Which investors are irrational?

Evidence from rights issues

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First draft: May 23, 2005
This version: March 16, 2006

ABSTRACT

This study documents patterns of investor irrationality in Finnish rights issues. Current shareholders of issuing companies lost at least MEUR 9.9 from 1995 to 2002 by exercising rights too early, selling rights in the open market below their intrinsic value, or leaving rights unexercised. Investors with small portfolios, inactive trading history, those who know neither of the official languages, or who are living abroad are most likely to act irrationally. The overall conclusion is that low sophistication and the costs of becoming informed contribute to irrational behavior.

JEL-classification: G32, D01

Keywords: Rights issue, irrationality, warrant, investor behavior

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1. Introduction

Not all shareholders are rational. Although modeling investor behavior traditionally relies on the rationality assumption, recent studies provide increasing support for the claim that households, and even institutional investors, are prone to gross errors in their investment decisions. For example, investors pay high management fees for index funds, even when lower cost funds are available (Elton, Gruber, and Busse, 2004), exercise American options early (Poteshman and Serbin, 2003), and trade too much (Barber and Odean, 2000). Even CBOT traders have been shown to deviate significantly—in fact, more than the control group of undergraduate students—from the expected utility maximization principle (Haigh and List, 2005).

The market for standard contingent claims provides ample opportunities for studying investor sophistication, as in this market it is straightforward to identify unambiguously irrational transactions. For example, exercising a call option with an exercise price above the current market price is clearly suboptimal. Similarly, an American call option's premature exercise is a dominated strategy if transaction costs are not an issue and no dividend is paid on the underlying asset. Diz and Finucane (1993) document that in the S&P 100 index options market, over 20% of all exercises are early. The authors conclude that the rational factors—transaction costs, dividends, and the wild card feature of index options—fail to explain at least 12.4% of the early exercises. With a similar research setting for common stock call options, Finucane (1997) reports that 8% of early exercises are nonattributable to ex-dividend day or transaction costs. Engström (2002) also finds evidence on early exercises in the Swedish equity call options market, but the proportion of early exercised calls, classified as irrational, is considerably lower, only 2% of all exercises. In a recent study, Poteshman and Serbin (2003) report that investors threw away more than USD 250,000 by exercising call options traded at the Chicago Board Options Exchange before maturity.

A related strand of literature investigates the relative sophistication of different investor categories. These studies generally find institutions and wealthier individuals to be more savvy than less wealthy individual investors (e.g., Grinblatt and Keloharju, 2000; Poteshman and Serbin, 2003; Barber, Lee, Li, and Odean, 2005; Agnew, 2006). Nevertheless, there is evidence that despite institutional investors' higher sophistication, they almost completely failed to take advantage of the market downturn at the turn of the millennium. With survey data, Vissing-Jørgensen (2003) finds that the very wealthy investors considered the stock market overvalued at the peak of 2000, but failed to act according to their beliefs by not reducing their stock market

exposure. In addition, it seems that sophisticated investors also failed to use the derivatives market to implement a bearish strategy. Neither firm proprietary traders nor full-service broker clients increased their purchases in put options at the height of the market as shown in Lakonishok, Lee, and Poteshman (2004). In contrast, hedge funds appeared to be sophisticated enough to take advantage of sharp market fluctuations. Brunnermeier and Nagel (2004) document evidence that hedge funds successfully rode the technology bubble until the peak, and brought down their holdings before the sharp decline.

This paper adds to the previous literature on investor sophistication by providing comprehensive evidence on undisputedly irrational behavior in a novel setting. Rights issues, which are a common seasoned equity flotation method in Europe and Asia,[1] offer a promising research avenue for studying investor rationality. In rights issues, shareholders are given subscription rights, which are in essence short-lived warrants. As always with standard contingent claims, there are several possible ways to make unambiguously irrational decisions. Investors can exercise their rights too early, exercise rights when the current market price is below the strike price, sell rights at too low prices, or fail to use the rights altogether.

By identifying suboptimal transactions in rights issues, this study provides additional evidence of clearly irrational behavior in a novel setting. However, there is very little previous empirical evidence on factors contribution to irrational behavior. The analysis of this paper attempts to fill this gap by finding answers to the following questions: *what* drives irrational behavior, *who* are the irrational investors, *which* investors profit from the actions of the irrational investors, and *how expensive* is irrationality?

I make two distinct definitions of rationality in this paper. My first definition of rationality is rather nonstringent and does not rely on such assumptions as logical omniscience to perform complex maximization problems in Simon's (1976) definition of substantive rationality. Instead, I define *rational* behavior in this paper as in Poteshman and Serbin (2003): investors are assumed to be rational as long as they prefer more to less and commit transactions consistent with this assumption. Correspondingly, any behavior which belongs to the complement of *rational* choices is considered as *irrational*. However, I also consider the possibility that, because of unobservable transaction costs (such as opportunity costs of time and costs of becoming informed), some investors make decisions that are seemingly irrational, but they are in fact *strictly rational*. For this purpose, I use the second definition of rationality conservatively when interpreting the

[1]For the UK, see Slovin, Sushka, and Lai, 2000; for Sweden, Cronqvist and Nilsson, 2005; for Norway, Eckbo and Norli, 2005; for China, Chen and Yuan, 2004; and for Hong Kong, Wu and Wang, 2005.

results. Investors are defined to be *strictly irrational* when the welfare loss from their actions is too large to be reconciled with any reasonable degree of unobservable transaction costs.

When identifying irrational transactions in rights issues by using the first definition of rationality, I find strong evidence that investors make unambiguously irrational decisions. First, investors largely ignore the time value of money when deciding when to exercise the rights: the majority of rights exercises occur long before the last exercise day. At least 78% of the households exercise rights before maturity, and even in the category of mutual funds, arguably the most sophisticated major investor category, at least 26% of the exercises are early. Second, institutions, and especially households, sell rights at excessively low prices, and sometimes allow them to lapse without compensation. At the same time, smart money takes advantage of the irrational investors. Financial institutions buy rights in the open market and profit at the expense of investors selling their rights for a price below the intrinsic value.

Why do some investors leave money on the table in rights issues? The results in this paper suggest that low sophistication, as well as the costs of becoming informed, contribute to irrational behavior. Investors with large portfolios and high trading activity, arguably the more savvy investors, are the least likely to leave rights unexercised. Moreover, investors who live abroad and who are not native speakers of either of the official languages in Finland, are more likely to forfeit their subscription rights without compensation. These are the investors who tend to incur the highest costs of becoming informed.

This paper also assesses the economic significance of investor irrationality. The irrational investors lost at least MEUR 9.9 in 18 rights issues between 1995 and 2002 by either selling rights for a price below their fair value, exercising them early, or allowing them to lapse altogether. On a relative basis, the wealth transfer from irrational investors to other investors is modest, but not trivial: the aggregate figure of MEUR 9.9 is equivalent to 0.7% of the total issue proceeds. Even if we take the very extreme position of arguing that all these transactions were caused by an unobservable cost, such as a restrictively high opportunity cost of time, the aggregate figure of MEUR 9.9 has also a straightforward interpretation. In this case, the aggregate figure can be understood as a lower boundary for the investor level cost of friction in a seasoned equity issue.

The remainder of this paper is organized as follows. The next section describes the data and Section 3 the relevant institutional details of rights issues in Finland. Section 4 presents empirical evidence on investor irrationality in rights issues and Section 5 concludes.

2. Data

The data for this study come from several sources. Data on the details of all rights issues in Finland from 1995 to 2002 were collected from issue prospectuses and stock exchange releases. There are 18 rights issues altogether, of which six issues were underwritten, and in three offerings, shares were issued simultaneously for two classes of listed stock. In seven cases, shareholders of dual-share class companies were entitled to subscribe for the share class with fewer votes. Furthermore, there are six underwritten issues, of which one issue (Neptun Maritime) was underwritten by seven blockholders and another issue (Done) was underwritten jointly by the arranging bank and a single blockholder. Additional issue characteristics are given in Table 1.

A particularly salient feature in the data is the substantial variation in issue size, as shown in Table 1: the smallest issues in the sample have only a few hundred participants and net proceeds of less than MEUR 10, whereas the largest rights issues of a recently privatized telecommunications company had almost 140,000 domestic and registered foreigner participants with proceeds exceeding EUR 1 billion. Because of the considerable issue size variability, I report both the volume weighted and equal weighted results, where appropriate.

Investor level data on rights issue subscriptions, trades, and removals are from the Finnish Central Securities Depositary (FCSD), which maintains a centralized, official electronic register of all securities transactions for virtually all companies listed on the Helsinki Exchanges (HEX, nowadays a part of OMX Group, Plc). The data comprise daily records for all stock market trades and other transactions, such as equity issue subscriptions, option exercises, and tender offers. Depending on the year, the FCSD data cover 97-100% of the total market capitalization, and thus representativeness is not an issue. The FCSD data run from January 1, 1995 through November 28, 2002, a period that includes both bull and bear markets. More detailed information on the data can be found in Grinblatt and Keloharju (2000).

All transactions in the FCSD data are tagged with a unique investor identification number enabling the computation of portfolio value and composition for each domestic investor in the entire market on every day. The data also contain records of subscription rights. Allocations, trades, subscriptions, and removals of unexercised subscription rights are identified from the data to build a complete dataset on investors exercising, trading, and ignoring allocated rights.

Table 1
List of rights issues
This table lists characteristics of 18 rights issues in the sample. Three issues included two share classes. Rights issues are classified either as *symmetric* (right to subscribe shares of the same class) or *asymmetric* (shareholders of both classes have a right to subscribe shares with fewer votes). Rights issues are either *uninsured* (underwriter sells shares on a best efforts basis) or *underwritten* (underwriter and/or blockholders have committed to buy all/portion of unsubscribed shares). *Overallotment option* is an arrangement in which shares unsubscribed in the initial subscription are either subscribed by investors chosen by the board of directors, or on a pro rata basis determined by the volume of initial subscriptions. *Subscription price discount* is calculated as the percentage difference between the subscription price and the cum-rights market price of the share. *Value offered* is the number of shares offered multiplied by the subscription price and *value realized* is the value of shares eventually subscribed. *Number of participants* is the number of domestic investors and registered foreigners who were initially allocated rights. *Subscription period* refers to the period when rightholders are entitled to subscribe for the shares.

	General issue characteristics							Subscription period	
Company Name	Asymmetric offering?	Underwritten?	Overallotment option	Value offered, MEUR	Value, realized, MEUR	Number of participants	Subscription price discount	Begins	Ends
Ålandsbanken B	Yes	No	Yes	4.04	4.04	7,370	-92 %	3/27/1995	4/28/1995
Finvest B	Yes	Yes	Yes	11.34	1.01	3,871	0 %	4/10/1995	5/10/1995
Ålandsbanken B	Yes	No	No	4.04	4.04	7,835	-70 %	4/1/1996	5/3/1996
Efore	No	No	Yes	5.49	5.01	251	-82 %	4/1/1996	4/30/1996
Ilkka II	Yes	No	Yes	4.57	4.57	4,741	-66%	5/13/1996	6/14/1996
Raisio Yhtymä V	No	No	Yes	24.12	24.12	12,079	-74 %	6/10/1996	7/10/1996
Raisio Yhtymä K	No	No	Yes	12.50	12.50	10,581	a)	6/10/1996	7/10/1996
Atria A	No	No	Yes	28.95	28.74	6,773	b)	5/14/1997	6/16/1997
Stockmann B	Yes	No	No	92.62	92.45	11,265	-84 %	5/14/1998	6/12/1998
Neptun Maritime A	Yes	Yes	Yes	88.06	82.91	3,604	-40 %	10/29/1998	11/12/1998
Instrumentarium B	Yes	No	No	93.09	92.30	9,162	-32 %	12/4/1998	12/18/1998
Ålandsbanken A	No	No	No	5.81	5.78	6,321	-66 %	4/6/1999	4/30/1999
Ålandsbanken B	No	No	No	5.13	5.11	8,129	-65 %	4/6/1999	4/30/1999
Chips A	No	No	No	6.05	6.05	2,471	b)	5/7/1999	5/31/1999
Chips B	No	No	No	7.48	7.47	989	-96 %	5/7/1999	5/31/1999
SSK Suomen Säästäjäin Kiinteistöt	No	No	No	2.37	2.16	277	-79 %	3/21/2000	4/4/2000
Menire	No	Yes	Yes	15.83	15.82	2,698	-37 %	6/7/2000	6/17/2000
Sonera	No	Yes	Yes	1003.77	1003.77	137,934	-56 %	11/15/2001	11/28/2001
Technopolis	No	No	Yes	6.86	6.86	2,467	-29 %	2/28/2002	3/18/2002
Done Solutions	No	Yes	Yes	3.96	2.44	1,835	-16 %	5/21/2002	6/4/2002
Evox Rifa	No	Yes	Yes	6.07	4.29	5,370	-36 %	6/19/2002	7/2/2002
All offers, average				68.20	67.21	11,715	-57%		
All offers, median				7.17	6.46	5,055	-65%		

Notes: a) Share price data unavailable. b) The A-share of Atria was not listed prior to the rights offering.

In addition, the data include very detailed information on the institutional status of every single investor. By using the institutional status information, I group the investors into the following six investor categories: nonfinancial corporations, financial corporations, mutual funds, nonprofit organizations, households, and foreigners. Although this grouping is basically consistent with Grinblatt and Keloharju (2001), it does treat mutual funds as a separate category and pools the general government category with other nonprofit organizations.

The aggregate group of foreigners, which consists primarily of large institutional investors, such as mutual and pension funds, accounts for 40-50% of the total trading volume in HEX. Foreign investors trading in the Finnish stock market have the option of registering their stockholdings in their own name or via a domestic financial institution using a nominee account. It is impossible to perform an investor level analysis on foreign investors not registered under their own names. Their trades appear in the data under the nominee institution's investor identification number, but with a separate flag for a nominee account trade. In the subsequent investor level analyses, I use data from registered foreigners (who represent only a small fraction of all foreign investors), but I also include observations originating from foreigners registered under nominee accounts in the market level analyses.

Prospectus information and investor level data from FCSD are supplemented with daily stock price and volume data from HEX (number of shares traded, daily close, intraday low, and intraday high), and interest rate data (12-month Helsinki Interbank Offered Rate, HELIBOR, until the end of 1998; 12-month EURIBOR thereafter) from Thomson/Datastream.

3. Institutional setting

3.1. Overview of a rights issue

The Finnish Companies Act states that the shareholders of an incorporated company have a right to a pre-emptive rights offering in which they can subscribe for shares according to their current ownership stake. Shareholders can waive this right in the shareholders' general meeting by a supermajority of two-thirds. Although raising equity capital through a rights issue has historically been the dominant equity issue method in Finland, during the past 10 years, general cash offerings to the investor public at large have been more frequent.

In a rights issue, shareholders are issued short-lived tradable warrants, commonly referred to as subscription rights, that are usually deep-in-the-money, as shown in the column *subscription price discount* of Table 1. The length of the subscription period varies from 8 trading days to 23 trading days, with a median of 18 days. An investor can also sell the rights in the open market.

The open market trading period for rights is usually shorter than the subscription period; the sample median is 15 trading days.

Rights not used in the initial subscription are forfeited without compensation. Some brokers have a policy of selling the rights in the open market if a shareholder fails to give instructions to the broker by the end of the subscription period.[2] This is also the case in the issue of Sonera, which has a dual listing on the NYSE. The prospectus states that the rights agent of American Depositary Shares would automatically attempt to sell any rights if no instructions are given prior to the beginning of the last subscription day. Yet, it must be emphasized that no law or regulatory mechanism exists to protect ignorant shareholders who fail to exercise or sell their subscription rights.

3.2. Compensating interest and overallotment option

Until the beginning of 1999, companies which raised equity capital through a rights issue paid compensating interest to investors who exercised their rights before a pre-specified date, hereinafter referred to as the last interest compensation day. Compensating interest, with annual rates varying between 4% and 8%, was paid to entice investors to exercise their rights early, so that the whole equity issue would not be jeopardized, should the market price of the underlying stock fall below the subscription price during the subscription period. From a shareholder's perspective, it may be rational to prematurely exercise rights before the last interest compensation day if the interest rate exceeds the shareholder's opportunity cost of capital. In the eight issues which paid a compensating interest, the median length between the last interest compensation day and the last exercise day was 11 days.

From 1999 onwards, no issuing company paid compensating interest. Hence, in all issues in the latter half of my sample period, it was not rational to exercise rights prior to the last subscription day. However, because of short maturity and substantial subscription price discount, the time value of a subscription right was low in all but one issue.[3]

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[2]It is impossible to accurately determine which shareholders have made an agreement with their broker to sell subscription rights by default, as this is confidential information between the broker and the shareholder. However, an anonymous broker, who acted as a market maker in Sonera's subscription rights, was able to identify from time-stamped HEX-transaction files block trades originating from shareholders who had not given instructions to the broker. These sales constituted up to 8.7% of the total rights sales volume for the broker in question. By using this estimate, the volume of sales by initial rightholders, and the fact in Table 2 that 0.21% of shareholders left their rights unexercised, I estimate the proportion of investors who have a sell by default agreement to be 74%. Details of this calculation are available from the author upon request.

[3]The only issue with subscription price discount less than 15% was Finvest B. Subscription price discounts are reported along with other descriptive statistics in Table 1.

Finnish rights issues often have an overallotment option for selling shares left unsubscribed in the initial subscription. The Finnish Companies Act does not explicitly state to whom the overallotment option should be given. In two issues, overallotments were made on a pro rata basis to shareholders with a signed overallotment precommitment. In eleven issues, the shareholders' general meeting approved the motion to give the board of directors the power to decide on the overallotment allocations. In two cases, the overallotment was an underwriting in disguise: large shareholders had given an explicit commitment to purchase shares with the overallotment option, should there be any unsubscribed shares after the initial subscription. Five issues did not have an overallotment option. As there are various overallotment rules, and they typically concern either a small number of shareholders or a small fraction of shares, I choose not to study the overallotments in detail.

3.3. Tax considerations

Domestic individuals, nonfinancial corporations, financial corporations, and most foreign investors must pay capital gains tax, while mutual funds and nonprofit institutions are tax-exempt at the investor level. The tax consequences of a rights issue are straightforward. No immediate tax comes due if an investor subscribes for shares in a rights issue, and capital gains fall due in the fiscal year in which the shares are eventually sold. The tax basis for computing capital gains is the subscription price. The Finnish tax law applies the FIFO-principle in determining the order of shares sold. Given the FIFO-principle and share price dilution due to subscription price discount, subscribing for shares in a rights issue postpones capital gains tax. For example, consider an investor who has bought 100 shares at EUR 10 each, and the current market price of a share is EUR 15. Also assume that the company announces a rights issue in which for every old share owned one new share can be subscribed at EUR 5. On the ex-rights day, the share price drops to EUR 10. When the investor subsequently sells 100 shares at a market price of EUR 10, no capital gains tax fall due because the current market price equals the purchase price for the first 100 shares sold.

In contrast, selling subscription rights in the open market triggers an immediate capital gain. A capital gains tax between 25% and 29% falls due for 70% (in 1995-1998) or 80% (in 1999-2002) of the proceeds,[4] if the rights have been allocated to a shareholder. If subscription rights are purchased in the market, the capital gains tax basis is the purchase price. Given the different

[4]Capital gains tax is due on 50% of the proceeds if, and only if, the shares have been held for more than 10 years.

Table 2
Descriptive statistics on rights issues
This table presents a descriptive analysis of 18 rights issues in the sample. The columns under *distribution of shares offered* list the number of shares offered and the percentage of shares subsequently subscribed, underwritten, and unsold. The columns under *distribution of rights traded* list the percentage of rights traded. The column *% of rights sold to non-rightholders* corresponds to the net percentage of rights sold by domestic shareholders and registered foreigners to investors who did not initially hold rights, and the *% of rights sold to other rightholders* the number of rights sold to other rightholders. The column *% of rights sold by nominee rightholders* corresponds to the net percentage (negative value corresponds to a net purchase) of rights sold by foreigners registered under nominee accounts.

	Distribution of shares offered					Distribution of rights traded		
Company Name	Offered shares, million	% subscribed in initial subscription	% subscribed through overallotment option	% underwritten	% unsold	% of rights sold to non-rightholders	% of rights sold to other rightholders	% of rights sold by nominee rightholders
Ålandsbanken B 1995	2.40	100.00	0.00	0.00	0.00	0.52	1.66	33.28
Finvest B	13.49	8.91	0.00	74.14	16.95	2.36	1.13	0.00
Ålandsbanken B 1996	0.80	100.00	0.00	0.00	0.00	2.24	5.38	15.41
Efore	0.82	91.33	0.00	0.00	8.67	9.33	2.34	3.82
Ilkka II	0.54	95.35	4.65	0.00	0.00	7.90	6.62	0.00
Raisio Yhtymä V	1.79	98.97	1.03	0.00	0.00	18.04	1.87	100.00
Raisio Yhtymä K	0.93	97.44	2.56	0.00	0.00	6.50	5.56	-4.17
Atria A	4.30	99.29	0.00	0.00	0.71	68.96	4.90	-52.18
Stockmann B	7.34	99.82	0.00	0.00	0.18	8.55	12.95	13.73
Neptun Maritime A	43.63	18.21	75.94	0.00	5.86	4.50	0.99	5.07
Instrumentarium B	3.95	99.15	0.00	0.00	0.85	9.14	16.05	21.64
Ålandsbanken A 1999	0.86	99.47	0.00	0.00	0.53	0.93	7.13	48.03
Ålandsbanken B 1999	0.76	99.64	0.00	0.00	0.36	2.21	3.44	13.28
Chips A	3.00	99.76	0.00	0.00	0.24	0.00	0.00	0.00
Chips B	3.70	99.92	0.00	0.00	0.08	0.15	0.05	0.00
SSK Suomen Säästäjäin Kiinteistöt	14.10	91.10	0.00	0.00	8.90	3.34	1.39	0.00
Menire	3.52	96.15	3.78	0.00	0.06	0.39	6.19	20.48
Sonera	371.77	99.79	0.21	0.00	0.00	0.95	1.82	-12.37
Technopolis	2.92	97.78	2.22	0.00	0.00	8.06	4.89	0.00
Done Solutions	24.73	27.23	34.48	38.30	0.00	0.01	0.14	0.00
Evox Rifa	86.69	63.82	6.91	29.27	0.00	0.04	0.38	0.00
All offers, average	28.23	84.91	6.27	6.75	2.07	7.35	4.04	9.81
All offers, median	3.70	98.97	0.00	0.00	0.08	2.36	2.34	0.00

tax consequences of selling subscription rights and subscribing to shares in a rights issue, taxable investors do not have an incentive to sell subscription rights at their fair (or lower) value.

4. Empirical results

4.1. Descriptive statistics

Table 2 shows that the rights issues are on average almost fully subscribed. The equal weighted average initial subscription rate is 85% and the median initial subscription rate is 99%. The underwriter was left with unsold shares in three issues. Moreover, in three other issues that were not underwritten, more than 5% of shares remained unsold.[5]

4.2. Irrational behavior: exercising subscription rights early

In the first analysis on investor irrationality, I study how investors time their subscriptions. As is known from standard option pricing theory, it is not optimal to prematurely exercise American call options, or subscription rights, unless the underlying stock pays a sufficiently large dividend. In my data, no early subscription is entitled to a dividend,[6] so rational investors should not exercise their rights until maturity.

In Figure 1, I plot the timing of exercises in issues which paid no compensating interest, and thus provided no incentive for an early exercise. To make sure that my conclusions on exercise timing are not affected by Sonera, the single largest issue, I plot the distribution of exercises separately for all 8 issues and for all issues excluding Sonera.[7]

The results in Figure 1 clearly show that a considerable percentage of exercises occur before maturity. In fact, exercises before the last subscription day account for 77% of the observations in the full sample and for 96% in the issue of Sonera. Hence, the vast majority of investors voluntarily forewent their option to wait and deliver the funds on the last possible day.

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[5] Table 2 also reports an empirical detail related to the literature on the choice of seasoned equity flotation method. On average (median), initial shareholders sold 4.04% (2.34%) of their rights to other rightholders, and 7.35% (2.36%) to outside investors. Eckbo and Masulis (1992) observe only the trading volume of rights, and with a lack of better information, assume that all rights will be sold to outside investors. However, the results in Table 2 suggest that a sizable fraction of the rights trading volume is attributable to trades between initial rightholders.

[6] Dividends are paid once a year in Finland, and in all issues except one (Technopolis), the subscription period did not coincide with the ex-dividend day. In the issue of Technopolis, investors exercising rights before the ex-dividend day received new shares with no entitlement to a dividend from the previous fiscal year.

[7] For every exercise in the data, I observe the settlement date instead of the actual exercise date. However, as every settlement must occur after the exercise, all settlements strictly before the last possible exercise day are unambiguously premature.

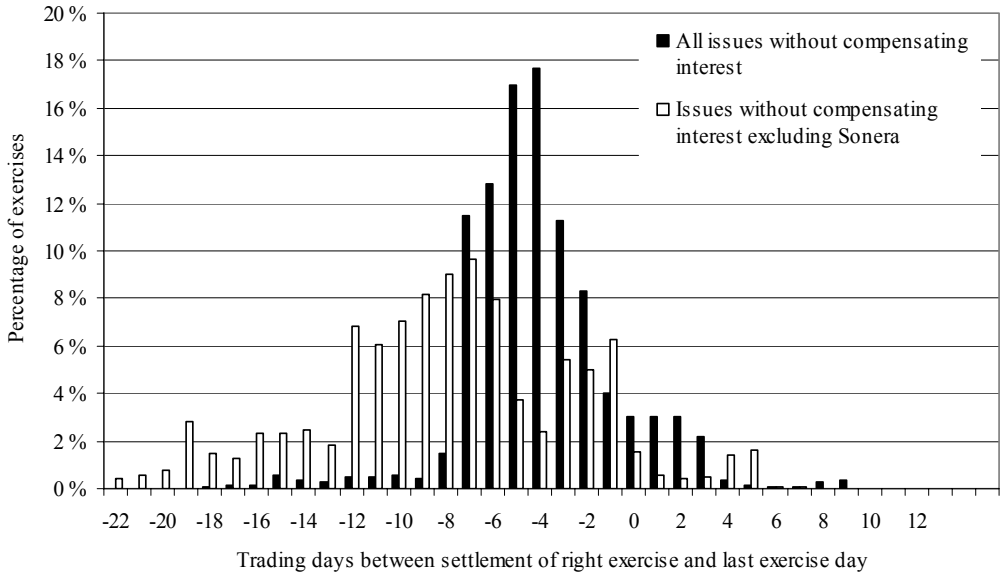


Fig. 1. Distribution of rights exercises in issues without compensating interest. The figure above plots the distribution of settlement dates for subscribed shares in eight issues (all issues since the beginning of year 1999 listed in Table 1) without compensating interest. The distribution of settlement dates is plotted separately for all observations, and for all observations without the single largest issue, Sonera. The number in the x-axis indicates the number of days between the settlement of shares (the actual exercise date for rights is unknown) and the last possible exercise day. Sonera has 199,257 observations and all other issues combined 53,931 observations.

I also investigate the distribution of subscription right settlement dates in eight issues that paid compensating interest. The key finding of this unreported analysis is that there are a substantial number of early exercises that are not entitled to compensating interest, but which are not at maturity either. Altogether, at least 17.8% of the exercises neither capture the compensating interest, nor are at maturity. More detailed results of this analysis are available from the author upon request.

Next, I assess the rationality of different investor categories. Not surprisingly, institutions tend to exercise their subscription rights closer to maturity, as shown in Figure 2, where I plot the issue volume weighted cumulative percentage of right exercise settlements relative to the last subscription day separately for households and institutions.[8] Despite having a smaller fraction of early exercises than households, at least 75.8% of the institutions exercised rights prematurely in the ten issues without compensating interest. The results for early exercises are consistent with Diz and Finucane (1993), Finuncane (1997), Engström (2002), and Poteshman and Serbin (2003), although the substantial proportion of premature exercises is unparalleled by any previous study.

[8] I also graph the equal weighted proportion of early exercises by computing the cumulative percentage of exercises separately for each issue and then taking the average. The results are similar and available from the author upon request.

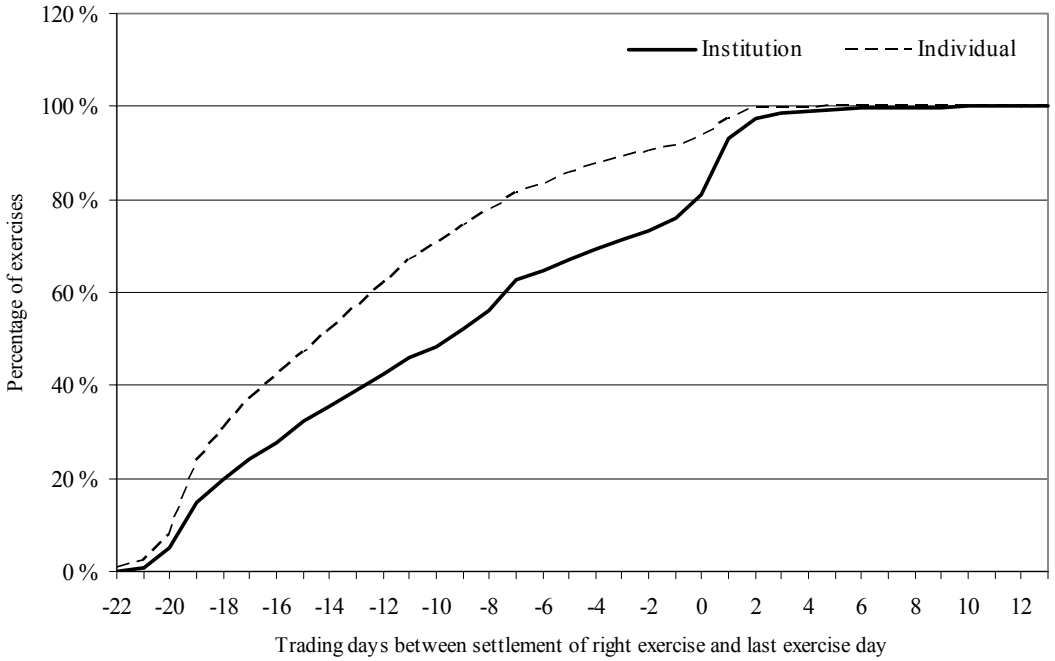


Fig. 2. Cumulative distribution of right exercises in non-interest paying issues: institutions versus individuals. The figure above plots the volume weighted distribution of right exercise settlement dates in all 8 rights issues (all issues since the beginning of year 1999 listed in Table 1) which paid no compensating interest for an early exercise.

Exercising a call option early may be optimal if there are market frictions. If the transaction costs for selling subscription rights are high, exercising the rights, and subsequently selling the shares, can be a better alternative than selling the rights. However, there is no evidence on investors actually following this trading strategy. Only 0.8% of the subscribed shares were subsequently sold during the subscription period—a negligible fraction compared with the percentage of investors exercising rights early.

In summary, it is safe to conclude that the majority of investors who subscribed for shares in rights issues did so too early. Results in Table 3 show that investors lost altogether MEUR 0.15 by exercising rights prematurely.[9] As also shown in Table 3, households and foreigners tend mostly to exercise rights early. I further study early exercises in the next subsection, which investigates the factors contributing to exercise timing.

[9]The costs of early exercise can be broken down into two components. First, an investor loses the time value of money for delivering the exercise funds too early. Second, an investor also loses the time value of the option to wait and make sure that the market price of the underlying stock does not fall below the subscription price before the maturity of the subscription right. The lost time value of the latter component is negligible due to the short life of the subscription right and substantial subscription price discount to the current market price. By using the Black and Scholes (1973) option pricing formula, I estimate the value of the latter component to be approximately EUR 12,400 for all exercises in the data (EUR 6,800 for households and EUR 5,600 for institutions). Further details of this calculation are available from the author upon request.

Table 3
Wealth loss resulting from early exercises by investor category
This table reports the time value of money lost by shareholders exercising their rights before the last subscription day. The sample covers all 18 Finnish rights issues from 1995 to 2002. In an issue without compensating interest, an exercise is classified as early if the settlement occurs strictly before the last subscription day. In an issue with compensating interest, the settlement of shares must occur between maturity and the second trading day following the last interest compensation day; the settlement lag is very seldom more than two trading days. The wealth loss for early exercise is computed as Σ Volume of shares subscribed x Subscription price x $(1 - e^{-rt})$, where r is the 12-month risk-free interest rate (HELIBOR/EURIBOR) and t the fraction of the year between the subscription settlement day and the last exercise day. *Proportion of early exercises, volume weighted* is calculated from the full sample, while *proportion of early exercises, equal weighted* is computed by first calculating the fraction of early exercises in every issue and then taking the average of all issues.

	Wealth loss for early exercise, EUR	N, early exercises	N, all observations	Proportion of early exercises, volume weighted	Proportion of early exercises, equal weighted
Nonfinancial corporation	15,416	5,250	7,340	0.72	0.48
Financial corporation	7,738	234	587	0.40	0.35
Mutual fund	1,279	33	125	0.26	0.19
Nonprofit institution	15,076	959	1,844	0.52	0.49
Household	53,375	150,461	192,876	0.78	0.54
Foreigner	55,779	1,967	2,811	0.70	0.57
All investors	148,661	158,904	205,583	0.77	0.54

4.3. Determinants of early exercise

Early exercise of subscription rights causes rather modest monetary losses, as shown in Table 3. It could be that investors decided to exercise the rights when contacting the stockbroker to trade stocks, or through the Internet when on-line. Hence, the time value lost in an early exercise could have been smaller than the opportunity cost of time for logging in twice or making an additional phone call to the stockbroker during the same week. However, investigating the determinants of early exercise is nevertheless useful because it helps to understand which investors are more sophisticated and which investors encounter less trouble in exercising rights closer to maturity.

Analyzing early exercises with the full sample is problematic for two reasons. First, the length of the subscription period varies in rights issues, as shown in Table 1. Second, as discussed earlier, I observe settlement dates rather than actual subscription dates, and different rights issues have different average settlement lags. For example, in issues in which it was possible to subscribe for shares through the Internet, the settlement lags were generally shorter. To overcome these two problems, I choose the largest issue in my sample, the issue of Sonera, to analyze the determinants of early exercise. In the issue of Sonera, majority of investors exercised their rights

early, as shown in Figure 3. Furthermore, Sonera paid no compensating interest. As a result, any settlement of shares before day zero in Figure 3 is unambiguously an irrational early exercise.

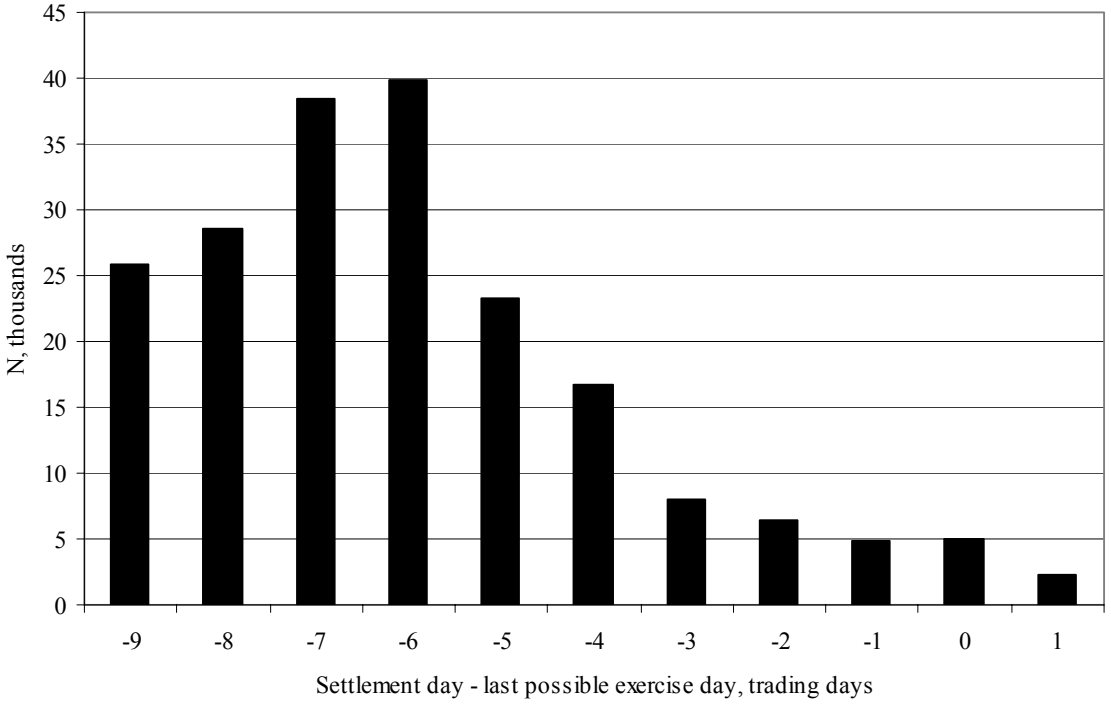


Fig. 3. Distribution of settlement dates in the rights issue of Sonera.
The figure plots the distribution of share settlement dates in the rights issue of Sonera. The number of trading days between the settlement day and the last possible exercise day is on the x-axis. For example, day zero corresponds to the number of share settlements on the last possible exercise day. Altogether there are 199,257 exercises, of which 32 are settled strictly after the last exercise day +1. These settlements are not shown in the figure above. The full population of exercises in the rights issue also includes exercises by foreigners registered under nominee accounts.

In the rights issue of Sonera, there are 113,854 exercises by domestic individual investors and 5,792 exercises by domestic institutional investors and registered foreigners. Further descriptive statistics are reported in Table 4.[10] The median subscribing domestic individual investor had a portfolio with a market value of EUR 42,000 and she traded once during the preceding 255 trading days (≈ 1 year). The corresponding figures for institutions are EUR 200,000 and 5 trades. As the investor level variables are unobservable for foreigners registered under nominee accounts, these investors are not included in the following analysis.

I model the determinants of early exercise with a duration model. The earliest exercises are settled nine days before maturity and I assign them a dependent variable value of 0. Correspondingly, for settlements at maturity, the dependent variable takes the value of 9. Thirty-

[10]I also calculate descriptive statistics (unreported) for the full sample and conclude that the average investor characteristics are very similar in both samples.

Table 4
Descriptive statistics on investors exercising subscription rights in the Sonera issue
This table presents descriptive statistics on the sample of investors who exercised rights in the Sonera issue. Min, max, mean, and median of *portfolio value* are reported in EUR thousand for households and in EUR million for institutions. *Number of trades* corresponds to the total number of stock market trades during 255 trading days (≈ 1 year) preceding the last cum-rights date. Language dummies indicate the FCSD registry language of the investor if it is other than Finnish. *Gift* is the fraction of currently owned shares of the issuing company which have been acquired as a gift, and *bequest* the fraction of inherited shares. Foreigners registered under nominee accounts are left out of the initial sample of 199,257 observations.

	Min	Max	Average	Median	St.Dev.	Skew-ness	Kurtosis	N
Panel A: Households								
Portfolio variables								
Portfolio value, 1000 EUR	0.00	21300.00	4990.74	23.99	799.51	31.89	1538.25	113,854
Number of trades	0.00	8888.00	9.60	1.00	0.25	58.68	4683.74	113,854
Investor language and domicile dummies								
Swedish	0.00	1.00	0.07	0.00	0.00	3.50	13.22	113,854
Not Finnish or Swedish	0.00	1.00	0.00	0.00	0.00	43.53	1895.57	113,854
Domiciled abroad	0.00	1.00	0.01	0.00	0.00	9.81	97.27	113,854
Individual investor specific variables								
Female dummy	0.00	1.00	0.30	0.00	0.00	0.86	1.74	113,854
Age	0.00	92.00	47.30	49.00	0.05	-0.32	2.76	113,854
Gift	0.00	1.00	0.01	0.00	0.00	9.71	96.45	113,854
Bequest	0.00	1.00	0.00	0.00	0.00	17.48	311.99	113,854
Panel B: Institutions								
Portfolio variables								
Portfolio value, MEUR	0.00	2610.00	4.99	0.02	751094.20	28.24	1006.92	5,792
Number of trades	0.00	903393.00	14620.35	5.00	1415.51	7.93	65.04	5,792
Investor language and domicile dummies								
Swedish	0.00	1.00	0.12	0.00	0.00	2.38	6.66	5,792
Not Finnish or Swedish	0.00	1.00	0.02	0.00	0.00	7.22	53.18	5,792
Domiciled abroad	0.00	1.00	0.07	0.00	0.00	3.45	12.89	5,792
Institutional investor category dummies								
Nonfinancial corporation	0.00	1.00	0.76	1.00	0.01	-1.19	2.41	5,792
Financial corporation	0.00	1.00	0.04	0.00	0.00	4.83	24.37	5,792
Mutual fund	0.00	1.00	0.01	0.00	0.00	12.94	168.36	5,792
Nonprofit institution	0.00	1.00	0.11	0.00	0.00	2.42	6.85	5,792
Foreigner	0.00	1.00	0.09	0.00	0.00	2.82	8.97	5,792

two settlements (0.02% of all observations) occur at least two days after maturity. As these observations can be unambiguously identified as delayed settlements, I assign them a dependent variable value of 10.

Before estimating a duration model, it is necessary to make an assumption on the distribution of the hazard function. To not overly restrict the shape of the hazard function, I allow it to switch between position duration dependence (hazard function is upward sloping) and

negative duration dependence (hazard function is downward sloping). Two standard distributions, the lognormal distribution and the loglogistic distribution, fulfill this requirement. I estimate the duration model in Table 5 separately for households and institutions by using both distributions.

Three patterns emerge that are consistent with the notion that more sophisticated investors exercise their rights closer to maturity. First, the coefficient for investor's log-number of trades is positive and highly significant in all specifications indicating that those who are most active in the stock market exercise their rights closer to maturity. This result can be interpreted in two ways. On the one hand, investors trading frequently have probably learned that the rights should not be exercised early. On the other hand, if an investor is not active in the market every day, there could be additional inconvenience in waiting until maturity. For example, it is easy to imagine an individual investor who goes to the bank for other financial matters on Wednesday and does not want to come back (or make a phone call) on Friday to exercise the rights optimally at maturity.

Second, Table 5 also shows that Swedish-speaking individuals exercise rights closer to maturity than Finnish-speaking individuals. This result could be explained by the fact that in Finland, the Swedish-speaking minority has traditionally held more financial wealth:[11] longer tradition in stock-market investing nurtures sophistication. Similarly, investors who have obtained the shares as a bequest are more likely to exercise the rights marginally closer to the last exercise date, a finding which may be interpreted as the coefficient of Swedish-speaking dummy: sophistication increases with a history of stock market participation.

Third, in the sample of institutions, the investor category dummy variable coefficients are consistent with the earlier univariate findings reported in Table 3. Financial institutions, especially mutual funds, are less likely to exercise rights prematurely than nonfinancial corporations, nonprofit investors, and registered foreign investors.

The results for portfolio value[12] are mixed: the coefficient for portfolio value rank is positive for institutions and negative for households. Hence, institutions with large portfolios and households with small portfolios are less likely to exercise rights prematurely. It could be the case

[11] Using data from the entire Finnish population, Karhunen and Keloharju (2001) document that 15.7% of Swedish-speaking and 11.6% of the Finnish-speaking individuals own shares. Furthermore, the investment wealth of an average Swedish-speaking investor is three times as large as that of an average Finnish-speaking investor.

[12] Due to time-variation in portfolio values, I use portfolio value rank within an issue rather than the absolute value to proxy sophistication. The portfolio value rank variable is defined as 1 – (Investor's portfolio value rank in the rights issue) / (Total number of observations in the issue). The investor with the smallest portfolio within an issue has a portfolio rank of 0, and correspondingly, the investor with the largest portfolio has a portfolio rank value close to 1. In the analysis of exercise timing, time variation in portfolio values is not a problem, as I study only one issue. However, for the sake of consistency, I use portfolio value rank instead of portfolio value also in the analysis of early exercise, with results reported in Table 5.

Table 5
Determinants of early exercise of subscription rights
This table reports results from a duration model for the determinants of subscription timing. The dependent variable is the number of days from the first settlement date of subscription rights. All 32 subscriptions which are settled at least two trading days after the last possible subscription date are assumed to be settled one day after the last possible subscription day. In the two leftmost columns, the estimated hazard function is loglogistic, $\lambda(t)= \lambda^{1/\gamma}t^{1/\gamma-1}/\ \gamma[1+(\lambda t)^{1/\gamma}]^2$, where $\lambda=e^{-x\beta}$ and x includes a constant term and a set of exogenous regressors. Correspondingly, in the two rightmost columns, the estimated hazard function is lognormal, $\lambda(t) = \frac{1}{t\sigma\sqrt{2\pi}} e^{\frac{-1}{2\sigma^2}[\ln(t)-\mu]^2}$, where $\mu=x\beta$. The right-hand side variables are defined in Table 4. The sample includes all share subscriptions in the rights issue of Sonera. In the sample of institutions, nonfinancial corporation is the reference category with omitted dummy. Foreigners in the sample include only registered foreign investors. All models are estimated with the maximum likelihood method. Asterisks mark significance at standard levels (*** for 1%, ** for 5%, and * for 10%, respectively).

Dependent variable	Number of days from first settlement date in the data			
Specification	Maximum likelihood estimation of duration			
Distribution of hazard function	Loglogistic		Lognormal	
Subsample	Household	Institution	Household	Institution
Constant	2.82***	2.78***	2.81***	2.77***
	934.04	*589.85*	*928.77*	*575.58*
Portfolio variables				
Portfolio value rank	-0.01***	0.02**	-0.01***	0.02**
	-4.56	*2.05*	*-3.60*	*2.47*
Log (Number of trades + 1)	0.005***	0.02***	0.003***	0.02***
	13.26	*21.16*	*8.99*	*23.12*
Language and domicile				
Swedish	0.01***	0.01	0.01***	0.01*
	6.15	*1.62*	*5.42*	*1.67*
Not Finnish or Swedish	-0.02	0.02	-0.02	0.02
	-1.28	*0.90*	*-1.04*	*0.95*
Domiciled abroad	0.03***	0.10***	0.03***	0.10***
	7.35	*6.63*	*6.76*	*6.22*
Household investor specific variables				
Female dummy	-0.002**		-0.002***	
	-2.48		*-2.67*	
Age	0.00		0.00	
	0.00		*0.84*	
Age^2	-0.00001***		-0.00001***	
	-11.34		*-12.16*	
% of shares gained as a gift	0.002		0.001	
	0.50		*0.22*	
% of shares gained as a bequest	0.02**		0.02***	
	2.36		*2.61*	
Institutional category dummies				
Financial corporation		0.02*		0.03**
		1.79		*2.18*
Mutual fund		0.11***		0.12***
		3.70		*4.34*
Nonprofit institution		0.005		0.01
		0.69		*1.56*
Foreigner		-0.05***		-0.05***
		-3.78		*-3.95*
Pseudo R^2	0.002	0.024	0.002	0.029
Chi-square statistic	2861.26	827.88	2695.85	919.98
Number of observations	113,854	5,792	113,854	5,792

that some households with less financial wealth are liquidity constrained and do not have liquid funds immediately available for subscription, and therefore exercise their rights later.

The dummy for domicile outside of Finland is positive and significant in all four specifications. Hence, investors who live abroad exercise their rights later than investors domiciled in Finland. The explanation for this finding may be technical: a letter to a broker containing instructions to exercise the rights takes longer to reach its destination from the United States than from Finland. Similarly, scheduling a phone call between two countries in different time zones (there is a seven-hour time difference between New York and Helsinki) is likely to take longer. Finally, women exercise their rights earlier than males, as do elderly investors.

Overall, the results point towards the conclusion that lack of sophistication drives investors to exercise rights early. I will present more results on the role of investor sophistication in Section 4.6., where I investigate why some investors fail to exercise or sell their subscription rights.

4.4. Irrational behavior: selling rights too cheap

Investors who do not want to subscribe for shares in a rights issue can sell their rights. However, they should not accept any price, because an alternative strategy of subscribing and selling the shares could yield higher proceeds. The analysis in this section tests whether the subscription rights are traded on the open market, on average, at their fair value. For this purpose, it is necessary to define a benchmark valuation method for subscription rights.

As described in Section 3.1., Finnish subscription rights are short-lived, deep-in-the-money warrants. Because of these two characteristics and parameter uncertainty on the underlying asset's volatility, I value rights by their intrinsic value. Throughout this paper, I value rights simply as

$$V = \text{MAX}(0, S - Xe^{-rt})N, \tag{1}$$

where V is the value of a single right, S the daily closing price of the underlying stock, X the subscription price of the right, N the number of shares that can be subscribed with one right, r the interest rate (12-month HELIBOR or EURIBOR), and t the fraction of the year between the transaction day and the last possible day for exercise.[13]

[13] Equation 1 is consistent with the argument in Galai and Schneller (1978) that there is no need for an explicit adjustment for dilution to value a warrant. In an efficient market, the value of the underlying stock should always reflect the dilution caused by the outstanding warrants—an investor can, at any time, exercise the warrants and sell the shares at the current market price *S*.

Table 6
Subscription right transaction price deviations from the intrinsic value
This table reports results for a comparison of actual open market transaction prices with the intrinsic value of a right. The intrinsic value of a subscription right is calculated as MAX(0, $S - Xe^{-rt}$)N, and the deviation as (Transaction price – Intrinsic value) / Intrinsic value, where S = the daily close price of the underlying stock, X = the subscription price of the right, r = the 12-month HELIBOR/EURIBOR, t = the maturity of the right (fraction of a year), and N the number of shares that can be subscribed with one right. The sample covers all subscription right transactions on all trading days in which the trading volume of the underlying stock was nonzero. The transaction price data are unavailable for subscription rights attached to American Depositary Shares and other transactions not executed through the HETI trading system. The six leftmost number columns report results for the distribution of price deviations. The two rightmost columns report the number of observations for which the lower bound of the right value is not violated (S – PV(X) > 0), and for which the lower bound is violated (S – PV(X) ≤ 0).

	Deviation from theoretical value S - PV(X)						N	
Rights issue	Average	Median	Volume weighted	Min	Max	St.dev.	S - PV(X) > 0	S - PV(X) ≤ 0
Ålandsbanken B 1995	-0.06	-0.06	-0.08	-0.13	-0.01	0.03	477	0
Finvest B	a)						0	53
Ålandsbanken B 1996	-0.05	-0.05	-0.04	-0.08	-0.01	0.02	1,134	0
Efore	-0.04	-0.04	-0.06	-0.29	0.03	0.07	65	0
Ilkka 2	-0.03	-0.02	-0.03	-0.11	0.03	0.04	167	0
Raisio Yhtymä K	-0.05	-0.04	-0.04	-0.13	0.01	0.03	289	0
Raisio Yhtymä V	-0.03	-0.03	-0.04	-0.13	0.03	0.03	584	0
Atria A	-0.16	-0.16	-0.16	-0.24	-0.07	0.04	77	0
Stockmann B	-0.09	-0.07	-0.09	-0.31	0.01	0.05	1,356	0
Neptun Maritime A	-0.66	-0.41	-0.66	-0.86	0.08	0.23	292	192
Instrumentarium B	-0.15	-0.17	-0.16	-0.39	0.29	0.11	2,475	0
Ålandsbanken A 1999	-0.08	-0.03	-0.12	-0.26	0.01	0.06	108	0
Ålandsbanken B 1999	-0.09	-0.11	-0.10	-0.20	0.02	0.06	407	0
Chips A	-0.09	-0.09	-0.11	-0.14	-0.04	0.04	29	0
Chips B	0.03	0.02	0.02	-0.02	0.08	0.02	22	0
SSK Suomen Säästäjäin Kiinteistöt	-0.85	-0.87	-0.86	-0.94	-0.29	0.09	82	0
Menire	-0.13	-0.15	-0.10	-0.35	0.72	0.17	887	0
Sonera	-0.01	-0.01	-0.01	-0.23	0.17	0.07	22,105	0
Technopolis	-0.63	-0.66	-0.64	-0.78	-0.22	0.10	495	0
Done Solutions	-0.01	-0.01	-0.01	-0.01	-0.01	0.00	1	10
Evox Rifa	-0.01	-0.01	-0.01	-0.01	-0.01	0.00	13	10
N, full sample							31,065	265
Average of all issues	-0.16	-0.15	-0.17	-0.28	0.04	0.06	1,479	13
Median of all issues	-0.07	-0.06	-0.09	-0.22	0.01	0.05	289	0
Pooled sample value	-0.07	-0.03	-0.04	-0.94	0.72	0.14	31,065	265

a) Deviations from theoretical value cannot be calculated because the intrinsic value of right was zero on all trading days.

Table 6 compares subscription right transaction prices with their intrinsic value given by Equation 1. The deviations in Table 6 are computed by dividing the difference between the transaction price and intrinsic value by the intrinsic value: negative value corresponds to a transaction below the intrinsic value. Deviations can be interpret as the existence of dominated securities, because buying a right in the open market at a price above the intrinsic value is inferior to a strategy of buying the underlying stock. Correspondingly, selling a right for a price less than the intrinsic value is dominated by a strategy of exercising the right and selling the subscribed shares.[14]

What does Table 6 tell us? First, it is obvious that shareholders who are allocated rights tend to sell them below their fair value: for all but one share class in one issue (Chips B) the average transaction price is larger than the instrinsic value. As an extreme example, in three issues the volume weighted price discount is more than 50%. Finding such extreme price deviations is consistent with Hietala (1994), who also documents several violations of stochastic dominance boundaries in the Finnish rights market. Similar evidence on the inefficiency of the subscription rights market is reported for Singapore in Poitras (2002). Second, the largest rights issue in my sample, Sonera, has the smallest transaction price deviations from the intrinsic value: both the equal and volume weighted average and the median price deviation are only 1%. This result is

explained by the fact that there was a liquid option market at EUREX for the Sonera shares at the time of the rights issue.[15] Hence, in the case of Sonera, arbitrageurs were able to purchase subscription rights and simultaneously establish a short position through the options market (or by selling short, see Footnote 12), whereas this strategy was not possible for other shares. This result highlights the importance of a functioning options market and of the possibility to sell short, which thereby contribute to efficient security pricing.

Next, I study which investors profit and which investors lose from trading. For this purpose, I define a wealth transfer as the difference between the transaction price and the intrinsic value of

[14] Taxes enter the decision by increasing the incentive of a taxable investor to exercise rights instead of selling them, as discussed in Section 3.3. Given this incentive, a rational investor subject to taxes should not sell rights for a price equal to, or lower than, the intrinsic value.

[15] An institutional framework for short-selling has existed in HEX with stock loans since the end of 1995. However, short selling is costly, and the securities lending market for all but the most traded shares is rather illiquid. The required margin for selling short is 125% of the underlying asset's current market value. In addition, a short seller must pay an annual premium to the lender (typically 1–3% of the underlying asset's market value), and additional transaction costs to HEX, which effectively has a monopoly in securities lending. Given the high costs and the illiquid securities lending market for all but the most traded shares, it is unlikely that arbitrageurs used stock loans to sell short stocks other than that of Sonera.

a right given by Equation 1 multiplied by the transaction volume. A transaction at a price which is lower (higher) than the intrinsic value incurs a wealth gain (loss) to the buyer and, correspondingly, a wealth loss (gain) to the seller.

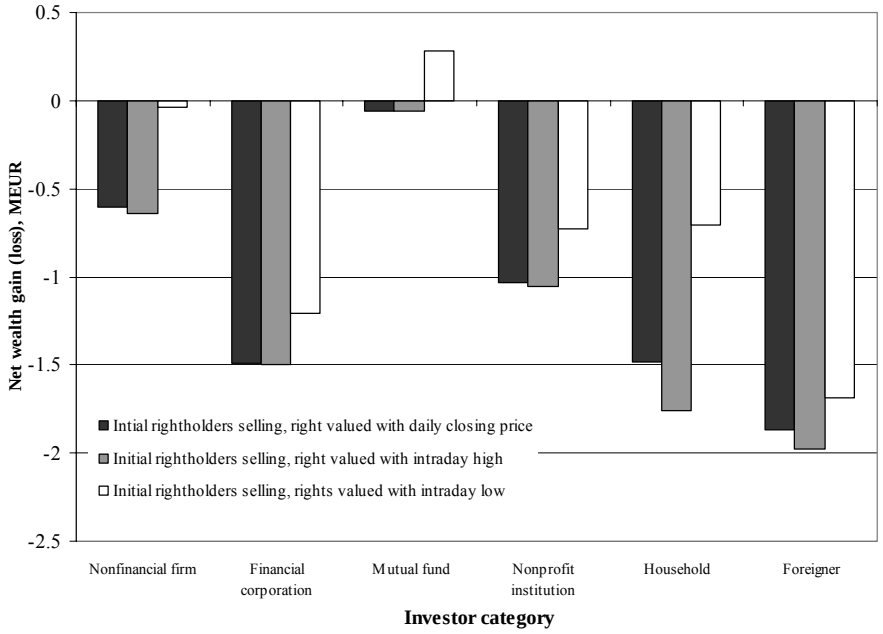
I compute the cumulative wealth transfer separately by using the daily close, high, and low prices of the underlying stock.[16] This ensures that intraday price variations will not affect any conclusions made from closing prices. Calculating the intrinsic value of a right by using the intraday low price of the underlying stock gives the lower boundary of wealth loss to selling shareholders. Correspondingly, using the intraday high gives the upper boundary of wealth loss to sellers.

Figure 4 plots the cumulative wealth gains and losses for the six investor categories. The magnitude of the wealth transfer for those initial rightholders who sold their rights is graphed in Panel A. Correspondingly, Panel B graphs wealth transfer for all investors in the category. If the members of a particular investor category buy rights cheap and sell dear, this will show up as a net gain in Panel B, although initial rightholders of the investor category would suffer wealth losses on aggregate.

Panel A in Figure 4 demonstrates the net wealth loss to initial shareholders who sold their rights in the open market. As would be expected on the basis of the results in Table 6, shareholders selling their rights are adversely affected by the low transaction prices: the aggregate wealth loss is at least MEUR 0.5 for all investor categories except for mutual funds. When I use the daily closing price to calculate the intrinsic value of a right, the total combined pre-tax wealth loss to all selling shareholders is MEUR 6.5, or 0.46% of the total issue proceeds. Furthermore, the MEUR 6.5 estimate is rather conservative, since taxes are ignored: those investors who sell rights are taxed for almost the full proceeds, whereas exercising rights and selling the subscribed shares generally postpones capital gains tax.[17]

[16] I make one exception: Sonera. During the subscription right trading period, there was a difference of at least 8% between the intraday low and high price on every trading day. When computing wealth gains and losses for Sonera, I replace intraday high and low prices with the daily closing price.
[17] See details of investor level capital gains taxation in Section 3.3.

Panel A: Initial rightholders selling



Panel B: All investors

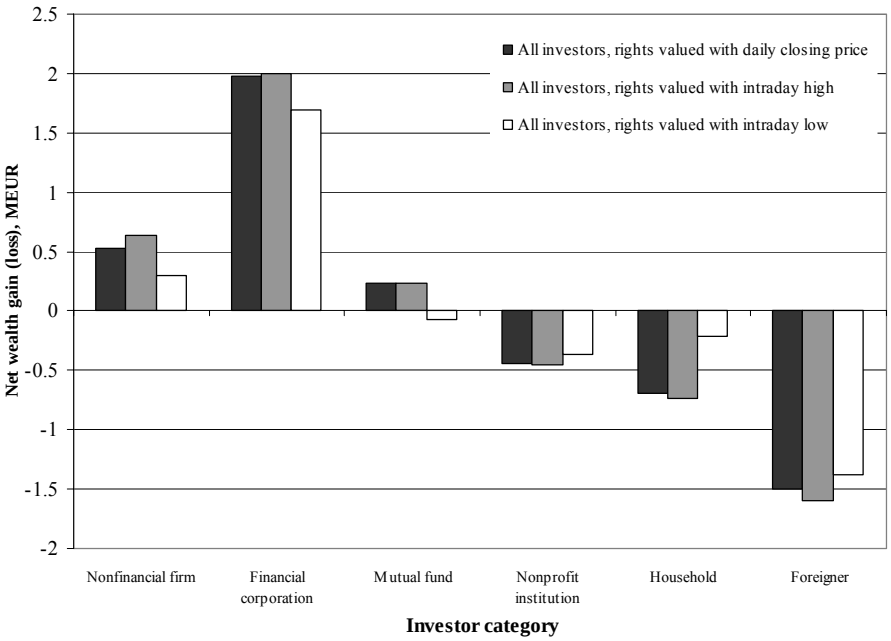


Fig. 4. Net wealth transfer resulting from trades of subscription rights by investor category. The graph in Panel A (*Initial rightholders selling)* shows the net wealth transfer to initial rightholders subsequently selling all or some of their rights in the open market. Panel B (*All investors*) shows the net wealth gain (loss) for the investor category by including sales and purchases of initial rightholders and investors who did not initially hold rights. Wealth transfer for a trade in subscription rights is calculated as $(P - \text{MAX}(0, (S - Xe^{-rt})* N)) * Volume$, where P = the transaction price, S = the current price of the underlying stock, X = the subscription price of the right, r = the 12-month HELIBOR/EURIBOR, t = the maturity of the right, N = the number of shares that can be subscribed with one right, and *Volume* the number of rights traded. The sample includes subscription right transactions for which subscription right price data are available, and the underlying stock had nonzero volume on the transaction day. In the Sonera rights issue, intraday high and low prices of the underlying stock are replaced with daily closing prices. There are 60,364 observations in Panel A and 93,195 observations in Panel B.

Table 7
Number of investors profiting and losing from trading in subscription rights.
This table reports descriptive statistics on wealth gains and losses of investors trading rights in the open market. The statistics are based on the investor level distribution of total wealth gains and losses computed separately over all trades in the issue of Sonera (Panel A), and the remaining 17 issues (Panel B). *Number of investors* corresponds to the number of investors in the category who traded subscription rights at least once during the sample period. *% of winners* is the fraction of investors whose cumulative result from trading subscription rights is zero or positive. To compute wealth gain (and correspondingly wealth loss) from a trade, subscription rights are valued at their intrinsic value given by Equation 1. Min, max, average, and median of *wealth transfer* are the respective figures from the distribution of wealth gains and losses. The sample includes investors who were initially allocated rights and outside investors. Foreigners registered under nominee accounts are not included in the analysis.

			Wealth transfer, EUR			
	Number of investors	% of winners	Min	Max	Average	Median
Panel A: Rights issue of Sonera						
Nonfinancial corporation	789	39.16	-67,808	167,255	250	-4
Financial corporation	86	61.63	-8,088	125,437	9,570	186
Mutual fund	24	83.33	-26,110	48,798	9,745	4,526
Nonprofit institution	356	27.25	-303,213	133,746	-1,313	-44
Household	13,480	24.39	-47,757	25,034	-38	-7
Foreigner	222	38.29	-2,194	4,831	-1	-9
Panel B: Remaining 17 issues						
Nonfinancial corporation	1,625	38.71	-67,808	188,589	326	-4
Financial corporation	102	50.98	-85,858	595,005	19,410	1
Mutual fund	27	66.67	-26,110	48,798	8,792	5,125
Nonprofit institution	433	29.10	-303,213	133,746	-1,014	-30
Household	33,662	32.25	-47,757	25,034	-21	-4
Foreigner	437	37.99	-4,913	4,831	-11	-5

As shown in Panel B, institutional investors take advantage of investors who sell their rights at too low prices. Nonfinancial corporations, mutual funds, brokers, investment banks, and commercial banks (the last three investor groups are under the category *financial corporation*) take advantage of the depressed prices by buying rights in the open market, while household investors, nonprofit organizations, and foreigners lose money. Financial institutions acquire the greatest profits from trading rights. The selling financial institutions lost altogether MEUR 1.5 while the aggregate wealth transfer to all financial institutions was MEUR 2. What is distinct in my results is that foreigners, who have been previously shown (Grinblatt and Keloharju, 2000) to outperform households in the Finnish stock market, acted irrationally by selling their rights at excessively low prices.

Next, I break up the gross wealth gains and losses in Panel B of Figure 4 to gain additional insight into the relative sophistication of different investor categories. The results in Table 7 indicate that there are both winners (investors with positive cumulative net result from trading) and losers (investors with negative cumulative net result from trading) in the population of

financial institutions. In the rights issue of Sonera, 17% of the mutual funds and 38% of the other financial institutions ended up in the red by trading subscription rights, whereas the corresponding percentages are 33% and 49% in the remaining 17 issues.

4.5. Irrational behavior: failing to exercise or sell rights

Exercising rights early or selling them below their fair value is irrational. Still, perhaps the most irrational investors are those who fail to exercise or sell their rights. In the remainder of this study, I investigate which investors leave rights unexercised and how costly this behavior is. To assess the costs of irrationality, I compute wealth losses under two alternative strategies.

Under the first strategy, I assume that instead of forfeiting rights without compensation, investors would have sold the subscription rights on their last trading day at the daily volume weighted market price. Five conditions must hold simultaneously to classify as irrational an observation in which an investor allows subscription rights to lapse. The conditions are related to direct transaction costs (C1), investor's opportunity cost of time (C2), liquidity of the underlying stock (C3), audit trail of the investor's trading records (C4), and the liquidity of the market for rights (C5). The five conditions are:

(C1) The value of lapsed rights must be at least EUR 27, the largest minimum brokerage commission for a trade.

(C2) The value of lapsed rights must be at least 0.1% of the investor's portfolio value. This condition is a proxy for the investor's opportunity cost of time.[18]

(C3) Cumulative turnover for the underlying stock (volume x close price) on the last subscription day plus the following five trading days must be strictly greater than the value of shares that can be subscribed with the rights. This condition ensures that an observation will not be classified as irrational if the market for the underlying stock is not liquid enough to absorb the subscribed shares

(C4) The investors' FCSD registry entries must have an unambiguous audit trail. This condition is not satisfied for less than 0.1% of investors with technical entries, such as corrections and combinations of book-entry accounts.

[18] The identities of foreign nominee account investors are unknown, and it is impossible to calculate their portfolio values. I therefore have no choice but to ignore condition (C2) for nominee account investors.

(C5) There must be at least ten open market transactions in subscription rights on their last trading day. This condition is consistent with Poteshman and Serbin (2003).

Under the second strategy, I assume that the investor would have exercised the rights and sold the shares. In condition (C1), I use the intrinsic value given by Equation 1 to value subscription rights rather than their market value. Conditions (C2)–(C4) are as in the first strategy. Furthermore, I add a condition for the liquidity of the underlying stock. The liquidity condition (C6) is defined as

(C6) The cumulative turnover of the underlying stock (volume x close price) on the last subscription day, plus the following five trading days, must be at least MEUR 0.1.

Table 8 reports the amount of wealth lost by investors who acted irrationally by forfeiting their rights without compensation. The results unambiguously indicate that a large number of investors acted irrationally by allowing their subscription rights to lapse, thereby suffering wealth losses totaling MEUR 3.2–3.4. Furthermore, the value of the lapsed rights is, in an extreme case, as high as EUR 706,000—well above virtually any investor's opportunity cost of time.

A large number of households forfeit their rights without compensation, which is consistent with earlier studies indicating that household investors are not fully rational (e.g., Odean, 1998; Barber and Odean 2000; Grinblatt and Keloharju, 2001). In contrast, financial institutions are least likely to behave irrationally. Mutual funds have zero observations classified as irrational, whereas financial corporations acted irrationally on only two occasions.

The fact that some investors fail to exercise or sell rights worth thousands of euros suggests that such behavior may not be due only to a lack of sophistication, but also to a lack of information. In the following subsection, I investigate the relevance of these two factors in greater detail.

Table 8
Wealth loss resulting from unexercised rights
This table documents conservative estimates for the amount of wealth loss suffered by investors who fail to exercise or sell their subscription rights. Panel A assumes a strategy of selling the rights in the open market on the last trading day for subscription rights. Panel B describes the wealth loss assuming a strategy of exercising rights on the last subscription day and selling the subscribed shares in the open market. For an observation to qualify as irrational, the following conditions must be met. First, the value of unexercised rights must be more than EUR 27 or 0.1% of the investor's portfolio value, whichever is higher. In Panel A, rights are valued at transaction volume weighted price on the last trading day of the subscription rights. In Panel B, rights are valued at MAX(0, S – X)*N, where *S* is the current price of underlying stock, *X* the subscription price of the right, and *N* the number of shares that can be subscribed with one right. Second, the cumulative trading volume during the last subscription day and the following five trading days must be higher than the value of shares that can be subscribed with the rights. Third, in Panel A, there must be at least ten trades in subscription rights on their last trading day. Fourth, in Panel B, the cumulative trading volume of the underlying stock must be at least MEUR 0.1 during a period which spans from the last trading day for the subscription rights until the fifth subsequent trading day. Fifth, the investors' FCSD entries must have an unambiguous audit trail.

	Min	Max	Average	Median	St.Dev.	Skew-ness	Kur-tosis	N	Total wealth loss
Panel A: Wealth loss assuming sold rights, EUR									
Nonfinancial corporation	28	5,643	587	182	1,057	3	10	106	62,191
Financial corporation	135	675	405	405	382	N/A	N/A	2	810
Mutual fund	0	0	0	0	0	N/A	N/A	0	0
Nonprofit institution	38	84,632	5,373	500	18,191	4	19	22	118,216
Household	28	60,049	382	135	1,654	24	758	2,616	999,525
Foreigner	31	706,066	15,843	600	69,471	-8	74	138	2,186,344
									3,367,086
Panel B: Wealth loss assuming exercised rights, EUR									
Nonfinancial corporation	31	111,303	1,664	160	11,234	10	96	98	163,056
Financial corporation	191	933	562	562	525	N/A	N/A	2	1,125
Mutual fund	0	0	0	0	0	N/A	N/A	0	0
Nonprofit institution	29	34,283	2,562	222	7,894	4	17	19	48,686
Household	27	24,325	320	118	959	15	287	2,534	811,856
Foreigner	30	687,233	16,170	628	68,514	-8	71	136	2,199,068
									3,223,790

4.6. What drives investor irrationality in a rights issue?

Figure 5 analyzes the relation between investor characteristics and irrationality by plotting univariate statistics on the proportion of investors who fail to exercise or sell their rights. Panel A depicts the relative frequency of unexercised rights for the six investor categories. The results are well in line with the findings for wealth losses reported in Table 8: financial institutions have a

very low proportion of irrationally unexercised rights (less than 0.5%), whereas for all other investor categories, the proportion is more than 1%.

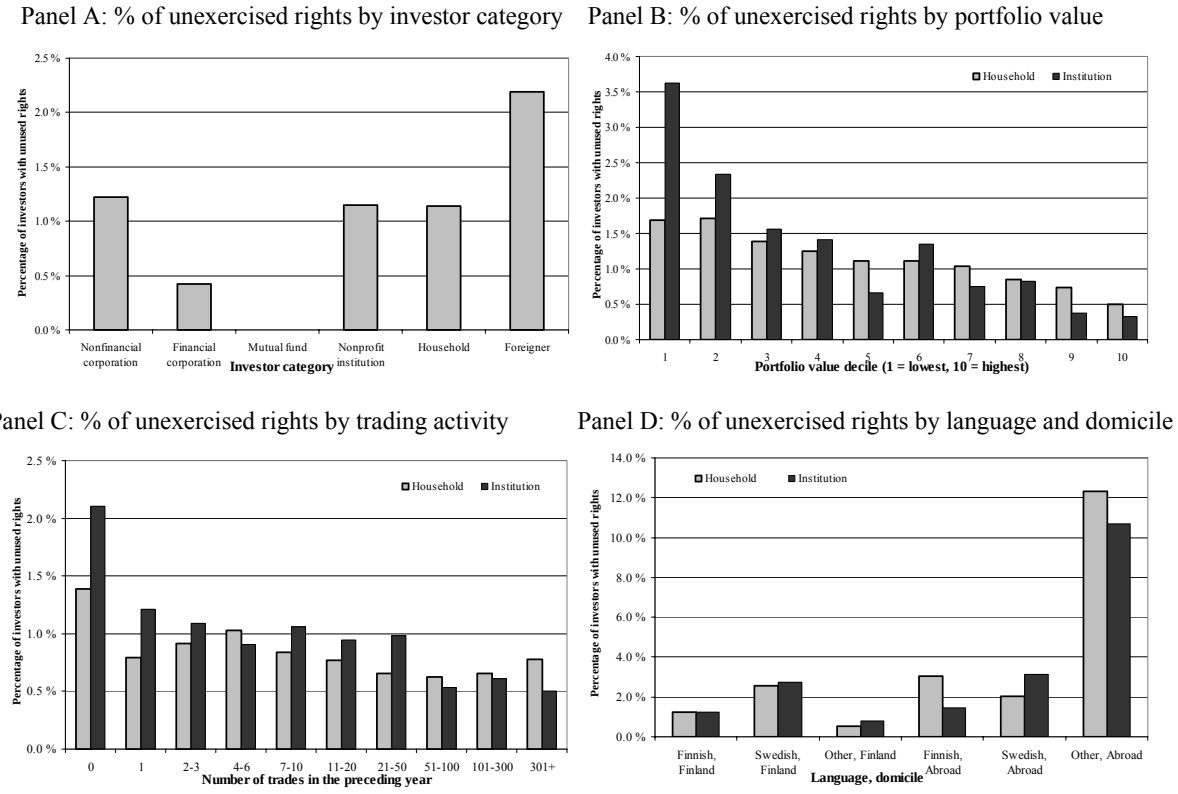


Fig. 5. Univariate distributions for unexercised rights
The graphs plot the relation between investor characteristics and the percentage of investors acting irrationally in failing to exercise or sell rights. When an investor fails to exercise or sell rights, the observation is classified as irrational if the following four conditions are met. First, the value of unexercised rights is at least EUR 27 (right valued as $(S - X)*N$, where S = the last exercise day closing price of the underlying stock, X = the subscription price, and N = the number of shares that can be subscribed with one right). Second, the value of unexercised rights must be at least 0.1% of the investor's portfolio value. Third, the cumulative turnover of the underlying stock during the last exercise day plus five following trading days must be at least MEUR 0.1 and higher than the value of exercisable shares. Fourth, the investor's FCSD registry entries for subscription rights must have an unambiguous audit trail. Panel A plots the percentage of unexercised rights by investor category, Panel B by portfolio value, Panel C by trading activity, and Panel D by investors' language and domicile. In Panel D, there are three language groups: Finnish, Swedish, and other (any language other than either of the two official languages, Finnish or Swedish). These three language groups are subsequently divided into investors living in Finland and those living abroad. The sample does not include unregistered foreigners. The number of observations in each panel is 243,681.

Another clear cross-sectional result for investor irrationality emerges when I relate the fraction of irrational investors with trading activity. The fraction of unexercised rights is highest (1.6% for households and 2.8% for institutions) for investors who did not trade at all during the preceding 255 trading days (≈ 1 year). The inactive investors are thus less savvy or even completely ignorant of their holdings.

The data show a particularly distinct pattern when I graph the fraction of investors failing to exercise or sell rights with their language and domicile. For investors living abroad and who speak neither of the official languages, the fraction of unexercised rights is substantial: more than 12% for households and more than 10% for institutions. The difference is statistically significant for Finnish- and Swedish-speaking investors with $p<0.001$. The result is consistent with the notion that investors domiciled abroad and not fluent in the local language allowed their rights to lapse because of higher opportunity costs, such as the costs of becoming informed.

Table 9 investigates irrational behavior in a multivariate framework by using logit regression. The dependent variable is an indicator function taking a value of 1 if the investor acts irrationally by failing to exercise or sell rights, 0 otherwise. I estimate the model separately for households and institutions by using two classifications for irrationality, as described in Section 4.5. There are four findings, which taken together give the impression that both low sophistication and the costs of becoming informed explain why investors sometimes act irrationally.

First, the coefficients for portfolio value and trading activity are negative and strongly significant, just as would be expected on the basis of the earlier univariate results. This result is highly significant for both institutions and households, but stronger for the latter group. Similar to my results, List (2003) and Feng and Seasholes (2005) find that market experience leads to more rational behavior.

Second, Swedish-speaking investors, as well as individuals who are domiciled in Finland, are less likely to behave irrationally. Coefficients for the Swedish-speaking and domiciled-abroad dummies are of the same magnitude for institutions and households, but only marginally significant for institutions because of the smaller sample size. Also, the earlier results for exercise timing indicate that Swedish-speaking individual investors are more savvy, perhaps because they have more investment experience, due to a longer tradition of stock market participation. The results for the gift variable provide additional evidence on sophistication differences. Gift-giving creates tax-planning opportunities for investors familiar with Finnish tax law,[20] and the negative coefficient indicates that tax savvy individuals are also more likely to act rationally in rights issues.

[20] More precisely, gifts worth up to EUR 3,400 can be donated tax-free every three years. There is also a basis step-up for calculating capital gains when shares worth up to EUR 3,400 are transferred to another party as a gift. For example, if an investor donates shares with a purchase price of EUR 20 and the current market price is EUR 30, EUR 30 is used as the basis for calculating capital gains when the receiving party subsequently sells the shares. In addition, when donating shares worth more than EUR 3,400, a flat gift tax of EUR 85-5,735 plus a variable gift tax between 10% and 16% for the value exceeding EUR 3,400 must be paid upon transfer. In this case, no capital gains tax is due when the shares are eventually sold.

Table 9
Logit regression for the determinants of failing to exercise or sell rights
This table reports results from a logit regression for the determinants of failing to exercise or sell rights in 18 Finnish rights issues. The dependent variable is binary, taking a value of 1 if the investor irrationally leaves rights unexercised, zero otherwise. Leaving rights unexercised is considered as irrational in two specifications under *assuming exercised rights*, if all four conditions described in Figure 5 are met (the value of rights is greater than EUR 27 and at least 0.1% of the investor's portfolio value, the underlying stock or the market for rights is liquid enough, the investor has no technical entries). Variables are defined in Table 8, except for *rank of portfolio value*, which is defined as 1 – (Investor's portfolio size rank in the rights issue) / (Total number of investors in the rights issue). All regressions include dummies for issues with at least 10 observations for both values of the dependent variable; all other issues are pooled into one group. In the sample of institutions, the dummy for financial institutions is omitted. Financial corporations and mutual funds are combined into one group; the latter group has no observations with a dependent variable value of 1. Asterisks mark significance at standard levels (*** for 1%, ** for 5%, and * for 10%, respectively).

Dependent variable	Binary: 1 for irrationally leaving rights unexercised, 0 otherwise			
Specification	Logit			
Alternative strategy	Assuming exercised rights		Assuming sold rights	
Sample	Household	Institution	Household	Institution
Constant	-3.82***	-3.61***	-3.57***	-3.34***
	-30.61	*-4.77*	*-28.79*	*-4.41*
Portfolio variables				
Rank of portfolio value	-1.34***	-2.12***	-1.59***	-2.21***
	-15.97	*-7.08*	*-18.58*	*-7.11*
Log (Number of trades + 1)	-0.15***	-0.07	-0.13***	-0.08
	-7.35	*-1.26*	*-6.41*	*-1.36*
Language and domicile				
Swedish	-0.58***	-0.50*	-0.20**	-0.27
	-7.92	*-1.94*	*-2.46*	*-1.02*
Other than Finnish or Swedish	0.77	2.07***	0.44	2.11***
	1.27	*5.50*	*0.61*	*5.57*
Domiciled abroad	0.72***	0.77*	0.66***	0.57
	5.58	*1.81*	*4.64*	*1.38*
Household investor specific variables				
Undistributed estate dummy	0.52***		0.69***	
	3.47		*4.98*	
Female dummy	-0.18***		-0.23***	
	-3.96		*-4.91*	
Age	0.01*		0.01	
	1.76		*1.07*	
Age^2	-0.0002***		-0.0001***	
	-3.30		*-2.60*	
% of shares gained as a gift	-0.39*		-0.51**	
	-1.66		*-2.16*	
% of shares gained as a bequest	-0.53		-0.59	
	-1.44		*-1.47*	
Institutional category dummies				
Nonfinancial corporation		0.20		0.04
		0.28		*0.05*
Nonprofit institution		0.40		0.27
		0.53		*0.36*
Foreigner		-0.37		-0.39
		-0.43		*-0.46*
Rights issue dummies	Included	Included	Included	Included
Pseudo R^2	0.09	0.14	0.07	0.10
Chi-square statistic	2553.01	262.91	2027.27	175.19
Observations	229,565	13,044	229,565	13,044

Transaction and opportunity costs are the most likely factors to explain why investors domiciled abroad leave more rights unexercised: those who reside outside Finland have to make a greater effort to exercise or sell their rights. International phone calls to brokers, acquiring information on the investment decision, and getting updated on the institutional details are examples of transaction and opportunity costs that are higher to investors domiciled abroad.[21] In addition, not being able to communicate in either of the official languages is likely to further increase the costs of becoming informed. This is the case in the sample of institutions, where the coefficient for the language other than Finnish or Swedish is positive and highly significant.

Third, the FCSD data also flag accounts belonging to deceased individuals whose assets are managed by a person appointed by claimholders of the undistributed estate. The results in Table 9 indicate that assets of undistributed estates are under worse management than the assets of the average private investor: the coefficient is positive and significant in both specifications and thus undistributed estates fail to exercise or sell rights more often. The explanation to this finding is most likely a mixture of low investor sophistication and ignorance. It is possible that an heir or an appointed lawyer managing the assets of the undistributed estate is not aware of the inherited stocks at the time of the rights issue, and perhaps, on average, those who have bought stocks themselves are more knowledgeable investors than those who have only recently inherited stocks.

Finally, the results for age are similar to what is reported for the determinants of early exercise, whereas the results for gender are just the opposite. Males fail to exercise or sell rights more often (albeit they exercise rights later), which is also the case for elderly investors.

It is a valid concern whether the results in Table 9 generalize, as slightly more than half of the observations come from one single issue, Sonera. To evaluate the robustness of the results over all issues in the sample, I take the approach of Fama and Macbeth (1973), which has also been utilized by corporate finance scholars (e.g., Cornelli and Goldreich, 2001). For this purpose, I estimate the logit model separately for each issue, calculate the average of coefficients, and test for each variable whether the average coefficient is different from zero. The data are as in the third column of Table 9, but here I estimate the model only for twelve issues in which the dependent variable has at least 10 observations for both binary values.

The results reported in Table 10 indicate that my earlier results are not driven by any single issue, although some coefficients lose their significance due to the small sample size and consequent weak statistical power. More sophisticated investors with low costs of becoming informed (e.g., investors who have large portfolios and who do not live abroad) are least likely to

[21] Knüpfer (2006) also provides evidence that distance matters in the decision to participate in an equity offering.

leave rights unexercised. In summary, investors who have small portfolios, live abroad, trade infrequently, and are unable to communicate in either of the official languages are most likely to leave their rights unexercised. These findings can be interpreted in two different ways. The first explanation is strict irrationality.[22]

Table 10
Average coefficients for the determinants of failing to exercise or sell rights.
This table reports average coefficients for the determinants of failing to exercise or sell rights. The model in the third column of Table 9 (sample of households, *assuming sold rights*) is estimated separately for 12 rights issues, and the average coefficient is reported. There are no regressions for 6 issues in which the dependent variable has fewer than 10 observations of either value. Independent variables *Swedish*, *other than Finnish or Swedish*, *domiciled abroad*, *undistributed estate dummy*, *% of shares gained as a gift*, and *% of shares gained as a bequest*, do not have enough variation in all 12 issues, and are therefore excluded, where appropriate. Asterisks mark significance at standard levels (*** for 1%, ** for 5%, and * for 10%, respectively) for the 2-tailed *t*-test with the null hypothesis that the average coefficient is different from zero.

Variable	Average	St.dev.	*t*-value	N
Constant	-3.27	1.63	-6.94***	12
Rank of portfolio value	-1.56	1.43	-3.78***	12
Log (Number of trades + 1)	-0.21	0.44	-1.65	12
Swedish	-0.67	0.83	-2.56**	10
Other than Finnish or Swedish	0.61	N/A	N/A	1
Domiciled abroad	1.01	0.52	5.80***	9
Undistributed estate dummy	0.86	0.60	3.79***	7
Female dummy	-0.40	0.36	-3.89***	12
Age	0.02	0.05	1.14	12
Age^2	0.00	0.00	-1.86*	12
% of shares gained as a gift	-0.24	0.38	-1.26	4
% of shares gained as a bequest	-0.47	0.64	-1.48	4

Some investors may be completely unaware of the rights issue, or not sophisticated enough to figure out that they will lose money if they do nothing with their rights. The second explanation is that investors are 'rationally irrational'. The costs of gathering information, the direct transaction costs, and the opportunity cost of time, or a combination of all three, could be too high for some investors, and thus they rationally decide to do nothing. This interpretation is consistent with Grossman and Stiglitz (1980): if there are costs of becoming informed, it may be rational to not become informed. The evidence of this paper is also broadly consistent with Zhu (2005) who finds that households with a higher opportunity cost of time are more likely to delegate portfolio management to mutual funds.

[22] The difference between *irrationality* and *strict irrationality* is defined in the introduction.

The earlier results in Table 8 lend support to the idea that both explanations contribute to my findings. On the one hand, in most cases the value of unexercised rights is rather small. The median loss for households is EUR 118–135, and well below EUR 1,000 for institutions. A broker or a corporate trader probably has more important things to do than to worry about subscription rights worth a few hundred euros.

On the other hand, the highest estimate for household wealth loss is EUR 60,000, and in 162 cases, the household wealth loss exceeds EUR 1,000. It appears implausible that households would have this high opportunity cost of time for filling in and mailing a broker a form instructing her what to do with the rights. In the most extreme case of EUR 60,000, the breakeven hourly opportunity cost of time is EUR 240,000, assuming that reading and mailing the broker's letter takes fifteen minutes. Jeremy Siegel charges USD 20,000–30,000 (EUR 16,150–24,200 at the time of writing) for a talk.[23] Provided that the talk lasts an hour, it must be that there are at least some unambiguously strictly irrational private investors in the Finnish market, or one of them has an opportunity cost of time ten times higher than that of Jeremy Siegel.

5. Conclusions

This paper examines clearly irrational behavior in a novel setting. Evidence from 18 rights issues suggests that even with conservative estimates, investors lost at least MEUR 0.15 by exercising subscription rights early, MEUR 6.5 by selling their rights below the fair value, and MEUR 3.2 by forfeiting their rights without compensation. The total loss of MEUR 9.9 is equivalent to 0.7% of the total issue proceeds. This is roughly 15% of the direct flotation costs of rights issues reported in Bøhren, Eckbo, and Michalsen (1997).

The finding that thousands of investors left money on the table by not selling or exercising their rights provide a mirror image of the too active investors described in Barber and Odean (2000). While it seems that the very active part of the household population pays a penalty for their excess trading activity, my results indicate that belonging to the most inactive segment of the investor population may also be less than optimal from welfare perspective.

The typical investor who leaves money on the table in a rights issue is an elderly individual with a small portfolio, infrequent trading activity, and who is not a native speaker of either of the official languages. As expected, financial institutions with large portfolios and high trading activity are at the other end of the rationality spectrum, and they even benefit from the actions of irrational investors by buying subscription rights at depressed prices. Further analysis indicates

[23] The data are from the International Speaker's Bureau (www.internationalspeakers.com).

that seemingly irrational decisions are often potentially explained by transaction and opportunity costs. However, sometimes the wealth loss is simply too large to be reconciled with these considerations. Transaction costs and opportunity costs could also explain other suboptimal behavior, such as underdiversification and lack of stock market participation reported by Calvet, Campbell, and Sodini (2006).

References

Agnew, J.R., 2006. Do behavioral biases vary across individuals? Evidence from individual level 401(k) data. Journal of Financial and Quantitative Analysis, forthcoming.

Barber, B.M., Lee, Y-T., Li, Y-J., Odean, T., 2005. Who loses from trade? Evidence from Taiwan. Unpublished working paper, University of California at Davis.

Barber, B.M., Odean, T., 2000. Trading is hazardous to your wealth: The common stock investment performance of individual investors. Journal of Finance 55, 773–806.

Black, F., Scholes, M., 1973. The pricing of options and corporate liabilities. Journal of Political Economy 81, 637–654.

Bøhren, Ø., Eckbo, B.E., Michalsen, D., 1997. Why underwrite rights offerings? Some new evidence. Journal of Financial Economics 46, 223–261.

Brunnermeier, M., Nagel, S., 2004. Hedge funds and the technology bubble. Journal of Finance 59, 2013–2040.

Calvet, L., Campbell, J.Y., Sodini, P. 2005, Down or out: the welfare costs of household investment mistakes. Unpublished working paper, HEC School of Management, Harvard University, and Stockholm School of Economics.

Chen, K.C.W., Yuan, H., 2004. Earnings management and capital resource allocation: evidence from China's accounting-based regulation of rights issues. Accounting Review 79, 645–665.

Cornelli, F., Goldreich, D., 2001. Bookbuilding and strategic allocation. Journal of Finance 56, 2337–2369.

Cronqvist, H., Nilsson, M., 2005. The choice between rights offerings and private equity placements. Journal of Financial Economics 78, 375–407.

Diz, F., Finucane, T.J., 1993. The rationality of early exercise decisions: evidence from the S&P 100 index options market. Review of Financial Studies 6, 766–797.

Eckbo, B.E., Masulis, R.W., 1992. Adverse selection and the rights offer paradox. Journal of Financial Economics 32, 293–332.

Eckbo, B.E., Norli, Ø., 2005. The choice of seasoned-equity selling mechanism: theory and evidence. Unpublished working paper, Tuck School of Business.

Elton, E.J., Gruber, M.J., Busse, J.A., 2004. Are investors rational? Choices among index funds. Journal of Finance 59, 261–288.

Engström, M., 2002. A note of rational call option exercise. Journal of Futures Markets 22, 471–482.

Fama, E.F., Macbeth, J.D., 1973. Risk, return, and equilibrium: empirical tests. Journal of Political Economy 81, 607–636.

Feng, L. Seasholes, M.S., 2005. Do investor sophistication and trading experience eliminate behavioral biases in financial markets? Review of Finance, 9, 305–351.

Finucane, T.J., 1997. An empirical analysis of common stock call exercise: a note. Journal of Banking and Finance 21, 563–571.

Galai, D., Schneller, M.I., 1978. Pricing warrants and the value of firm. Journal of Finance 33, 1333–1342.

Grinblatt, M., Keloharju, M., 2000. The investment behavior and performance of various investor types: a study of Finland's unique data set. Journal of Financial Economics 55, 43–67.

Grinblatt, M., Keloharju, M., 2001. What makes investors trade? Journal of Finance 56, 589–616.

Grossman, S.J., Stiglitz, J.E., 1980. On the impossibility of informationally efficient markets. American Economic Review 70, 393–408.

Haigh, M.S., List, J.A., 2005. Do professional traders exhibit myopic loss-aversion? An experimental analysis. Journal of Finance 60, 523–534.

Hietala, P., 1994. The efficiency of the Finnish market for rights issues. Journal of Banking and Finance 18, 895–920.

Karhunen, J., Keloharju, M., 2001. Shareownership in Finland 2000. Finnish Journal of Business Economics 50, 188–226.

Knüpfer, S., 2006. Do search costs matter? Evidence from IPO subscriptions. Unpublished working paper, Helsinki School of Economics.

Lakonishok, J., Lee, I., Poteshman, A.M., 2004. Investor behavior in the option market. NBER Working paper 10264.

List, J.A., 2003. Does market experience eliminate market anomalies? Quarterly Journal of Economics 118, 41–71.

Odean, T., 1998. Are investors reluctant to realize their losses? Journal of Finance 53, 1775–1798.

Poitras, G., 2002. Short sales restrictions, dilution and the pricing of rights issues on the Singapore Stock Exchange. Pacific-Basin Finance Journal 10, 141–162.

Poteshman, A.M., Serbin, V., 2003. Clearly irrational financial market behavior: evidence from the early exercise of exchange traded stock options. Journal of Finance 58, 37–70.

Simon, H.A., 1976. From Substantive to Procedural Rationality. In: Latsis, S.J. (Ed.), Methods and Appraisal in Economics. Cambridge, Cambridge University Press, pp. 129–148.

Slovin, M.B., Sushka, M.E., Lai, K.W., 2000. Alternative flotation methods, adverse selection, and ownership structure: evidence from seasoned equity issuance in the U.K. Journal of Financial Economics 57, 157–190.

Vissing-Jørgensen, A., 2003. Perspectives on behavioral finance: does "irrationality" disappear with wealth? Evidence from expectations and actions. NBER Macroeconomics Annual 2003.

Wu, X., Wang, Z., 2005. Equity financing in a Myers-Majluf framework with private benefits of control. Journal of Corporate Finance 11, 915-945.

Zhu, N., 2005. Cost of time and household choice between direct and delegated investment. Unpublished working paper, University of California at Davis.