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Abstract
In this paper we examine a comprehensive set of 2,567 UK IPOs launched between mid-1975 and the end of 2004. We find compelling evidence of long run underperformance that persists for between 36 and 60 months post-flotation, depending on the precise method chosen to measure abnormal returns. Following Schultz (2003), we ask whether our results are consistent with "pseudo-timing". Equally-weighted returns in calendar time provide further evidence of under-performance, a result that favours the Loughran and Ritter (2000) behavioural timing hypothesis rather than the Schultz (2003) pseudo-timing hypothesis. However, when we measure valueweighted returns in calendar time we find that abnormal returns are not significantly different from zero. To some degree, this result is consistent with the findings of other studies which show that IPO under-performance is concentrated in smaller firms. However, we also show that these value-weighted returns are heavily influenced by the high abnormal returns associated with UK privatisations.

JEL Classification: G14; G32

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Introduction

Recently, US evidence on the under-performance of Initial Public Offerings (IPOs) (Ritter, 1991; Loughran and Ritter, 1995, 2000) has been challenged on two counts. First, the validity of the assumptions inherent in event time methodologies (e.g. Mitchell and Stafford, 2000) has been questioned. This is important, as the evidence for the UK and elsewhere potentially seems to differ depending on whether calendar time methods or event time methods are used (e.g. Espenlaub et al., 2000). The second challenge comes from the "pseudo timing" hypothesis of Schultz (2003). Pseudo-timing is Schultz's term for the situation where managers of firms, believing markets are inefficient, react to market-wide pricing conditions by issuing equity (or launching an IPO) even though in reality market prices are efficient. This stands in marked contrast to the Loughran and Ritter (2000) hypothesis where market prices are assumed to be inefficient, a condition that is exploited by managers knowingly issuing over-valued equity. Under the Loughran and Ritter story, the observed under-performance of IPOs (and seasoned equity offerings, SEOs) is real and the result of managers successfully exploiting market mispricing. However, the Schultz version of events is entirely different. Here, managers merely observe market prices and adjust the supply of IPOs so that there are more offerings following price rises (and less following price falls). They have zero market timing ability. Using a simple simulation model, Schultz shows that under such conditions, an event time methodology falsely leads to a conclusion of market timing ability, because the number of events observed is not an exogenous variable, but rather one that depends on the level of the market in the first place. Thus we will observe significant negative returns in event time, which will lead us to (falsely) conclude that managers have market timing ability. However, calendar time returns are not so affected, leading Schultz to prefer calendar time tests to event time tests. Schultz reports that the significant event-time negative returns for US IPOs become much closer to zero and insignificant when calculated on a calendar time basis. Support for the Schultz hypothesis can be found in Butler et al. (2005), but counter-evidence emerges in Baker et al. (2006) and Chan et al. (2007).

Approval of the calendar time approach is not universal. Loughran and Ritter (2000) argue that the use of value-weighted returns and calendar time returns will result in extremely weak tests if managers do, in fact, possess behavioural timing ability when making corporate financing decisions. Second, from a statistical testing viewpoint, whilst the use of calendar time portfolios is advocated by Mitchell and Stafford (2000) and by Fama (1998), who notes that it mitigates the effects of the "bad model" problem and also argues that most of the apparent anomalies found in the literature disappear or become less significant when abnormal returns are estimated in calendar time, the main disadvantage is that it does not reflect investor experience as well as the event-time approach. A recent paper by Liu and Strong (2006) warns against the general danger of drawing false inferences from market-based studies. Although that paper was concerned primarily with single month partitioning of longer period returns, the biases they discuss are implicit in the calendar time portfolio approach. Whether value-weighting or equal weighting is employed, the implied portfolio rebalancing inherent in a calendar time approach could give rise to the biases noted by the authors, and in addition result in portfolios which seem implausible from an investor point of view. Furthermore, both Fama (1998) and Mitchell and Stafford (2000) recognise that a potential problem with the calendar time approach is that changing the number of firms in the calendar time portfolio through time has the potential to create residual heteroscedasticity that can affect inferences about the coefficients. A further problem with a factor approach to calendar time portfolios is that the method imposes the requirement that the factor loadings are constant, even though the portfolio composition changes radically over the period of the study. Nonetheless, both Lyon et al. (1999) and Dichev and Piotroski (2001) recommend that buy-and-hold returns and calendar-time regressions ought to be considered as complements rather than substitutes. In this paper we follow that advice, and report both calendar time and event time returns. However, we employ new methods in the calendar time portfolios to take account of possible heteroscedasticity in portfolio returns.

Our objectives in this research are several fold. First, in employing by far the most comprehensive data set of UK IPOs investigated to date, covering 2,567 IPOs floated on the London market between January 1975 and December 2004, we are able to lay to rest any hints that results from previous UK study may have been time period and sample specific. Results for the UK that broadly confirm the US findings outlined above are reported by Aggarwal and Rivoli (1990), and Levis (1993). These authors confirmed that underperformance of UK IPOs extend over 36 full months after the first day of issue. In particular Levis (1993) suggested that the long-term underperformance extends beyond the 36 months.[1] More recent evidence on the UK is provided by Espenlaub, Gregory, and Tonks (2000).[2] However, they point out that tests of underperformance may be sensitive to the choice of empirical method used to measure performance. Abnormal returns over a three years period after the offerings were significant and negative irrespective of the benchmark employed in their event-time approach though over a five year period, the underperformance was less dramatic and sensitive to the benchmark employed. This study plays an important role in extending the time period examined in these studies back to 1975 and forward to the end of 2004.

Second, in employing the BHAR methods of Lyon et al. (1999) with control portfolios calculated according to the principles set out in Liu and Strong (2006), we are able to calculate abnormal returns that could actually have been achieved by investors systematically buying new IPO issues. Despite the well-known problems of cumulated abnormal returns (CARs), we nonetheless note results from such a method for completeness. Third, we employ a more sophisticated bootstrapping approach to estimating the significance levels of the BHARs than the simple bootstrapping method of Lyon et al. (1999). Fourth, we directly examine the timing issue in order to test whether the data suggest any evidence of market timing, either “pseudo” or behavioural. Fifth, despite our reservations about the realism of abnormal returns derived from calendar time methods, by employing them we are able to shed light on whether managers of IPO firms appear to have genuine market timing ability, or

[1] Levis’s (1993) results were based on a sample of 712 issues from 1980-1988.
[2] They use a sample of 588 UK IPO firms over the period 1985 to 1992. Their study compares abnormal performance based on five alternative benchmarks using both event-time approach and calendar –time approach.

whether they are exhibiting the characteristics associated with "pseudo-timing". Last, we employ some innovative approaches to the problem of heteroscedasticity in calendar time portfolio returns.

The paper now proceeds as follows. The first section gives the usual description of data and research methods. The second section discusses the results obtained from event period returns analysis, the third examines the timing issue, whilst the fourth shows the results from calendar time approaches.

Data and research method

IPO data

A comprehensive sample of UK IPOs from January 1975 to December 2004 was collected from London Stock Database Price (LSPD), using the LSPD "birth marker" to identify the nature of the IPO. A total of 365 IPOs were then excluded from the sample because they are identified as investment trusts, leaving a final sample of 2567 IPOs of ordinary shares by firms on the London Stock Exchange. The following criteria were used in selecting the final sample:

i. We retain only ordinary share issue IPOs, but exclude investment trust offerings.

ii. Stock price/return data for issuers and market capitalisation data must be available on the London Share Price Database.

The listing methods in the sample comprise placements (80.4%), offers for sale at fixed price (12%), offer for sale by tenders (2.3%), and offer for sale by subscriptions (1.2%), placing combined with open offer (0.6%), placing combined with intermediaries offer (0.5%), and lastly placing combined with offer for sale (3%). Table 1 shows the distribution of the IPOs by type and by year. The table reveals that there is considerable time variation in the number of IPOs, with peaks occurring in the pattern of IPOs. The more recent increase in numbers coincides with the opening of the AIM market on the LSE.

[Table 1 about here]

Calculation of abnormal returns

We measure returns for IPOs and the control sample of firms using monthly returns from the London Share Price Database (LSPD). The market capitalisations of all firms in January of each year were also obtained from the LSPD database. We measure event time abnormal returns using two metrics. Our main method is the Buy and Hold Abnormal Return (BHAR):

$$BHAR_{i\tau} = \left[\prod_{t=1}^{\tau}(1+R_{it})\right] - \left[\prod_{t=1}^{\tau}(1+R_{it}^{b})\right] \quad (1)$$

where τ is the period of investment in months, R_{it} is the return on security *i* in month *t*. The benchmark return, R_{it}^{b}, is formed in three ways: our first (and preferred) method is to use decile reference portfolios, constructed as described below. Two variants of this approach are employed: an equally weighted control portfolio and a value-weighted one. The *BHAR* derived from these benchmarks represents the abnormal return on the portfolio of IPOs compared to that of an equivalently size-controlled passive investment portfolio with no monthly rebalancing. Although we have a strong preference for control portfolios, we also report a third version of the BHAR results using a matched-firm approach. For the matched-firm control an IPO firm that went public in a given year is matched by a firm with the closest available market capitalisation at January of the same year. For an IPO firm that does not have a matching firm the returns of which last for the whole test period, we substitute the returns of the next available size-matched firm at the point of delisting. By necessity, this involves the effective re-balancing of the control portfolio.

When the estimation of abnormal returns is based on a benchmark, such a benchmark should, in principle, match the characteristics of the event firm as closely as possible. Lyon et al. (1999) emphasised that a careful construction of reference portfolios should be made to eliminate the new listing and rebalancing biases. The benchmark and the event portfolio should, in principle, be a plausible and investable opportunity set, in accordance with Liu and Strong (2006). Thus our main benchmark is based upon initial value-weightings. However, we also check our results against an equally weighted benchmark, with results qualitatively similar to those obtained from a value-weighted benchmark. Our reference, or benchmark, portfolios are purged of 5 year

IPO firms listed in London stock exchange market during the period of study (January 1975-December 2006), as suggested by Loughran and Ritter (2000). Our choice of size-decile control portfolios, rather than size and book-to-market portfolios, follows Loughran and Ritter (2000). Besides the "behavioural timing" arguments put forward by Loughran and Ritter, there is a further practical reason for not using book-to-market controls in a UK context. Whereas the LSPD data is comprehensive, covering returns and market capitalisations for all UK stocks, the same is not true of Datastream or any other UK source of book-to-market values. Some firms simply have missing book values (this is particularly true for the early years of our sample) but for some sectors (e.g. banking) Datastream does not have market-to-book ratios. This is a particular problem for a comprehensive study of all IPOs which includes all issuers except investment trusts. To construct the size control portfolios, each year all UK firms are ranked each year according to their market capitalisation in January, and decile portfolio are constructed with equal number of firms in each decile. The return for each size control portfolio is then tracked from January of year t for τ months, with the returns being value-weighted according to their initial market capitalisations. These control portfolios do not therefore require re-balancing and follow the principles set out in Liu and Strong (2006). Each IPO is then assigned a control portfolio based on its market capitalisation, defined as the offering price times the number of shares outstanding at the first day of trading.

A further problem that we confront both in the IPO sample and the benchmark portfolio sample is that of firms that de-list within the 60 month measurement period. Liu and Strong (2006, p.13) replace de-listed firm returns by either zero or the risk-free rate. They find similar results in both cases. Lyon, Barber and Tsai (1999) and Mitchell and Stafford (2000, p.298) replace all de-listed firms by the benchmark return. This has the potential to create an upward bias in the estimated BHAR returns, since some of these de-listings are bankruptcies. While CRSP deals with de-listings by accounting for the final return, including bankruptcies, not all of these effects of bankruptcies are actually taken into account. First, some of these corrections are made several months or even several years after any de-listing. Second, a proportion of de-listed returns remain 'missing' permanently in CRSP.[3] While CRSP make some

[3] http://www.crsp.chicagogsb.edu/resources/files/crsp_white_paper_delist_returns.pdf

attempt to record a final return (the firm's worth at delisting), the LSPD does not provide such a service. Under LSPD, de-listed firms have a missing value, although the reason for delisting is recorded. In computing BHAR returns, de-listed firms were treated on the basis of the following rule. If a de-listed firm has preserved its value (such as a merger or an acquisition), we replace the return of that firm by the return of the benchmark. If the delisting is due to a total loss of value (bankruptcy), we replace the return by -1. In making this distinction, we use LSPD G10 description. The most important codes are 7, 16, 20 and 21. As can be seen from the description in Appendix 1, these types of delisting are most likely to be stocks that are either worthless or a long way from giving shareholders any terminal value, and so we treat these cases as if investors lost all their investment. By contrast, the remaining types of de-listing would seem to be value preserving.

Significance tests in event time

For each τ we calculate the conventional t-statistic as

$$t_\tau = \frac{\overline{BHAR}_\tau}{\sigma(BHAR_{i\tau})\big/\sqrt{N}} \tag{2}$$

where $\overline{BHAR}_\tau$ is the (cross sectional) sample mean, $\sigma(BHAR_{i\tau})$ is the cross-sectional standard deviation, and N is the number of IPO firms.

Because the data is likely to be skewed, we correct for skewness using Johnson's (1978) correction

$$SKadj - t_\tau = \sqrt{N}\left(S + \frac{1}{3}\hat{\gamma}S^2 + \frac{1}{6N}\hat{\gamma} \right) \tag{3}$$

where $\hat{\gamma}$ is the coefficient of skewness, and $S \equiv \overline{BHAR}_\tau / \sigma(BHAR_{i\tau})$. This adjustment was advocated by Lyon et al. (1999) because of the suspected skewness of BHAR returns. They use the standard bootstrap procedure with bootstrap sample size of $N/4$. However, this standard bootstrap does not address the questions of cross-sectional correlation and heteroscedasticity. To our knowledge, the first problem cannot be addressed in a cross-sectional test, and although Mitchell and Stafford (2000, pp 304-6) argue for t-statistics corrected for cross-sectional dependence these are not t-statistics that are simultaneously corrected for skewness. In any event, Mitchell and Stafford (2000) have a strong preference for calendar time methods to allow for cross-sectional correlation. Neither is the second problem of heteroscedasticity addressed by the ordinary bootstrap. We advocate the use of the wild bootstrap instead. This procedure has the merit that it preserves the first and second moments of the parent distribution. The difference between the ordinary and wild bootstrap is simple. Let the residuals from a regression be $\hat{\varepsilon}_i$ (in our case $\hat{\varepsilon}_i = BHAR_i - \overline{BHAR}$). In the regular bootstrap we resample by drawing $N^* < N$ residuals, $\hat{\varepsilon}_i^*$, with replacement from the series $\hat{\varepsilon}_i$. In the wild bootstrap we create the bootstrap residuals $\hat{\varepsilon}_i^*$ as the product of the original residuals and an independent random variable, η_i, with zero mean and unit variance. This guarantees that the bootstrap variance will be the same as that of the parent distribution. For example, η_i can be standard normal and hence

$E(\hat{\varepsilon}_i^*) = E(\eta_i)E(\hat{\varepsilon}_i) = 0$ and $V(\hat{\varepsilon}_i^*) = V(\eta_i)V(\hat{\varepsilon}_i) = V(\hat{\varepsilon}_i)$

However, if the data is skewed, re-sampling based on the standard normal will yield zero skewness since $E(\eta_i^3) = 0$. To preserve skewness, Liu (1988) and Mammen (1993) suggest ways of obtaining $E(\eta_i^3) = 1$. One suggestion is

$$\eta_i = \begin{cases} \dfrac{1+\sqrt{5}}{2} & w.p. \quad p = \dfrac{\sqrt{5}-1}{2\sqrt{5}} \\ \dfrac{1-\sqrt{5}}{2} & w.p. \quad 1-p \end{cases}$$

This will guarantee that $E(\eta_i) = 0$, and $E(\eta_i^2) = E(\eta_i^3) = 1$. However, this scheme will not preserve the kurtosis of the parent distribution since $E(\eta_i^4) = 2$. An alternative scheme (see Davidson et al. (2007)) is to use

$$\eta_i = \begin{cases} 1 & w.p. \quad p = \dfrac{1}{2} \\ -1 & w.p. \quad 1-p \end{cases}$$

This will preserve mean, variance and kurtosis ($E(\eta_i) = 0$, and $E(\eta_i^2) = E(\eta_i^4) = 1$) but not skewness ($E(\eta_i^3) = 0$). Achieving both preservations is not possible. Davidson et al. (2007) suggest some combination that will achieve partial refinement. However, here we advocate combining the skewness adjusted t-statistic with the kurtosis preserving wild bootstrap. Assuming that the skewness adjustment of Johnson (1978) is reasonably accurate, the parent distribution of the adjusted statistic will be expected to be symmetric. Therefore, achieving $E(\eta_i^4) = 1$ will be more important than achieving $E(\eta_i^3) = 1$. Accordingly, we adopt this combined Skewness-Adjusted and Kurtosis Preserving Bootstrap approach in our tests.

Calendar time methodology

When calculating returns in calendar time, we have the choice between measuring returns relative to a risk-controlled benchmark, or using a regression-based framework. We can usefully summarise all the approaches used to estimate abnormal returns as follows. Let $R_{\tau,t}$ be a time series of portfolio of IPO returns of companies that were born within the previous τ months. In general, calendar time tests can be seen as testing for the significance of α in a time series model

$$R_{\tau,t} = \alpha + (R_{\tau,t})^E + \varepsilon_t \qquad (4)$$

where $(R_{\tau,t})^E$ is the required return and ε_t is a zero mean disturbance term. We can think of this expected return either in terms of a factor model (for example the CAPM or the Fama-French three factor model) or some benchmark, R_{bt}, where the benchmark is matched on the basis of firm-specific characteristics, such as market capitalisation. If we write expected return as:

$$(R_{\tau,t})^E = R_{ft} + \beta(R_{bt} - R_{ft}) \qquad (5)$$

we can then view the simple CTAR as being a special case that has the additional restriction that $\beta = 1$. Lyon et al. (1999, p. 197) emphasise that such simple CTAR methods appear to be better specified (and more conservative) than the Fama-French three factor approach, "suspecting" that the former "generally dominate" the latter for two reasons: first, the assumed linearity in factor exposures inherent in the Fama-French model in calendar time; second, the problem of inter-actions between the factors. Mitchell and Stafford (2000, p.321) also favour the CTAR methodology rather than the Fama-French regression-based approach, noting that because it suffers from fewer statistical flaws "more faith should be placed in these results". An additional concern for UK researchers is that it is far from clear that the Fama-French model is entirely appropriate in a UK context. Issues raised include the questions of whether the model adequately describes the cross-section of expected returns in the UK, whether other factors (such as R&D expenditure to market value) may actually dominate the Fama-French factors in the explanation of this cross-section, and whether results may anyway be highly sensitive to the precise construction of the factors (Gregory, Harris and Michou, 2001; Al-Horani, Pope and Stark (2006); Michou, Mouselli and Stark, 2007). For these reasons there seems to be little reason to favour calendar time regressions based upon a Fama-French model, and so we do not report results on this basis.

However, in more general terms we can think of (5) as a model that allows for some variation between the characteristics of the benchmark portfolio and the characteristics of the IPO portfolio. If the benchmark perfectly matches the risk characteristics of the IPO portfolio, then β should be unity. However, if the IPO portfolio has more or less risk than the benchmark (because, for example, the mean IPO firm does not have exactly the same mean market capitalisation as the benchmark), then allowing β to vary can take account of this. The approach is not new, for example the same model is employed in an investigation of UK IPOs by Espenlaub, Gregory and Tonks (2000), but a further advantage of the regression approach, not previously exploited in the literature, is that it allows more sophisticated approaches to the well-known problem of heteroscedasticity (Mitchell and Stafford, 2000) in calendar time portfolios to be accommodated. The first, and most simple approach to the problem that we employ is the estimation of robust standard errors using White (1980) corrections. The alternative approach is to use GLS. Assuming an equally weighted portfolio and that all returns are iid at time t, a τ -month holding period portfolio return is obtained as

$$R_{\tau,t} = \frac{1}{n_{\tau,t}} \sum_{i=1}^{n_{\tau,t}} R_{it}^{(\tau)}{}_{it} \qquad (6)$$

where $n_{\tau,t}$ is the number of firms in the portfolio and $R_{it}^{(\tau)}$ is the return of a firm i that was born within the last τ months.

The variance of this portfolio is

$$Var(R_{\tau,t}) = \frac{1}{(n_{\tau,t})^2} n_{\tau,t} \sigma^2 = \frac{1}{n_{\tau,t}} \sigma^2 = \sigma_t^2 \qquad (7)$$

So even under the unrealistic assumption that returns are iid, the portfolio variance will be time varying and will depend on the number of IPO stocks included in the portfolio. Unfortunately, the portfolio variance will probably be more complex than (7) because asset returns are not iid.

When heteroscedasticity has a simple form as in (7), one way of dealing with this problem is to standardise the residuals such that they have a constant variance. For example, in a simple regression like

$$R_{\tau,t} = \alpha + \beta\ R_{bt} + u_t$$

If $Var(u_t) = \omega_t^2$, then we can use the fact that $Var(u_t / \omega_t) = 1$ and standardise the equation above by dividing the whole equation by ω_t. GLS involves replacing the unknown ω with some estimate. One simple case is to set $\omega_t = 1/\sqrt{n_{\tau,t}}$. This is identical to Mitchell and Stafford's (2000) suggestion of estimating[4]

$$\sqrt{n_t} R_{\tau,t} = \sqrt{n_t}(\alpha + \beta\ R_{bt} + u_t)$$

A more flexible approach would be to estimate the variance, since we do not know its exact form. Here, we assume that it is a linear function of the number of the firms entering the portfolio. Thus, we assume that the variance can be approximated by some function of $\hat{\delta}_0 + \hat{\delta}_1 n_t$. To ensure that the variance is positive we set $V\hat{a}r_t(u_t) = \exp(\hat{\delta}_0 + \hat{\delta}_1 n_t)$. To operationalise this we first obtain the unrestricted residuals $\hat{u}_t$ from

$$R_{\tau,t} = \alpha + \beta\ R_{bt} + u_t$$

Then estimate the regression

$$\log(\hat{u}_t^2) = \delta_0 + \delta_1 \log(n_t) + error_t$$

Finally, set $V\hat{a}r(u_t) = \exp(\hat{\delta}_0 + \hat{\delta}_1 \log(n_t))$. As we show below, the GLS formulation appears to offer a better fit in terms of adjusted R-squared statistics, although the

[4] However, the authors argue against this transformation since it "completely defeats the purpose of forming calendar-time portfolios" (p.317). Instead, they use a bootstrapping procedure to compute critical values.

inferences from both the GLS and OLS with robust (White (1980) corrected) standard errors are broadly similar.

Results

Buy and hold returns in event time

Our first results, presented in Table 2 Panel A, show the BHAR derived from an equally-weighted size decile control portfolio. The BHAR falls from an insignificant +0.7% after 6 months to -3.1% (significant at the 10% level) after 12 months, becoming highly significant thereafter and continuing to fall to -9.9% after 24 months, -14.9% after 36 months, -27.6% after 48 months and -43.1% after 60 months. All returns are skewed and leptokurtic. It is worth recording that the IPO buy and hold return itself is highly skewed and leptokurtic throughout the period, and that the benchmark is also skewed and leptokurtic, but to a lesser extent.

Panel B of Table 2 shows the results from a comparison against our preferred value-weighted size-decile control portfolios. In general, the BHARs are smaller in absolute value than those obtained with an equally weighted benchmark. Again the BHAR is insignificantly positive after 6 months, falling to a marginally significant -2.8% after 12 months. Beyond 12 months the rate of decline accelerates, with abnormal returns reaching -8.4% after 2 years, -10.1% after 3 years, -17.4% after 4 years and -28.6% after 5 years. The skewness and kurtosis of the BHARs is greater than under the equally weighted benchmark, the difference being attributable to the smaller levels of skewness and kurtosis found in the value-weighted control portfolio compared to those of the equally-weighted portfolio.

In Table 3 we present the results from matching against a control firm portfolio. Although the pattern of abnormal returns is consistent with those from the other two methods, we note that the abnormal returns here are considerably larger in terms of absolute magnitude, being -7.3% after 12 months, -27.6% after 36 months, and a massive -61.8% after 60 months. These abnormal returns have considerably less skewness and kurtosis than is found under the portfolio-control methods. However, the reason for this turns out to be that the matched firms themselves have returns that are highly skewed and leptokurtic.

[Table 2 about here]

[Table 3 about here]

Whilst one might take comfort from the fact that all three benchmarks lead to a statistically consistent conclusion, the large differences in the size of the BHARs is troubling. As a robustness check on these figures, we calculated a conventional cumulative abnormal return using the value-weighted size benchmark. The CARs (in all cases significant at the 5% level using a simple cross-sectional t-test) were: -5.7% after 12 months; -17.5% after 24 months; -18.5% after 36 months; -10.2% after 48 months; and -12.7% after 60 months. Although the problems of positive bias in CARs are well known (e.g. Kothari and Warner, 1997) there is a hint in the comparison between the CARs and BHARs of the compounding problem argument of Fama (1998), Mitchell and Stafford (2000), and Gompers and Learners (2003) where the buy-and hold return method can magnify underperformance, even if it occurs in only a single sub-period.

Evidence on timing

Our next tests investigate the timing issue. Under both behavioural timing and pseudo-timing hypotheses, managers respond to movements in market prices. Chan et al. (2007) run regressions of share repurchase activity on past market performance to test for evidence of market timing. However, they were investigating share repurchase decisions, where one might reasonably assume managers are able to respond fairly quickly to changes in market prices, provided a buy-back programme is in operation. The authors use monthly data to investigate their hypotheses, which seems entirely reasonable for buy-backs. By contrast, the planning horizon for IPOs is likely to be far longer than a month. Quite whether quarterly or annual data are more appropriate to investigate timing is debatable, but here we choose annual data. If pseudo-timing exists, we should observe a positive relationship between IPO activity and past market performance. IPO activity is proxied by two variables. The first is simply the relative number of IPOs in a particular year, n_t. This relative number of IPOs in year *t* is given by $n_t = 100 \times (IPOn_t / Mn_t)$ where $IPOn_t$ is the number of IPOs in year *t*, and Mn_t is number of listed firms in the market in the same year. This proxies for the IPO activity in year t in terms of numbers. The second activity measure is the relative market value of IPOs in the same year, v_t. The IPO relative value in year t is given by $v_t = 100 \times (IPOv_t / Mv_t)$ where $IPOv_t$ is the value of all IPOs issued in year *t*, and Mv_t is the total market capitalisation in the same year. This second variable proxies for the IPO activity in year t in terms of value.

Explanatory factors are the lagged dependent variable, average (excess) market return, the return on SMB, and the return on HML for a given year. To investigate the issue, we run an OLS regression of the form:
Dependent = function of lagged (Dependent, co-dependent, rm, smb, hml) and Trend.

The lagged dependent variables capture possible cyclical behaviour, while the trend captures the long term growth of the economy. The other factors capture market timing. SMB and HML factors are from Gregory and Michou (2007) and formed as described in Gregory, Harris and Michou (2001). The regressions are run in two steps, a full model and a restricted model, and all are estimated using White (1980) corrected standard errors.

The results are shown in Table 4, Panel A (with relative number as the dependent variable) and Table 4, Panel B (with relative value as the dependent variable). The adjusted R-squared values are high, particularly for the relative number regression. Which lags are significant depends upon whether the relative number of IPOs or the relative value of IPOs are taken as the dependent variable, but the former regression is consistent with a four year cycle in IPOs being present. In terms of relative numbers, both lagged market returns and lagged SMB returns are significant predictors of IPO activity, an effect consistent with the pseudo-timing hypothesis. IPOs tend to be smaller firms, and our evidence indicates that more flotations take place when markets are performing strongly and smaller firms in particular are performing well. Last, the trend term in the Panel A regressions shows that there is a long term upward drift in IPO activity over time. Last, there is no evidence that HML influences the number of IPOs. The Panel B regressions with relative value of IPOs as the dependent variable show a different and more puzzling dynamic in terms of the lagged variables, and indicate a weaker role for market returns, with the SMB factor now exhibiting a negative relationship with IPO value, but only at a 2 year lag. Last, HML is positively related to IPO value, suggesting that larger IPO activity by value follows periods when "value" firms are performing particularly strongly. Last, the relative value trend is downwards. Whilst some of the relationships shown by the relative value regressions seem hard to explain, as we show below the large privatisations that took place during the second quarter of our sample period probably have a major impact on these relative value regressions, but not on the relative number regressions.[5]

[Table 4 about here]

Calendar time results

As Chan et al. (2007, p.2684) state a "key implication of pseudo-timing is that while abnormal performance may exist when measured in event time, this result should not exist when evaluated in calendar time". Accordingly, having shown that some form of market timing appears to be taking place in observed IPO activity, we now turn to the analysis of IPO portfolios formed in calendar time. The first results we report are from the simple CTAR method of Lyon et al. (1999) and Mitchell and Stafford (2000) where the portfolio of IPO firms is compared to a size-matched portfolio of control firms. We employ two weighting schemes. The first is a simple equal weighting, where in any month each firm that has experienced an IPO in the previous 12, 24, 36, 48 or 60 months is included in the portfolio, so that in any given month, t, the weight given to that firm is $1/N_t$, where N_t is the number of firms in that portfolio. The second is a value weight, where each firm is weighted according to its market capitalisation, M_i, at the time of the initial IPO. The weight given to any firm in month t is therefore:

$$M_{i,t} / \sum M_{i,t}$$

[5] We provide a listing of the largest 40 IPOs by relative value in Appendix 2.

Note that in both cases the benchmark return for the CTAR calculation is that IPO's value-weighted size-control decile portfolio return. Whether value-weighted CTARs or equally weighted CTARs are better specified is an empirical question that is yet to be resolved. One feature of value-weighted calendar time abnormal returns that has not been discussed in the literature is that in markets with an expected positive return and dividend payout rates of less than 100%, value-weighted abnormal returns will tend to place more weight on recent issues in the portfolio of CTARs. To see this, first assume that IPOs (or any other event of interest) occur randomly through time. A priori, in, say, the 60 month CTAR portfolio, the weights given to IPOs in the past 12 months will be 12/60, the weight to IPOs in the past 13-24 months 12/60, and so on. However, positive expected nominal returns and less than 100% payout rates imply that the market capitalisations of all firms rise through time, partly through an inflation effect and partly through a real expected rate of return effect. The consequence is that on average, weights will no longer be evenly distributed through time even if the IPOs themselves are, because more recent IPOs will tend to have higher market capitalisations than older IPOs. Of course, if IPOs are not randomly distributed through time then the weighting for any individual 12 monthly period may not be 12/60, but the argument that recent IPOs have greater weight in the value weighted portfolio than the equally weighted one will still hold. In our portfolios this is indeed the case. The weightings to up to 12 months through to 48 to 60 month portfolios for the equally-weighted CTARs are, respectively, 29.5%, 21.6%, 18.5%, 15.4% and 15%, whilst those for the value-weighted scheme are, respectively, 32.3%, 22%, 17.5%, 14.5% and 13.8%. This matters if abnormal returns occur at a non-linear rate through time. The BHARs reported in Table 2 suggest that the rate of abnormal return is at its smallest in the first 12 months – indeed, the first 6 months show a positive return. A second issue with value-weighted returns is that they are less likely to detect abnormal performance if this is concentrated in smaller firms (Chan et al., 2007; Loughran and Ritter, 2000).

Turning to the results themselves, in Table 5 we present results using the basic CTAR method described in Lyon et al. (1999) and Mitchell and Stafford (2000). Panel A shows the results from the equally-weighted portfolio. Monthly returns are significant for the 24 and 36 month portfolio formation periods, where returns are -0.51% and

-0.44% respectively. For the 48 month period returns are -0.3% per month, significant at the 5.26% level. However, after 60 months returns are an insignificant -0.23% per month after 60 months. The negative abnormal returns implied by the CTAR method are actually greater than those from the value-weighted benchmark BHAR returns for 24 and 36 month horizons, which does not support a pseudo-timing argument. However, the CTAR returns suggest that the rate of under-performance in IPOs slows after 36 months, a result we find in the CARs discussed in the previous section, and also a result found in an earlier investigation of UK IPOs in Espenlaub et al. (2000). The conclusion from the equally-weighted CTAR analysis seems clear – the under-performance of IPOs is real enough, supportive of a Loughran and Ritter (2000) behavioural timing explanation of IPOs, and not the result of "pseudo-timing". When we conduct the same analysis using value-weighting, reported in Panel B of Table 5, the results are simply insignificant. At least two explanations are possible for this divergence between equally-weighted and value-weighted returns. The first is that abnormal returns are concentrated in smaller firms. For the US, Brav and Gompers (1997) show that under-performance is concentrated in smaller non-venture capital backed IPOs. However, this is not entirely consistent with earlier evidence for the UK. Espenlaub et al. (2000, Table 2) find that although underperformance is concentrated in the low deciles, the very worst decile for IPO performance is the largest.[6] We show below that there are in fact two major factors influencing these value-weighted calendar time returns. The first is that large IPOs do indeed perform better, on average, than smaller IPOs. However, the second, and major, factor is that large privatisations have an even greater impact on the value-weighted returns.

In Table 6, we run the regression model implied by (5) above, employing White (1980) corrected robust standard errors. Panel A shows the results for the equally-weighted portfolio, which are broadly consistent with those from the basic CTAR method, except for the fact that results are generally more significant. The intercept terms, or "alphas", look very close to the monthly abnormal returns from Table 4 Panel A, but returns at 48 and 60 months are now significant at the 5% level. The beta on the benchmark portfolios is on average slightly above one for the portfolio

[6] Although they note that these are a small number of observations in this group. Nonetheless, the median abnormal return of these 8 firms is not supportive of an "outlier" effect.

formation periods, but never significantly different from one for any individual formation period. Finally the adjusted R-squared figures suggest that the implied model of expected returns performs reasonably well in explaining the cross-section of observed returns. Taken as a whole, these results strengthen the picture painted by the CTARs in Table 5, Panel A. There again appears to be no support for a "pseudo-timing" explanation of IPO returns. However, once again the value-weighted CTARs, reported in Panel B, yield abnormal returns that are wholly insignificant. Whilst the betas on the control portfolios are not significantly different from one, the standard errors of those betas have increased and the adjusted R-squared figures are well below those of the equally weighted CTAR model for all portfolio formation periods, suggesting that a value-weighted model does a poorer job of explaining the cross-section of returns than an equally weighted model.

[Table 5 about here]

[Table 6 about here]

Our final GLS regressions are shown in Table 7. Table A shows the results from equally-weighting firms in the IPO calendar time portfolio. First, by comparing these results with those in Table 6 Panel A we can see that the GLS model does indeed appear to add to a simple White-corrected OLS model of abnormal returns. For example, for the 60 month formation period the adjusted R-squared has improved from 75.3% to 81.7%. Second, betas of the control portfolios increase somewhat, and are significantly greater than one at the longer horizons (36, 48 and 60 months). Third, all the results with respect to the significance of the under-performance of IPOs are preserved. However, the magnitude of the under-performance is somewhat increased. The 24-month CTAR is now -0.7% per month, the 36 month CTAR -0.6% per month, the 48 month CTAR -0.4% per month and the 60 month CTAR -0.4% per month. Whether we use the simplest or the most sophisticated of approaches to analysing the equally-weighted CTARs we get a simple and unambiguous message. IPOs show all the characteristics of genuine under-performance (as suggested by the BHARs), and the results are supportive of the behavioural timing hypothesis of Loughran and Ritter (2000) rather than the pseudo-timing hypothesis of Schultz (2003). Once again, all of the value-weighted CTARs simply fail to be significant.

As with the robust standard error OLS approach, standard errors on betas are larger than under the equally-weighted model, and the adjusted R-squared values far lower.

[Table 7 about here]

Returns by relative size and type

Given the large differences between value and equally weighted returns in calendar time, we now turn to a sub-analysis of the BHAR results which divides the sample according to the relative size of the IPO, the sub period in which the IPO occurs, and whether or not the IPO was a privatisation. It is important to classify IPOs by relative rather than absolute size because of the enormous changes in market capitalisation between the early and later years of our sample. To classify IPOs, break-points were obtained as follows. We first calculated the relative value of a given IPO by dividing its market value at issue by the total market capitalisation of all firms in January of that year. This produces the size of the IPO relative to its current market. We then divided IPOs into five quintiles. The smallest quintile (Q1) includes IPOs whose value was less than 0.0005% of the total market capitalisation at the time of issue, while the largest quintile (Q5) includes IPOs whose value was greater than or equal to 0.05% of the total market capitalisation The resultant distribution is shown in Table 8. Whilst any such categorisation may be viewed as somewhat arbitrary, the figures clearly show that the majority of our IPOs fall into the middle quintile, with the smallest number (122) in the largest quintile. Means and medians are not that different in Q1-Q4, but are very different in Q5. In terms of relative size, the largest IPO by far was the BT privatisation and our top three by size are all privatisations (the fourth being Wellcome plc). A list of the top 40 IPOs by size is shown in Appendix 2.

When we divide up the whole sample by size and sub-period (1975-90; 1991-2004) in Table 9, we can clearly see that both the equally and value weighted benchmark 60 month BHARs increase monotonically with size. However, for shorter holding periods Q4 actually has a greater return. There is some variation in this pattern for the sub-periods, but for all sub periods the Q5 returns are positive at all horizons, and in general the two smallest quintiles show the worst performance whilst the two largest quintiles show the best performance.

[Table 8 about here]

[Table 9 about here]

In Table 10 we perform a similar analysis, but drop the privatisations. The results are striking. Long horizon returns are now negative for all quintiles, although the 36 month BHARs are positive for the fourth quintile. The most marked changes occur in the first sub-period, which is not surprising given the bulk of relatively large privatisations occurred then (although the electricity company privatisations took place in 1991). Although the results suggest an improvement in performance for all groupings except Q3 in the second half, a certain amount of caution is needed in interpreting these results, as returns are only accumulated up to Dec 2006, meaning that full period returns for IPOs occurring late in our sample period have not been calculated.

Our final tests of the effect of size and privatisation on BHAR is a regression-based test reported in Table 11. In these regressions, BHAR is regressed on four size dummies, one for each quintile, with the intercept capturing the lowest quintile performance, and a further dummy for privatisation Although adjusted R-squared values are somewhat disappointing, we can see that the general impression from Tables 8 and 9 clearly shows up in the regressions. BHARs increase with relative size, up to Q4, and the increases are significant. However, Q5 exhibits smaller increases than Q4, and the coefficient is only significant at the 10% level. However, the coefficient on privatisations is enormous, particularly against the value-weighted benchmark. The other point of note is that once we control for privatisation, the implied 60 month BHAR for any quintile, obtained by adding the intercept term and the relevant dummy variable, is negative. The only group with implied positive 60 month BHARs is the privatisation group.

Taken as a whole, and seen in conjunction with the equally weighted results, it seems clear the value-weighted CTAR results are being heavily influenced by some large privatisation issues. Given that these were politically motivated, and that mangers in these firms would have had little influence over the timing of the issue, and indeed little to gain personally from "market timing", it is hard to see the value-weighted CTARs as providing support a pseudo-timing hypothesis. However, once privatisations are excluded, the results how that in general larger IPOs perform better than smaller IPOs, a result previously found for the US by Brav and Gompers (1997) and for the UK by Espanlaub et al. (2000). Nonetheless, the evidence still shows that the performance of all size groupings (net of privatisations) is disappointing.

[Table 10 about here]

[Table 11 about here]

Conclusion

Our results clearly show that in event time, IPOs under-perform, and under-perform significantly. We place most on the performance measured relative to our value-weighted control portfolios, and under that metric IPOs under-perform by just over 10% after three years and by 28.6% after 5 years. Under-performance is greater when either equally-weighted control portfolios are used as the benchmark, or when a matched-firm approach is used. A robustness check using CARs confirms the under-performance of IPOS, though suggests a flattening off in this after three years. Under the pseudo-timing hypothesis of Schultz (2003), such observed under-performance of in event time of IPOs *ex post* is not indicative of under-performance *ex ante*, and he argues strongly in favour of calendar time portfolio tests. A calendar time portfolio test amounts to investing a fixed amount of cash in IPO portfolios each month. The arguments and simulations used by Schultz do not require any particular weighting scheme for these calendar time portfolios, and neither do his US results appear to be sensitive to the choice of weighting. We examine results using both equally weighted returns and value-weighted returns in calendar time.

Whilst it is clear from our analysis that timing effects exist, the equally weighted calendar time results lead us towards dismissing a pseudo-timing explanation of IPOs. These CTARs are indicative of substantial under-performance of IPOs, which is not compatible with a pseudo-timing hypothesis. In contrast, our results are in keeping with the behavioural timing hypothesis of Loughran and Ritter (2000). Using the simple CTAR approach of Lyon et al. (1999) we show strong under-performance for up to 36 months post IPO, with slightly weaker results after 48 months but insignificant returns after 60 months. More complex analyses using a regression framework which controls for heterscedasticity show significant under-performance of between -0.5% and -0.6% per month after 36 months, and between -0.3% and -0.4% per month after 60 months depending on whether a robust standard errors OLS or a GLS approach is used. These figures are in line with those implied by the BHAR approach. It is only when we value-weight these CTARs that we are unable to detect any abnormal performance. This does not, in our view, support a pseudo-timing argument; rather, it is indicative of under-performance being associated with smaller IPOs and of even more importance, the value-weighted returns being heavily influenced by privatisation issues.

Of course, there are the usual caveats that our results are contingent upon the correct risk-adjusted benchmarks being employed in the analysis. Here, we have employed size-decile controls and size-matched firm controls. Some might argue for different matching procedures. We favour size-controls rather than, say, size and book-to-market controls, for three reasons. The first two are theoretical. First, there is a growing body of evidence (Gregory et al., 2001; Al-Horani et al., 2003; Michou et al., 2007) that suggests UK returns may not be entirely captured by either a Fama-French model or a model based on Fama-French style portfolios. Second, as Loughran and Ritter (2000) observe, if behavioural timing does occur, then more powerful tests result from using size-control portfolios than using size and book-to-market portfolios. Our third reason for choosing size-matching is pragmatic, in that it enables us to use the largest possible number of IPO and control firms, and avoids any possible survivorship biases affecting our results.

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Table 1: IPOs on the UK official list by the year of issue (1975-2004) and the total market capitalisation of all issues at the time of entering the market for each year.

Year	Placings	Offers for sale	Tenders	Sub-scriptions	Placing & open offer	Placing & interme-diaries offer	Placing & offer for sale	Total	Total Market Cap. (£m)
1975	1							1	3
1976	1	1						2	30
1977	3	2						5	43
1978	2	8						10	108
1979	3	4	2					9	330
1980	6	5	1	2				14	132
1981	27	16	2	5				50	1290
1982	26	7	3	3				39	3127
1983	56	15	22	2				95	1848
1984	74	27	7	2				110	14419
1985	73	40	8	2				123	3160
1986	86	47	8	3				144	14077
1987	116	22	4	1				143	7588
1988	117	18		2			1	138	7565
1989	73	14						87	8036
1990	16	13		2			1	32	8471
1991	8	8		1			1	18	9153
1992	26			1				27	4648
1993	83	1		4		1	1	90	7502
1994	104	3	1		1	6	4	119	13523
1995	59	4						63	5408
1996	143	5		1	1	5	5	160	17845
1997	111	7			1		9	128	17789
1998	67	2					2	71	7625
1999	82	6			3		1	92	38408
2000	211	14			3		22	250	29767
2001	92	9			1		10	112	7758
2002	58	3			2		10	73	13323
2003	71	3			1		4	79	7738
2004	270	3			2		8	283	22600
Total	**2065**	**307**	**58**	**31**	**15**	**12**	**79**	**2567**	**273314**

Note: Initial public offerings include offers for sale at fixed price, placement, Offers for sale by tender, and subscriptions. Investment trusts are excluded. The entire population are based on 2932 issues, **365** firms are excluded, and the sample is 2567 firms issued during the period 1975-2004.

Table 2: Buy and Hold Abnormal Return (BHAR) event time returns from size-control (decile) benchmarks

Panel A: Using an equally-weighted size-decile control portfolio

Month	Mean BHAR	Conventional t-ratio	Skewness	Kurtosis	Skewness-adjusted t-statistic	1%	99%	5%	95%	Sig
6	0.007	0.747	7.286	109.937	1.056	-2.669	2.666	-1.742	1.865	n.s.
12	-0.031	-2.178	4.078	37.135	-1.721	-2.408	2.695	-1.683	1.901	*
18	-0.067	-3.62	2.394	12.396	-3.124	-2.29	2.453	-1.623	1.758	***
24	-0.099	-3.781	3.899	35.677	-3.367	-2.313	2.399	-1.563	1.701	***
30	-0.125	-3.66	4.299	37.458	-3.295	-2.289	2.229	-1.573	1.57	***
36	-0.149	-3.395	5.985	72.491	-3.247	-2.24	2.392	-1.541	1.576	***
42	-0.213	-4.623	4.635	53.508	-4.468	-2.261	2.249	-1.596	1.641	***
48	-0.276	-5.645	2.948	22.629	-5.098	-2.468	1.967	-1.621	1.531	***
54	-0.341	-6.151	3.778	36.864	-4.957	-2.002	2.24	-1.506	1.689	***
60	-0.431	-6.881	3.565	41.923	-5.422	-2.178	2.24	-1.553	1.611	***

Panel B: Using a value-weighted size-decile control portfolio

Month	Mean BHAR	Conventional t-ratio	Skewness	Kurtosis	Skewness-adjusted t-statistic	1%	99%	5%	95%	Sig
6	0.009	0.913	7.442	113.791	1.069	-2.51	2.707	-1.815	1.766	n.s.
12	-0.028	-1.937	4.262	39.379	-1.675	-2.496	2.275	-1.625	1.639	*
18	-0.062	-3.394	2.527	13.092	-3.127	-2.298	2.516	-1.685	1.774	***
24	-0.084	-3.248	4.14	37.894	-3.144	-2.24	2.289	-1.601	1.775	***
30	-0.093	-2.793	4.69	41.571	-2.773	-2.116	2.316	-1.511	1.66	***
36	-0.101	-2.358	6.372	77.968	-2.555	-2.142	2.146	-1.56	1.43	***
42	-0.138	-3.084	5.09	59.652	-3.354	-2.13	2.203	-1.559	1.546	***
48	-0.174	-3.722	3.47	25.795	-3.744	-2.159	2.102	-1.518	1.622	***
54	-0.212	-4.038	4.599	44.414	-3.639	-2.377	2.15	-1.558	1.649	***
60	-0.286	-4.864	4.664	50.058	-4.119	-2.194	2.414	-1.565	1.542	***

The columns show the mean BHAR, a conventional t-ratio, skewness and kurtosis, together with the skewness adjusted t-statsitic. The last columns show the cut-off values for the wild boostrapped skewness and kurtosis adjusted t-statistic described in the text. The final column shows the significance level of the mean BHAR, with “n.s.” representing not significant, and “*”,”**” and “***” representing significance at the 10%, 5% and 1% levels respectively.

Table 3: Buy and Hold Abnormal Return (BHAR) event time returns from a size-matched firm benchmark

Month	Mean BHAR	Conventional t-ratio	Skewness	Kurtosis	Skewness-adjusted t-statistic	1%	99%	5%	95%	Sig
6	-0.021	-1.816	4.645	68.22	-1.58	-2.464	2.593	-1.635	1.637	n.s.
12	-0.073	-4.166	2.127	20.303	-3.812	-2.38	2.46	-1.685	1.517	***
18	-0.134	-5.799	0.776	7.249	-5.491	-2.265	2.449	-1.61	1.607	***
24	-0.174	-5.61	1.388	16.387	-5.454	-2.374	2.369	-1.568	1.555	***
30	-0.228	-5.639	1.552	19.842	-5.633	-2.162	2.311	-1.59	1.771	***
36	-0.276	-5.33	3.083	41.298	-5.578	-2.431	2.332	-1.618	1.584	***
42	-0.336	-5.948	1.839	29.525	-6.479	-2.347	2.435	-1.598	1.615	***
48	-0.474	-7.15	-0.739	17.314	-8.133	-2.118	2.305	-1.616	1.538	***
54	-0.58	-7.774	-0.837	22.275	-8.664	-2.175	2.194	-1.42	1.691	***
60	-0.618	-7.779	0.919	18.567	-7.702	-2.182	2.321	-1.552	1.575	***

The columns show the mean BHAR, a conventional t-ratio, skewness and kurtosis, together with the skewness adjusted t-statsitic. The last columns show the cut-off values for the wild boostrapped skewness and kurtosis adjusted t-statistic described in the text. The final column shows the significance level of the mean BHAR, with "n.s." representing not significant, and "*","**" and "****" representing significance at the 10%, 5% and 1% levels respectively.

Table 4: Panel A: Relative number of IPOs regressions

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	Full Model			Restricted Model		
	Coefficient	t-statistic	p-value	Coefficient	t-statistic	p-value
Constant	-0.75	-0.97	0.331	-0.32	-0.44	0.657
n_{t-1}	-0.36	-1.90	0.058			
n_{t-2}	0.09	0.68	0.495			
n_{t-4}	0.33	2.36	0.018	0.29	2.49	0.013
n_{t-5}	-0.56	-3.62	0.000	-0.54	-3.76	0.000
v_{t-1}	0.07	0.69	0.493			
v_{t-2}	0.49	5.02	0.000	0.46	7.04	0.000
m_{t-1}	116.81	5.77	0.000	112.99	5.00	0.000
m_{t-2}	54.51	1.27	0.206			
smb_{t-1}	185.21	5.27	0.000	153.03	3.98	0.000
smb_{t-2}	24.18	0.50	0.618			
hml_{t-1}	3.16	0.14	0.886			
hml_{t-2}	3.53	0.12	0.906			
Trend (t)	0.32	5.52	0.000	0.26	5.58	0.000
Adjusted R^2	0.75			0.82		

Table 4: Panel B: Relative value of IPOs regressions

	Full Model			Restricted Model		
	Coefficient	t-statistic	p-value	Coefficient	t-statistic	p-value
Constant	3.17	3.10	0.002	2.83	3.27	0.001
v_{t-1}	-0.32	-2.62	0.009	-0.24	-1.93	0.054
v_{t-2}	0.45	3.27	0.001	0.48	3.94	0.000
v_{t-4}	-0.38	-2.78	0.005	-0.34	-2.52	0.012
v_{t-5}	-0.05	-0.84	0.399			
n_{t-1}	0.37	2.29	0.022	0.20	1.74	0.082
n_{t-2}	0.11	1.34	0.180			
m_{t-1}	31.76	1.71	0.087	32.78	1.72	0.086
m_{t-2}	-33.00	-1.21	0.228			
smb_{t-1}	7.08	0.34	0.737			
smb_{t-2}	-157.34	-3.56	0.000	-103.43	-3.51	0.000
hml_{t-1}	61.94	2.40	0.016	55.24	2.13	0.033
hml_{t-2}	3.41	0.17	0.867			
Trend (t)	-0.18	-2.71	0.007	-0.12	-2.43	0.015
Adjusted R^2	0.38			0.53		

Dependent variables are the relative number of IPOs (n_t) and the relative value of IPOs (v_t) in Panels A and B respectively. Independent variables are the lagged values of these variables, together with lagged values for the return on the market (m_t), and the other Fama-French factors (smb_t and hml_t)

Table 5: Calendar Time Abnormal Returns (CTAR) from a size-control benchmark

Panel A: Equally weighted CTAR

Holding Period	Mean CTAR	t-stat	p-value
12	-0.0011	-0.4339	0.6644
24	-0.0051	-2.8303	0.0047
36	-0.0044	-2.7727	0.0056
48	-0.0030	-1.9382	0.0526
60	-0.0023	-1.5566	0.1196

Panel B: Value Weighted CTAR

Holding Period	mean	t-stat	p-value
12	0.0044	1.4046	0.1601
24	0.0016	0.6078	0.5433
36	0.0022	0.9863	0.3240
48	0.0032	1.5392	0.1238
60	0.0023	1.1619	0.2453

Table 6: Robust (White 1980 Corrected) OLS regressions of IPO Calendar Time Returns on Size_Control Benchmark Return

Panel A: Equally Weighted Portfolios

Holding Period	Alpha	Beta	AdjR2
12	-0.001	1.011	51.5
(t-stat)	-0.542	15.048	
24	-0.005	0.98	64.1
(t-stat)	-2.859	19.593	
36	-0.005	1.041	72.7
(t-stat)	-3.195	21.769	
48	-0.004	1.061	74.3
(t-stat)	-2.514	23.852	
60	-0.003	1.061	75.3
(t-stat)	-2.135	24.651	

Panel B: Value Weighted Portfolios

Holding Period	Alpha	Beta	AdjR2
12	0.004	0.998	39.3
(t-stat)	1.46	13.091	
24	0.002	0.997	44.3
(t-stat)	0.62	14.005	
36	0.002	1.071	57.4
(t-stat)	0.736	17.098	
48	0.003	1.069	59.8
(t-stat)	1.293	18.722	
60	0.002	1.067	62.6
(t-stat)	0.913	20.461	

Table 7: GLS regressions of IPO Calendar Time Returns on Size_Control Benchmark Return

Panel A: Equally Weighted Portfolios

Holding Period	Alpha	Beta	AdjR2
12	-0.004	1.092	58.1
(t-stat)	-1.636	16.543	
24	-0.007	1.044	69.2
(t-stat)	-3.974	21.677	
36	-0.006	1.115	78.7
(t-stat)	-4.397	23.445	
48	-0.004	1.145	80.6
(t-stat)	-3.063	24.538	
60	-0.004	1.14	81.7
(t-stat)	-2.844	25.909	

Panel B: Value Weighted Portfolios

Holding Period	Alpha	Beta	AdjR2
12	0.002	1.074	41.4
(t-stat)	0.747	11.965	
24	0	1.06	46.1
(t-stat)	0.101	13.713	
36	0.001	1.124	58.8
(t-stat)	0.254	15.786	
48	0.002	1.125	61.7
(t-stat)	0.848	17.339	
60	0.001	1.133	65.3
(t-stat)	0.342	18.87	

Table 8: IPO firms by relative size.

Break-points were obtained as follows. We first calculate the relative value of a given IPO by dividing its market value at issue by the total market capitalisation of that year. This will give us the size of the IPO relative to its current market. We then divide IPOs into five quintiles. The smallest quintile (Q1) includes IPOs whose value is less than 0.0005% of the total market capitalisation (at the time of issue), while the largest quintile (Q5) includes IPOs whose value is greater than or equal to 0.05% of the total market capitalisation

	Q1	Q2	Q3	Q4	Q5
Definition	<0.0005	>=0.0005 <0.001	>=0.001 <0.01	>=0.01 <0.05	>=0.05
N	340	252	1430	413	122
Mean %tge	0.000265	0.000737	0.003902	0.019830	0.273828
Median %tge	0.000259	0.000707	0.003227	0.016319	0.103966
Min %tge	0.000017	0.000506	0.001011	0.010000	0.050723
Max %tge	0.000496	0.000991	0.009989	0.049732	6.945661

Table 9: The tables show the results for the equal and value weighted BHAR for each quintile and for three holding periods of 12, 36 and 60 months. IPOs include privatisations

Panel A: Equally Weighted Benchmark BHAR

Holding Period	Q1	Q2	Q3	Q4	Q5
			Full Sample		
12	-0.41	-0.13	-0.04	0.22	0.07
36	-1.23	-0.60	-0.23	0.27	0.14
60	-2.16	-1.37	-0.55	-0.08	0.03
			1975-1990		
12	-0.35	-0.30	-0.04	0.17	0.11
36	-1.19	-1.14	-0.30	0.06	0.22
60	-1.66	-2.46	-0.61	-0.30	0.02
			1991-2004		
12	-0.41	-0.10	-0.04	0.27	0.04
36	-1.24	-0.50	-0.15	0.49	0.06
60	-2.26	-1.12	-0.48	0.17	0.04

Panel B: Value Weighted Benchmark BHAR

Holding Period	Q1	Q2	Q3	Q4	Q5
			Full Sample		
12	-0.30	-0.10	-0.05	0.20	0.07
36	-0.64	-0.42	-0.21	0.24	0.14
60	-1.01	-0.80	-0.43	-0.08	0.06
			1975-1990		
12	-0.20	-0.20	-0.04	0.15	0.11
36	-0.64	-0.77	-0.24	0.03	0.22
60	-0.64	-1.32	-0.42	-0.27	0.08
			1991-2004		
12	-0.32	-0.08	-0.06	0.26	0.03
36	-0.63	-0.35	-0.17	0.47	0.05
60	-1.08	-0.68	-0.43	0.14	0.04

Table 10: The tables show the results for the equal and value weighted BHAR for each quintile and for three holding periods of 12, 36 and 60 months, excluding privatisations

Panel A: Equally Weighted Benchmark BHAR

Holding Period	Q1	Q2	Q3	Q4	Q5
	Full Sample				
12	-0.42	-0.13	-0.04	0.21	0.04
36	-1.30	-0.60	-0.23	0.23	-0.02
60	-2.36	-1.37	-0.55	-0.18	-0.21
	1975-1990				
12	-0.48	-0.30	-0.04	0.17	0.06
36	-1.81	-1.14	-0.30	0.06	0.04
60	-3.02	-2.46	-0.61	-0.31	-0.52
	1991-2004				
12	-0.41	-0.10	-0.04	0.25	0.03
36	-1.24	-0.50	-0.15	0.42	-0.07
60	-2.26	-1.12	-0.48	-0.03	0.03

Panel B: Value Weighted Benchmark BHAR

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Holding Period	Q1	Q2	Q3	Q4	Q5
	Full Sample				
12	-0.31	-0.10	-0.05	0.19	0.04
36	-0.70	-0.42	-0.21	0.21	-0.01
60	-1.18	-0.80	-0.43	-0.18	-0.18
	1975-1990				
12	-0.29	-0.20	-0.04	0.15	0.06
36	-1.20	-0.77	-0.24	0.02	0.07
60	-1.86	-1.32	-0.42	-0.28	-0.45
	1991-2004				
12	-0.32	-0.08	-0.06	0.24	0.02
36	-0.63	-0.35	-0.17	0.41	-0.07
60	-1.08	-0.68	-0.43	-0.06	0.02

Table 11: Regressions of BHAR on dummy variables for size and privatisation

$$BHAR = \beta_1 + \beta_2 D2 + \beta_3 D3 + \beta_4 D4 + \beta_5 D5 + \beta_6 PR$$

Where D2 to D5 are dummies for size. For example, D3 equals 1 for firms belonging to the third quintile and zero otherwise. The intercept accounts for the lowest size. PR is a dummy for privatised companies and equals 1 if a firm was privatised and zero otherwise.

Holding Period		ß1	ß2	ß3	ß4	ß5	ß6	R-sq
Equally Weighted Benchmark								
12	Coefficient	-0.42	0.29	0.38	0.63	0.42	0.30	
	T-stat	-11.51	5.25	9.38	13.11	5.75	2.86	0.07
36	Coefficient	-1.28	0.68	1.06	1.54	1.11	1.19	
	T-stat	-11.70	4.18	8.82	11.00	5.39	4.24	0.06
60	Coefficient	-2.30	0.93	1.75	2.20	1.58	2.72	
	T-stat	-15.15	4.10	10.66	11.62	5.75	7.36	0.09
Value Weighted Benchmark								
12	Coefficient	-0.31	0.21	0.26	0.51	0.31	0.28	
	T-stat	-8.69	3.91	6.60	10.71	4.36	2.66	0.05
36	Coefficient	-0.68	0.27	0.47	0.92	0.53	1.09	
	T-stat	-6.30	1.65	4.01	6.63	2.63	3.94	0.03
60	Coefficient	-1.14	0.34	0.71	1.04	0.49	2.57	
	T-stat	-7.91	1.56	4.55	5.78	1.88	7.34	0.04

Appendix 1. LSPD Codes and Descriptions of Type of Delisting.

Code	Description
5	Acquisition/takeover/merger
6	Suspension/cancellation with shares acquired later. Meanwhile, may be traded under rule 163(2)
7	Liquidation (usually valueless, but there may be liquidation payments)
8	Quotation cancelled (maybe suspended initially) as company becomes a private company, or there is insufficient trading in the shares. Dealings continue under rule 163(2) or (3)
9	As for 8, but no dealings under rule 163
10	Quotation suspended – if suspended for more than three years, this may lead to automatic cancellation
11	Voluntary liquidation, where value remains and was / is being distributed
12	Changed to foreign registration
13	Quotation cancelled for reason unknown. Dealings continue under rule 163(2) or (3)
14	As for 13, but no dealings under rule 163
15	Converted into an alternative security for the same company
16	Receiver appointed/liquidation. Probably valueless, but not yet certain
17	Unitisation of an investment or financial trust
18	Nationalisation
19	Enfranchisement
20	In Administration/Administrative receivership
21	Cancelled and assumed valueless

Source: LSPD manual handbook 2006. This table represents the type of death (G10) in the LSPD manual, which indicates to the reason why the security ceased to be in the SEDOL.

Appendix 2: Top 40 IPOs in terms of relative size.

	%	Year	Privatised	Name		%	Year	Privatised	Name
1	6.946	1984	Yes	BT Group	21	0.334	1999		SABMiller
2	2.561	1986	Yes	BG Group plc	22	0.326	1997		BHP Billiton plc
3	2.559	1982	Yes	BRITOIL	23	0.318	1987	Yes	British Airways plc
4	0.808	1986		Wellcome plc	24	0.311	1996	Yes	RT Group plc
5	0.775	1986		TSB Group plc	25	0.309	1981	Yes	Cable & Wireless plc
6	0.716	1997		Norwich Union plc	26	0.290	1987	Yes	Rolls Royce Group plc
7	0.677	1988	Yes	Corus Group plc	27	0.290	2000		Dimension Data Holdings plc
8	0.640	1991	Yes	International Power plc	28	0.289	1989	Yes	Thames Water plc
9	0.536	1984		Reuters Group plc	29	0.287	1984	Yes	JAGUAR PLC
10	0.532	1994		British Sky Broadcasting Gp	30	0.267	1985		Lloyds Abbey Life Group
11	0.498	1988		Vodafone Group plc	31	0.261	1989	Yes	United Utilities plc
12	0.492	1992		Waste Management Intnl plc	32	0.253	1989	Yes	Severn Trent plc
13	0.452	1991	Yes	Scottish Power plc	33	0.245	1984	Yes	Enterprise Oil plc
14	0.412	1991	Yes	Powergen plc	34	0.243	1996		Orange plc
15	0.411	1999		Freeserve plc	35	0.228	1989	Yes	AWG plc
16	0.400	1999		Old Mutual plc	36	0.224	1986		MORGAN GRENFELL GRP PLC
17	0.386	1999		Eircom plc	37	0.214	1991	Yes	Scottish & Southern Energy
18	0.366	2002		YM Biosciences Inc	38	0.185	1996	Yes	British Energy Group
19	0.362	1987	Yes	BAA plc	39	0.184	2001		Friends Provident plc
20	0.339	1979		STC plc	40	0.184	1985		Hillsdown Holdings plc