these three components would imply a micro-cap premium of 12.9 percent, and the difference between this and the actual premium of 9.7 percent can be attributed to fluctuations in dividend income over the measurement interval (-2.88 percent).

The higher price/dividend multiple in 1988 left micro-caps yielding 1.6 percent less than high-caps, having adjusted to an expectation of higher dividend growth. Unfortunately, the following decade witnessed micro-cap dividends growing at 2.0 percent less than high-caps. Combined with the resulting fall in the price/dividend multiple of 4.2 per year, these three effects, totalling –7.5 percent, largely explain the –6.8 percent micro-cap "premium" over this period (see the row in bold typeface in the second panel of Table 13).

The evidence for the US shown in the bottom half of Table 13 is remarkably similar, except that at the start of the period in 1955, US micro-caps were selling on almost exactly the same yield as high-caps. From 1955-83 (i.e., the period ending two years after the publication of Banz's (1981) and Reinganum's (1981) research on the size effect), the US micro-cap premium of 5.5 percent was supported by superior dividend growth from micro-caps of 4.3 percent. Over the subsequent period from 1984-99, the US micro-cap premium of –8.1 percent was accompanied by inferior dividend growth of –1.6 percent, coupled with an initial dividend yield which was also 2.1 percent lower on micro-caps. This is consistent with Fama and French's (1995) observation that the post-Banz period corresponds to a prolonged earnings depression for small stocks. The evidence in Table 13 for other periods, in the US as well as the UK tells a consistent story. Yield differentials, and variation in dividend growth rates, have been key components of the longer-term relative performance of small stocks.

This, of course, replaces one question with another. If we conclude that the stock market performance of smaller companies over the last decade reflects investor disappointment in smaller company fundamentals, the new puzzle that emerges is why the fundamental performance of small-caps has been so much worse than high-caps over this period. While it is possible to speculate about this, a full answer clearly requires further research (see Dimson and Marsh, 1999). Our aim here is simply to demonstrate that the availability of the new long-term returns series allows one to address issues that would not hitherto have been researchable.

VI. Conclusion

In this paper we have presented a new set of indices for UK financial asset returns. These cover equities, including high-, low and micro-cap stocks; government bonds, comprising long- and mid-maturity bonds, index-linked bonds and treasury bills; and inflation. The data are consistent with the CRSP/Ibbotson series for the US. The series are constructed from monthly data for individual securities, and provide comprehensive coverage. In addition to indices of capital appreciation and total return, we estimate indices covering real returns, dividend income, and equity and bond premia. Our risk and maturity premia are compared with other markets for which premia are available, notably the US, Germany and Japan.

The new monthly return series allow us to investigate issues where previous findings relate almost exclusively to US data. We illustrate four such applications. First, we examine equity market seasonality. We find that the small firm effect, which in the US is concentrated at the turn of the year, behaves quite differently in the UK, casting doubt on some of the theories relating to the January seasonal in US small-caps. Second, we provide evidence that index-linked bonds behave rather more like conventional bonds than might have been expected. Since we find that the behavior of conventional UK government bonds resembles that of US bonds, our analysis is clearly of relevance to researchers interested in US inflation-linked bonds. Third, we examine the time series of real dividend flows. The extreme variability of dividend growth rates indicates a need for caution in interpreting research that extrapolates dividend growth into the future. Fourth, we reconsider explanations for the small firm effect. Over the last decade the “premium” from investing in small stocks has been negative. Our dividend series indicates that this recent underperformance, and the earlier outperformance, may largely be attributed to the underlying fundamental performance of smaller companies.

The broad message is a simple one. The UK has experienced a financial market history that is comparable to the US, Germany and Japan. However, there are also several interesting differences. The availability of our new monthly index series for the UK will provide the opportunity to investigate a range of issues related to the British capital market and its linkages with other countries, and will facilitate comparisons between the world's major economies.

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FOOTNOTE

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Table 1: Prior Estimates of Annualised Real Rates of Return*

Country†	Period	Small stocks		Equities		Bonds		Bills		Inflation	
Australia	1937-94			5.1	(23)	0.0	(10)	-0.0	(4)	5.9	(4)
Canada	**1950-87**	**10.**	**(25)**	**6.4**	**(18)**	**-0.6**	**(10)**	**0.7**	**(4)**	**4.8**	**(4)**
France	**1950-92**	**7**		**9.2**	**(24)**	**4.2**	**(6)**			**6.3**	**(5)**
Germany	**1954-88**		**(25)**	**8.7**	**(28)**	**3.9**	**(6)**	**2.2**	**(2)**	**3.1**	**(2)**
Italy	1861-94	**11.**		3.3	(26)	-0.1	(14)	**-2.2**	(11)		
Japan	**1971-92**	**4**	**(35)**	**6.6**	**(29)**	**2.8**	**(9)**	**1.6**	**(4)**	**5.0**	**(5)**
Netherlands	1947-95			6.8	(22)	1.3	(8)	1.0	(4)	4.3	(3)
New Zealand	**1931-92**	**11.**		**4.4**	**(23)**	**0.2**	**(9)**	**0.9**	**(5)**	**5.7**	**(6)**
Spain	1941-90	**0**		2.6	(25)			-2.0	(6)	9.2	(7)
Sweden	**1919-90**			**5.8**	**(21)**	**1.2**	**(10)**	**2.1**	**(6)**	**3.5**	**(6)**
Switzerland	1926-93			5.3	(20)	2.0	(6)			2.5	(4)
UK	1919-98			8.0	(23)	2.4	(15)	1.5	(7)	4.1	(7)
USA	**1926-99**		**(33)**	**8.0**	**(20)**	**2.0**	**(11)**	**0.7**	**(4)**	**3.1**	**(4)**
		9.3									

*Standard deviation of annual returns in parentheses. Bold typeface = Based on monthly returns. Roman typeface = Based on annual returns (monthly data not available).

†Sources: Australia, Russell (1995) and Officer (1989); Canada, Hatch and White (1986,1988); France, Gallais-Hamono and Arbulu (1995); Germany, Stehle and Hartmond (1991) and Stehle (1992); Italy, Panetta and Violi (1999); Japan, Hamao (1991) and Hamao and Ibbotson (1995); Netherlands, Van Schaik (1996); New Zealand, Chay, Marsden and Stubbs (1993);

Spain, González and Suárez (1994); Sweden, Frenneberg and Hansson (1992); Switzerland, Wydler (1989) and Tolle, Bagutti and Wydler (1994); United Kingdom, Barclays Capital (1999); United States, Ibbotson and Sinquefield (1976) and Ibbotson (2000).

Table 2: Details of Asset Returns Series Used in this Study

Asset	Composition of index at rebalancing date	No of constituents	
	1.1.2000	1955-99	
All equities	Comprehensive index of all equities*	2172	1308
High-cap equities	Largest 90% by cumulative value of all equities*	419	186
Low-cap equities	Next 9% by cumulative value of all equities*	958	495
Micro-cap equities	Smallest 1% by cumulative value of all equities*	795	627
Long-maturity bonds	All high-coupon gilts with maturity of 15½-30½ years	4	2
Mid-maturity bonds	All high-coupon gilts with maturity of 4½-6½ years	2	2
Index-linked bonds	All index-linked gilts with maturity of 15½-25½ years	3	2
Treasury bills	Rolled-over 90-day treasury bills	1	1
Inflation	Retail Price Index (before 1962, Index of Retail Prices)	1	1

*Excluding closed-end funds. At 1.1.2000, there were 359 closed-end funds listed on the London Stock Exchange, accounting for 3.4 per cent by market capitalization of the UK equity market.

Table 3: Composition of Size-Decile Portfolios as at 1.1.2000

A: Market value deciles		B: Deciles by no of companies	
Decile	No of companies %	Decile	Market value %
MV1 (Large)	0.15	No 1 (Large)	85.50
MV2	0.15	No 2	7.86
MV3	0.23	No 3	2.93
MV4	0.38	No 4	1.62
MV5	0.69	No 5	0.95
MV6	1.07	No 6	0.54
MV7	1.61	No 7	0.30
MV8	2.75	No 8	0.17
MV9	7.19	No 9	0.09
MV10 (Small)	85.78*	No 10 (Small)	0.04

*Of which, the low-cap index (top nine-tenths of MV10) is 47.94% and the micro-cap index (smallest tenth of MV10) is 37.84%

Table 4: Definition of Component Returns Derived in this Study

Component return*	Definition of component return series	Start date
Micro-cap premium	Micro-cap equities return *relative to* High-cap return	1955
Low-cap premium	Low-cap equities return *relative to* High-cap return	1955
Equity risk premium	High-cap equities return *relative to* Treasury bill return	1955
Long-maturity premium	Long-maturity bond return *relative to* Treasury bill return	1955
Mid-maturity premium	Mid-maturity bond return *relative to* Treasury bill return	1955
Real term premium	Index-linked bond return *relative to* Treasury bill return	1981
Real rate of interest	Treasury bill return *relative to* Inflation rate	1955

*Each component *c* is the difference between two total elements, an asset return *a* and a benchmark return *b*. The differencing may be arithmetic, i.e. $c = a - b$, or it may be geometric, i.e. $(1+c) = (1+a) / (1+b)$.

Table 5: Summary Statistics for Annual Returns on UK Assets, 1955-99

Asset return	Geometric mean return (capital gain)	Arithmetic mean return (capital gain)	Standard deviation	Max return	Min return	Percent ≥ zero	Percent highest	Serial correlation	Skew-ness	Kurt-osis
Nominal Returns										
Micro-cap equities	21.2 (14.3)	24.7 (17.7)	24.7	96[f]	-39[d]	87	42	.06	-0.3	0
Low-cap equities	17.2 (11.1)	20.9 (14.6)	25.6	119[e]	-52[d]	80	9	-.10	-0.5	2.6
High-cap equities	15.0 (9.6)	17.9 (12.5)	22.9	145[e]	-49[d]	78	22	-.21	-0.3	4.0
All equities	15.3 (9.9)	18.2 (12.7)	22.7	146[e]	-49[d]	78	2	-.23	-0.3	4.3
Long-maturity bonds	8.5 (-0.5)	9.4 (0.3)	12.9	53[i]	-17[d]	76	9	.02	0.6	0.4
Mid-maturity bonds	8.9 (0.4)	9.2 (0.6)	7.6	36[i]	-5[a]	84	4	-.03	0.7	0.7
Index-linked (1981-99)	8.5 (5.5)	8.8 (5.8)	7.8	23[k]	-8[j]	84	0	-.22	-0.2	-0.6
Treasury bills	8.3	8.3	3.2	17[g]	3[a]	100	11	.83	0.6	-0.6
Inflation	6.3	6.4	4.7	25[e]	0[b]	98		.80	1.5	2.1
Real Returns										
Micro-cap equities	14.0 (7.5)	17.6 (10.9)	25.7	88[b]	-48[d]	78	42	.10	-0.6	1.3
Low-cap equities	10.3 (4.5)	13.8 (7.9)	26.3	83[f]	-60[d]	71	9	-.05	-1.1	3.4
High-cap equities	8.1 (3.1)	10.9 (5.7)	23.4	96[e]	-57[d]	71	22	-.14	-1.1	4.4
All equities	8.5 (3.4)	11.1 (6.0)	23.2	97[e]	-57[d]	73	2	-.16	-1.2	4.7
Long-maturity bonds	2.1 (-6.4)	3.0 (-5.5)	13.5	45[i]	-31[d]	49	9	.09	0.1	0.9
Mid-maturity bonds	2.4 (-5.6)	2.8 (-5.3)	8.1	29[i]	-12[c]	67	4	.09	0.3	0.1
Index-linked (1981-99)	3.7 (0.9)	4.1 (1.2)	8.7	20[k]	-12[h]	74	0	-.12	-0.2	-0.6
Treasury bills	1.8	1.9	3.7	8[i]	-11[e]	73	11	.74	-1.2	2.6

a=1955 b=1959 c=1973 d=1974 e=1975 f=1977 g=1980 h=1981 i=1982 j=1994 k=1998

Table 6: Correlations Between Annual Asset Returns, 1955-99

Asset return	Micro-cap equities	Low-cap equities	High-cap equities	Long-mat bonds	Mid-mat bonds	Index-linked	Bills	Inflation
Micro-cap equities	1.00	**.92**[*]	**.69**	**.38**	**.12**	**-.08**	**-.29**	**-.13**
Low-cap equities	*.92*[*]	1.00	**.88**	**.55**	**.31**	**.04**	**-.17**	**-.07**
High-cap equities	*.71*	*.89*	1.00	**.62**	**.41**	**.52**	**.01**	**.00**
Long-maturity bonds	*.45*	*.59*	*.64*	1.00	**.87**	**.73**	**.26**	**.05**
Mid-maturity bonds	*.26*	*.39*	*.46*	*.89*	1.00	**.58**	**.49**	**.20**
Index-linked (1981-99)	*.08*	*.21*	*.59*	*.76*	*.64*	1.00	**-.04**	**-.28**
Treasury bills	*.05*	*.07*	*.15*	*.41*	*.58*	*.23*	1.00	**.61**
Inflation	*-.31*	*-.24*	*-.20*	*-.30*	*-.39*	*-.50*	*-.73*	1.00

[*]Bold typeface = Nominal returns. Italic typeface = Real returns

Table 7: Summary Statistics for Annual Component Returns, 1955-99

Component	Geometric mean	Arithmetic mean	Standard deviation	Max return	Min return	Percent ≥ zero	Serial correlation	Skew-ness	Kurt-osis
Arithmetic Premia									
Micro-cap premium	2.5	6.8	32.7	60[j]	-80[d]	62	.06	-2.8	12.3
Low-cap premium	1.8	3.0	15.5	58[e]	-31[h]	58	.16	0.2	1.0
Equity risk premium	6.3	9.6	25.8	134[d]	-61[c]	64	-.21	-0.8	5.2
Long-maturity premium	0.2	1.1	13.6	40[g]	-30[c]	44	-.04	0.4	0.6
Mid-maturity premium	0.6	0.9	7.3	23[e]	-12[b]	53	-.20	0.7	0.4
Real term premium (1981-99)	-1.3	-0.9	9.2	16[i]	-15[f]	53	.03	0.1	-0.9
Real rate of interest	1.8	1.9	4.2	8[g]	-14[d]	73	.72	-1.6	4.4
Geometric Premia									
Micro-cap premium	5.4	7.2	18.9	50[j]	-33[d]	62	.19	-0.4	-0.4
Low-cap premium	2.0	2.7	12.1	39[e]	-22[h]	58	.18	0.3	0.4
Equity risk premium	6.2	9.0	23.1	121[d]	-54[c]	64	-.21	-0.5	4.3
Long-maturity premium	0.2	1.0	12.4	35[g]	-27[c]	44	-.05	0.4	0.5
Mid-maturity premium	0.6	0.8	6.7	21[e]	-11[b]	53	-.20	0.7	0.3
Real term premium (1981-99)	-1.0	-0.7	8.5	15[i]	-13[f]	53	.02	0.1	-0.9
Real rate of interest	1.8	1.9	3.7	8[g]	-11[d]	73	.74	-1.2	2.6
Inflation	6.3	6.4	4.7	25[d]	0[a]	98	.80	1.5	2.1

a=1959 b=1973 c=1974 d=1975 e=1977 f=1981 g=1982 h=1989 i=1998 j=1999

Table 8: Correlations Between Component Returns, 1955-99

Geometric premia	Micro-cap premium	Low-cap premium	Equity risk premium	Long-mat premium	Mid-mat premium	Real term premium	Real rate of interest	Inflation
Micro-cap premium	1.00	**.88**[*]	**-.26**	**-.16**	**-.20**	**-.19**	**-.13**	**-.16**
Low-cap premium	*.87*[*]	1.00	**.02**	**.10**	**.03**	**-.22**	**-.16**	**-.14**
Equity risk premium	-*.59*	-*.38*	1.00	**.63**	**.46**	**.56**	**.00**	**-.09**
Long-maturity premium	-*.21*	-*.06*	*.37*	1.00	**.88**	**.72**	**.15**	**-.11**
Mid-maturity premium	-*.25*	-*.08*	*.41*	*.84*	1.00	**.59**	**.15**	**-.07**
Real term premium (1981-99)	-*.23*	-*.12*	*.33*	*.52*	*.58*	1.00	**.02**	**-.52**
Real rate of interest	*.05*	*.00*	-*.10*	*.06*	*.02*	*.00*	1.00	**-.73**
Inflation	-*.13*	-*.07*	*.08*	-*.04*	*.02*	-*.05*	-*.91*	1.00

[*]Bold typeface = Annual returns. Italic typeface = Monthly returns

Table 9: International Comparison of Annual Component Returns, 1955-99

Geometric premia	Micro-cap premium	Low-cap premium	Equity risk premium	Long-mat premium	Mid-mat premium	Real rate of interest	Inflation
			Geometric Mean				
UK	5.4	2.0	6.2	0.2	0.6	1.8	6.3
US	0.3	1.0	6.2	0.4	1.0	1.3	4.2
Germany	3.4	1.2	6.3	1.9	na	1.8	3.0
Japan	-0.6*	2.7*	7.0	2.7	na	1.0	4.1
			Arithmetic Mean				
UK	7.2	2.7	9.0	1.0	0.8	1.9	6.4
US	1.6	1.7	7.3	0.9	1.2	1.4	4.2
Germany	4.7	1.6	8.9	2.0	na	1.8	3.0
Japan	0.5*	3.6*	9.7	3.9	na	1.1	4.1
			Standard Deviation				
UK	18.9	12.1	23.1	12.4	6.7	3.7	4.7
US	16.5	12.0	15.5	10.3	5.7	2.2	3.1
Germany	16.2	9.5	22.3	5.8	na	1.8	1.8
Japan	15.5*	13.3*	22.5	15.2	na	3.8	4.1
			Serial Correlation				
UK	.19	.18	-.21	-.05	-.20	.74	.80
US	.35	.33	-.10	-.08	-.12	.71	.78
Germany	.19	.23	.08	.01	na	.72	.76
Japan	-.10*	-.20*	-.01	-.36	na	.68	.69
			Correlation with Equity Risk Premium				
UK	-.26	.02	1.00	.63	.46	.00	-.09
US	.26	.24	1.00	.29	.22	.24	-.40
Germany	-.35	-.36	1.00	.35	na	.05	-.31
Japan	-.14*	-.10*	1.00	.18	na	.28	-.29
			Correlation with Inflation				
UK	-.16	-.14	-.09	-.11	-.07	-.73	1.00
US	.07	.14	-.40	-.36	-.32	-.50	1.00
Germany	.09	.17	-.31	-.20	na	-.43	1.00
Japan	.26*	.14*	-.29	-.13	na	-.87	1.00

*Data commence in 1971

Table 10: Mean Monthly Arithmetic Premia, 1955-99

	Equity premium		Micro-cap premium	
Month	US	UK	US	UK
January	0.99	2.83	5.81	.60
February	.43	.64	.81	1.27
March	.70	1.05	.74	.03
April	1.03	2.67	-.62	-.27
May	.21	-.46	-.31	1.63
June	.27	-.71	-.76	.59
July	.47	-.24	.00	.88
August	.10	.91	-.19	-.66
September	-.93	-.65	.20	.67
October	.52	-.10	-2.64	.37
November	1.71	.08	-.57	.27
December	1.28	1.86	-.81	-.63
Jan *minus* non-Jan	**0.46**	**2.38**	**6.19**	**.23**
Apr *minus* non-Apr	**0.51**	**2.20**	**-0.82**	**-.73**
KW	13.77	24.11**	63.58****	21.78**

Kruskall-Wallis (KW) test statistic denotes significance at the * 10%, ** 5%, *** 1% or **** 0.1% level

Table 11: Correlations between Monthly Bond Returns, April 1981-December 1999

Statistic	Inflation	Treasury bills	Mid-maturity bonds	Long-maturity bonds	Index-linked bonds
United Kingdom					
Mean real return (%)	.00	.39	.54	.69	.30
Standard deviation (%)	.00	.48	1.83	2.98	2.43
Serial correlation (nominal returns)	.24	.98	.11	.08	-.02
Correlation with inflation	1.00	**.35***	**-.04**	**-.11**	**-.01**
Correlation with treasury bills	*-.87**	1.00	**.20**	**.10**	**.01**
Correlation with mid-maturity bonds	*-.31*	*.38*	1.00	**.89**	**.58**
Correlation with long-maturity bonds	*-.27*	*.31*	*.90*	1.00	**.52**
Correlation with index-linked bonds	*-.22*	*.19*	*.60*	*.55*	1.00
United States					
Mean real return (%)	.00	.24	.51	.64	na
Standard deviation (%)	.00	.25	1.62	3.18	na
Serial correlation (nominal returns)	.47	.95	.21	.06	na
Correlation with inflation	1.00	**.41**	**-.10**	**-.19**	na
Correlation with treasury bills	*-.60*	1.00	**.20**	**.10**	na
Correlation with mid-maturity bonds	*-.25*	*.35*	1.00	**.91**	na
Correlation with long-maturity bonds	*-.26*	*.31*	*.92*	1.00	na

*Bold typeface = Correlation of nominal returns. Italic typeface = Correlation of real returns

Table 12: Real Dividend Growth Rates for UK and US Equities, 1955-99

Country and index	Differencing interval	Geometric mean	Arithmetic mean	Standard deviation	Serial correlation	Standard error of serial correlation
Growth rates based on monthly dividend payments*						
UK	Monthly	0.17	39.57	138.34	-0.23	0.04
All equities	Quarterly	0.51	13.42	63.68	-0.49	0.07
(This study)	Annual	2.04	2.59	10.92	0.07	0.15
US	Monthly	0.09	52.70	152.14	-0.41	0.04
CRSP	Quarterly	0.28	0.76	9.30	-0.58	0.07
(All NYSE)	Annual	1.11	1.20	4.56	0.24	0.15
Growth rates based on rolling annual yields*						
UK	Monthly	0.11	0.13	3.72	-0.47	0.04
FTSE	Quarterly	0.32	0.58	4.49	0.12	0.07
All Share	Annual	1.30	1.52	6.76	0.42	0.15

*The upper panel is based on monthly dividend payments for stocks that go ex-dividend. The lower panel is based on published rolling annual dividend yields for the UK FTSE All Share index, and before 1962, a reconstructed index that follows the same principles.

Table 13: Decomposition of the Annualised Micro-cap Premium, 1955-99

Period	Micro-cap premium	Initial income premium	Relative dividend growth	Relative change in P/D ratio	Impact of income fluctuations
			United Kingdom		
1955-78	11.00	4.61	5.07	2.93	-1.89
1955-83	9.28	4.61	3.65	3.29	-2.42
1955-88	**9.70**	**4.61**	**4.46**	**3.36**	**-2.88**
1955-93	6.25	4.61	1.82	3.06	-3.21
1955-99	5.38	4.61	2.82	1.42	-3.40
1979-99	-.57	.04	.41	-.21	-.81
1984-99	-1.27	-.93	1.39	-1.78	.07
1989-99	**-6.79**	**-1.55**	**-1.95**	**-4.20**	**.79**
1994-99	-.35	-1.41	9.38	-8.40	.88
			United States		
1955-78	3.97	.04	3.09	1.70	-.87
1955-83	5.50	**.04**	**4.28**	**2.45**	**-1.29**
1955-88	3.48	.04	3.46	1.32	-1.32
1955-93	1.96	.04	.79	2.52	-1.37
1955-99	.35	.04	2.11	-.66	-1.11
1979-99	-3.47	-1.61	1.04	-3.18	.29
1984-99	-8.06	**-2.14**	**-1.59**	**-5.88**	**1.43**
1989-99	-8.47	-1.45	-1.84	-6.38	1.07
1994-99	-9.26	-1.68	10.89	-18.62	2.27

Micro-cap premium is defined in Table 4. Initial income premium is *1+initial income on micro-caps* divided by *1 + initial income on high-caps* less one. Relative dividend growth is *1 + dividend growth of micro-caps* divided by *1 + dividend growth of high-caps* less one. Relative change in P/D ratio is *1 + change in micro-cap P/D ratio* divided by *1 + change in high-cap P/D ratio* less one. Impact of income fluctuations takes account of differences between initial income and average income over the entire period. All figures are annualised percentages. In bold typeface we highlight the periods before and after dissemination of research results on the UK and US small firm effects.