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Eric Brown (University of Edinburgh)

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University of Edinburgh
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Long-Run Performance Analysis of a New Sample of UK IPOs

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Abstract

36 month buy-and-hold returns are calculated for a recent sample of initial public offerings (IPOs) on UK stock markets in order to test the robustness of earlier results which suggest that IPOs deliver abnormally low long-run returns. A bootstrapped and skew-adjusted t statistic is employed. Overall, there is little evidence of significant abnormal long-run performance. Further tests reveal that the electronics and information technology IPOs experienced by far the highest initial returns but their long-run abnormal performance was poor. This may be the result of chance, or alternatively the sector may offer an isolated area of empirical support for theories of irrational stock market behaviour.

JEL Classification: G12, G15, G12, G14,
Key words: abnormal security returns, bootstrapped t-statistic, noise traders

*Eric Brown, University of Edinburgh, Department of Economics, William Robertson Building, George Square, Edinburgh EH8 9JY, UK, tel: (0)131 650 3840, fax: (0)131 650 4514, email: ebrown@ed.ac.uk

Long–Run Performance Analysis of a New Sample of UK IPOs

1. Introduction

Three features of the performance of initial public offerings (IPOs) have been highlighted. They are that initial returns on IPOs are, on average, abnormally high; that the magnitude of this abnormally high initial return is variable, indeed cyclical; and that in the longer run, IPOs yield significantly *negative* abnormal returns. The first two propositions are more strongly supported by empirical evidence than is the third. This paper contributes to the research on the three issues, but focuses on the third, that of long-run abnormal performance. The principal conclusion is that the IPOs in this new dataset do not display general long-run abnormal performance which is statistically significant.

Broadly, there are three ways in which the paper builds or sheds further light on the results of existing research in this area. Firstly, the new dataset examined here covers IPOs issued in UK between 1990Q2 and 1995Q1 and is as recent as possible. This is of interest because other efficient markets anomalies such as the size effect and certain patterns of serial correlation in stock returns have tended to get weaker over time, and it may be that a parallel trend is occurring or will occur in long-run IPO performance. Secondly, since there have recently been highlighted various problems with both the measurement of abnormal returns and the specification of tests for non-zero abnormal returns, a bootstrapped skew adjusted test statistic has been employed. Thirdly, the paper presents results on abnormal returns which control for industry sector. Industry sectory is not, admittedly, a risk factor which is frequently suggested in portfolio theory but the analysis throws up some curious results which may be of interest to the proponents of behavioural finance and “noise trader” theories in particular: the performance of information technology related IPOs, (quite plausibly those which attracted the most attention from “noise traders” during the period) is quite different from the performance of IPOs in any other industry sector. Information technology related IPOs experience initial returns far in excess of those in any other industry sector but then drastically underperform the rest of their own industry sector during the subsequent three years. Both of these findings are statistically significant.

The central hypothesis under investigation is that IPOs underperform in the long-run: on average, they yield significant negative abnormal returns during their first few years of trading. Evidence of this anomaly has been documented, for example, by Ritter (1991) and Ritter and Loughran (1993) using US data, and by Levis (1991, 1993), and Espenlaub *et al* (1997) using data from the UK. It’s an intriguing hypothesis which appears to contradict fundamental efficient markets tenets. Confirmation would clearly raise a difficult question for economists : if IPOs consistently and significantly underperform during their first few years of trading, why does anyone ever buy them?

The matter of long-run performance is germane to research on IPO performance more broadly. *Positive* and highly significant *initial* abnormal returns for IPOs (meaning returns over the first day or two of trading), are an empirical phenomenon almost universally accepted, and confirmed in the present dataset. There has grown a large theoretical literature which seeks to explain this phenomenon[1]. Frequently the premise is that IPOs are underpriced by firm owners and/or their advisers, and the theories seek to explain this underpricing. If, however, it is confirmed that IPOs perform poorly during the early years of trading, then this basic premise in the analysis of initial returns must be faulty. A satisfactory theory of IPO performance would not explain why IPOs are underpriced at issue, but why the open market price jumps up irrationally when the stock starts trading, only for these initial gains to be dissipated slowly over subsequent years. This would appear to be a far more perplexing puzzle. To summarize this point, existing evidence of short-run overperformance and long run underperformance of IPOs suggests that theoretical research is incomplete or misguided if it seeks *only* to explain IPO *underpricing*. If the results on long-run performance presented in this paper gain credence, however, IPO underpricing *is* in fact the only empirical puzzle.

Existing research on long term returns has tended to follow the IPOs for 3 or 5 years after issuance. No particular length of post-event window is suggested by theory. In order to permit as recent a dataset as possible a post event window of 3 years is used in this paper. A consequence of this decision is that the present dataset overlaps very little with IPO datasets used in existing research. It is also the case that since measurement error in the calculation of abnormal returns is inevitable, and since this error must increase with the length of the post-event window, tests which are directed at longer horizon returns are more susceptible to the econometric problems discussed below.

Results from this type of investigation can be sensitive to the model of abnormal returns and the test statistic which are employed. This paper relies on the market-adjusted returns model to account for expected return. The market adjusted returns model is usually employed in conjunction with a broad-based stock index such as the FTSE Allshare. The results of this procedure are set out below but in a further experiment the the same model is implemented with the FTSE *sector indices* taking the place of the Allshare index. This represents an attempt to control for the effects of industry clustering within the sample. The analysis concentrates on the buy and hold abnormal returns ($\overline{BHAR}$ s) of the sample. $\overline{BHAR}$ s are essentially averages which can be equal weighted or value weighted (by market capitalisation) across a sample. This distinction proves to be important and results using both forms of statistic are presented. There is

[1] See Ibbotson and Ritter (1997) for a very comprehensive survey

a discussion of some of the methodological difficulties in section 3 below.

Section 2 describes the data. Section 3 discusses methodology and test statistics. Section 4 presents results. Section 5 concludes.

2. Data

The starting point for data collection was KPMG's quarterly publication "New Issue Statistics", which reports all new issues of stock to markets organized by the International Stock Exchange in London. After excluding rights issues, seasoned equity offers, investment trust issues and the government's privatisation issues, returns information was collected on the remaining issues using Datastream[2]. Datastream was also the source of the FTSE Allshare index and the FTSE sector indices data. Ideally, all IPOs would be included, (including those on the Unlisted Securities Market), but Datastream does not carry researchable historic price information for all listed firms. Data was collected successfully for 232 out of 288 IPOs fitting the criteria set out above; the equity raised in the 232 included offerings was £10.137bn which is 91.36% of the total amount raised in the 288 offerings.

The root of the missing data problem is that many IPOs are extremely small. Frequently floated by way of placement to a small number of specialist institutional investors, such issues can be highly illiquid after flotation and, in fact, very rarely traded. When such a stock doesn't trade for days on end, a daily closing price series, even if available, may not be particularly helpful.

Datastream generates a total returns index which is ideal for the calculation of $\overline{BHAR}$s and CAARs. The index is available at daily frequency. It incorporates all dividends on the appropriate

[2] Espenlaub, Gregory and Tonks (1997) exclude privatisation issues from their IPO dataset, but Levis (1993) does not. It is arguable that the motivations for the decision to sell, and indeed the pricing decision itself, may be different in the case of government privatisations. For example, the government may deliberately offer shares cheaply "to leave a good taste in investors' mouths", if it cares more about encouraging new shareholders than does a private firm. As a practical matter, the main suspicion must be that privatisation issues are offered cheaply in order to help the government's popularity with investors and as such we suspect that government IPO's long-run returns may have a positive bias. Since we have in mind a one tailed alternative hypothesis that IPOs *under*perform on average, the exclusion of such issues

dates and is adjusted for scrip issues, rights issues and other recapitalisations.

Table 1 presents summary statistics on the dataset. IPO issuance clearly varies with the economic cycle: issuance is low in the early years of the sample, a period in which the UK economy was close to, or in, recession. Stock market valuations at that time were relatively depressed. Table 2 contains the same data, sorted by market sector rather than by year of flotation. Compared with earlier datasets used in existing research, Table 2 illustrates an increase in information technology related issues and a decline in the importance of extractative industries.

from the dataset should lead to tests which are more demanding.

Table 1: Summary Statistics

year	number of IPOs	total funds raised (£m)	average funds raised per IPO (£m)	total market value on flotation (£m)
1990-91	9	32.372	3.60	1751.47
1991-92	13	748.585	57.58	1648.23
1992-93	28	1701.795	60.78	4219.36
1993-94	98	3808.191	38.86	7871.27
1994-95	84	3846.048	45.79	11014.27
1990-95	232	10136.991	43.69	26504.60

Table 2: Summary Statistics by Industry

Market Sector	number of IPOs	total funds raised (£m)	Average funds raised per IPO (£m)	total market value on flotation (£m)
healthcare and pharmaceuticals	23	576.689	25.073	1475.768
food production, forestry and paper, packaging, engineering, autos, chemicals, construction and building materials, diversified industrials	43	2421.862	56.322	5010.710
oil, gas, mining	10	160.165	16.017	391.630
transport and distribution	27	735.912	27.256	1453.170
beverages, restaurant, leisure, media	33	1743.448	52.832	6398.440
banks, insurance, real estate and speciality financial	34	1327.924	39.057	3688.120
electronics, infotech hardware, computer software services, support services, telecommunications	40	1573.621	39.341	5254.283
retailing, stores, household goods	22	1597.370	72.608	2832.480
All	232	10136.991	43.694	26504.601

3. Methodology

In order to measure abnormal return, it is first necessary to have some notion of normal return. This is not an important matter in the analysis of initial returns, since the post event window is just a day, but it is very important in the analysis of long-run returns.

In this paper, the analysis of *initial* returns uses raw returns data, i.e. returns which don't take any account of what a normal return, (expected return), might be. As illustrated in Section 4 below, IPO raw returns on the first day of trading are of such a magnitude and variance that differences in the underlying model of expected return or "normal return" are of second order. The initial returns observed in existing research on IPOs range from 5% to over 20% during particular sub-periods in particular markets (the variation over subperiods appears to be cyclical and has been described as the "hot markets phenomenon"). This compares with an average daily return on ordinary UK stock of somewhere between 0.025-0.03% in postwar data.

For any analysis of *long-run* returns, however, a model of expected return is most certainly required. The model which has been used most frequently in existing research on IPOs is the market adjusted returns model. This model measures abnormal return in a particularly straightforward way:

(1) $ar_{it} = r_{it} - r_{mt}$

Abnormal return is the raw return on the IPO minus the return on the market during a particular period. Usually, the return on the market will be measured by a broad share price index, such the FTSE Allshare Index.

Clearly, this model has the advantage of simplicity, but just as clearly it is not an accurate representation of any conventional portfolio theory. Any such theory of expected asset returns would predict more cross-sectional variation in expected return. The market adjusted returns model implies that the expected return of any asset, or any portfolio for that matter, is the same. In the context of the traditional CAPM for example, it implies the restriction that the beta coefficient for any and all assets is 1. The unrestricted CAPM suggests that the expected return from an asset depends positively on its covariance with the market portfolio. Some writers have calculated an estimate of the CAPM beta using ex post price data[3], but this approach suffers from a drawback in that it imposes an extra data requirement (of at least two years) for parameter estimation. Furthermore, deviations from the CAPM have been well documented, and appear to be frequent. Applications of the CAPM in IPO research have suggested that beta coefficients may not be stable over time[4]. Nor has there emerged any other equilibrium model of asset prices which performs well enough empirically to gain the support of a majority. Of course any model is an imperfect description of reality so an amount of measurement error is inevitable. All models are wrong and this “bad model problem” can be a serious one leading to misspecified test statistics. There is evidence to suggest, however, that the market adjusted returns model is often the model under which the size and power of subsequent hypothesis tests are least inaccurate[5]. From this pragmatic point of view, the primitive market adjusted model of abnormal returns may be as good as a more complicated procedure.

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[3] See Espenlaub, Gregory, Tonks(1997) for example.

[4] Ibbotson (1975), Levi(1995)

[5] This was one of the conclusions of Brown and Warner (1980), supported more recently by Barber and Lyon (1997)

There is, though, at least one caveat: a sample of IPOs typically includes a very wide range of firm size. It is unlikely to reflect accurately the size composition of any particular market index, so calculations of abnormal returns may not be accurate if firm size is a determinant of return[6]. In the present sample more than half of the IPOs are capitalized at £50m or less at the initial offering price, while at the other end of the spectrum the average initial market capitalization over the largest 5 IPOs is over £2bn per firm. Thus the present sample has a higher proportion of small stocks than the FTSE Allshare.

Even if size doesn't matter there are further problems with the calculation of statistics based on index adjusted abnormal returns. These problems are taken up below.

Test Statistic

The test statistic which has proved most popular in existing literature is the CAAR. Briefly, the average abnormal return over all IPOs in the sample during event month *t* is the average abnormal return,

$$(2) \quad AAR_t = \frac{1}{n}\sum_{i=1}^{n} ar_{it}$$

and the cumulative average abnormal return (CAAR) over *T* months is just

[6] Relative returns on small stocks and large stocks have certainly varied widely in the past. For a long time there was evidence that on average small stocks yielded significantly higher returns than large stocks. This was known as the size effect, but it is an anomaly which is undetectable in recent data. In fact small firms have on average yielded lower returns than large firms during most years in the last decade in both the US and the UK.

(3) $CAAR_T = \sum_{t=1}^{T} AAR_t$

In order to test the null hypothesis $H_0 : CAAR_T = 0$ against the one-sided alternative $H_1 : CAAR_T < 0$, the test statistic

(4) $t = CAAR_T / (\sigma(AAR_t) * T^{1/2})$

has been used. $\sigma(AAR_t)$ is unknown, and must be estimated from the data. A complication is that $\sigma(AAR_t)$ clearly ought not to be constant over the test period if the number of firms in the sample is falling due to delistings.

The alternative methodology involves calculation of buy and hold returns (*BHAR*s):

(5) $BHAR_{iT} = \prod_{t=1}^{T}(1 + r_{it}) - \prod_{t=1}^{T}(1 + r_{mt})$

The mean abnormal return is

(6) $\overline{BHAR_T} = \frac{1}{n}\sum_{i=1}^{n} BHAR_{it}$

and a test statistic might be

(7) $t = \overline{BHAR_T} / \hat{s}(BHAR_{iT}) * n^{1/2}$

Conceptually, CAARs are less attractive statistics because they imply a counterintuitive form of portfolio rebalancing. Equation (2) is an equal weighted arithmetic average. Equation (3) is a summation of these equal weighted averages. The implication is that at the end of every month the portfolio is rebalanced back to equal weights. That is, to receive the return reported by the CAAR, an investor would have to sell off some of the winning stocks and buy more of the losing stocks at the end of each month. For example, imagine that there are only two IPOs in a sample, both issued on the same day. One issue yields a return of 50% in the first month and a further 50% in the second month. The other issue yields a return of -50% in the first month and the same again in the second month. The benchmark is a stock index which does not move in price over the 2 month period. Clearly, the AAR in both months is zero, and therefore the 2 month CAAR is zero. But it is just as clear that £100 invested in each of the IPOs would be worth more after 2 months than £200 in the stock index.(The IPOs would be worth £100*1.5*1.5 + £100*0.5*0.5=£250 whereas the stock index is still worth £200. The BAHR would be (2.25+0.25)/2=1.25 suggesting an abnormal return of +25%.)

The example shows that the two statistics measure different things. *CAAR*s can be used to test the null hypothesis that the average monthly abnormal returns are zero in the *T* months after issuance. $\overline{BHAR}$ s, on the other hand, allow tests of the hypothesis that average *T*-period abnormal returns are zero. The latter concept corresponds more closely to the ordinary understanding of *long-term* abnormal returns. CAARs generate results which are clouded by the effects of a particular trading strategy, (monthly rebalancing is exactly that, a trading strategy, and an odd one too.) $\overline{BHAR}$ s are therefore conceptually more appealing statistics. The *t* statistic in (7) applies to a null that the average (three year) return on an IPO is equal to the average three year return on the market portfolio. It is not the case that the CAAR must always be lower than the BHAR - this depends on the serial correlations in the sample IPO returns and in the benchmark portfolio itself.

Potential biases

In a famous paper Brown and Warner (1980) presented a step by step guide for good practice in tests for abnormal security returns. They highlighted several reasons to suspect test statistic misspecification in many long-run event studies. The issues which were raised proved only to be the tip of an iceberg. More has been discovered recently by Kothari and Warner (1997), Barber and Lyon, (1997), and Lyon Barber and Tsai (1998) among others. Tests of long-run abnormal security performance, whether based on the CAAR or the $\overline{BHAR}$, are likely to be subject to a skewness bias, a rebalancing bias, and possibly a new listings bias. Certain measures may alleviate or occasionally remove these problems, (see below), but even if such measures are followed diligently the resulting test statistics will only be well specified in truly random samples, circumstances which are simply are not available in most event studies. Industry clustering, calendar time clustering, nonrandom levels of pre-event level returns performance and book to market value are elements of non-randomness which have been shown to affect adversely the size and power of conventional *t*-tests.

Security returns in all markets over all time periods are right-skewed. The longer is the holding period the greater is the extent of the skewness, so in the present context it is clear that $\overline{BHAR}$ s will be more skewed than CAARs. Positive skewness in the distribution of returns leads to negative skewness in the sampling distribution of the standard t-test statistic. This leads to overrejection of the null in favour of an alternative of negative abnormal performance. Loosely, this is because when a particular sample includes some observations from the (large) right tail of the distribution, this sample will have a higher than normal variance due to the presence of these outliers, and this higher variance depresses the t-statistic.

The rebalancing bias arises from market microstructure considerations. The reported closing price of a stock may be the bid price (if the client in the last trade was a seller) or it may be the offer price (if the client in the last trade was a buyer). Thus even if the real price of a stock does not move for several periods on end the official closing price probably would move. In this case the CAAR, which is constructed on the basis of monthly rebalancing, would incorporate a spurious (unattainable) trading profit. The direction of this bias is complicated in cases where a stock index is used in the model of normal returns, because the index itself is rebalanced from time to time. $\overline{BHAR}$ s constructed with the aid of market indices which are themselves rebalanced will be biased downwards (since there is definitely no rebalancing in the data on the sample firm), but the direction of this rebalancing bias on CAARs is not clear.

Since there has been evidence from USA presented by Ritter (1991) and others to suggest that IPOs underperform in the long-run, it may be that the use of a market index based model of expected return may bias upwards the abnormal performance of a truly random sample of stocks, since the market index includes these IPOs which tend to underperform. The point of the present investigation, however, is to investigate the robustness of this very finding. A circular argument arises if this argument is adopted as a premise, but more importantly, if it is true then the tests below should still identify negative abnormal performance for IPOs, even if its magnitude cannot be identified perfectly.

To summarize the conclusions of this research on event study methodology, rebalancing bias suggests that $\overline{BHAR}$ s will be negative on average, and skewness bias suggests the true size of standard t-tests of no abnormal returns null against the one sided alternative of negative abnormal returns is likely to be higher than the theoretical size of the test.

In order to confront these problems as much as possible, the test statistics presented in this paper are a skew-adjusted and bootstrapped version of the traditional t statistic. The skew-adjusted t statistic developed by Johnson (1978) can be written as

$$(8) \qquad t_{sa} = t + \hat{\gamma}\left(\frac{1}{6n} + \frac{\overline{BHAR}_T^2}{3\hat{\sigma}^2}\right)\sqrt{n}$$

where t and $\hat{\sigma}$ are the traditional t statistic and sample standard deviation from equation (7), and $\hat{\gamma}$ is the sample coefficient of skewness given by $\hat{\gamma} = \frac{1}{\hat{\sigma}^3} \cdot \frac{1}{n} \sum_i^n (BHAR_{iT} - \overline{BHAR_T})$. Sutton (1993) demonstrates that there are various computer intensive techniques based on bootstrap resampling which can improve the performance of t_{sa} yet further[7]. The form of statistic presented here is a variation of the normal approximation method and is one of the statistics recommended by Sutton (1993) for testing the mean of an asymmetric distribution. It proceeds as follows:

i) from the original sample of 232 IPOs take 1000 bootstrap resamples each of size n and for each of them calculate the (skew adjusted) *t* statistic as in (8) above.

ii) Calculate the standard deviation s_t of these 1000 *t*-statistics

iii) Calculate the ratio t_{sa} / s_t using the (skew-adjusted) t-statistic from the original sample, and compare to the critical values of the standard normal distribution.

This procedure is only justified when the null hypothesis sampling distribution of the test statistic

[7] Essentially, bootstrap resampling involves treating the original sample as a population, and resampling

is approximately standard normal. Hence the skew-adjustment is crucial: this form of bootstrapping procedure will generate badly misleading results if applied to the conventional t-statistic when the underlying observations come from a distribution which is skewed (because in such cases the sampling distribution of *t* is itself skewed in the opposite direction).

Lyon, Barber and Tsai, (1998) recommend skew-adjustment and bootstrapping when testing long-run security returns but these authors are quick to point out on the basis of their research that elements of non-randomness in the sample can still lead to inaccuracies in the size of the test. Indeed they state in their conclusion that “Our central message is that the analysis of long-run abnormal [security] returns remains treacherous.” Unfortunately, a sample of IPOs is unquestionably nonrandom: private firms’ decisions to go public are likely to be related to economy wide factors such as the overall level of the stock market and credit conditions as well as to factors such as product market conditions and stock market valuations of particular industry sectors. In this paper, these problems are confronted pragmatically: as many results as possible are presented, using different benchmarks for expected return and different test statistics.

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from it with replacement.

4. Results

Results on the abnormal returns of the IPOs in the present dataset are reported in two stages: initial returns and long-term returns are examined separately. The analysis is split in this way because existing research suggests that the initial return is abnormally positive yet the long-term return is abnormally negative. If studied together, the one will mask the effect of the other.

The closing price on the first trading day is arguably the most appropriate place to begin measurement of long-run performance of IPOs for a second reason: in many cases it is not possible for non-specialist investors to buy stock at the offering price so the abnormal return measured from the closing price of the first day's trading is an achievable return whereas in some cases the return measured from the offering price may not be.

4.1 Initial Abnormal Returns and the "Hot Markets Phenomenon"

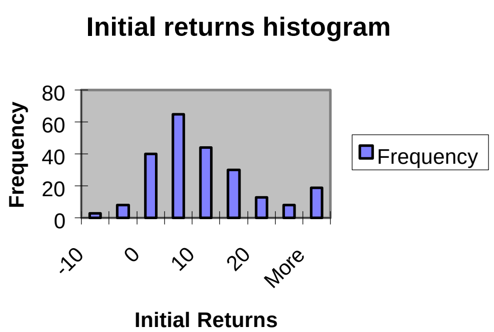
Tables 3 and 4 summarize the results on initial returns of the IPOs in the present dataset. Initial return is defined as the return from buying shares at the offering price and selling them at the closing price on the first day of trading. An overall average 1st day return of 8.70% is slightly on the low side of but broadly in line with previous studies, and obviously statistically significant. As stated earlier the returns reported are raw - there has been no adjustment for expected return. The average daily return on the FTSE Allshare index over the sample period was 0.045%, far lower than the initial returns on IPOs, so any adjustment according to a model of expected returns would make virtually no difference. The median initial return and value-weighted average returns yield further insights. The median return is lower than the (equal weighted) average return suggesting that the distribution of initial returns is skewed to the right, as expected. This is easily discernible from Figure 1, the histogram of initial returns. The value-weighted average returns are yet lower, though still substantial, indicating that on average it is the smaller stocks which have the very high initial returns. (In the value weighted calculations the smaller stocks receive lower weights). Over the entire sample, the equal-weighted average initial return exceeds the value-weighted average by a factor of 1.75, which suggests that size is an important determinant of initial return. Viewed loosely, and from a different perspective, one may conclude that the strategy of placing a level stake in all IPOs in the sample would have beaten the strategy of spending the same sum of money on an equal proportion of the share capital of each of the floated firms, (if the positions were all sold at the first day's closing prices).

Table 3: Initial returns

year	no of new issues	(equal-weighted) average initial return	median initial return	(value-weighted) average initial return	12 month BAHR on FTSE Allshare (%)
1990-91	9	107.4	107	103.349	12.46
1991-92	13	102.7692	102	100.4256	3.31
1992-93	28	114.2214	110	106.1503	26.18
1993-94	98	111.1663	108.5	106.2214	15.16
1994-95	84	105.031	102.45	104.5991	2.79
1990-95	232	108.697	105.1	104.9857	73.53165

73.53165% is the 60 month BAHR on the FTSE Allshare, rather than an sum of the 5 different 12 month BAHRs above.

Figure 1



Initial returns are quite clearly skewed to the right: the skew statistic is 4.5314.[8]

One may argue that value weighted averages bring the appropriate perspective to any anomalies

[8] This statistic is calculated as follows: $Skew = \frac{n}{(n-1)(n-2)} \sum_{i=1}^{n} \left[\frac{IR_i - \overline{IR}}{s} \right]^3$ where IR stands for (gross) initial

which are uncovered: it is worth restating that the small firms in a sample of IPOs are really very small indeed, and to use patterns in their market performance to draw inferences about the efficiency of the entire stock market would be rather rash. A second consideration is that asset pricing models such as CAPM or the Fama and French 3 factor model perform less well in explaining the returns behaviour of small stocks[9]. When we come to adjust the raw returns for expected return in the long-term analysis, bad model problems will inevitably interfere with test statistics, and to the extent that these problems are more severe in the case of small stocks, it may be reasonable to be more interested in the value weighted results rather than the equal weighted results.

The "hot markets phenomenon" refers to the observation first made by Ibbotson and Jaffe (1975) that the size of average initial returns on IPOs, and the number of IPOs, appear to vary over time. Indeed they appear to vary with the economic cycle: average initial returns are high when the economy is growing and the stock market is bullish, and periods of high initial returns are followed shortly afterwards by periods of high issuance. The present sample probably does not span a long enough time period to permit a rigorous examination of the "hot markets phenomenon". It is clear, however, that during 1992-94 (years when the stock market was particularly strong) IPO issuance was heavy and average initial returns were high, so some weak supporting evidence for this phenomenon may be detected in these results[10].

Similar patterns emerge in Table 4 when the initial returns are sorted by industry sector: all market sectors delivered positive initial returns. The extreme outlier is the information technology

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return, and *s* is the sample standard deviation.

[9] See, for example, Brav and Gompers (1997)

[10] The 12 month BAHR of 12.46% for the FTSE Allshare Index in 1990-91 is slightly misleading: 12.46% is a healthy annual return but the period should not be thought of as a bull market period: the economy was in recession, and business and stock market sentiment was gloomy - the relatively high BAHR can be connected with the observation that the market fell very sharply in the last weeks of 1990Q1, (this dataset begins on the first day of 1990Q2).

and telecommunications sector, mainly composed of fairly small offerings, which delivered an average initial return of 17.9%. This, of course, is a spectacular average one-day return. As in the data for the whole sample we see that in every market sector the average initial return is higher than the median initial return, indicating the presence of positive skewness. In all market sectors except for transport and distribution, we find that the equal weighted average initial return exceeds the value weighted average initial return, confirming that in most sectors the positive initial returns are more exaggerated in the case of small firms.

Table 4: initial returns by market sector

Market Sector	number of IPOs	(equal-weighted) average initial return	median initial return	(value-weighted) average initial return
healthcare and pharmaceuticals	23	106.609	103.6	103.725
food production, forestry and paper, packaging, engineering, autos, chemicals, construction and building materials, diversified industrials	43	108.142	105.9	106.037
oil, gas, mining	10	104.140	103.95	99.414
transport and distribution	27	106.974	106.3	108.675
beverages, restaurant, leisure, media	33	107.191	104.8	105.909
banks, insurance, real estate and speciality financial	34	105.035	102.1	101.575
electronics, infotech hardware, computer software services, support services, telecommunications	40	117.938	107.75	106.057
retailing, stores, household goods	22	107.268	106.25	103.029
All	232	108.697	105.1	104.986

4.2 Long-run Abnormal Returns

15 of the 232 firms in the sample did not survive their first three years of trading. For these 15 firms the buy and hold abnormal returns from the end of the first day's trading until the day of delisting have been measured. These abnormal returns have been used with an equal weight in the calculation of average abnormal return. The implicit assumption is that when an IPO is delisted an investor is able to switch out of the IPO at the last day's trading price, and into the stock market index.[11]

Table 5 shows results on long run returns for the entire sample and for subsamples of each of the financial years 1990 to 1994.

[11] This seems perfectly reasonable in the cases where the delisting is due to takeover or merger etc, but unrealistic when the delisting is due to suspension pending bankruptcy. I have been unable to ascertain exactly the circumstances of all delistings in the sample. When I recalculate results assigning –100% raw return to the 5 firms I believe delisted pending bankruptcy, the average abnormal 3yr BAHR for the entire sample is slightly lower at –1.02% (the result is not much changed because these firms already display very low raw returns)

Table 5: Long-Run BAHRs

year	no of new issues	average 3yr BAHR on IPO	average 3yr BAHR on FTAllshare	average abnormal 3yr BAHR	skew-adjusted bootstrapped t statistic
1990-91	9	98.081	47.328	50.75	1.19
1991-92	13	55.228	42.716	12.51	0.54
1992-93	28	32.505	53.22	-20.72	-0.99
1993-94	98	34.733	44.361	-9.63	-0.96
1994-95	84	79.294	70.22	9.08	0.51
1990-95	232	54.205	55.113	-0.909	-0.083

critical values for the skew-adjusted bootstrapped t-statistic come from the standard normal distribution, so if the test is H_0: no abnormal performance vs H_1: negative abnormal performance (one sided) then $t_{sa} < -1.645$ is significant at 5%

Whereas results on initial abnormal returns in Tables 3 and 4 above conform very closely with results of earlier studies, the present results on long-run abnormal returns clearly do not. Average abnormal 3 year BAHRs vary quite wildly during the sample period, but the aggregate average abnormal performance, roughly -1%, is remarkably close to zero. In other words the IPOs in the sample tended to provide roughly the same 3 year holding period return as the stock index over the relevant period. These returns were calculated from the closing price on the first day of trading – this means, since the average initial (raw) return was 8.70%, that if an investor had been able to buy each IPO at the *offer* price rather than the first trading day's closing price, the IPOs in the sample would have proved superior investments.

Brav and Gompers (1997) have suggested that much of the underperformance identified in earlier IPO research disappears when BAHRs are value-weighted. As illustrated clearly in Table 6, however, the underperformance of the present sample of IPOs is far stronger if the $\overline{BHAR}$ s are value-weighted. The difference between results in Tables 5 and 6 suggests, again, that a size effect is pervasive in the data. As in the results on initial performance, but in contrast to the Brav and Gompers (1997) results on long term abnormal performance, the smaller firms in the sample have performed better than the larger firms. Of course the data used by Brav and Gompers spanned an earlier time period, and used data from different stock markets. In fact the value weighted average in the present sample is strongly affected by the presence of 2 outliers: Telewest Communications and Waste Management Group. These two firms, capitalized on flotation at £1501m and £2193m respectively, delivered 36 month *BHAR*s of –131.9% and –112.3% respectively. If they are both dropped from the sample the value weighted abnormal BAHR rises to –3.8%, which is smaller in absolute terms than the (positive) value weighted average initial return, and quite close to the equal weighted $\overline{BHAR}$ of Table 5.

Table 6: long-run value weighted BHARs

year	**number of IPOs**	**total funds raised (£m)**	**average funds raised per IPO (£m)**	**(total)mkt cap on flotation (£m)**	**value-weighted 3-yr abnormal BAHR**
1990-91	9	32.372	3.60	1751.47	-9.863
1991-92	13	748.585	57.58	1648.23	-7.472
1992-93	28	1701.745	60.78	4219.365	-68.915
1993-94	98	3808.191	38.86	7871.27	-0.554
1994-95	84	3846.048	45.79	11014.27	-18.769
1990-95	232	10136.94	43.69	26504.61	-20.051

It is also of interest to look at $\overline{BHAR}$ s at periods other than 36 months. Figure 2 shows value weighted and equal weighted $\overline{BHAR}$ s measured at the end of each of the first 36 event months. The figure suggests that if one had chosen to be interested in almost any post-event window shorter than 36 months, one would have concluded that the long run abnormal performance of the present sample of IPOs was in fact positive.

Figure 2: 1-36 month equal weighted and value weighted BHARS

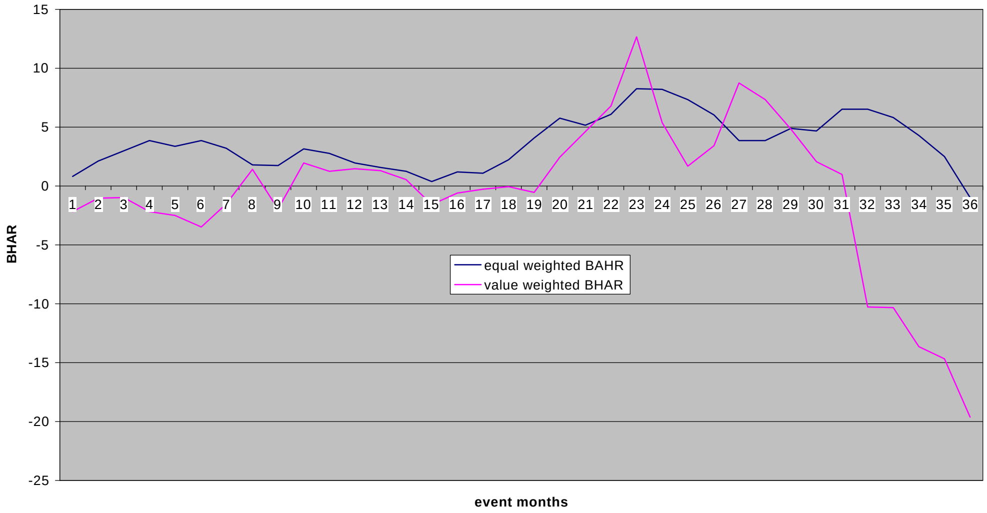
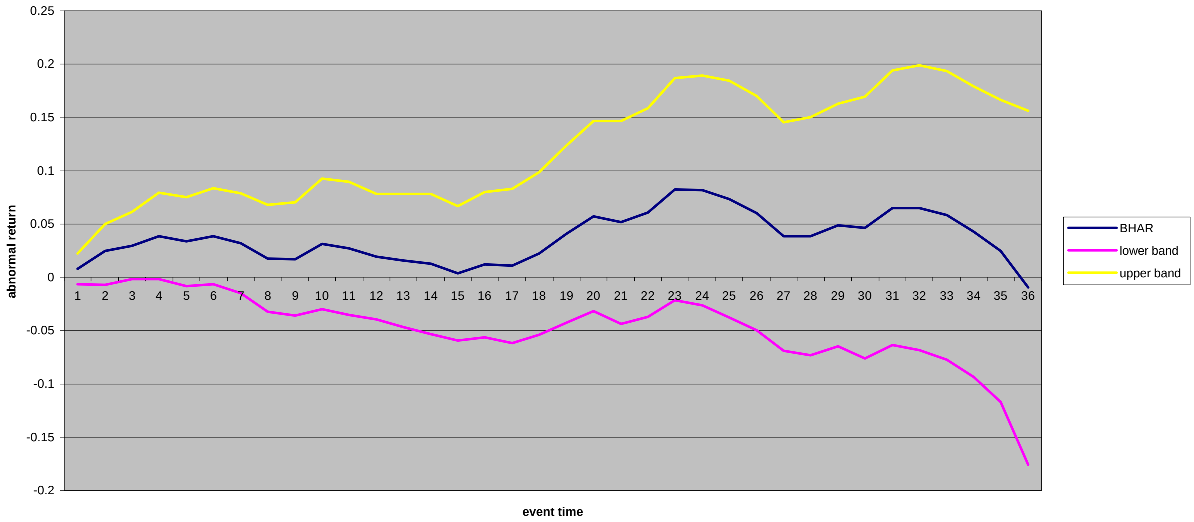


Figure 3 shows the equal weighted $\overline{BHAR}$ with confidence bands. Zero is contained in the confidence interval at each of the 36 data points, suggesting little basis on which to claim abnormal performance.

Figure 3: (equal weighted BHARs with 95% confidence intervals)



As in the analysis of initial returns the sample can be divided by industry sector. The third column in Table 7 rearranges the data of Table 5 above, sorting by industry sector instead of year of issue. It appears that the IPOs in the beverages, restaurants, leisure and media sector, and in the retailer and household goods sector, delivered average buy and hold returns substantially higher than the broad FTSE Allshare index. Even this abnormal performance of 44.9% and 38.8% over 36 months for these two sectors respectively, however, is not statistically significant at 5%[12]. The 43 firms in the food production, forestry and paper,… etc sector delivered negative abnormal performance of 39% over three years when measured against the FTSE Allshare index, and this is, in fact, statistically significant at 5%.

Table 7 also contains the results of another experiment designed to examine the effects of controlling for market sector in the measurement of abnormal return. BHARs are recalculated for each firm in the sample using the market adjusted returns model as before, but in this case the return on the FTSE Allshare index is replaced by the return on the appropriate FTSE sector index. This procedure is justified if industry sector is a determinant of expected return. As mentioned above, this is not a common idea in portfolio theory but the model of expected returns employed in this study, the market adjusted returns model, is clearly rather rigid: applying the model with reference to sector indices rather than a broad market index allows for more cross-sectional variation in expected return. The philosophy is quite similar to the control firms method for measuring abnormal performance in event studies. (The idea behind the control firms approach is to estimate abnormal return by taking the difference between the sample return and the return on a matching firm which controls for as many firm characteristics as possible.)

The two columns on the right of Table 7 show that controlling for industry sector greatly changes the results on abnormal performance. Under this model the sample of IPOs delivered negative abnormal performance of 13.88% over 36 months, which is greater in absolute terms than the (positive) initial returns but not statistically different from zero. Most notably the IPOs issued in the electronics, information technology hardware,… etc sector are now seen to be dire performers (compared to their corresponding sector index). The average abnormal performance of -132.6% over 36 months is statistically significant and is particularly intriguing in view of the results in Table 4 above on initial returns, which showed that this sector experienced by far the highest initial returns. Those who believe in investor “fads” may be able to argue that during the time period from which the present sample arises IPOs for firms in information technology businesses were targeted aggressively by over-optimistic and irrational investors (ie, noise traders). Such IPOs could therefore be offered and successfully sold at unrealistically high prices. Even then,

[12] When the sample is divided in this way, the power of the t-tests is reduced due to the small number of firms in each sector

irrational investors chased the shares in early open market trading and their initial returns were consequently high. In the long-run however, that initial optimism proved unjustified as the shares lost value compared to older more established information technology businesses.

Table 7: BHARs built using the market index, and the sector index

market sector	number of IPOs	3yr market index BHAR (%)	skew-adjusted bootstrapped t-statistic	3yr sector index BHAR (%)	skew-adjusted bootstrapped t-statistic
food production, forestry and paper, packaging, engineering, autos, chemicals, construction and building materials, diversified industrials	43	-39.031	-2.310	-10.714	-0.79
healthcare and pharmaceuticals	23	-10.926	-0.300	-19.589	-0.62
oil, gas, mining	10	18.212	0.650	14.775	0.53
transport and distribution	27	5.173	0.260	40.341	2.16
beverages, restaurant, leisure, media	33	44.940	1.590	38.219	1.25
banks, insurance, real estate and speciality financial	34	-18.764	-1.380	-26.697	-1.69
electronics, infotech hardware, computer software services, support services, telecommunications	40	-7.952	-0.330	-132.638	-3.23
retailing, stores, household goods	22	38.773	1.330	63.881	3.11
All	232	-0.982	-0.810	-13.883	-1.17

t-statistics are skew-adjusted and bootstrapped as before

5. Conclusion

The abnormal returns from a new sample of UK IPOs have been analysed. Data collection was guided by a desire to use as recent data as possible, and to use data from the UK. These constraints led inevitably to a smaller sample than has generally been analysed in existing research. Although results on initial abnormal returns conform closely with those reported in existing research, those on long-term abnormal returns do not. Results on long-run performance are, unfortunately, model dependent and also depend on whether equal-weighted or value-weighted *BHAR*s are presented, but the benchmark calculations yield an equal weighted *BHAR* of almost exactly zero. Value-weighted *BHAR*s and *BHAR*s which control for industry sector are negative but not significantly different from zero. Ibbotson and Ritter (1997, page 1007) suggest that since the long-run holding periods which are investigated must overlap, and since the number of independent observations is therefore limited, the evidence on negative long-run abnormal returns must be considered tentative and must be treated with caution. The results reported here, and the econometric problems discussed in passing, would appear to corroborate this conclusion.

Some support for theories of irrational behaviour in stock markets may perhaps be drawn from the results of dividing the sample by industry sector. IPOs in the information technology related subsector yielded by far the highest initial return on their first day of trading, but, especially when controlling for industry sector in the measurement of abnormal return, long term returns were extremely poor. During the period spanned by the sample, (early 1990s), it is easy to imagine that this sector could have received the most speculative interest from unconventional (noise) traders. Even if it is the case that noise traders exerted an identifiable influence on observed market prices in one sector over one period, however, the results presented in this paper do not suggest that efficient markets anomalies are pervasive with respect to IPOs.

References

Barber, B.M., and Lyon, J.D. (1997): "Detecting Long-Run Abnormal Stock Performance: The Empirical Power and Specification of Test Statistics", *Journal of Financial Economics*, vol. 43, pp. 341-372

Brown, S., and Warner, J., (1980) : "Measuring Security Price Performance", *Journal of Financial Economics,* vol. 8, pp. 205-258

Espenlaub, S., Gregory, A., and Tonks, I. (1998): "Testing the Robustness of Long Term Underperformance of UK Initial Public Offerings", LSE Financial Markets Group discussion paper 285.

Ibbotson, R.G., (1975): "Price Performance of Common Stock New Issues", *Journal of Financial Economics*, vol. 2, pp. 235-272

Ibbotson, R.G., and Jaffe, J.F., (1975): "Hot Issues" Markets", *Journal of Finance*, vol. 30, pp.1027-1042

Ibbotson, R.G., and Ritter, J.R. (1997): "Initial Public Offerings" in Jarrow, R.A., Maksimovic, V., and Ziemba, W.T. (ed.), *Handbooks in Operations Research and Management Science*, Elsevier Science, pp. 993-1017

Johnson, N.J., (1978): "Modified *t* Tests and Confidence Intervals for Asymmetric Populations", *Journal of the American Statistical Association*, vol. 73, pp. 536-544.

Kothari, S.P., and Warner, J.B. (1997): "Measuring Long Horizon Security Returns", *Journal of Financial Economics*, vol. 43, pp. 301-339

Levis, M. (1995): "Seasoned Equity Offerings and the SHort and Long-run Performance of IPOs in the UK", *European Financial Management*, vol. 1, no. 2, pp. 125-146

Levis, M. (1993): "The Long-Run Performance of Initial Public Offerings", *Financial Management*, vol. 22, pp. 26-41

Loughran, T., and Ritter, J.R. (1995): "The New Issues Puzzle", *Journal of Finance*, vol. 50, pp. 23-51

Lyon, J.D., Barber, B.M., and Tsai, C., (1998) : "Improved Methods for tests of Long-Run Abnormal Stock Returns", *Journal of Finance*, vol. 54, no. 1, pp. 165-203.

Ritter, J.R. (1991): "The Long-Run Performance of Initial Public Offerings", *Journal of Finance*, vol. 46, pp. 3-27

Sutton, C.D., (1993): “Computer-Intensive Methods for Tests About the Mean of an Asymmetrical Distribution”, *Journal of the American Statistical Association, vol. 88, pp. 802-810*