The Winner's Curse and Lottery-Allocated IPOs in China[†]

Jerry Coakley[*], Norvald Instefjord and Zhe Shen

Department of Accounting, Finance and Management and
Essex Finance Centre
University of Essex, Wivenhoe Park, CO4 3SQ, UK

February 2007

Abstract

This is the first study of Rock's (1986) winner's curse hypothesis in which over-subscribed IPOs are allocated by a pure lottery mechanism. It employs a unique dataset of 562 Chinese IPOs 1996-2001 which provides information for the estimation of allocation-weighted returns. The results provide much stronger support than hitherto for the winner's curse hypothesis. Allocations are inversely related to underpricing in line with adverse selection. Weighting by allocation dramatically reduces median abnormal returns more than 200-fold from 116% and uninformed investors earn a median return of just 0.51%. The winner's curse can explain underpricing in our sample of Chinese IPOs.

JEL classification: G14
EFMA classification: 350

Keywords: Winner's curse; Allocation-weighted returns; Underpricing; Lottery.

[†] An earlier version of this paper was presented at the 2006 30th Anniversary Conference of the Journal of Banking and Finance at Beijing, P.R. China. We thank participants and Jay Ritter in particular, for helpful comments and suggestions.

[*] Corresponding author. Tel.: +44 1206872455. Fax: +44 1206 873429. Email: jcoakley@essex.ac.uk

The Winner's Curse and Lottery-Allocated IPOs in China

I. Introduction

Rock (1986) proposes that uninformed investors subscribing to good or more profitable IPOs receive smaller allocations on average due to the participation of informed investors. The probability of investors obtaining an allocation in good IPOs is much smaller than that in bad (less profitable) ones as underpricing induces a higher participation rate in the former. If his model is correct, weighting abnormal returns by allocations should leave uninformed investors with zero abnormal profits. To our knowledge, Rock's winner's curse hypothesis has not been tested in the context of a pure lottery mechanism due to lack of data. However, this is possible for those Chinese IPOs where appropriate allocation data are available.

Testing the winner's curse hypothesis for the case of China is interesting since IPO underpricing there has particularly captured the imagination due to its sheer magnitude relative to other countries. Mok and Hui (1998) and Su and Fleisher (1999) examine IPOs in the early years of China's stock markets. The former report that the average underpricing of 101 IPOs during the 1990-1993 period is 289% while the latter find the underpricing of 308 IPOs exceeds 948% if earlier IPOs are included. Recently, Chan et al. (2004) establish that underpricing is 178% on average for a sample of 570 IPOs during the 1993-1998 period. We employ a unique sample of Chinese IPOs for the more recent 1996-2001 period to test Rock's (1986) winner's curse hypothesis.

Our paper makes several contributions to the literature. The primary contribution is that, to our knowledge, this is the first study of Rock's (1986) winner's curse hypothesis where oversubscribed IPOs are allocated exclusively by a pure

lottery mechanism. While existing studies such as Koh and Walter (1989), Levis (1990), and Keloharju (1993) have employed samples where allocation is by a ballot mechanism, there is some bias in all cases. Although the ballot ensures a fair game for applications of the same size, it is invariably biased against small applications. There is no such bias in our sample. In this respect, our paper complements the seminal study of Amihud et al. (2003) of 284 IPOs on the Tel Aviv Stock Exchange (TASE) 1989-1993. Their sample comprises exclusively of issues allocated by a pure proration method and so is free of the problems found in previous tests of the winner's curse hypothesis. Our study is arguably more in line with the spirit of Rock's (1986) model. Under the pure lottery mechanism (hereafter lottery), investors are still exposed to the risk of being allocated no shares in IPOs. By contrast, investors are always guaranteed an allocation – however small – in IPOs assigned by proration.

The second contribution is that is that we demonstrate Rock's (1986) model can explain underpricing for our large sample of Chinese IPOs 1996-2001. We find evidence of adverse selection in Chinese IPOs. Moreover, our results indicate that allocation-weighting does indeed cause a very substantial drop in nominal abnormal returns. Median abnormal returns fall more than 227-fold from 116% which is far more dramatic than elsewhere. The huge abnormal returns documented in the literature disappear and the effective return to the typical investor is virtually zero. Uninformed investors participating indiscriminately in all IPOs earn a median return of just 0.51%.

The implication is that the huge documented initial returns in China in the literature are largely hypothetical. A typical investor would never realise these since most issues are massively oversubscribed and thus allocations are severely rationed. The clear implication is that both the relative and absolute impacts of allocation

weighting on returns are dramatic. In fact, they are far more so for Chinese IPOs than in the extant studies that address the winner's curse problem.[1] We conclude that the winner's curse can explain the apparently huge underpricing of our sample Chinese IPOs.

The final contribution is that our unique sample avoids some pitfalls of extant studies of Chinese IPOs.[2] It does so by carefully restricting our sample only to those IPOs that employ the same issuing method and are subject to the same regulatory regime. Both the stock issuing and the IPO pricing methods vary significantly over the 1990s and early years of the new millennium which leads to very extreme underpricing in some cases. For instance, in four out of six of the sample years, the maximum initial return was in excess of 3000%. The conflation of samples with different issuing methods and regulatory regimes in extant studies leaves the determinants of underpricing susceptible to the influence of such outliers which are excluded from our sample. Controlling for this problem, our sample still comprises the considerable number of 562 IPOs issued during the period 1996-2001. This makes it the largest sample to date employed in studies of the winner's curse hypothesis.

The paper proceeds as follows. In section II, we outline our sample selection criteria and relate these to China's institutional characteristics. In Section III, we describe the various mechanisms for underpricing, allocation, and their determinants in the Chinese new issue markets. Section IV presents the results of our tests of Rock's (1986) model and a discussion of their implications. A final section concludes.

[1] See Koh and Walter (1989), Levis (1990), and Keloharju (1993), for example.

[2] See Mok and Hui (1998), Su and Fleisher (1999), Tian (2003), Chan et al. (2004), Su (2004), and Chi and Padgett (2005) for example.

II. Data and China's Institutional Characteristics

Although the Shanghai and Shenzhen Stock Exchanges were officially established only in the early 1990s, methods of price determination, share issuance and allocation have undergone numerous changes throughout the 1990s and the early 2000s. These influence the extent of underpricing to varying degrees. The most extreme underpricing is often found for the case of special institutional arrangements only. For this reason, we exercise extreme care in selecting our Chinese IPO sample. Thus it excludes outliers such as the 70 IPOs 1996-2001 whose price was set by the authorities resulting in an average initial run up of some 1475%.

In this section, we outline our sample selection criteria and review these methods as they impact on our sample. Our data requirements for testing the winner's curse hypothesis imply that the sample IPOs are confined to the 1996-2001 period. Given this, the main restriction on our sample is that we have data on the allocation method which restricts the sample IPOs to those allocated by a pure lottery mechanism.

A. Sample

Our IPO data are obtained from three sources: the SinoFin CCER[3] Chinese IPO database, DataStream, and the GTA (*Guo Tai An*) CSMAR[4] China Stock Market Database. The basic IPO data are supplemented in two respects. Data on both the method of share issuance and the number of applicants are manually collected from the prospectuses and the listing announcements. The data are double-checked and corrected according to the original prospectus if differently documented.

[3] China Centre for Economic Research

[4] China Stock Market Accounting Research

The IPOs finally chosen for our sample satisfy the following five criteria:

(a) The IPO is an A-share issue[5];

(b) The shares remain listed on the market until the end of 2001;

(c) The method of share issuance is an online fixed price offering to investors in the primary market;

(d) Data are available on the number of applicants;

(e) Data on the rate of allocation are available.

Notably, criterion (c) regarding institutional share issuance and related arrangements in China is of great importance in selecting an appropriate sample for this study. For these IPOs, the exact period for which subscription funds are tied up is known and, more importantly, the associated pure lottery mechanism for oversubscribed IPOs facilitates the estimation of the effective return to a typical investor. Excluding some IPOs with missing allocation details, a total of some 562 out of 829 IPOs qualify for inclusion in our study. They are representative of Chinese IPOs 1996-2001 in two important respects: share issuance and allocation, and price determination.

B. Share Issuance and Allocation

China has quite specific and distinctive institutional arrangements for IPO issues. For the 1996-2001 period, the methods of share issuance include the prepayment in full proportional allocation approach, the fixed price approach, and the bookbuilding approach.[6] The methods of share allocation comprise the proration and lottery mechanisms. Table 1 presents the distribution of the sample by method of share issuance and allocation in terms of the number of IPOs.

[5] A-shares are designated for domestic investors only.

[6] See Appendix for more details on the methods of share issuance.

[Table 1 around here]

It shows that, the variety of issuing methods notwithstanding, the dominant method is the fixed price online offering to investors in the primary market. This accounts for over two thirds of new issues during this period and our final sample is drawn from this.

More significantly, the allocation method for these fixed price online issues is a pure lottery which operates as follows. Following the end of the subscription period, a series of lottery numbers is randomly allocated to subscribing investors on the basis of each 1000-share subscription. For example, a successful investor with a subscription order of 8000 shares will be allocated 8 lottery numbers. Note that the pure lottery mechanism does not discriminate against the size of orders although there are in practice limits on subscriptions by investors.[7] Successful investors with large subscription orders are simply given more lottery numbers. Finally note that the pure lottery in our sample differs from the lottery used for Chinese IPOs in early 1990s. In the latter, 10% of the fixed number of application forms sold was chosen for IPO shares. The issuing process of application forms was criticized and investigation found extensive corruption on the part of government officials and bank staff alike.

We identified 111 IPOs 1996-2001 that were allocated by proration. For the 74 with relevant data, we found no significant relation between underpricing and allocation for them. Their average and median allocation-weighted returns are statistically significant at 5.13% and 2.68%, respectively. These clearly differ from our lottery-allocated sample results.

[7] Apart from the minimum subscription of 1000 shares, there is an upper limit on investor subscription: 5% of total shares for institutional investors and 0.5% for retail investors. Quantitatively, these translate to 13,200,000 and 1,320,000 on average for the two types of investors in our study, respectively.

C. Price Determination of Chinese IPOs

China's stock markets are characterised by stringent political controls inherent in central planning and the price determination of IPOs is no exception. Table 2 presents the details.

[Table 2 around here]

Although a variety of methods appears to be have been used during the 1996-2001 period, the first six pricing methods are all examples of fixed price determination. Our sample is representative in terms of share pricing since it is drawn exclusively from fixed price IPOs. It excludes the 70 outlier IPOs which are largely priced at par value of RMB 1.00 by the authorities and so conventionally excluded and also the 12 IPOs which are priced in a bookbuilding mechanism.

We can distinguish between two approaches to fixed price determination, one governed by a formula during the period 1996-1999 and the other during the period 1999-2001. The former is the administrative approach to share pricing while the latter is more in line with international practice. The former uses a formula that applies a pricing-earnings (P/E) multiple to an earnings measure as follows:

$$\text{IPO price} = \text{earnings per share (EPS)} \times \text{P/E multiple}$$

For the period 1996-1999, there were several changes in rules governing the pricing formula. Before 1996, the calculation of EPS was primarily based upon earnings forecasts. In December 1996, the China Securities Regulatory Commission (CSRC)[8] issued a notice to standardize the earnings measure as the arithmetic average over the past three years. In September 1997, the CSRC required the measure to be based upon the arithmetic average of the EPS over the IPO year and the previous year. In March

[8] This is an institution of the State Council and the main regulator for mainland People's Republic of China (PRC). Its function is similar to that of the Securities and Exchange Commission in the USA.

1998, the CSRC stipulated that EPS should be calculated based upon forecasted earnings divided by the weighted average number of shares outstanding in the IPO year.

In contrast to the changes in the earnings measures, there appears to have been no change in the choice of P/E multiple. The underlying reason is that the issuer and the lead underwriter had no power to influence the P/E multiple which was determined by the central government. The CSRC policy during that period was that IPO shares should sell for P/E ratios of around 15 and in the range of 13-18. It is not until the promulgation of the Securities Law in 1999 that the predominant administrative approach to share pricing came to an end.

On July 28, 1999, the CSRC announced the experimental adoption of a new approach to price domestic IPOs. The 1999 regulations for the first time permitted the issuer and the lead underwriter to decide IPO prices.[9] They allow the underwriters to set a price range and seek investor bids on this basis. Based on information such as institutional orders, they then choose the offer price for online retail offering. Although the offer price was the result of negotiation between the issuer and the lead underwriter, it was still subject to CSRC approval, especially when the selection was not within the range suggested by the pricing methods.

III. Underpricing and Allocation

A. Underpricing

There are two definitions of IPO underpricing in the literature. One defines it as the percentage by which the first-day closing price exceeds the offer price. Ritter and Welch (2002) among others follow this definition. The other defines underpricing as

[9] New rules only apply to issuers of IPOs with total equity capital of more than RMB400 million.

the initial return in excess of the market return and is the approach adopted by Amihud et al. (2003). We employ both concepts in this paper and call them the initial run-up and the initial (excess) return, respectively. The returns are defined as follows:

- *Initial run-up*

$$(1) \qquad R_{j,1} = \left(\frac{P_{j,1}}{P_{j,0}} - 1 \right) \times 100\%$$

- *Initial excess return*

$$(2) \qquad IR_{j,1} = \left(\frac{P_{j,1}}{P_{j,0}} - \frac{P_{m,1}}{P_{m,0}} \right) \times 100\%$$

where $P_{j,0}$ and $P_{j,1}$ are the offer price and the closing price of new issue j on the first day of trading. $P_{m,,0}$ and $P_{m,1}$ are the market index on the offer date and first trading day, respectively.

Figure 1 shows the distribution of initial returns on the 562 sample IPOs.

[Figure 1 around here]

Two features stand out. On one hand, almost no (5 or les than 1%) issues exhibit negative initial returns. On the other hand, there is clear evidence of right skewness. The source of the latter is the 22 IPOs with extreme initial returns in excess of 300%.

Table 3 provides descriptive statistics on initial run-ups and initial returns, respectively, for all 829 IPOs (Panel A) and for our sample IPOs during the 1996-2001 period.

[Table 3 around here]

Since both the initial run-up and initial return series are skewed to the right, we focus our analysis on the medians. Generally, our sample is representative of total IPOs over this period. The IPO issue numbers in both panels peak in 1997 – around the time of the Asian crisis – and then decline before reaching another peak in 2000 near the end of the internet bubble. The median initial run-ups and initial returns in both panels

follow a similar pattern of peaks and declines. The one clear difference between the two panels is the total panel exhibits more volatile returns which are driven by outliers that are excluded from our sample. Even allowing for the latter, both the median initial run-up of 118% and the median initial return of 116% for the 562 sample IPOs are huge by both international standards and by comparison with those in extant studies of the Rock (1986) model.[10]

B. Allocation

Direct tests of Rock's (1986) model require information on allocation details in oversubscribed IPOs. These data are unavailable in the US but are readily available for our Chinese sample 1996-2001. Due to the lack of relevant data in the US, Rock's model has been examined indirectly in studies such as those of Ritter (1984), Beatty and Ritter (1986), Beatty and Welch (1996), Ljungqvist and Wilhelm (2003), to name but a few. However, there are still a few notable exceptions outside the US market where data availability and institutional arrangements facilitate direct tests such as in the cases of Singapore (Koh and Walter, 1989), the UK (Levis, 1990), Finland (Keloharju, 1993) and Israel (Amihud et al., 2003). However, the samples employed in all these studies are all relatively small by comparison with ours.

Allocation for our sample IPOs is by means of a pure lottery for oversubscribed new issues. The probability of obtaining an allocation in an IPO lottery, denoted as $ALLOC_j$, is simply the ratio of the number of shares issued over the total number of shares subscribed to in every IPO. The distribution of $ALLOC_j$ is depicted in Figure 2.

[10] See Table 1 of Loughran et al. (1994). For the most recent information, please visit Jay Ritter's website at http://bear.cba.ufl.edu/ritter/Int.pdf.

[Figure 2 around here]

The distribution is L-shaped because the allocation rate is less than the average (mean=1.4008%) in 477 out of 562 IPOs. The median allocation (0.4761%) is tiny and considerably less than the average indicating our sample IPOs are vastly oversubscribed. The L-shaped distribution is not really consistent with the implication of information cascades (Welch 1992) where investors who arrive late can mimic the decisions of the investors who arrive early and herd into subscribing or abstaining. Our data contain just as few as three sample IPOs with allocations over 50% at one extreme of information cascades in which investors herd into abstaining: 54%, 72% and 90%, respectively.[11]

There is virtually no (5 out of 562) overpricing of our sample IPOs due to the pricing mechanism employed. Since Rock's model distinguishes between good and bad IPOs on the basis of underpricing and overpricing, we differentiate between them on them basis of more and less profitable IPOs, respectively. Table 4 shows the allocation details relative to median initial returns.

[Table 4 around here]

For bad IPOs (whose initial returns are below the median), the mean and median allocations is 2.24% and 0.68%, respectively, while for good IPOs, the mean and median are 0.56% and 0.38%, respectively. Thus the median allocation in good IPOs is just over one half that in bad IPOs. For bad IPOs, the mean and median AWIRs to is 0.62% and 0.38%, respectively, while for good IPOs, the mean and median are 0.93% and 0.62%, respectively. Thus the median AWIR in good IPOs exceeds that in bad IPOs by more than 60%. Similar relationships when good and bad IPOs are defined relative to the mean.

[11] We also formally tested the hypothesis of no relation between uninformed investors and allocations and confirmed the impression of no information cascades from Figure 2.

C. The Determinants of Underpricing and Allocation

In Rock's (1986) strategic model the new issue is priced by the underwriter and deliberate underpricing induces a given level of excess demand. However, the offer price is mainly determined by a fixed formula in our sample. The central government via the competent authorities chooses a low P/E multiple for the issuer to use in underpricing the new issue. The motivation for this is to generate enthusiasm among investors and attract more participants though not necessarily in the sense predicted by Rock (1986). His model predicts that there should be no relationship between excess demand and observed firm-specific factors. Our allocation data proxy for excess demand and enable us to examine this question.

We wish to examine the determinants of the initial return on and the demand for IPOs.[12] We employ the following two variables that are also used in existing studies:

(i) *PROCEEDS* is the logarithm of the IPO gross proceeds or sizein monetary units. Beatty and Ritter (1986) propose that the issue size is a proxy for valuation uncertainty. The larger is the size of the issue, the smaller the uncertainty.

(ii) *SDIR* is the standard deviation of the daily return in the aftermarket from day +2 to +21. This proxy measures the asymmetry in information about the value of the new issue. The greater the uncertainty about the value of the new issue, the greater underpricing is required to compensate the

[12] We do not consider the market's past returns because the IPO price in China is not decided by the issuer but by formula. When the price is set, the recent market returns are not reflected in the initial returns.

investors taking the risk. Rock (1986) and Beatty and Ritter (1986) have contributions with this feature.

The effects of these explanatory variables are examined in two regression models where initial returns or underpricing and allocation are the respective dependent variables:

$$IR_j=\alpha_0+ \alpha_1 PROCEEDS_j+ \alpha_2 SDIR_j+ u_j$$

$$ALLOCT_j=\beta_0+ \beta_1 PROCEEDS_j+ \beta_2 SDIR_j+ v_j$$

In the allocation model, we use $ALLOCT_j$, the logistic transform of $ALLOC_j$ suggested by Cox and Snell (1989, p.32) to accommodate the cases where $ALLOC_j$ is practically zero:

(3) $$ALLOCT_j=log\ \{(ALLOC_j+a)/(1-ALLOC_j+a)\}$$

The "*a*" in the transformation equation is defined as $0.5/N$ where N is the number of observations.

The estimation results with *t*-statistics in parentheses calculated using White's (1980) robust standard errors are presented in Table 5.

[Table 5 around here]

It shows that underpricing is inversely related to issue size but positively related to standard deviation and both coefficients are significant at the 1% level. This holds for the overall sample and for individual years. By contrast, allocation is positively related to issue size at the 5% level or better but mainly unrelated to standard deviation. The latter is plausible in the context of Rock's (1986) theory since the coefficients of factors related to underpricing are expected to be insignificant in the allocation model. However the fact that the issue size is positively related to underpricing and negatively related to allocation may suggest that underpricing is greater than necessary to ensure a given level of oversubscription.

IV. Testing Rock's Theory

A. Adverse Selection

Rock (1986) proposes a winner's curse in IPOs since informed investors selectively subscribe to good new issues while the uninformed investors subscribe indiscriminately to all issues, good and bad. The latter receive larger share allocations in bad IPOs and smaller allocations in good IPOs due to the participation of informed investors. In Rock's (1986) model, underpricing offsets the bias in allocation and this forms the basis for Hypothesis 1.

Hypothesis 1: There is no relationship between the initial return and the probability of obtaining an allocation.

We use our sample of 562 IPOs with allocation data 1996-2001 to test this hypothesis. The results with *t*-statistics in parentheses calculated using White's (1980) robust standard errors are given in Table 6.

[Table 6 around here]

The inverse relationship between initial returns and allocations is consistent with Rock's proposition of adverse selection. The coefficient on $ALLOCT_j$ is significantly negative at the 1% level which indicates greater underpricing is associated with smaller allocations and thus stronger excess demand. Amihud et al. (2003) perform an extra test on adverse selection in case their results are affected by extremely high allocations. But in the Chinese new issue market, instances of low demand and high allocations are extremely rare for new issues. Exclusion of the handful of such observations leaves the results virtually the same.

In Panel A of Table 6, the regression is run for each individual year as a robustness check. The negative relation persists in every calendar year at the 1% significance level except for 1997 when the level is 5%. Panel B presents another

robustness check on a structural change in the pricing methodology. Before July 1999 IPO pricing is governed by a formula while afterwards prices are set in agreement between the issuer and the lead underwriter. The significantly negative coefficients in both periods indicate that the presence of adverse selection is not affected by the change in pricing method.

Rock's proposition of adverse selection in IPOs rests on a discriminating investment strategy. It predicts a greater number of investor orders for good IPOs. An increase in the total number of investor orders is different from existing investors increasing order sizes as Amihud et al. (2003) argue. Two institutional arrangements in China make it feasible to identify the number of orders. One is that every investor is only allowed to submit one subscription order from his or her registered stock account. The other is that the lead underwriter must publicise the allocation details including the number of valid subscription orders (or of applicants) accepted in the lottery.

We use the data on the number of applicants to test the following hypothesis:

Hypothesis 2: There is no relationship between the number of applicants and the degree of underpricing.

The regression results with *t*-statistics in parentheses calculated using White's (1980) robust standard errors are presented in Table 7.

[Table 7 around here]

The positive and significant relation between underpricing and the number of applicants (proxied by subscription orders) is consistent with the prediction that underpricing attracts more investors to the IPO. Robustness checks on this coefficient are also provided in Table 7. On one hand, the positive relation is significant at the 5% level or better for each calendar year except 1999. On the other, this relation

remains significant at the 1% level before and after the structural change in the pricing mechanism around July 1999. Since naïve uninformed investors presumably subscribe to all new issues or some of them on a random basis, their participation is unrelated to underpricing. Thus the positive relation between underpricing and the number of applicants implies that it is informed investors who increase demand for underpriced issues.

B. Allocation-Weighted Initial Returns

Rock (1986) proposes that underpricing does not necessarily imply capital gains for all and especially for uninformed investors because greater initial returns are offset by smaller allocations. The implication is that, after adjusting for the bias in allocation, uninformed investors subject to adverse selection in IPOs should not generally receive a positive abnormal return.

Hypothesis 3: After adjusting for allocations, uninformed investors earn zero abnormal returns.

We need to define a new rate of return that is adjusted for the allocation bias. Here we follow the Amihud et al. (2003) methodology in defining the allocation-weighted initial return (AWIR) as:

$$AWIR_j = ALLOC_j IR_j - interest_j \quad (4)$$

where $ALLOC_j$ is the probability of receiving an allocation of new issue j in the IPO lottery; IR_j is the initial return on the first trading day; $interest_j$ is the four-day interest rate[13] that prevailed at the time of the IPO j. During the period under study, the

[13] We use the interest rate on one-year bank loans. The source is People's Bank of China, the central bank of China. The practice for IPOs was that funds must be paid in full before the subscription but no interest was paid. Subscription incurs an opportunity cost as funds for unsuccessful issues are tied up

average four-day interest rate was 0.0561%. The characteristics of the lottery mechanism enable us to estimate the effective return earned by typical uninformed investors. Our estimation of *AWIR* is based upon the assumption that there are a fixed number of retail investors and that naïve or uninformed investors subscribe to all IPOs or some of them on a random basis.

Figure 3 presents the distribution of $AWIR_j$.

[Figure 3 around here]

The distribution is L-shaped and clustered around the median of 0.51% with a long right hand tail. The latter implies that mean $AWIR_j$ is higher at 0.78% and is statistically significant with t=16.76. These results are approximately consistent with break-even prediction since the naïve strategy of subscribing to all IPOs produces a median $AWIR_j$ of just 0.51%. The latter could easily reflect minor risk or sentiment factors that we have not taken into account. Since abnormal profits are virtually zero in economic terms, so we cannot reject Rock's (1986) break-even prediction. The most striking finding in our study is that adjusting for allocation, the huge abnormal returns documented in the literature disappear and the effective return by the typical investors is essentially zero.

The latter is noteworthy given that the unweighted median initial return was 116%. Thus allocation weighting produces an absolute fall in initial returns of more than 115% and a relative fall of more than 200-fold. This is all the more remarkable since extant studies of Chinese IPOs either ignore allocation weighting or treat it as one of many determinants of underpricing in cross-sectional models.

---

for 4 days before being returned to investors. This is stipulated in *Provisional Regulations on Stock Issues and Transactions*.

When compared with analogous studies in other countries, our findings are more robust than those of Koh and Walter (1989), Levis (1990), Keloharju (1993), and Amihud et al. (2003) in two respects. First, our sample is considerably larger – twice at a minimum – than those in extant studies. Second, as far as the data are concerned, our sample is more consistent. For instance, there is an allocation bias against large orders in Singapore, Finland and the UK. Furthermore, the lottery allocation mechanism in our Chinese sample is more in keeping with the spirit of Rock's (1986) theory of the winner's curse than the proration mechanism in Israel.

Figure 4 shows the mean results from extant studies and form ours.

[Figure 4 around here]

This demonstrates that the absolute and relative drop in abnormal returns is comparatively modest in the other studies. AWIRs fall from 27% to 1% in Singapore (Koh and Walter, 1989), from 8.64% to 5.16% or less in the UK (Levis, 1990), from 8.7% to 0% or below in Finland (Keloharju, 1993), and from 11.99% to –1.18% in Israel (Amihud et al., 2003). These decreases are dwarfed by the dramatic average drop from 129.15% to 0.78% in China.

V. Conclusions

Previous studies of the winner's curse in IPOs have produced supporting evidence for two related hypotheses. One for the presence of adverse selection implies that it is generally more difficult to obtain an allocation in more underpriced IPO. The other for the break-even prediction implies that weighting abnormal returns by allocation leaves uninformed investors with zero abnormal profits. However, none of these studies has employed a sample where allocation is by a pure lottery mechanism. We

remedy by using a unique dataset of 562 Chinese lottery-allocated IPOs for the 1996-2001 period.

The pure lottery mechanism sample is particularly suited for testing the winner's curse hypothesis. On one hand, the lottery mechanism of share allocation used for oversubscribed issues in China does not discriminate between orders of different sizes. On the other, investors in the lottery are still exposed to the risk of being allocated no shares in IPOs. The former is more in keeping with the spirit of Rock's (1986) theory of the winner's curse than other allocation mechanisms like proration while a zero allocation is an extreme case of the winner's curse scenario.

Consistent with Rock's predictions, we find strong evidence of adverse selection. The inverse relationship between initial returns and allocations is significant at the 5% level or better both for the full sample and for each individual year. This indicates greater underpricing is associated with smaller allocations and thus stronger excess demand. Moreover, the significantly positive relation between underpricing and the number of applicants (proxied by subscription orders) is consistent with the prediction that underpricing attracts more investors to IPOs.

Finally we establish that allocation-weighting does indeed eliminate the huge initial returns reported in extant studies of Chinese underpricing. Median abnormal returns fall dramatically by more than 200-fold from some 116% to just 0.51%. This is far more striking in both absolute and relative terms than that reported in existing winner curse studies. The huge abnormal returns documented in the literature on Chinese IPOs disappear leaving an effective median return of virtually zero to the uninformed investor as predicted by Rock (1986). We conclude that the winner' curse can explain the apparently huge underpricing of our sample Chinese IPOs.

References

Amihud, Y., S. Hauser, and A. Kirsh. "Allocations, adverse selection and cascades in IPOs: Evidence from the Tel Aviv Stock Exchange." *Journal of Financial Economics,* 68 (2003), 137-158.

Beatty, R.P., and J.R. Ritter. "Investment banking, reputation, and the underpricing of initial public offerings." *Journal of Financial Economics,* 15 (1986), 213-232.

Beatty, R.P., and I. Welch. "Issuer expenses and legal liability in initial public offerings." *Journal of Law and Economics,* 39 (1996), 545-602.

Chan, K., J. Wang, and K.C. Wei. "Underpricing and long-term performance of IPOs in China." *Journal of Corporate Finance,* 10 (2004), 409-430.

Chi, J., and C. Padgett. "Short-run underpricing and its characteristics in Chinese Initial Public Offering (IPO) markets." *Research in International Business and Finance,* 19 (2005), 71-93.

Cox, D.R., and E.J. Snell. *The Analysis of Binary Data*. 2nd, Chapman and Hall (1989).

Keloharju, M. "The winner's curse, legal liability, and the long-run price performance of initial public offerings in Finland." *Journal of Financial Economics,* 34 (1993), 251-277.

Koh, F., and T. Walter. "A direct test of Rock's model of the pricing of unseasoned issues." *Journal of Financial Economics,* 23 (1989), 251-272.

Levis, M. "The winner's curse problem, interest costs and the underpricing of initial public offerings." *Economic Journal,* 100 (1990), 76-89.

Loughran, T., Ritter, J.R., and K. Rydqvist. "Initial Public Offerings: International Insights." Pacific-Basin Finance Journal, 2 (1994), 165-199.

Ljungqvist, A., and W.J. Wilhelm. "IPO underpricing in the Dot-Com Bubble." *Journal of Finance,* 58 (2003), 723-752.

Mok, M.K., and Y.V. Hui. "Underpricing and aftermarket performance of IPOs in Shanghai, China." *Pacific-Basin Finance Journal,* 6 (1998), 453-474.

Ritter, J.R. "The hot issue market of 1980." *Journal of Business,* 57 (1984), 215-240.

Ritter, J.R., and I. Welch. "A review of IPO activity, pricing and allocations." *Journal of Finance,* 57 (2002), 1795-1828.

Rock, K. "Why new issues are underpriced." *Journal of Financial Economics,* 15 (1986), 187-212.

Su, D. "Adverse selection versus signalling: evidence from the pricing of Chinese IPOs." *Journal of Economics and Business,* 56 (2004), 1-19

Su, D., and B. M. Fleisher. "An empirical investigation of underpricing in Chinese IPOs." *Pacific-Basic Finance Journal,* 7 (1999), 173-202.

Welch, I. "Sequential sales, learning and cascades." *Journal of Finance,* 47 (1992), 695-732.

White, H. "A heteroskedasticity-consisitent covariance matrix estimator and a direct test for heteroskedasticity." *Econometrica,* 48 (1980), 817-838.

Table 1: Methods of Share Issuance and Allocation 1996-2001

Methods of Share Issuance	No.	Initial Run-up	Median	Methods of Share Allocation
"Firm commitment"	70	1474.87%	1264.50%	N/A
Certificates of deposits	8	162.38%	155.91%	Normal/Pure Lottery
Prepayment in full, proportional allocation	111	148.81%	129.71%	Proration
Online primary offering	592	129.72%	117.70%	Pure Lottery
Online primary and secondary offering	35	158.08%	146.86%	Pure Lottery/Proration
Online bookbuilding	6	160.24%	137.02%	Pure Lottery
Online and offline bookbuilding	6	55.94%	57.19%	Pure Lottery/Proration
Unknown	1	452.77%	452.77%	-
Total	829	247.45%	128.95%	

- "Firm commitment": enterprises committed to issuing shares to their employees and the public.
- Certificates of deposits: instead of application forms, investors interested in new issues had to buy certificates of deposits upon which lottery was based.
- Prepayment in full, proportional allocation: funds for subscriptions are required to be deposited and allocation is done by proration.
- Online primary offering: fixed price offerings issued online to investors in the primary market.
- Online primary and secondary offering: fixed price offerings issued online to investors in the primary and secondary markets.
- Online bookbuilding: general investors competitively bid for the new issue using the national electronic trading system.
- Offline bookbuilding: bookbuilding approach for institutional investor bids.
- Unknown: methods of issuance could not be identified from the prospectus and listing announcement.

Table 2: Methods of price determination 1996-2001

Method of price determination	Total of 829		562 in sample		% included	Formula
	No.	Initial Run-up	No.	Initial Run-up		
Earnings Forecasts	88	84.41%	47	70.46%	53.41	YES
EPS in the past 3 years	224	147.34%	146	141.51%	65.18	YES
50/50	77	148.09%	53	138.53%	68.83	YES
Weighted Average	169	122.64%	165	120.82%	97.63	YES
Negotiated	189	148.33%	151	146.93%	79.90	NO
Authorities	70	1474.87%	0	-	-	-
Bookbuilding	12	108.09%	0	-	-	-
Total	829	247.45%	562	130.67%	75.34	

- *Earnings forecasts*: IPO pricing is governed by formula and earnings forecasts are used for the earnings measure in the formula;
- *50-50*: IPO pricing is governed by formula and arithmetic average of EPS in the IPO year and the year before is used for the earnings measure in the formula;
- *Average EPS in past three years*: IPO pricing is governed by formula and the arithmetic average of EPS in the previous three years before IPO.
- *Weighted average*: IPO pricing is governed by formula and forecasted EPS weighted by the average number of share outstanding in the IPO year is used for the earnings measure in the formula;
- *Negotiated*: the offer price is the result of negotiation between the issuer and the lead underwriter;
- *Authorities*: IPOs are priced by the competent authorities, mostly at par value of RMB1.00;
- *Bookbuilding*: IPOs are priced by a bookbuilding mechanism.

Table 3: Initial run-ups and initial returns 1996-2001

Panel A: 829 total IPOs 1996-2001

Year	No.	Initial run-up	Min	Median	Max.	St. dev.
1996	203	323.48%	-15.31%	114.23%	4900.00%	560.19%
1997	206	272.45%	30.76%	137.70%	4380.00%	508.18%
1998	106	320.01%	2.08%	131.13%	3857.00%	656.27%
1999	98	116.30%	7.14%	102.10%	830.21%	106.70%
2000	137	150.82%	0.28%	139.36%	476.77%	86.51%
2001	79	219.78%	0.74%	127.31%	3485.00%	522.08%
Total	829	247.45%	-15.31%	128.95%	4900.00%	478.80%

Year	No.	Initial return	Min	Median	Max.	St. dev.
1996	203	317.88%	-18.35%	115.95%	5003.23%	571.16%
1997	206	260.68%	27.36%	136.19%	4440.90%	484.81%
1998	106	309.98%	-5.46%	131.72%	3816.12%	632.82%
1999	98	114.26%	6.01%	128.95%	820.50%	103.90%
2000	137	148.23%	0.70%	140.72%	477.98%	85.90%
2001	79	194.73%	3.41%	127.95%	3071.81%	378.14%
Total	829	238.81%	-18.35%	126.72%	5003.23%	458.46%

Panel B: 562 sample IPOs 1996-2001

Year	No.	Initial run-up	Min	Median	Max	Std. Dev.
1996	99	106.86%	-6.17%	97.00%	341.24%	70.95%
1997	116	142.67%	30.77%	127.35%	468.48%	73.21%
1998	87	130.68%	2.08%	119.76%	429.48%	81.25%
1999	96	112.96%	7.14%	99.74%	830.21%	102.08%
2000	99	149.99%	0.28%	136.82%	476.77%	86.99%
2001	65	142.23%	0.74%	137.84%	413.79%	89.44%
Total	562	130.67%	-6.17%	118.01%	830.21%	85.17%

Year	No.	Initial returns	Min	Median	Max	Std. Dev.
1996	99	100.95%	-18.35%	96.20%	336.88%	69.87%
1997	116	142.80%	34.58%	124.75%	463.65%	71.75%
1998	87	131.59%	1.27%	117.29%	430.65%	80.35%
1999	96	111.19%	6.01%	92.96%	820.50%	99.23%
2000	99	147.24%	0.70%	137.42%	477.98%	86.68%
2001	65	143.42%	3.41%	136.63%	413.56%	87.47%
Total	562	129.15%	-18.35%	115.90%	820.50%	84.06%

Notes:

- *Initial run-up* $R_{j,1} = \left(\frac{P_{j,1}}{P_{j,0}} - 1 \right) \times 100\%$
- *Initial excess return* $IR_{j,1} = \left(\frac{P_{j,1}}{P_{j,0}} - \frac{P_{m,1}}{P_{m,0}} \right) \times 100\%$

where $P_{j,0}$ and $P_{j,1}$ are the offer and closing price of new issue j on first trading day. $P_{m,,0}$ and $P_{m,1}$ are the market index on the date of offering and trading, respectively.

Table 4: Allocations and allocation-weighted returns for bad and good IPOs

	Mean	Min.	Median	Max.	N
	1.4008	0.0558	0.4761	90.5777	562
ALLOC (%)					
Bad IPOs: IR_j<median	2.2408	0.1326	0.6789	90.5777	281
Good IPOs: IR_j>median	0.5604	0.0558	0.3770	5.8139	281
Bad IPOs: IR_j<mean	2.0427	0.1247	0.6697	90.5777	326
Good IPOs: IR_j>mean	0.5141	0.0558	0.3485	5.8139	236

	Mean	Min.	Median	Max.	N.
	0.7787	-2.8155	0.5082	14.2136	562
AWIR (%)					
Bad IPOs: IR_j<median	0.6213	-2.8155	0.3849	8.8805	281
Good IPOs: IR_j>median	0.9362	0.0772	0.6184	14.2136	281
Bad IPOs: IR_j<mean	0.6631	-2.8155	0.4218	8.8805	326
Good IPOs: IR_j>mean	0.9385	0.0922	0.6117	14.2136	236

$ALLOC_j$ is the allocation to subscribers in the IPO firm j, calculated as the ratio of the number of shares issued over the number of shares subscribed to every IPO.

$AWIR_j$ is the allocation weighted initial return to investor for the IPO firm j, given by

$$AWIR_j = ALLOC_j IR_j - interest_j$$

IR_j is the initial return for the new issue j, given by:

$$IR_{j,1} = \left(\frac{P_{j,1}}{P_{j,0}} - \frac{P_{m,1}}{P_{m,0}} \right) \times 100\%$$

where $P_{j,0}$ and $P_{j,1}$ are the offer price and closing price of new issue j on the first day of trading. $P_{m,,0}$ and $P_{m,1}$ are the market index on the date of offering and trading respectively.

$interest_j$ is the four-day interest rate that prevailed at the time of the IPO j.

Table 5: Determinants of IPO underpricing and allocation

Panel A: Underpricing

	No.	α_1	α_2	R^2 (%)
1996	99	-90.94 **(-3.90) ***	40.79 **(5.89) ***	41.00
1997	116	-96.13 **(-4.25) ***	41.74 **(2.88) ***	36.55
1998	87	-168.34 **(-7.75) ***	70.26 **(4.83) ***	64.41
1999	96	-79.44 **(-2.05) ****	114.72 **(2.87) ***	57.35
2000	99	-162.28 **(-5.34) ***	44.04 **(2.79) ***	40.35
2001	65	-208.23 **(-5.35) ***	20.21 **(2.10) ****	60.17
Total	562	-56.61 **(-6.06) ***	43.18 **(6.20) ***	23.83

Panel B: Allocation

	No.	β_1	β_2	R^2 (%)
1996	99	0.79 **(2.34) ****	-0.15 **(-2.76) ***	13.33
1997	116	0.24 **(2.92) ***	0.01 (0.24)	6.51
1998	87	0.56 **(5.47) ***	-0.12 **(-2.84) ***	35.41
1999	96	0.77 **(8.17) ***	-0.05 (-1.22)	61.06
2000	99	0.60 **(6.93) ***	-0.09 **(-3.70) ***	36.06
2001	65	0.60 **(5.01) ***	-0.03 (-0.55)	39.53
Total	562	0.12 **(2.32) ****	-0.03 (-1.41)	1.68

$$IR_j=\alpha_0+ \alpha_1 PROCEEDS_j+ \alpha_2 SDIR_j +u_j$$

$$ALLOCT_j=\beta_0+ \beta_1 PROCEEDS_j+ \beta_2 SDIR_j +v_j$$

IR_j is the initial return of the new issue j on the first day of trading. $ALLOCT_j = log((ALLOC_j+a)/(1-ALLOC_j+a))$ is the transformed $ALLOC_j$, the probability of obtaining an allocation in oversubscribed IPOs, $0< ALLOC_j \leq 1$, and a=0.5/562. $PROCEEDS_j$ is the logarithm of the issue size in monetary unit. $SDIR_j$ is the standard deviation of daily initial returns over days +2 to +21, a period of 20 days in the aftermarket. *t*-statistics in parentheses are calculated using use White's (1980) robust standard errors.

* Significant at the 1% level

** Significant at the 5% level

Table 6: IPO underpricing and allocation 1996-2001

Panel A

Year	N	α_1	t-value	R^2 (%)
1996	99	-54.94	**-7.26***	24.13
1997	116	-55.34	**-2.08****	5.51
1998	87	-137.92	**-5.45***	26.88
1999	96	-130.50	**-3.95***	15.33
2000	99	-154.72	**-7.56***	29.33
2001	65	-183.49	**-6.81***	41.54
Total	562	-87.84	**-9.46***	17.99

Panel B

Period	No.	α_1	t-value	R^2 (%)
Pre-July 1999	411	-69.40	**-7.38***	12.88
Post-July 1999	151	-168.78	**-10.44***	37.07
Total	562	-87.84	**-9.46***	17.99

$$IR_j=\alpha_0+\alpha_1 ALLOCT_j+\varepsilon_j$$

$$ALLOCT_j=log\ \{(ALLOC_j+a)/(1-ALLOC_j+a)\}$$

t-statistics in parentheses are calculated using use White's (1980) robust standard errors. The "*a*" in the transformation equation is defined as 0.5/*N* where *N* is the number of observations.

* Significant at the 1% level
** Significant at the 5% level

Note: "Before" and "After" in panel B refer to the period before and after a structural change took place in July 1999. IPO prices are determined by a fixed formula before that while they are set in agreement between the issuer and the lead underwriter afterwards.

Table 7: Subscription order regression 1996-2001

Panel A

Year	N	α_1	α_2	α_3	R^2 (%)
1996	99	0.17 **(2.52) ****	-0.16 (-0.75)	-0.15 **(-5.39) ***	8.88
1997	116	0.12 **(3.34) ***	0.13 **(1.71) *****	-0.06 (-1.59)	7.48
1998	87	0.08 **(2.39) ****	-0.02 (-0.23)	0.04 (0.80)	14.39
1999	96	0.04 (1.23)	-0.09 (-0.91)	-0.01 (-0.09)	5.68
2000	99	0.12 **(3.21) ***	-0.02 (-0.22)	-0.02 (-0.65)	16.11
2001	65	0.18 **(2.86) ***	0.09 (0.39)	-0.12 **(-2.56) ****	23.05
Total	562	0.18 **(9.41) ***	0.23 **(5.37) ***	-0.13 **(-7.61) ***	19.81

Panel B

Year	N	α_1	α_2	α_3	R^2 (%)
Pre-July 1999	411	0.14 **(6.50) ***	0.16 **(3.05) ***	-0.12 **(-5.89) ***	12.73
Post-July 1999	151	0.15 **(4.48) ***	0.04 (0.34)	-0.07 **(-2.67) ***	19.32
Total	562	0.18 **(9.41) ***	0.23 **(5.37) ***	-0.13 **(-7.61) ***	19.81

$$ORDERS_j = \alpha_0 + \alpha_1 IR_j + \alpha_2 PROCEEDS_j + \alpha_3 SDIR_j + \varepsilon_j$$

where $ORDERS_j$ is the (logged) number of subscription orders in IPO j, the other variables are as previously defined and t-statistics in parentheses are calculated using use White's (1980) robust standard errors.

* Significant at the 1% level
** Significant at the 5% level
*** Significant at the 10% level

Note: "Before" and "After" in panel B refer to the period before and after a structural change took place in July 1999. IPO prices are determined by a fixed formula before that while they are set in agreement between the issuer and the lead underwriter afterwards.

Table 8: Summary regression result of information cascades in IPOs 1996-2001

Year	No.	α_1	*t*-value	R^2
1996	99	0.8144	1.25	14.14%
1997	116	4.0670	**4.69***	49.32%
1998	87	0.8660	**3.40***	35.94%
1999	96	0.7326	**3.70***	22.03%
2000	99	0.6696	**2.77***	21.83%
2001	65	0.4850	**2.49****	17.95%
Total	562	1.2396	**3.61***	22.73%

$AWIR_j = \alpha_0 + \alpha_1 ALLOCT_j + \varepsilon_j$

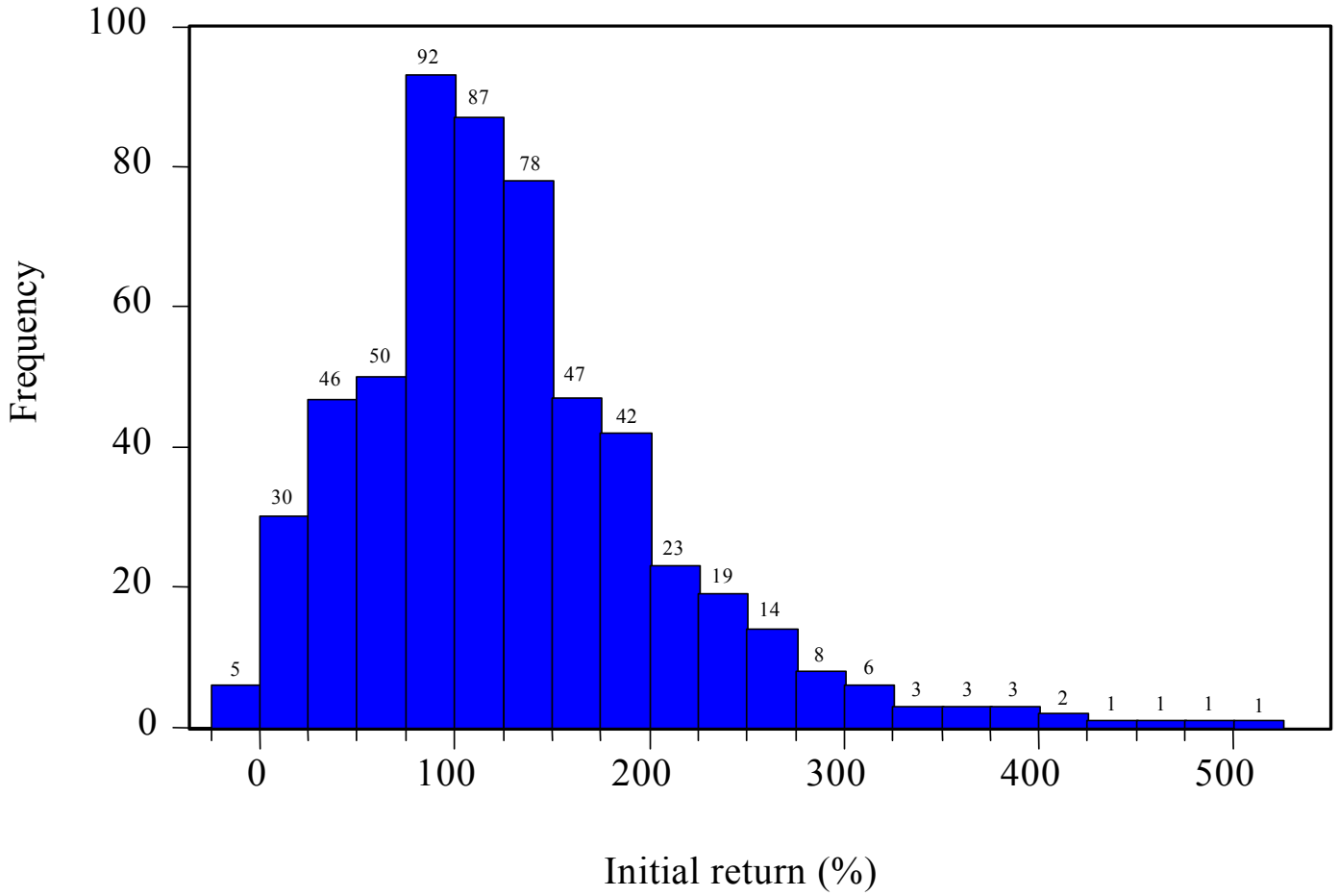
$AWIR_j$ is the allocation weighted initial return for the new issue *j*. $ALLOCT_j$ is the logistic transformation of $ALLOC_j$, allocation to investors in the issue.

$$ALLOCT_j = log\ \{(ALLOC_j + a)/(1 - ALLOC_j + a)\}$$

where the "*a*" in the transformation equation is defined as 0.5/*N* (N=562).

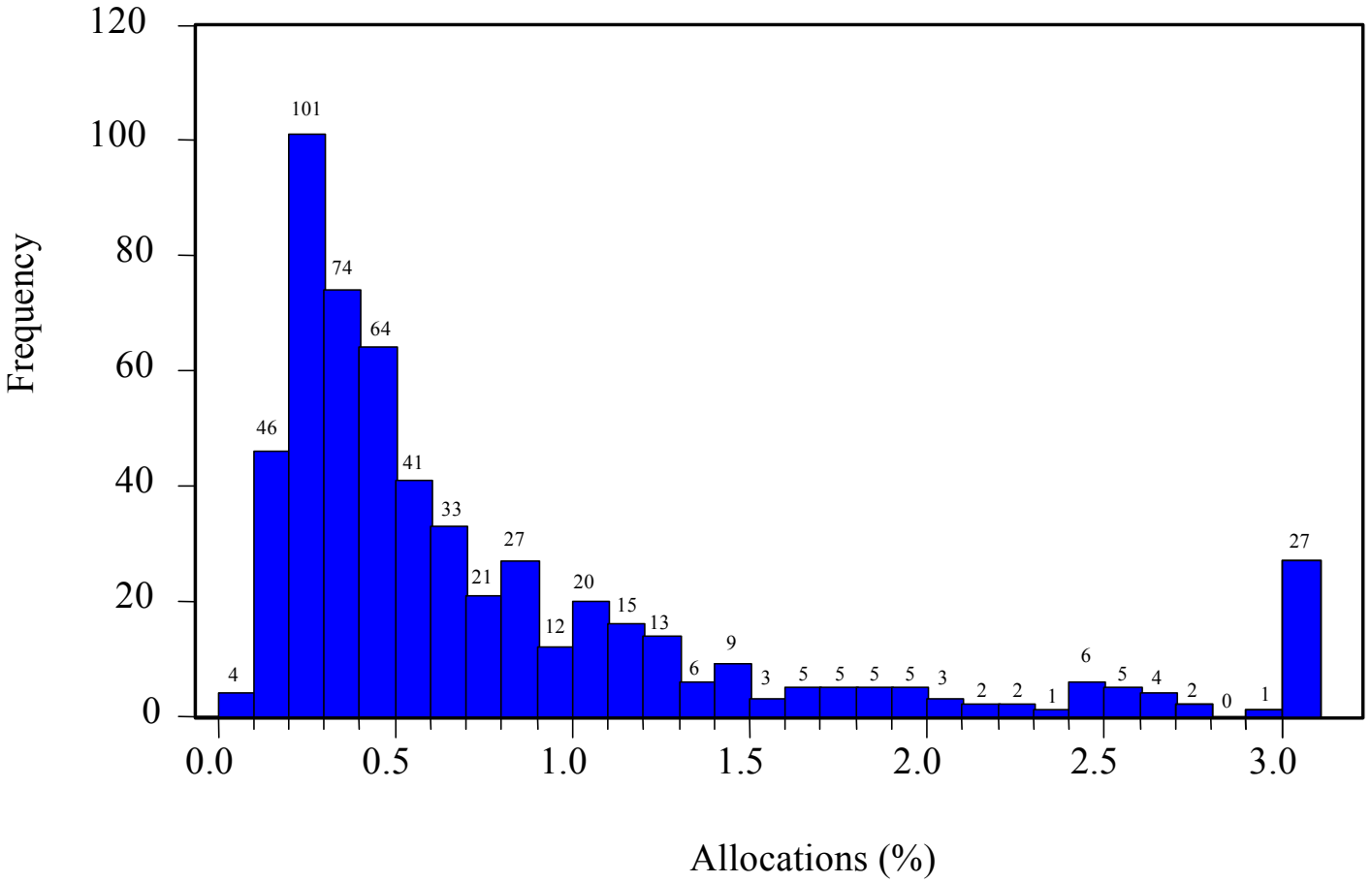
* Significant at the 1% level
** Significant at the 5% level

Figure 1: Histogram of initial returns of 562 IPOs



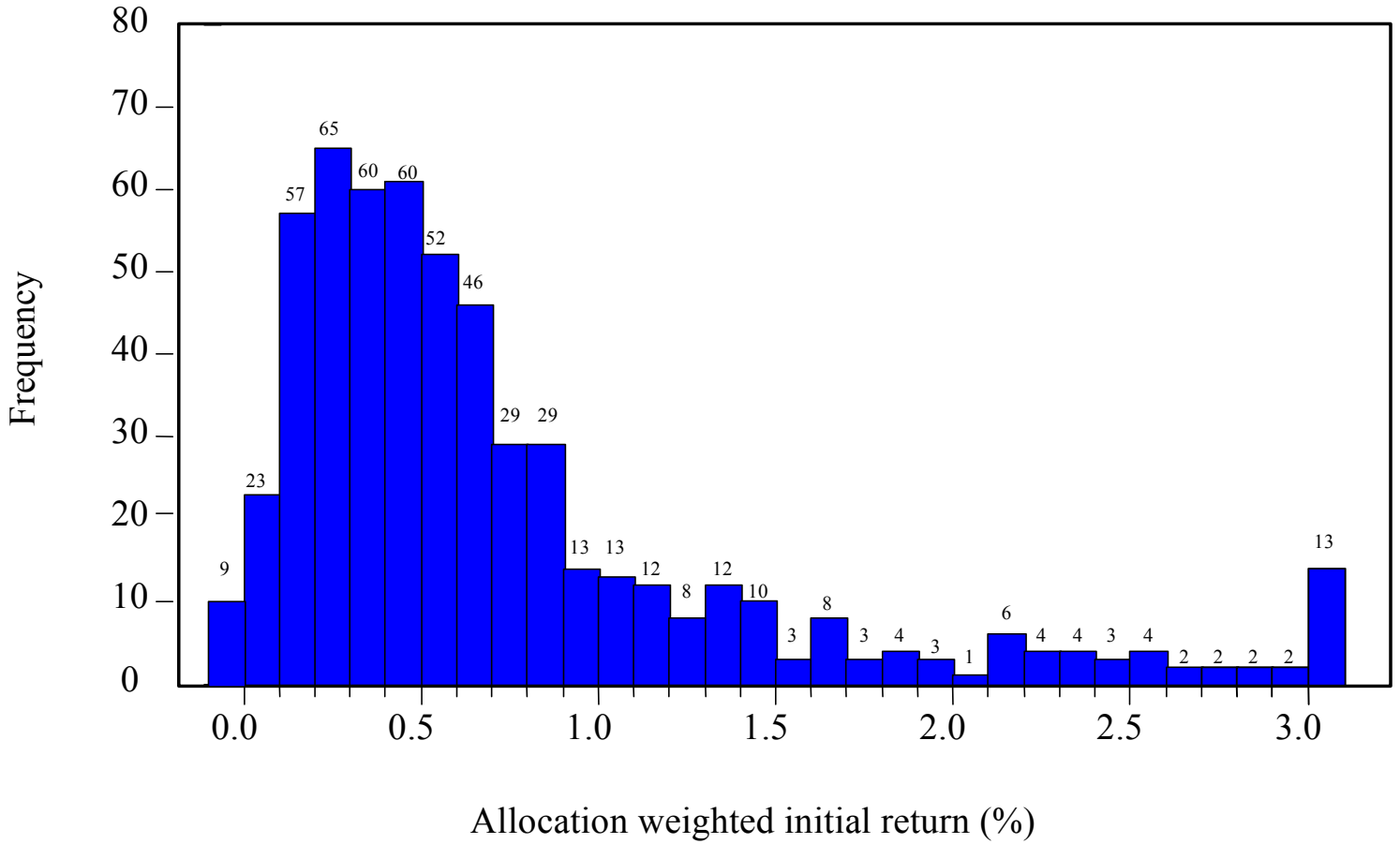
Note: The only observation greater than 500% is 820.50%

Figure 2: Histogram of allocations to investors



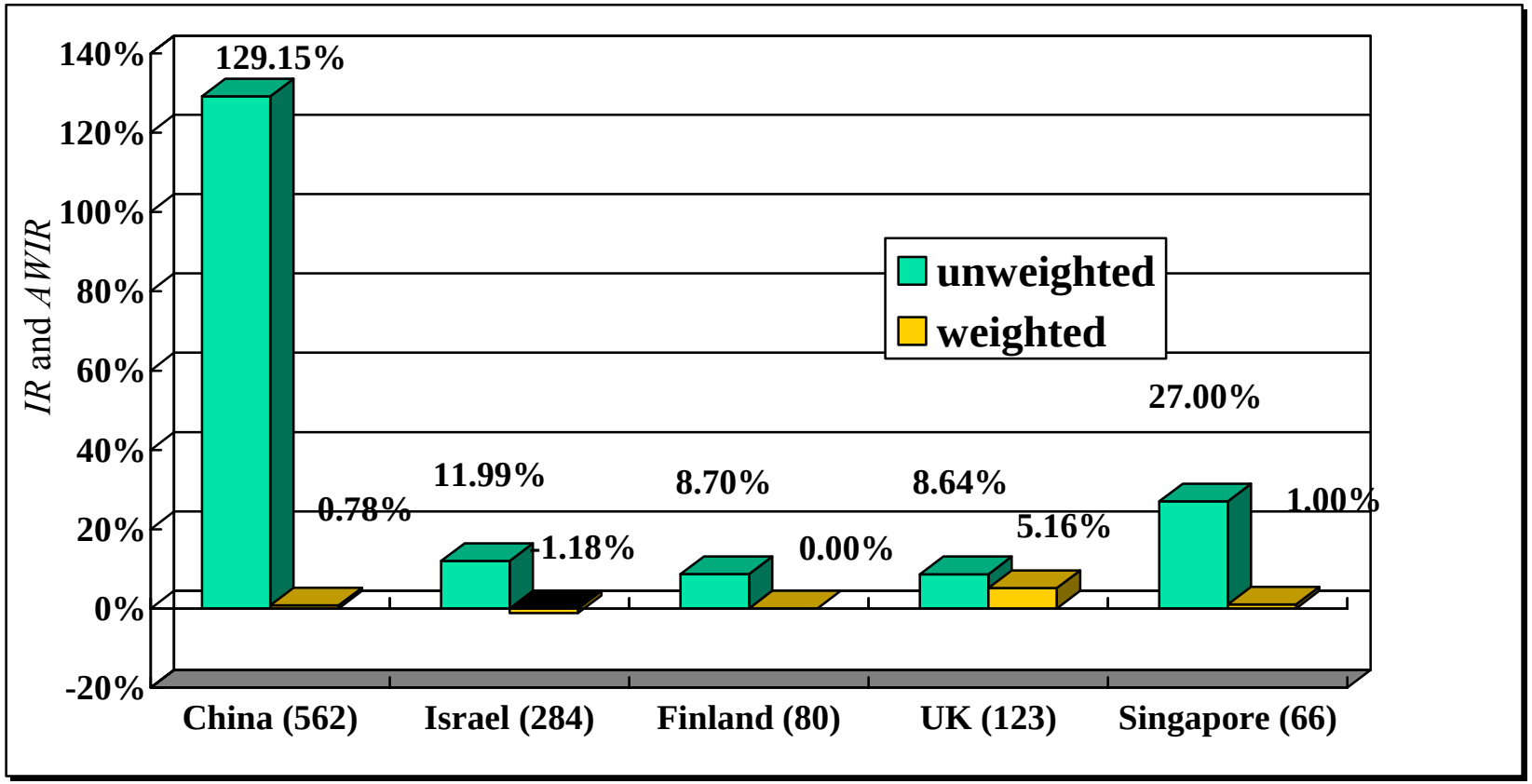
Note: The rightmost bar includes 27 observations with allocation rates ranging from 3.0% to 90.6%.

Figure 3: Histogram of allocation weighted initial returns



Note: The rightmost bar includes 13 observations with *AWIR* ranging from 3.0% to 14.2%.

Figure 4: Comparison of results on mean initial returns and allocation-weighted initial returns



Notes: Countries are presented in order of publication year. The numbers in parentheses are the sample size in each study