



ELSEVIER

Journal of Financial Economics 68 (2003) 137–158

JOURNAL OF  
Financial  
ECONOMICS

www.elsevier.com/locate/econbase

# Allocations, adverse selection, and cascades in IPOs: Evidence from the Tel Aviv Stock Exchange<sup>☆</sup>

Yakov Amihud<sup>a,\*</sup>, Shmuel Hauser<sup>b</sup>, Amir Kirsh<sup>c</sup>

<sup>a</sup> *Stern School of Business, New York University, New York, NY 10012-1126, USA*

<sup>b</sup> *School of Management, Ben-Gurion University, Be'er-Sheva 84105, Israel*

<sup>c</sup> *Faculty of Management, Tel Aviv University, Ramat Aviv 69978, Israel*

Received 24 January 2002; accepted 11 March 2002

---

## Abstract

We examine theories of IPO underpricing using unique data from Israel where the allocation to subscribers is by equal proration. This enables us to simulate the return earned by uninformed investors. Consistent with Rock's (1986) theory of adverse selection, allocations were negatively related to underpricing. But uninformed investors earned a *negative allocation-weighted initial return*, although the average initial return was 12%. They could break even, however, by using publicly available information. The data also supports Welch's (1992) theory of information cascades: demand is either extremely high or there is undersubscription, with very few cases in between.

© 2002 Published by Elsevier Science B.V.

*JEL classification:* G24; G12; G14; G32

*Keywords:* IPO; Underpricing; Uninformed subscribers; Proration

---

---

<sup>☆</sup> We thank Amir Barnea, Eli Berkovitch, Ari Ginsberg, Iftekar Hasan, Alexander Ljungqvist, Jay Ritter, Oded Sarig, N. Prabhala, participants of Yale Law School seminar and especially an anonymous referee for helpful comments and suggestions. Amihud is Ira Leon Rennert Professor of Finance. The research was partially financed by the Israeli Institute for Business Research, Recanati Graduate School of Business, Tel Aviv University. We thank Dorit Korner for research assistance and the Library of the Tel Aviv Stock Exchange for providing data on IPOs.

\*Corresponding author. Tel.: +1-212-998-0720; fax: +1-212-995-4220.

*E-mail address:* yamihud@stern.nyu.edu (Y. Amihud).

## 1. Introduction

Stocks issued in IPOs appear underpriced because they earn an average positive return immediately following the IPO. Loughran, Ritter and Rydkqvist (1994), Ritter (1998), and Jenkinson and Ljungqvist (2001) show this to be true in many countries. This paper presents tests of some theories of underpricing in IPOs using data from the Tel Aviv Stock Exchange (TASE) which make these tests feasible. These data also enable us to study the excess demand for new issues, its determinants, and its relationship to underpricing.

Rock (1986) proposes that high positive returns observed in IPOs cannot be earned in practice because of adverse selection. Uninformed investors are allocated greater quantities in overpriced IPOs and smaller quantities in underpriced IPOs. This is because investors who are informed about the issuing company's value select to invest in underpriced IPOs. Underpricing is then needed to attract uninformed investors. In equilibrium, "weighting the returns by the probabilities of obtaining an allocation should leave the uninformed investor earning the riskless rate" (Rock, 1986, p. 205). Indeed, uninformed strategy should yield zero profit in a frictionless market with rational investors.

We test the hypothesis that uninformed IPO investors earn zero profit using data from the TASE that enable to calculate the return to these investors. The data are the allocation to investors relative to their subscriptions, which is used to calculate the allocation-weighted returns. In the TASE during the study period, in case of oversubscribed IPOs, securities were allocated mechanically by *equal proration* to all subscribers, each receiving an equal fraction of his or her subscription. The allocation rate is publicly announced at the end of the IPO day. This enables us to simulate the initial return that would be earned by *uninformed* investors and to examine whether allocations are related to underpricing. In contrast, in the US, the allocation rate to subscribers in IPOs is at the discretion of underwriters and brokers and varies across subscribers. Therefore, these tests cannot be done in the US.

Using data on the rate of allocation to subscribers, we test Rock's (1986) theory in two ways:

- (i) We test for adverse selection by examining whether the allocation rate to subscribers is greater in overpriced IPOs.
- (ii) We simulate the initial return that would be earned by uninformed investors by calculating the *allocation-weighted* initial return that would be earned by an investor who participated equally in all IPOs (or randomly in some IPOs).

Consistent with Rock (1986), we find evidence of adverse selection in IPOs. However, uninformed investors earned a small *negative* excess initial return, even though the average IPO excess initial return was 12%. This means that IPOs were slightly *overpriced* for uninformed investors, or that the demand of these investors for IPOs was on average too high. Still, "minimal information conditioning" investors could do better and earn zero initial return. These investors, while being uninformed about the issuing firm, could condition their participation in IPOs on

publicly available information about the recent market performance or other investors' participation.

The second theory that we examine is that of information cascades or herding in IPOs, due to [Welch \(1992\)](#). If investors learn about the value of the issued company by observing the behavior of other investors, issuers will underprice their stock to create a cascade or herding of buyers. We find that investors either subscribe overwhelmingly to new issues, which results in very small allocations, or largely abstain so that the issue is undersubscribed and subscribers received full allocation, with very few cases in between. This is consistent with herding.

The rules of the TASE exclude two explanations of underpricing proposed in the US. One explanation of underpricing is that price stabilization or price support by underwriters after the IPO curtails the negative returns ([Hanley et al., 1993](#); [Ruud, 1993](#); [Schultz and Zaman, 1994](#)). This explanation does not apply in our case since price support by underwriters is not allowed on the TASE. [Loughran and Ritter \(2002\)](#) propose an agency explanation. Since underwriters have complete discretion to allocate shares, they have an incentive to lower the offering price to provide gains to preferred buy-side clients and then benefit from the quid pro quos received from them. However, in the TASE underwriters had no discretion to allocate shares since it was done pro-rata, yet we still observe their high initial returns.

In the US, [Rock's \(1986\)](#) winner's curse theory is tested indirectly under the assumption that institutional investors are better informed. [Michaely and Shaw \(1994\)](#) show that in IPOs with small participation of institutional investors, underpricing is smaller since then investors know they do not have to compete with informed investors. [Aggrawal, Prabhala and Puri \(2002\)](#) use data on the proportion of the issue that is allocated to institutional investors and retail investors. They find that institutional investors receive a larger proportion of new issues in IPOs that are more underpriced and earn more than retail investors, avoiding "lemons" in the IPO market. However, in the US there are no data on the allocation rate to subscribers relative to their subscriptions.<sup>1</sup> Therefore, it is impossible to test [Rock's \(1986\)](#) proposition that although IPOs are underpriced, uninformed investors earn zero initial return.

[Rock's \(1986\)](#) theory is examined in countries where there are data on allocation to subscribers ([Koh and Walter, 1989](#); [Levis, 1990](#); [Keloharju, 1993](#)),<sup>2</sup> but the results are not conclusive. The results are inconsistent among these studies. In two studies the initial return is decreasing in order size (in one, the relationship is non-monotonic), while in one study return is increasing in order size. In addition, there are some problems with the allocation procedure in IPOs in these countries that are absent in Israel.

---

<sup>1</sup>Our allocation data are different from those in [Aggrawal et al. \(2002\)](#). Our allocation is the proportion of each subscriber's order that is filled in the IPO. Their allocation is the proportion of each issue that is allocated to a type of investor (institutional or retail). The same data are also used by [Ljungqvist and Wilhelm \(2002\)](#) who find that underpricing is negatively related to the allocation to institutional investors. By their model there is substitution between the amount that these investors receive and the extent of underpricing on this amount.

<sup>2</sup>[Ljungqvist and Wilhelm \(2002\)](#) do a survey of allocation methods around the world.

Koh and Walter (1989) study 66 IPOs in Singapore during 1973 to 1987. There, allocation to subscribers is done by “combinations of full allocation, pro-rata allocation, and balloting” (p. 268) with the selection of an allocation basis done by the issuer after the IPO. The probability of allocation is a non-monotonic decreasing function of the order size. Koh and Walter find that the IPO return, adjusted for allocation, is positive but insignificantly different from zero. It is higher for small orders and lower for larger ones, with the return-order size relationship being non-monotonic, having a saw-teeth pattern that reflects the allocation method. Levis (1990) analyzes 123 IPOs during 1985–1989 in the UK, where issuers have discretion as to the method of allocation as a function of the order size, involving ballot, rationing, or both. Rationing can “involve any form or pattern that suits the particular circumstances” (p. 78). Then, “the probability that an investor obtains a specified number of shares ... is proportional but not always linear to the size of the application” (p. 78). The average return, adjusted for allocation, is positive and statistically significant. The return is increasing in the order size and then decreasing for larger orders, being insignificant for the largest orders above 2 million pounds. (This is calculated using estimates on the probability of obtaining certain number of shares at a specific level of application.) Keloharju (1993) studies 80 cases of IPOs in Finland during 1984–1989, where the allocation is a function of the order size with the formula of allocation being set *ex post*. He finds that the allocation-weighted initial return is a declining function of the order size, being positive for small orders and negative for large orders.

In these studies, the uninformed investors' return is affected by their order placement strategy since allocation is a function of the order size and its method (balloting, rationing, or a combination of both) is sometimes determined *ex post*. This makes it difficult to simulate the strategy for uninformed investors. In addition, in Finland, investors can be effectively excluded from participating in IPOs that garner high demand: the acceptance of new orders can be stopped at any time before the IPO day by the management of the issue, after learning that the issue has been fully subscribed. (Indeed, subscriptions to IPOs are often discontinued before the closing day of the offering.) And, payment is done one or two months after the first day of issue, which raise the effective return due to the time value of money. Finally, the reliability of rationing data in Finland is varying.

In contrast, in the TASE during the study period, the rate of allocation to subscribers is quite mechanistic (simply proportional to order size<sup>3</sup>) and every investor wishing to participate at the IPO could subscribe at any time during the IPO day. This enables us to simulate the returns earned by uninformed investors and test Rock's (1986) propositions on the return-allocation relationship.

In what follows, Section 2 describes the data and the main variables, initial return and allocation, and their determinants. Section 3 presents two tests of Rock's (1986) theory. Section 3.1 provides a test of the existence of adverse selection in IPOs, and Section 3.2 provides evidence on the initial return earned by uninformed investors.

---

<sup>3</sup>This is true except in four cases during the study period (1.4% of the sample), in which allocations are a decreasing function of the quantity ordered by investors.

Section 4 analyzes the performance of uninformed investors who can condition their participation on publicly available information. Section 5 presents the conclusions.

## 2. Data, underpricing, and allocation

The study includes 284 IPOs in the Tel Aviv Stock Exchange between November 1989 and November 1993, after which time the IPO method changed. (In December 1993, it was mandated that *all* IPOs be auctioned with no maximum prices; see [Kandel et al., 1999](#)). [Table 1](#) includes information about our sample. Most IPOs (84.6%) are of units, a bundle of stocks and warrants or bonds (mostly convertible) or both, which are sold together but separate right after the IPO.

During the study period, issues are sold either at a fixed predetermined price or at a price determined in a sealed-bid uniform-price auction with specified minimum and maximum prices. Auction is by far the preferred method as it is used in 86% of the sample's IPOs. In auctions, investors submit sealed bids specifying a quantity and a price within the given range (including the upper and lower bounds). Most auctioned IPOs (77%) are effectively fixed-price IPOs since they closed at the maximum price, which ended up being the issue price, and the allocation among subscribers was done by equal proration to all. When the equilibrium price is below the maximum, subscribers at the maximum price received the full quantity they had ordered and paid the equilibrium auction price.

The unit price or the auction minimum and maximum prices are stated in the prospectus, published one week (five business days) before the IPO day. The offer price could not be revised between then and the IPO day. There are neither road shows nor a bookbuilding process. On the IPO day, subscriptions are received by brokers from morning until noon and passed on to the underwriter. The results are announced immediately thereafter. To guarantee the integrity of the orders, a subscriber deposits with a broker the full amount of the subscription on the day of the IPO.

The scenario seems to bear close resemblance to [Rock's \(1986\)](#) model. Our simulation of an uninformed investor assumes subscribing for a fixed amount in each and every IPO. The subscription price is either the fixed issue price or, in case of an auction, the auction's maximum price. This would guarantee the investor gets apportioned some units in *all* IPOs. Bidding below the maximum price would have excluded the investor from about three-quarters of auctioned IPOs settling at the maximum price.

### 2.1. Underpricing

Trading in the stock commences on the day after the IPO day, and trading in the other securities included in the unit usually commences three days after the IPO. Securities issued in IPOs trade by a once-a-day auction, called *Karam*, that is used for small-cap securities. Under this trading method, securities prices are noisier and

Table 1

## Characteristics of the IPOs in this study

The last line gives the proportion of the number of IPOs at that category out of the total number of IPOs. The proportion in the last column is out of the 245 IPOs sold by the auction method. There are 284 IPOs during November 1989 to November 1993. "Closed at max" means that the demand at the auction's maximum price exceeded the issued quantity and rationing was necessary. In auctions, underwriters specified maximum and minimum prices.

Year of issue	Total num.	Composition of unit issued				Method of IPO pricing			
		Stock only	Stock + warrant	Stock + warrant + bonds	Stock + bonds	Fixed price	Auction	Total	Closed at max
11/1989–1990	10								
1991	16	3	11	1	1	2	14	10	
1992	87	13	57	13	4	11	76	57	
1993	171	28	104	34	5	25	146	116	
<b>Total</b>	<b>284</b>	<b>44</b>	<b>177</b>	<b>52</b>	<b>11</b>	<b>39</b>	<b>245</b>	<b>189</b>	
Proportion	1.00	0.155	0.623	0.183	0.039	0.137	0.863	0.771	

adjust more slowly to information than in a continuous trading market (see Amihud et al., 1997). We therefore measure the initial IPO return six days after the issue day, which are two or three days after the warrants and bonds in the unit started trading. The six-day initial return on the IPO unit of securities of firm  $j$ , in excess of the market return, is

$$IR_j = P_{j,6}/P_{j,0} - M_{j,6}/M_{j,0} \quad (1)$$

$P_{j,t}$  is the market price of unit  $j$  on day  $t$ , day 0 being the IPO day, and  $P_{j,0}$  is the unit's offer price. The post-IPO unit price is the sum of the market prices of the components that make up the unit. (For example, if the unit of firm  $j$  includes one share of stock and two warrants,  $P_{j,6}$  is the share price plus twice the warrant price.)  $M_{j,t}$  is the closing price of the TASE *Karam* market index on day  $t$  relative to the IPO day of firm  $j$ . This index is the proper benchmark for IPO securities since it includes securities with relatively small float, similar to the newly issued securities. Longer-term initial returns are calculated over 15 and 150 trading days after the IPO as

$$IR15_j = P_{j,15}/P_{j,0} - M_{j,15}/M_{j,0} \quad (2)$$

and

$$IR150_j = P_{j,150}/P_{j,0} - M_{j,150}/M_{j,0} \quad (3)$$

The time period after the IPO is limited to 150 days because of later expirations of warrants and conversion option on bonds, which are included in most of the IPOs.

Statistics on initial excess returns in IPOs are presented in Table 2 and the distribution of  $IR_j$  is depicted in Fig. 1. The average  $IR_j$  is positive and significant: the mean is 11.99% with  $t=7.20$ . Two-thirds of the initial returns (66.6%) are positive; this proportion is significantly different from a chance result of 50% ( $t=5.58$ ). The average 15-day and 150-day initial excess returns,  $IR15_j$  and  $IR150_j$ , are slightly higher, 13.14% ( $t=6.77$ ) and 15.00% ( $t=4.16$ ), respectively. Notably, the mean initial return from day +6 to day +150 is not significantly different from zero (mean = 2.95%,  $t=1.10$ ), which implies that there is no momentum effect in pricing. Nor does the initial return  $IR_j$  show evidence of overshooting that is subsequently reversed: the correlation between  $IR_j$  and the subsequent initial return over days +6 to +150 is very small,  $-0.028$ , insignificantly different from zero. This evidence suggests that the market prices the issued units efficiently immediately after the IPO and that the initial return is not a result of fad or overreaction. All three initial return distributions are positively skewed, reflecting the very high returns obtained in a few cases (see Fig. 1).

## 2.2. Allocation

Testing Rock's (1986) theory requires data on "the probabilities of obtaining an allocation" (p. 205) in IPOs. These data, which are unavailable in the US, are available in Israel. There, the allocation is an equal proportion to all subscribers and it is publicly announced at the end of the IPO day. The allocation rate to subscribers is quite mechanistic, simply the ratio of the number of units issued to the number of

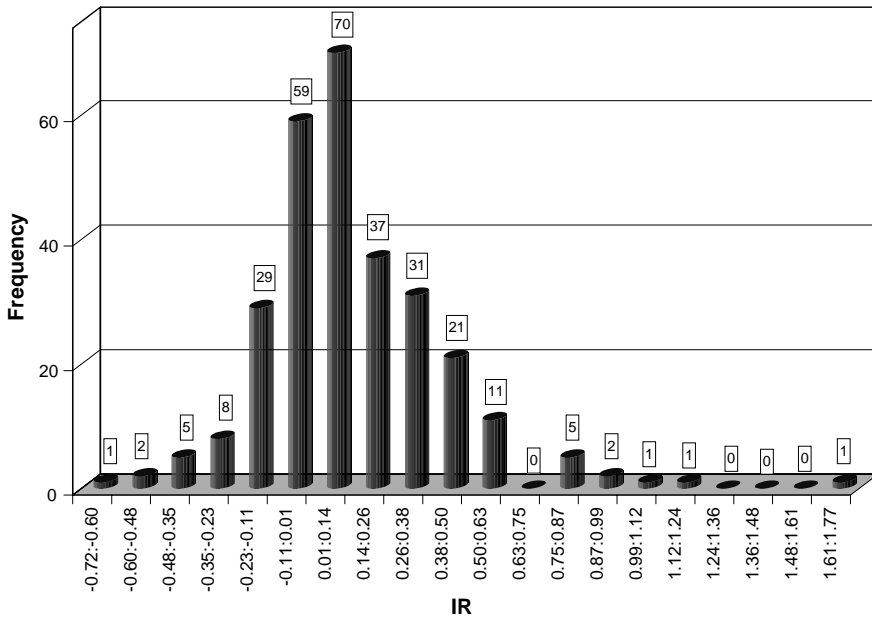


Fig. 1. The distribution of the initial excess return in IPOs.  $IR_j = P_{j,6} / P_{j,0} - M_{j,6} / M_{j,0} - P_{j,t}$  is the price on the offered unit of firm  $j$  on day  $t$ , where day zero is the IPO day and  $M_{j,t}$  is the TASE *Karam* market index on day  $t$  pertaining to the IPO of firm  $j$ .

units subscribed by investors, so that each subscriber receives the same proportion of his or her order. The allocation rate is naturally not greater than 1.0 when the issue is undersubscribed, in which case the underwriter absorbs the unsold quantity.<sup>4</sup>  $ALLOC_j$  denotes the allocation rate in IPO  $j$ ,  $0 < ALLOC_j \leq 1$ .

Statistics for  $ALLOC_j$  are presented in Table 3, and the pattern of its distribution is shown in Fig. 2. The distribution of  $ALLOC_j$  is an extreme U-shaped distribution that is skewed to the left. While the mean  $ALLOC_j$  is 0.360, the median is far lower, 0.048. The allocation in most IPOs is extremely small due to overwhelming oversubscription, and in about a quarter of the cases there is undersubscription at the offer price or at the auction maximum price, resulting in  $ALLOC_j = 1.0$ .

The distribution of  $ALLOC_j$  is consistent with the implications of Welch's (1992) model of information cascades. There, each investor has a prior belief about the true value of the IPO, which is revised after having observed the offer price and whether other investors subscribe or abstain. Based on the revised belief, the investor decides on whether to subscribe to the IPO. Since one investor's decision is influenced by that of others, there is herding into subscribing or abstaining. As a result there is either overwhelming oversubscription or undersubscription. Fig. 2 indeed shows evidence of very high demand or abstention, with only a few issues in between these extremes.

<sup>4</sup>In the four IPOs where allocation was declining in order size,  $ALLOC_j$  is the ratio of issued units to the quantity subscribed. Excluding these four observations does not change the results in any meaningful way.

Table 2

Initial returns in IPOs, with adjustment for allocation

The initial excess return is  $IR_j = P_{j,6} / P_{j,0} - M_{j,6} / M_{j,0} \cdot P_{j,t}$  is the price on the IPO unit of firm  $j$  on day  $t$ , where day 0 is the IPO day and  $M_{j,t}$  is the TASE *Karam* market index on day  $t$  pertaining to the IPO of firm  $j$ . day 0 is the IPO day.  $IR15_j = P_{j,15} / P_{j,0} - M_{j,15} / M_{j,0}$  is the 15 day initial return on the IPO unit.  $IR150_j = P_{j,150} / P_{j,0} - M_{j,150} / M_{j,0}$  is the 150 day initial return on the IPO unit. The allocation-weighted initial return is  $AWIR_j = ALLOC_j \cdot IR_j - interest_j$ , where  $ALLOC_j$  is the allocation to subscribers in the IPO of firm  $j$ ,  $0 < ALLOC \leq 1$ , and  $interest_j$  is the one-day interest cost.  $AWIR150_j$  is the allocation-weighted initial return over 150 days after the IPO. There are 284 IPOs during November 1989 to November 1993. The  $t$ -statistics test that the mean is different from zero.

	Variable	Mean	Median	Skewness	Minimum	Maximum
<i>Initial return (underpricing)</i>						
1	<i>IR</i>	0.1199 (7.20)	0.0660	1.264	-0.6581	1.7671
2	<i>IR15</i>	0.1314 (6.77)	0.0563	1.603	-0.6775	2.1920
3	<i>IR150</i>	0.1500 (4.16)	0.0563	1.728	-0.9450	3.7424
<i>Allocation-weighted initial return</i>						
4	<i>AWIR</i>	-0.0118 (1.77)	0.0001	-0.736	-0.6587	0.5731
5	<i>AWIR15</i>	-0.0177 (2.41)	0.0001	-0.440	-0.6781	0.5057
6	<i>AWIR150</i>	-0.0243 (1.52)	-0.0002	0.706	-0.9457	1.1848

### 2.3. The determinants of underpricing and allocation

If underpricing is done just to the extent necessary to attract sufficient demand to accommodate some observed factors, there should be no relationship between *excess* demand and these factors. Our data on the rate of allocation, which measures excess demand, enables us to examine this issue. We find that excess demand is predictable by factors that are publicly known before the IPO. Also, those factors which lead to greater underpricing also lead to greater excess demand. This means that underpricing is done to a greater extent than necessary to attract sufficient demand.

The following are variables likely to affect the initial return and the demand for IPO units:

(i) *The market's past returns*. If underwriters fully adjust the offer price to market conditions, the market return (before the offer price is set) should not affect underpricing. However, Loughran and Ritter (2002) and Lowry and Schwert (2001) find that the initial return reflects partial adjustment to recent market return. In Israel, the pricing decision of the IPO is made by the time that the prospectus is submitted, five or six days before the issue day, with no revision thereafter.<sup>5</sup> We therefore consider the market return before the offer price is set, the 10-day period

<sup>5</sup> Issuers could withdraw the prospectus and cancel the IPO, but this is extremely rare.

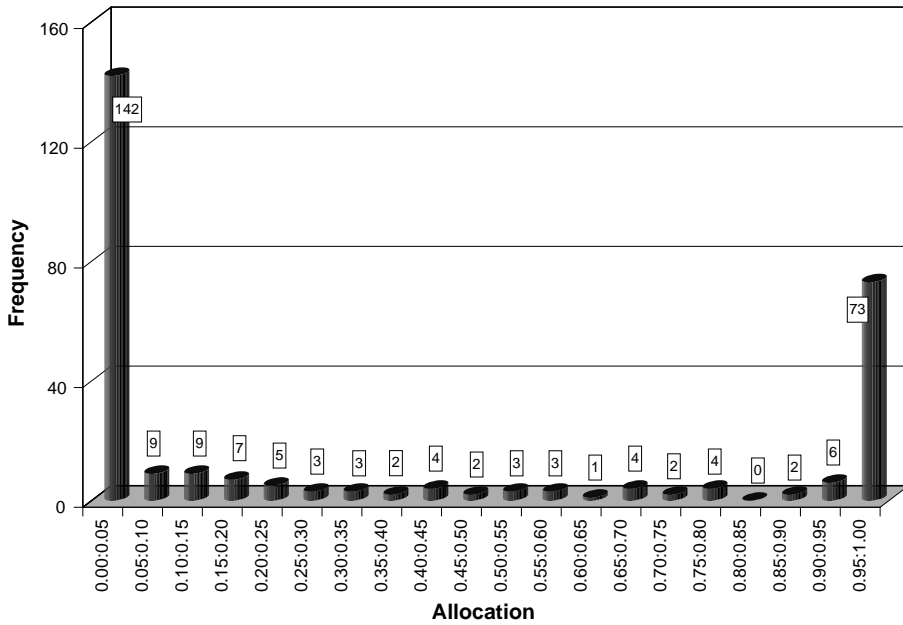


Fig. 2. The distribution of allocations to investors in IPOs. The allocation is the proportion that a subscriber receives of his or her order.

−16 to −6, as

$$RM6-16_j = M_{j,-6} / M_{j,-16} - 1, \tag{4}$$

where  $M_{j,t}$  is the TASE *Karam* market index. We also consider the five-day market return between the price setting day and the IPO day, days −6 to −1 (day −1 is the last full day with information about the market before investors entered their orders on day zero), as

$$RMI-6_j = M_{j,-1} / M_{j,-6} - 1. \tag{5}$$

$RMI-6_j$  should positively affect  $IR_j$  since this market return occurs after the setting of the issue price. But  $RM6-16_j$  should have no effect on  $IR_j$  if this information about the market is fully incorporated in the pricing of the IPO.

(ii)  $PROCEEDS_j$  is the logarithm of the IPO proceeds or the issue size in monetary units (Israeli Shekels, in constant prices of December 1992). If the issued securities are uniquely unhedgeable,<sup>6</sup> it would give rise to a declining demand function. Then, larger issues need more underpricing to attract sufficient demand, as observed by Logue (1973). On the other hand, if larger issue size means smaller uncertainty (Beatty and Ritter, 1986), it should have a negative effect on underpricing (see next).

<sup>6</sup>Short selling is extremely difficult and costly at the TASE during the sample period. Therefore, hedging is almost impossible.

Table 3

## Allocations in IPOs

$ALLOC_j$  is the allocation to subscribers in the IPO of firm  $j$ , calculated as the ratio of issued units to the total demand but bounded by 1,  $0 < ALLOC \leq 1$ . The initial return is  $IR_j = P_{j,6} / P_{j,0} - M_{j,6} / M_{j,0}$ .  $P_{j,t}$  is the price on the IPO unit of firm  $j$  on day  $t$ , where day 0 is the IPO day and  $M_{j,t}$  is the TASE *Karam* market index on day  $t$  pertaining to the IPO of firm  $j$ . Day 0 is the IPO day. There are 284 IPOs during November 1989 to November 1993.

	Mean	Median	Minimum	Maximum	Obs.
$ALLOC$	0.3595	0.0478	0.0003	1.0000	284
<i>Allocation classified by initial return (underpricing)</i>					
For $IR_j < 0$ : $ALLOC_j$	0.6134	0.9200	0.0015	1.000	95
For $IR_j > 0$ : $ALLOC_j$	0.2319	0.0127	0.0003	1.000	189

(iii)  $SDIR_j$  is the standard deviation of the daily initial return in the after-market, days +6 to +15. This proxy for uncertainty about the value of the issued securities is proposed by Ritter (1984), who finds that it has a positive effect on underpricing. Theory predicts that underpricing is positively related to uncertainty. Rock (1986, p. 189) states: “the greater the uncertainty about the true price of the new shares, the greater the advantage of the informed investors and the deeper the discount the firm must offer to entice uninformed investors into the market.” Beatty and Ritter (1986) propose that greater uncertainty induces more investors to spend resources and become informed, which in turn increases asymmetry in information and requires greater underpricing to attract uninformed investors. Welch (1992) proposes that underpricing is an increasing function of a mean-preserving increase in the spread of investors’ prior beliefs about the IPO price. We also examine here the effect of uncertainty on excess demand, measured by the allocation rate.

(iv)  $AUCTION_j = 1$  for IPOs sold by the auction method with upper and lower price limits and  $AUCTION_j = 0$  for IPOs sold at a fixed price. Because the auction has an upper price limit, it effectively becomes a fixed-price method when that limit is binding, in which case rationing is necessary. This occurs in 77.1% of the auctions (see Table 1). Yet, in auctions where an equilibrium price is reached below the maximum and above the minimum price, the underwriter does not need to absorb the unsold quantity. Underwriters could therefore set higher maximum prices than they would in fixed-price IPOs since their risk of undersubscription is lower. As a result, underpricing is expected to be smaller in IPOs by auction. While evidence shows that IPO underpricing is smaller in countries where auctions are used (Loughran et al., 1994), this study compares the effects of the two methods of IPOs within the *same* market.<sup>7</sup>

<sup>7</sup>The selection of the method of issue could also affect underpricing. We examine the determinants of the selection of the issuing method (single price or auction) by a Probit model, the explanatory variables being  $PROCEEDS_j$ ,  $SDIR_j$ , and  $RM6-16_j$ . These variables have no significant effect.

(v)  $UNIT_j=1$  in an IPO where a unit of securities is issued and  $UNIT_j=0$  in an IPO of stock alone. In our sample, units include stock and warrants and/or bonds (mostly convertible) and constitute about 85% of the cases. The decision to issue a unit of securities instead of stock alone is affected by agency costs and incentive issues (Schultz, 1993), and can also be affected by marketing considerations. In response to our inquiry, underwriters say that it is “easier” to sell units that include warrants and convertibles, meaning that they can issue the securities at higher prices.

The effects of these variables are examined in regression models where the initial excess return,  $IR_j$ , and the allocation rate  $ALLOC_j$  are functions of the pre-IPO market returns  $RMI-6_j$  and  $RM6-16_j$ , the logarithm of the issue size  $PROCEEDS_j$ , the method of sale  $AUCTION_j$ , the uncertainty  $SDIR_j$  and the composition of the issued unit  $UNIT_j$ . In the allocation model we use  $ALLOCT_j$ , the logistic transformation of the allocation rate:<sup>8</sup>

$$ALLOCT = \log(ALLOC + a)/(1 - ALLOC + a), \quad (6)$$

where  $a=0.5/284$ , to accommodate the cases where  $ALLOC=1$  or is practically zero. The estimation results of these models are presented in Table 4.

The results show that factors which lead to greater underpricing also stimulate higher excess demand and bring about smaller allocation: the signs of the coefficients in one model are the opposite of those in the other model. This suggests that underpricing is greater than necessary to ensure a given level of (excess) demand. An exception is the type of unit,  $UNIT_j$ , whose effect is insignificant in the allocation equation (therefore it is not included in the final estimation of the allocation model).

It is expected that  $RMI-6_j$  should affect both underpricing and excess demand (allocation). Since the offer price is set by day  $-6$ , it is already stale by the IPO day. Therefore, the change in market prices during the last five days before the IPO should affect the demand for the issue. However, the significant coefficients of  $RM6-16_j$  in both equations imply that underwriters deliberately underprice IPOs relative to information they have before the IPO about market return during days  $-16$  to  $-6$ . This is consistent with the results of Loughran and Ritter (2002) and Lowry and Schwert (2001). Notably, underpricing is not affected significantly by the market return in the preceding ten-day period, days  $-26$  to  $-16$ , suggesting that this information about the market is fully incorporated into the offer price.

In Table 5 we observe that IPOs are timed to take place after an unusual rise in market prices. The average daily return during days  $-26$  to  $-16$  is 2.36 times the return after the IPO, days 0 to  $+10$ , and the return during days  $-16$  to  $-6$  is 56% greater than the return on days 0 to  $+10$ . The return since the IPO price is announced in the prospectus, days  $-6$  to  $-1$ , is practically the same as the return on days 0 to 10. That is, issuers do not have any predictive power regarding the return between the prospectus day and the IPO day, but they time the IPO after a period of an unusually high market price run-up.

Doing IPOs after a rise in market prices enables issuers to raise their offer price and raise more money. The partial adjustment of the offer price to the recent market

<sup>8</sup>This transformation is suggested by Cox (1970, p. 33). The term  $a=0.5/N$ , where  $N$  is the sample size.

Table 4

The determinants of IPO allocations and initial returns

$$IR_j = \alpha_0 + \alpha_1 RM1-6_j + \alpha_2 RM6-16_j + \alpha_3 PROCEEDS_j + \alpha_4 AUCTION_j + \alpha_5 SDIR_j + \alpha_6 UNIT_j + v_j$$

$$ALLOCT_j = \beta_0 + \beta_1 RM1-6_j + \beta_2 RM6-16_j + \beta_3 PROCEEDS_j + \beta_4 AUCTION_j + \beta_5 SDIR_j + u_j.$$

$IR_j$  is the initial return on the IPO unit of firm  $j$  from day zero (the IPO day) to +6.  $ALLOCT_j = \log((ALLOC_j+a)/(1+ALLOC_j+a))$  is the transformed  $ALLOC_j$ , the proportional allocation rate to subscribers,  $1 < ALLOC_j \leq 1$ , and  $a=0.5/284$ .  $RM1-6_j$  is the market return from day -6 to day -1.  $RM6-16_j$  is the market return from day -16 to day -6.  $PROCEEDS_j$  is the logarithm of size of issue in Israeli Shekels (in December 1992 prices).  $SDIR_j$  is the standard deviation of daily initial returns over days +6 to +15.  $AUCTION_j$  equals 1 for IPOs sold at the auction method (with an upper and lower bounds) and equals zero for IPOs sold at a fixed price.  $UNIT_j$  equals 1 in IPOs of units that include other securities in addition to stock, and equals zero in IPOs of stock alone. There are 284 IPOs during November 1989–November 1993.  $t$ -statistics are in parentheses; standard errors use White's (1980) robust estimation.

	Regression results: Dependent variable		Statistics of variables	
	$IR_j$	$ALLOCT_j$	Mean	Std. Dev
<i>Constant</i>	-0.563 (1.89)	15.343 (2.02)		
$RM1-6_j$	1.388 (2.82)	-26.502 (3.04)	0.0072	0.0297
$RM6-16_j$	2.343 (5.53)	-33.251 (4.40)	0.0226	0.0353
$PROCEEDS_j$	0.043 (2.39)	-0.893 (2.00)	16.4173	0.8526
$SDIR_j$	4.500 (3.31)	-68.215 (3.90)	0.0273	0.0138
$AUCTION_j$	-0.128 (2.20)	1.348 (2.02)	0.8626	0.3448
$UNIT_j$	-0.120 (2.27)		0.8451	0.3625
$R^2$	0.213	0.150		

return  $RM6-16_j$  is consistent with Loughran and Ritter's (2002) proposition,<sup>9</sup> based on prospect theory, that issuers do not mind "leaving money on the table" when the IPO brings them higher value than they anticipate.

Underpricing is greater for IPOs that are larger and have greater uncertainty. Such IPOs also have greater excess demand, as measured by allocation. This means that new issues are underpriced by more than is necessary to offset the negative effects of large size and uncertainty. This indicates deliberate underpricing.

<sup>9</sup> Loughran and Ritter (2002) explain the evidence in Hanley (1993) about underpricing being larger when the offer price is moved upward following the bookbuilding process. We apply it here to information about the recent market return (in Israel, there is no bookbuilding process).

Table 5

Market return around the IPO day

Average daily return on the market *Karam* index before and after day 0, the IPO day.

	Days–26 to –16	Days–16 to–6	Days–6 to –1	Days 0 to +10
Market return (%)	0.326	0.225	0.144	0.138
Ratio relative to return in (0, +10)	2.36	1.56	1.04	1.00

Auctioned IPOs are associated with smaller underpricing, which explains the popularity of this method (see Table 1). The smaller underpricing also reduces the excess demand in auction IPOs. Indeed, in December 1993 the Israeli Securities Authority mandated the auction method without an upper price limit. As expected, Kandel et al. (1999) find that underpricing in these auctions is much smaller. In their sample of 27 IPOs, the initial return is 0.045 and significant. A recent study by the Israeli Securities Authority finds that for 14 IPOs during the period April 1995 to December 1996, the initial return is –0.014, insignificantly different from zero.

Finally, underpricing is smaller in IPOs of units of securities including in addition to stock, warrants or bonds or both. This is consistent with the underwriters' claim that unit IPOs are easier to sell. Underpricing is not significantly affected by whether the additional securities in the unit are warrants or bonds or both.

Underpricing does not necessarily imply gains to uninformed investors. Rock (1986) suggests that greater initial returns are offset by smaller allocations of shares to subscribers and uninformed investors should earn zero excess gain. This is examined in the next section.

### 3. Two tests of rock's theory

#### 3.1. Test I: adverse selection

Rock's (1986) hypothesis of adverse selection (or winner's curse) in IPOs implies a negative correlation between initial returns and allocations to investors. Since informed investors avoid overpriced IPOs, uninformed investors then receive larger allocations of shares on which they earn negative returns. In underpriced IPOs that earn positive returns, uninformed investors receive smaller allocation.

Consistent with Rock's (1986) proposition of adverse selection in IPOs, we obtain the following relation:

$$IR_j = 0.093 - 0.028 ALLOC_j,$$

(*t* statistic) (6.62) (9.07)  $R^2 = 0.225$

To examine whether the results are affected by extremely high allocations, we excluded observations where  $ALLOC_j > 0.95$  (25.7% of all IPOs). For the remaining

211 IPOs, the results are:

$$IR_j = \begin{matrix} 0.033 & -0.044 \\ (t \text{ statistic}) & (1.56) & (6.74) \end{matrix} ALLOCT_j, \quad R^2 = 0.136. \quad (8)$$

The results thus strongly support the existence of adverse selection in IPOs. The  $t$ -statistics are calculated using White's (1980) robust standard errors.<sup>10</sup>

Another examination of the adverse selection proposition is presented in Table 3, where the sample divided between overpriced and underpriced IPOs. In overpriced IPOs (where  $IR_j < 0$ ) the average allocation rate is 0.613 whereas it is much less than half, 0.232, in underpriced IPOs (where  $IR_j > 0$ ). The difference between the medians is much greater: allocation of 0.920 in overpriced IPOs vs. 0.013 in underpriced ones. This strongly supports the proposition of adverse selection in IPOs.

While the results are consistent with Rock (1986), the negative relationship between initial returns and allocations can also be obtained under a simpler scenario. If underwriters set a different offer price than what investors believe it should be (for example, due to error in estimating the market's expectations), there will be a negative relationship between initial returns and allocations.<sup>11</sup> When the offer price is smaller than the market's expectation of the company's value, there will be excess demand (low allocation) and high initial return. The opposite will occur when the offer price is above the market's expectation.

Another aspect of Rock's (1986) theory is examined as follows. If informed investors participate in underpriced IPOs and avoid the overpriced ones, there should be a greater number of investors participating in underpriced IPOs. Notably, this is different from the same investors increasing their order size in response to IPO underpricing. We test this hypothesis as follows. We denote the number of orders accepted in the IPO by  $ORDERS_j$ . These include all the orders in fixed-price IPOs and those who bid at least the auction price in auctioned IPOs ( $LORDERS_j = \log(ORDERS_j)$ ). Then,

$$LORDERS_j = \begin{matrix} -3.650 & +1.595IR_j & +0.623PROCEEDS_j \\ (t \text{ statistic}) & (1.34) & (6.29) & (3.84) \\ & +6.661RMI-16_j & +10.818SDIR_j, \\ & (4.29) & (2.0) & R^2 = 0.348. \end{matrix} \quad (9)$$

The results support the hypothesis that underpricing attracts more investors to participate in the IPO. Since the participation of uninformed investors is unrelated to underpricing (this is the very meaning of their being uninformed), the increase in the number of orders in response to underpricing signifies the participation of informed investors joining the demand for the new issue. These results are also consistent with the hypothesis that underpricing increases the investor base and ownership

<sup>10</sup>See Koh and Walter (1989), Levis (1990) and Brennan and Franks (1997) who find a positive relationship between oversubscription and underpricing.

<sup>11</sup>Error in setting the offer price relative to the market's valuation can also explain the pattern in Fig. 2 where most offers are either undersubscribed or greatly oversubscribed. But it cannot explain underpricing.

dispersion with the objective of increasing liquidity (Booth and Chua, 1996) or reducing monitoring by large shareholders (Brennan and Franks, 1997).

### 3.2. Test II: allocation-weighted initial returns

Rock (1986) proposes that in equilibrium, the initial return should be zero to uninformed investors in IPOs who are subject to adverse selection. We expect that in general an uninformed strategy should not produce positive initial returns in a frictionless market with rational investors. To test this proposition, we assume that uninformed investors subscribe a fixed amount for each and every IPO (or subscribe randomly to some IPOs). Their allocation-weighted initial return is given by

$$AWIR_j = ALLOC_j IR_j - interest. \quad (10)$$

$IR_j$  is the initial return over days 0 to +6 (defined in Eq. (1)),  $ALLOC_j$  is the allocation received in the IPO by equal proration to all subscribers, and  $interest_j$  is the one-day interest rate<sup>12</sup> that prevailed at the time of the IPO of company  $j$ . This is because investors subscribing to an IPO had to deposit for one day the entire amount of their order, to ensure that they could buy the number of units ordered at the specified price. In the period under study, the average one-day interest rate was 0.054%.

The distribution of  $AWIR_j$  (Fig. 3) is negatively skewed, affected by the “lemons” where the return is negative and investors are allocated a larger proportion of their order (sometimes the full amount of their order). This gives the negative returns greater weight. Fig. 4 presents the relationship between  $AWIR_j$  and the initial return  $IR_j$ . Because investor herding makes most allocations either close to zero or 1.0, most observations of  $AWIR_j$  are either close to zero or equal to  $IR_j$ , in which case they are on the 45° line. Fig. 4 presents two interesting observations. While high  $IR_j$  is associated with very small allocation and  $AWIR_j$  close to zero, we observe many cases where  $IR_j < 0$  yet  $AWIR_j$  is close to zero, meaning that these overpriced IPOs are greatly oversubscribed. And, when  $IR_j < 0$ ,  $AWIR_j$  is commonly along the 45° line since then it is likely that  $ALLOC_j = 1$ . But there are quite a few observations on the 45° line with  $IR_j > 0$ , meaning that these are underpriced IPOs that are undersubscribed. These observations show the extent of errors of investors in subscribing to IPOs.

The statistics for  $AWIR_j$  are presented in Table 2. The mean  $AWIR_j$  is negative, -1.18%, with  $t = 1.77$ , marginally significant, and the median  $AWIR_j$  is practically zero.<sup>13</sup> The 15-day allocation-weighted initial return,  $AWIR15j$ , has a mean of -1.77% with  $t = 2.41$ , statistically significant. The long-term allocation-weighted

<sup>12</sup>We use the interest rate for withdrawals from bank accounts (source: Bank of Israel report, various issues). The practice was that banks, which are by far the largest brokers in Israel, provided the funds for the one-day deposit.

<sup>13</sup>An alternative formulation of the allocation-weighted excess return is  $AWIR_j^M = ALLOC_j \cdot IR_j - M_{j,0} / M_{j,-1}$  which uses the market return as a benchmark for the one-day deposit. The results are similar. The mean of  $AWIR_j^M$  is -1.17% with  $t = 1.75$ .

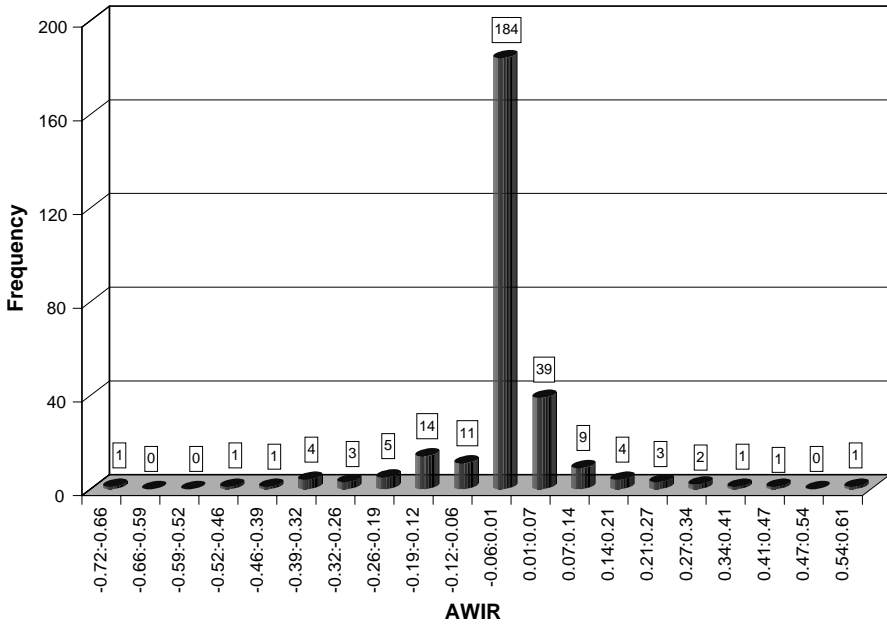


Fig. 3. The distribution of allocation-weighted initial excess return in IPOs.  $AWIR_j = ALLOC_j \cdot IR_j - interest_j$ , where  $IR_j = R_j - RM_j$ , the initial excess return on the offered unit over days 0 to +6,  $ALLOC_j$  is the proportional allocation to subscribers in the IPO of firm  $j$ , and  $interest_j$  is the one-day interest cost.

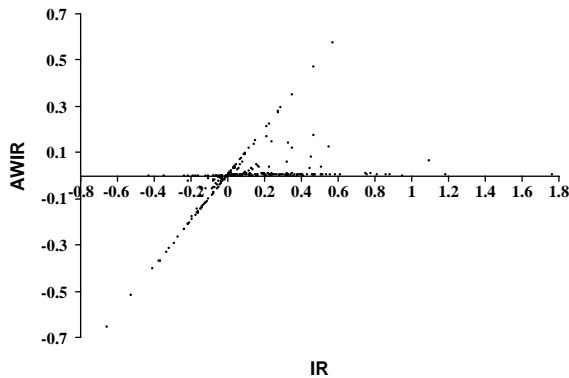


Fig. 4. Initial excess return,  $IR$ , and allocation-weighted initial excess return,  $AWIR$ .  $IR_j = P_{j,6}/P_{j,0} - M_{j,6}/M_{j,0}$ .  $P_{j,t}$  is the price on the IPO unit of firm  $j$  on day  $t$ , where day zero is the IPO day and  $M_{j,t}$  is the TASE Karam market index on day  $t$  pertaining to the IPO of firm  $j$ .  $AWIR_j = ALLOC_j \cdot IR_j - interest_j$ .  $ALLOC_j$  is the proportional allocation to subscribers in the IPO of firm  $j$ , and  $interest_j$  is the one-day interest cost.

initial return for 150 days after the IPO,  $AWIR150_j$ , has a mean of  $-2.43\%$  with  $t = 1.52$ .

The evidence on the negative allocation-weighted initial return at IPOs is inconsistent with Rock's (1986) prediction. This evidence may imply that demand in

IPOs is generated by investors who overvalue the issued securities. Uninformed rational investors can avoid the IPO market if their return is negative and informed investors can subscribe selectively to underpriced issues, but they cannot arbitrage away the overconfidence of other investors.

#### 4. Conditioning IPO subscriptions

Investors uninformed about the values of the issuing firms are assumed here to subscribe to all IPOs or subscribe randomly to some of them. Such investors realize a small loss, which seems inconsistent with the result of zero gain in Rock's (1986) model that assumes rationality. Now, consider investors who are uninformed about the issuing firms, but can easily observe market information. The question is whether they could improve their performance by conditioning their subscription on publicly available information that is unrelated to the firm's value. We call these investors "minimal information conditioning" (MIC) investors. The following examines two strategies available to such investors and their results.

##### 4.1. Conditioning on pre-IPO market returns and volatility

Investors could use publicly available information about the market conditions prior to the IPO that includes market return and market volatility. We examine the effect of this information as follows. Over the 15-day period before the IPO we measure

- (i)  $RMI-16_j$ , the market return (using the *Karam* index), days  $-16$  to  $-1$ , and
- (ii)  $SDRM_j$ , the standard deviation of the market return, days  $-16$  to  $-1$ .

We then estimate the effects of these variables on the allocation-weighted initial return by the following models:

$$AWIR_j = -0.0248 + 0.432RMI - 16_j, \quad (11)$$

(t statistic) (2.87) (3.33)  $R^2 = 0.031$

and

$$AWIR_j = 0.0291 - 4.024SDRM_j, \quad (12)$$

(t statistic) (1.61) (2.34)  $R^2 = 0.025$

The results suggest that MIC investors in IPOs could increase their allocation-weighted return by subscribing only to IPOs preceded by favorable market conditions (high market return or low market volatility). When both measures of market performance,  $RMI-16_j$  and  $SDRM_j$ , are included in the model, market return emerges as the one with the stronger effect (the correlation between the two measures is  $-0.45$ ). Doing further analysis, we divide the sample into two halves by the median of  $RMI-16$ . The results are as follows:

- (i) In IPOs preceded by  $RMI-16 > \text{median}$ : mean  $AWIR_j = 0.0086$  ( $t = 1.11$ ).
- (ii) In IPOs preceded by  $RMI-16 < \text{median}$ : mean  $AWIR_j = -0.0320$  ( $t = 3.04$ ).

The difference between the two means is significant ( $t = 3.10$ ). It follows that zero initial return is earned only by investors who selectively participate in IPOs preceded by relatively high market return.

Conditioning subscription to IPOs on other variables does not improve investors' performance. We estimate a regression model similar to the one in Table 4, where  $AWIR_j$  is a function of lagged market returns as well as of the variables  $PROCEEDS_j$ ,  $AUCTION_j$ ,  $SDIR_j$ , and  $UNIT_j$ . While these four variables affect the initial return  $IR_j$ , they also affect  $ALLOC_j$  in the opposite direction, and on balance they have no significant effect on the allocation-weighted initial return  $AWIR_j$ . The absence of a significant effect of  $SDIR_j$  on  $AWIR_j$  means that investing in riskier IPOs does not yield for risk averse investors a higher risk premium, as might be expected.

It thus seems that Rock's (1986) equilibrium, in which uninformed investors earn zero initial return, applies to MIC investors. While being uninformed about the issuing firm, these investors could use pre-IPO information about the market, which is available without cost, to improve their performance and erase the small loss that would be incurred if they subscribe indiscriminantly to all IPOs (or to some of them at random).

#### 4.2. Conditioning on allocation

We now show that MIC investors could improve their performance by choosing to participate in IPOs conditional on the flow of orders entered by other investors. This resembles the scenario described by Welch (1992), which leads to information cascades. During the IPO day, subscriptions to IPOs can be entered at any time from morning until noon, and no information is available during the day on accumulated orders. However, many investors could obtain coarse information about the extent of demand by talking to other investors and to brokers.

The evidence shows that the information about the extent of the pre-IPO demand is valuable since  $Corr(AWIR_j, ALLOC_j) = -0.215$  and is statistically significant. However, this relationship is driven by the cases of undersubscribed IPOs. There are 73 cases of  $ALLOC_j > 0.95$ , undersubscribed and almost-undersubscribed IPOs (25.7% of the sample). Excluding these IPOs, we obtain  $Corr(AWIR_j, ALLOC_j) = 0.122$ . While the mean  $AWIR_j = -0.0602$  ( $t = 2.31$ ) for the undersubscribed IPOs, for the rest of the IPOs the mean  $AWIR_j = 0.0049$  ( $t = 2.00$ ), a small gain which is statistically significant.<sup>14</sup> Thus, MIC investors gain by avoiding IPOs with low investor interest if they have this information.

Since demand begets additional demand, what prevents an unstoppable cascade of demand? Welch's (1992) model limits an investor's purchase to no more than one share. Here, the cascade is bounded by the requirement that investors deposit the entire monetary value of their subscriptions for one day, which entails an interest

<sup>14</sup>The results do not depend on the exact extent of subscription. For example, using  $ALLOC_j = 0.50$  as the breaking point, 98 IPOs with higher allocation have mean  $AWIR_j = -0.045$  ( $t = 2.39$ ), while 186 cases with smaller allocation have mean  $AWIR_j = 0.0050$  ( $t = 2.96$ ).

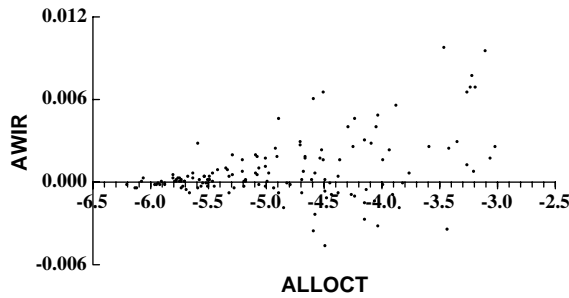


Fig. 5. The allocation-weighted initial excess return against allocation.  $AWIR_j = ALLOC_j \cdot IR_j - interest_j$ , where  $IR_j = R_j - RM_j$  is the initial excess return on the offered unit over days 0 to +6,  $ALLOC_j$  is the proportional allocation to subscribers in the IPO of firm  $j$ , and  $interest_j$  is the one-day interest cost.  $ALLOCT_j = \log(ALLOC_j + a) / (1 - ALLOC_j + a)$ , where  $a = 0.5/284$ . The data presented here is for half the sample (142 IPOs) for which  $ALLOC_j$  is below its median.

cost,  $interest_j$  (see Eq. (10)). This cost offsets the gain in IPOs with very small allocation (high demand) and thus discourages subscribing to them. We estimate the relationship between investor gain and allocation for half the sample (142 IPOs) for which  $ALLOC_j < 0.0478$  (the median):

$$AWIR_j = 0.0065 + 0.0012 ALLOCT_j, \quad (13)$$

(t statistic) (4.24)      (4.09)       $R^2 = 0.174$ .

The results show that investors gain significantly less in IPOs with very high demand and very small allocation. Fig. 5 depicts the relationship between the allocation and the respective  $AWIR_j$  for IPOs with allocations below the median. And, given the very small allocation-weighted gain in the case of very small allocation, considering the fixed cost of time and effort involved in subscribing to an IPO, investors who know the extent of demand are better off avoiding the very hot IPOs altogether.

## 5. Conclusion and discussion

This paper examines major theories of underpricing in IPOs, using unique data from Israel on the rate of allocation to subscribers in IPOs, where each subscriber received an equal proportion of her or his order. Such data are unavailable in the US.

We first test Rock's (1986) theory of adverse selection by which informed investors choose to participate in underpriced IPOs and uninformed investors receive larger allocations of the overpriced IPOs. In equilibrium, uninformed investors should earn zero initial return. We find that underpricing is negatively related to the rate of allocation to subscribers, consistent with the existence of adverse selection. However, the mean initial return earned by uninformed investors is negative. Investors who participate in all IPOs (or subscribed randomly to some) earn a return of  $-1.18\%$  or  $-1.77\%$  when measured over six days or 15 days after the IPO, respectively. This is inconsistent with Rock's (1986) prediction and suggests that IPOs are overpriced from the viewpoint of uninformed investors.

The negative returns earned by uninformed investors means that their demand for new issues is, on average, too high. They lose on overpriced offers while apparently their allocations in underpriced offers are too small. As a result, their allocation-weighted return is negative. We show that “minimal information conditioning” investors (those who are uninformed about the firm but condition their participation in IPOs on publicly available information about the market that could be obtained without cost) are able to improve their performance. Subscribing only to IPOs that are preceded by high market return or low volatility enable them to break even, as [Rock \(1986\)](#) proposes.

Second, we examine [Welch’s \(1992\)](#) theory of information cascades by which investors set their own demand after having observed the demand of others. This leads to herding where investors’ demand is either very high or is very low, in which case the offering fails. Then, underpricing is a means to create a cascade of high demand that will ensure the success of the offering. We obtain that the distribution of allocations to IPO subscribers exhibits an extreme U-shaped pattern, indicating strong herding among investors. They either subscribe overwhelmingly to new issues or largely abstain, in which case the issue is undersubscribed. We again consider the return earned by MIC investors. Those with information about the extent of demand can improve their performance by avoiding IPOs with low demand and joining those with high demand.

We find that IPOs are timed to take place after an unusual rise in market prices and that the offer prices are not fully adjusted to this information. As a result, underpricing and excess demand are related to the pre-IPO market return. This is consistent with [Loughran and Ritter’s \(2002\)](#) proposition that issuers do not mind “leaving money on the table” when they raise more money than they anticipate.

Our results that excess demand is affected by factors that are known before the IPO (recent market return and issue characteristics) cast doubt on [Rock’s \(1986\)](#) explanation of underpricing. Suppose that underpricing is done to attract a desired level of excess demand. Then, the issue can be priced just right (that is, with no underpricing) and then the offer price can be lowered by a constant. Then, excess demand would not be related to any factor known before the IPO. However, we do find that excess demand is affected by factors that affect underpricing. This raises question on the motivation for underpricing by issuers and underwriters.

## References

- Aggrawal, R., Prabhala, N.R., Puri, M., 2002. Institutional allocation in initial public offerings: Empirical evidence. *Journal of Finance*, forthcoming.
- Amihud, Y., Mendelson, H., Lauterbach, B., 1997. Market microstructure and securities values: Evidence from the Tel Aviv Exchange. *Journal of Financial Economics* 45, 365–390.
- Beatty, R.P., Ritter, J.R., 1986. Investment banking, reputation, and the underpricing of initial public offerings. *Journal of Financial Economics* 15, 213–232.
- Booth, J.R., Chua, L., 1996. Ownership dispersion, costly information and IPO underpricing. *Journal of Financial Economics* 41, 291–310.

- Brennan, M.J., Franks, J., 1997. Underpricing, ownership and control in initial public offerings of equity securities in the UK. *Journal of Financial Economics* 45, 391–413.
- Cox, D.R., 1970. *The Analysis of Binomial Data*. Methuen & Co., London.
- Hanley, K.W., 1993. Underpricing of initial public offerings and the partial adjustment phenomenon. *Journal of Financial Economics* 34, 231–250.
- Hanley, K.W., Kumar, A.A., Seguin, P.J., 1993. Price stabilization in the market for new issues. *Journal of Financial Economics* 34, 177–197.
- Jenkinson, T., Ljungqvist, A., 2001. *Going Public*. Oxford University Press, England.
- Kandel, S., Sarig, O., Wohl, A., 1999. The demand for stocks: an analysis of IPO auctions. *Review of Financial Studies* 12, 227–247.
- Keloharju, M., 1993. The winner's curse, legal liability, and the long-term price performance of initial public offerings in Finland. *Journal of Financial Economics* 34, 251–277.
- Koh, F., Walter, T., 1989. A direct test of Rock's model of the pricing of unseasoned issues. *Journal of Financial Economics* 23, 251–272.
- Levis, M., 1990. The winners curse problem, interest costs and the underpricing of initial public offerings. *Economic Journal* 100, 76–89.
- Ljungqvist, A.P., Wilhelm, W.J., 2002. IPO allocations: Discriminatory or discretionary? *Journal of Financial Economics*, forthcoming.
- Logue, D., 1973. On the pricing of unseasoned equity issues: 1965–69. *Journal of Financial and Quantitative Analysis* 8, 91–103.
- Loughran, T., Ritter, J.R., 2002. Why don't issuers get upset about leaving money on the table in IPOs? *Review of Financial Studies* 15, 413–443.
- Loughran, T., Ritter, J.R., Rydqvist, K., 1994. Initial public offerings: international insights. *Pacific-Basin Finance Journal* 2, 165–199.
- Lowry, M., Schwert, G.W., 2001. Biases in the IPO pricing process. Unpublished working paper. University of Rochester, NY.
- Michaely, R., Shaw, W., 1994. The pricing of initial public offerings: tests of adverse selection and signaling theories. *Review of Financial Studies* 7, 279–317.
- Ritter, J.R., 1984. The "hot issue" market of 1980. *Journal of Business* 57, 215–240.
- Ritter, J.R., 1998. Initial public offerings. *Contemporary Finance Digest* 2, 5–30.
- Rock, K., 1986. Why new issues are underpriced? *Journal of Financial Economics* 15, 187–212.
- Ruud, J.F., 1993. Underwriter price support and the IPO underpricing puzzle. *Journal of Financial Economics* 34, 135–152.
- Schultz, P.H., 1993. Unit initial public offerings: a form of staged financing. *Journal of Financial Economics* 34, 199–229.
- Schultz, P.H., Zaman, M.A., 1994. After-market support and underpricing in initial public offerings. *Journal of Financial Economics* 35, 199–219.
- Welch, I., 1992. Sequential sales, learning, and cascades. *Journal of Finance* 47, 695–732.
- White, H., 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica* 48, 817–838.