Elias Rantapuska

ESSAYS ON INVESTMENT DECISIONS OF INDIVIDUAL AND INSTITUTIONAL INVESTORS

HELSINKI SCHOOL OF ECONOMICS

ACTA UNIVERSITATIS OECONOMICAE HELSINGIENSIS

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To Ulla-Maija

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Helsinki, April 2006

Elias Rantapuska

ABSTRACT

This thesis studies investment decisions of individual and institutional investors. The thesis aims to contribute to the literature with three interrelated essays, which investigate investor behavior around dividend payments and in rights issues. Taken together, the results from the three essays indicate that both rational and irrational factors have an impact on investment decisions. Institutional investors put relatively more weight on rational factors in their investment decisions than individual investors.

The first essay examines trading behavior of Finnish investors around the ex-dividend day. Investors who are entitled to the imputation tax credit and thus a preference for dividend income buy shares cum-dividend and sell ex-dividend; the reverse is true for investors who are not entitled to the tax credit. At individual investor level, idiosyncratic risk and transaction costs are important determinants in the choice of tax arbitrage stock. The results from a firm level analysis show that transaction costs and dividend yield jointly determine whether the degree of tax arbitrage activity is nonzero.

The second essay documents how much investors reinvest dividends and tender offer proceeds. Households reinvest only a small proportion of funds within two weeks, less than 1% of cash-dividends and around 10% of tender offer proceeds. Tender offer proceeds are more likely to be reinvested, even when the investor and size of the cash flow are kept constant. This finding is consistent with the idea that investors follow at least to some extent the rule of thumb "consume dividends but never touch the principal."

The third essay 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: G35; G35, D12, G34; G32, D01

Keywords: ex-dividend day, tax arbitrage, dividend clientele; dividend reinvestment, dividend payment, self-control, mental accounting; tender offer; rights issue, irrationality, warrant, investor behavior

LIST OF ESSAYS

1. Rantapuska, E., 2005. Ex-dividend day trading: who, how, and why? HSE working paper W 392.
2. Rantapuska, E., 2005. Do investors reinvest dividends and tender offer proceeds? HSE working paper W 393.
3. Rantapuska, E., 2005. Which investors are irrational? Evidence from rights issues. HSE working paper W 394.

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1. Introduction

There is a buyer and a seller for every trade in the stock market. The seller may be an institutional investor who needs liquidity or has a negative outlook on the future prospects of the stock, while the investor on the buy side may be an individual who thinks that the stock will increase in value. Without further information, an outside observer who sees that a trade takes place can only guess as to why the two investors chose to trade.

Due to limited data, very few researchers have been able to examine what drives investment decisions in the stock market. Although a number of recent studies investigate why investors trade in general (e.g., Odean, 1998; Barber and Odean, 2001; Grinblatt and Keloharju, 2001a), very little is known about the determinants of investment decisions around corporate finance events, such as dividend payments and equity issues. These investment decisions cannot necessarily be studied with ordinary research designs relying on publicly available data, such as event dates, returns, and trading volume.

This doctoral thesis aims to contribute to the literature on investment decisions around corporate finance events with three interrelated essays. The first essay studies the extent to which taxes influence trading decisions around the ex-dividend day. The second essay investigates whether investors put different labels on capital assets and dividend income. Finally, the third essay studies whether investors behave irrationally in rights issues.

Some authors (e.g. Shiller, 2003) have argued that there is an ongoing paradigm shift in the field of financial economics, although not all economists share the view (e.g. Fama, 1998). The proponents of this paradigm shift argue that the assumption of fully rational agents cannot explain all aspects of empirical finance literature, such as the degree of trading volume and stock price volatility. This doctoral thesis stands in the middle of the paradigm shift: while the first essay is based entirely on rational models, the second and the third essay lean heavily towards behavioral finance.

The two first essays are related to one of the most important decisions faced by a financial manager: how large a dividend a company should pay. The influence of taxes on investor trading decisions, which is the focus of the first essay, is crucial to corporate payout policy. To illustrate this argument, consider two alternative scenarios. First, suppose that the shares of a company are entirely held by investors taxed heavily on dividend income, and that no trading takes place around the ex-dividend day. As a consequence, a rise in dividend increases investors' tax liability, resulting in a decrease in shareholder wealth. Second, suppose that, as a result of trading around the ex-dividend day, all shares of the company end up with nontaxable investors. In this

case, the corporate payout policy is irrelevant from the tax perspective, because the amount of dividend paid out will have no impact on the shareholders' tax burden.

The second essay is also related to payout policy, but the perspective differs from that of the first essay. The essay takes a step away from the neoclassical paradigm of economics by providing empirical evidence on whether investors are following the rule of thumb "consume dividends and never touch the capital." If investors actually behave in this way, they could favor a generous payout policy, even if it leads to a higher tax burden. As a result, corporations may want to cater to their shareholders by paying large dividends, despite incurring higher taxes.

The third essay shifts the focus from dividends to investor sophistication in rights issues. My analysis shows that thousands of investors clearly act irrationally. The results also indicate that differences in sophistication and the costs of becoming informed explain why some investors do not maximize their wealth in rights issues. Small, inactive household investors who live abroad tend to behave irrationally. The third essay also challenges assumptions of the neoclassical paradigm: a strict neoclassical theory would always assume that investors would never behave irrationally by leaving money on the table in a rights issue.

The remainder of this introductory chapter is structured as follows. Section 2 describes how taxes, investor psychology, and differences in sophistication influence investment decisions in the financial market. Section 3 summarizes the three essays in this thesis. Finally, Section 4 discusses how financial market practitioners and policymakers can apply the findings of this thesis to make better decisions and formulate sounder policies.

2. Investment decisions of individual and institutional investors

The literature on factors influencing investors' investment decisions is far too extensive to be covered completely in this section. Instead of trying to compile a comprehensive survey on all possible determinants of investment decisions, I review the three subject areas within the focus of this thesis: taxes and investor behavior around the ex-dividend day, investor psychology, and investor sophistication.

2.1. Taxes and investment decisions around the ex-dividend day

Studying stock prices and investor trading behavior around the ex-dividend day is crucial to answering two important research questions. First, do investor level taxes affect security prices? Second, if investor level taxes influence prices, *whose* taxes are incorporated in security prices?

To illustrate the importance of these two issues, suppose that there is a security entitling its holder to a EUR 10 dividend tomorrow. Also, assume that there are two investors, one who is not taxed and another who is taxed for dividend income at 10%. If the untaxed and the taxed investor both hold one unit of the security, it is not obvious how the security should be priced. The price may fully incorporate the 10% tax rate, in which case the security should be priced at EUR 9. Alternatively, it is possible that the market price of the security is EUR 10, and thus driven solely by the untaxed investor. Finally, the price could be between EUR 9 and EUR 10, reflecting the tax rates of both investors.

2.1.1. Theories on taxes and investment decisions around the ex-dividend day

How can we know which investors drive security prices? One way to tackle this question is to study share price changes around the day when a buyer of a share is no longer entitled to the dividend, the ex-dividend day. Elton and Gruber (1970) propose that there is a link between the tax rates of the price-setting investor category, or the marginal investor, and the ex-day stock price changes. They argue that, in equilibrium, the marginal investor must see no difference between selling a share before or after the ex-dividend day. Hence, the ex-dividend day price change divided by the amount of the cash dividend (a quotient which is also referred to as the ex-day ratio) should reflect the relative tax rates of the marginal investor.

The main drawback of the model of Elton and Gruber is that it is static and thus does not take into account the fact that investors can trade with one another to reduce their tax burden. Dynamic models and their corresponding empirical tests are built on the argument that it is not the static holding clientele, but the active trading clientele that drives stock prices around the ex-dividend day. This dynamic dividend clientele literature leads to several empirical predictions of investors' trading activity around the ex-dividend day, which is the focus of the first essay.

Kalay (1982) is the first to argue that dynamic dividend clienteles influence security prices around the ex-dividend day. Kalay's argument is based on the absence of arbitrage: if the ex-dividend day ratio differs from unity, tax-neutral short-term traders keep trading until the ex-day ratio is close to unity and arbitrage becomes unprofitable. Consequently, deviations from the equilibrium ex-day ratio of unity can be attributed to transaction costs.

Michaely and Vila (1995, 1996) argue that since investors can realize mutual gains by trading around the ex-dividend day, stock prices are driven by all traders in the market around the ex-day, not just by the short-term traders. Thus, the argument of Michaely and Vila is

inconsistent with the idea of having only one marginal investor category, such as the long-term price setting investor of Elton and Gruber or the short-term trader of Kalay.

Boyd and Jagannathan (1994) also support the view that the market around the ex-dividend day may be populated by both long- and short-term investors. Short-term traders only enter the market when the dividend yield is high and the transaction costs low enough; this complicates interpretation of ex-day ratios. Boyd and Jagannathan (1994) further argue that it is impossible to differentiate between the tax hypothesis of Elton and Gruber and the short-term trading hypothesis of Kalay using stock price data; the relation between dividend yield and ex-day price change can be nonlinear, depending on the number of trading clienteles in the market.

2.1.2. Empirical evidence on taxes and investment decisions around the ex-dividend day

The empirical literature on investor trading decisions and security prices around the ex-dividend day is rather voluminous, which is why I concentrate below on the more recent literature. The reader is referred to Graham (2003) and Allen and Michaely (2004) for comprehensive reviews on earlier ex-day studies.

Early empirical tests use share price changes around the ex-dividend day to infer the identity of the marginal investor. Elton and Gruber (1970), Kalay (1982), Eades, Hess, and Kim (1984), and Kaplanis (1986) all find that stock prices drop by less than the value of dividend on the ex-dividend day, a result which is commonly interpreted as investor level taxes being incorporated in security prices. Some authors come to the same conclusion by studying tax reforms and their impact on ex-day ratios. Lakonishok and Vermaelen (1983), Poterba and Summers (1984), and Barclay (1987) all conclude that, consistent with the notion that personal taxes affect security prices, the ex-day ratio changed after a tax reform. However, Michaely (1991) points out that there was no change in the ex-day ratio after the United States Tax Reform Act of 1986. Michaely attributes his result to changes in the weights of different trading groups rather than to changes in the relative tax-rates of the marginal investor.[1]

Later ex-day studies propose that inference from trading volume is crucial to understanding whether the market is populated by tax-motivated long-term traders, short-term arbitrageurs, tax-motivated short-term traders, or a combination of several trading clienteles. Lakonishok and

[1]Hietala (1990), Hietala and Keloharju (1995), Sorjonen (2000), and Liljeblom, Löflund, and Hedvall (2001) have studied ex-day price behavior in the Finnish stock market. Hietala (1990) and Hietala and Keloharju (1995) find that the short-term trading hypothesis of Kalay (1982) is less relevant in the Finnish market than the tax hypothesis of Elton and Gruber (1970). Both Sorjonen (2000) and Liljeblom et al. (2001) find that after the abolishment of foreign ownership restrictions on Finnish stocks in 1993, foreign investors have contributed to ex-day pricing of Finnish stocks.

Vermaelen (1986), Kato and Loewenstein (1995), Michaely and Murgia (1995), Michaely and Vila (1995, 1996), Green and Rydqvist (1999), and Dhaliwal and Li (2006) all find evidence of abnormal trading volume around the ex-dividend day, which is positively related to dividend yield and negatively related to transaction costs. The broad conclusion from the trading volume studies is that no single marginal investor group exists, but several investor groups with differing tax statuses trade with one another around the ex-dividend day.

One further complication of studying the ex-day price and volume data to infer the identity of the marginal investor is the existence of market frictions, which may cause ex-day price changes to be partially driven by microstructure effects. Boyd and Jagannathan (1994), Frank and Jagannathan (1998), and Bali and Hite (1998) argue that price discreteness and bid/ask bounce cause additional difficulties in interpreting ex-day price changes. However, Graham, Michaely, and Roberts (2003) note that after the pricing increments became smaller on the NYSE, ex-day ratios did not move closer to unity, as the microstructure theories would predict. Similarly, Allen and Michaely (2004) assess a broad range of ex-day studies, arguing that although microstructure effects may partially contribute to ex-day price changes, they cannot completely rule out the tax-based explanations.

More recently, researchers have gained access to investor level data. A direct investigation on investor trading around the ex-dividend day overcomes several obstacles evident in earlier studies relying on inference from price and volume data. Koski and Scruggs (1998) use NYSE audit file data to identify the trading volume around the ex-dividend day separately for three investor categories. However, in their data only the tax status of securities dealers is unambiguous, while the trades in the remaining two categories originate from several investor groups with different tax statuses. In a recent study, Graham and Kumar (2006) use data from a large discount brokerage house to examine trades of private investors around the ex-dividend day. They find weak evidence of tax-motivated trading around the ex-dividend day, which is also reflected in the pricing of stocks in the lowest size quintile.

2.2. Investor psychology and investment decisions

Traditionally, finance literature has relied on the assumption that investors are fully rational. The first essay of this thesis is an example of a study under this paradigm: investors rationally reduce their tax burden by trading around the ex-dividend day. Simply put, all that matters is the expected return and the risk associated with the ex-day investment strategy. However, only relatively recently has it become widely, although not completely, accepted in academic finance

research that human beings are subject to systematic behavioral biases, which must also be accounted for when modeling investor behavior in the financial market.

The second essay of this thesis accepts the notion that investors are subject to behavioral biases. In particular, it assumes that investors have self-control problems which they alleviate by mental accounting and framing. Below, I review these concepts and discuss their relevance to investor behavior.

2.2.1. Self-control

Self-control problems are familiar to all but the most abstinent persons. Human beings cannot resist doing things which are bad for them. Prime examples are smoking, overeating, substance abuse, and lack of exercise. Virtually everybody agrees that smoking and lack of exercise are bad for the individual's long-term health, but far too many people fail to quit smoking or find excuses not to take exercise.

The notion of self-control is very old, and is often characterized as a conflict of two actors within a single human being. Plato describes the human soul as a charioteer who tries to control two winged horses: one of noble breed and the other of ignoble breed. The horses give the charioteer a great deal of trouble by pulling in different directions. Freud (1958) also characterizes Man as having several preferences. The preferences are inconsistent, but they still simultaneously influence the behavior of a human being.

In economics, Thaler and Shefrin (1981) are the first to introduce a model of economic behavior incorporating the concept of self-control. The authors argue that the role of self-control is very important for understanding savings and consumption decisions. Thaler and Shefrin model human behavior as a two-self economic man consisting of a planner and a doer. The planner has a long-term view, is fully rational, and wishes to optimize the lifetime consumption path. In contrast, the doer is hopelessly myopic and wants to consume everything now. To prevent the doer from dominating consumption decisions, the planner must rely on pure discretion ("I must consume less this year") and rules ("I can consume the salary, but not the money in my savings account"). The planner is unable to achieve a first-best solution, but is able to achieve the second-best solution by exercising willpower and setting rules for the doer.

In a closely related paper, Shefrin and Thaler (1988) develop a more detailed model of life-cycle consumption incorporating the concepts of self-control, mental accounting, and framing.[2] Shefrin and Thaler argue that because of self-control problems, individuals rely on rules of thumb

[2]See definitions of the latter two concepts in Section 2.2.2.

in savings decisions. Rules of thumb, such as "consume dividends and leave the capital intact," "never withdraw money from the savings account except for buying a car or a house," or "salary can be spent, but not stock market gains," help individuals to control their consumption. Rules are useful because individuals are afraid that the myopic doer in the model of Thaler and Shefrin (1981) will take over. As an example, consider an individual who gives up the rule of "consume dividends and leave the capital intact." Without the rule, the individual would end up selling shares and consuming too much in the short-term, although this would be suboptimal in the long term.[3]

Shefrin and Statman (1984) argue that self-control could also explain why firms pay dividends, even if they are more heavily taxed than capital gains. Because individuals are under constant temptations to consume, a simple rule of consuming dividends but never selling stocks to finance consumption helps to alleviate self-control problems. Managers, therefore, cater to their shareholders by paying dividends, even when this results in a higher tax burden.

2.2.2. Mental accounting and framing

The concept of mental accounting was first introduced by Kahneman and Tversky (1984), based on earlier work by Kahneman and Tversky (1979), Tversky and Kahneman (1981), and Thaler (1980, 1985). The idea of mental accounting is relatively simple: individuals evaluate decisions one by one, rather than by aggregating. The problem of balancing the advantages and disadvantages of each option separately is that there will be too little or no consideration of the aggregate outcome.

Mental accounting requires psychological separability of actions: whether the same decision is framed as a single decision or as two separate decisions can greatly influence individual behavior. Consider the following example, which is a direct quote from Shefrin (2005, pp. 378-379), and originally from Tversky and Kahneman (1986):

> Imagine that you face the following pair of concurrent decisions. Think of making your choices in the morning, with the outcome to the first decision being determined in the afternoon, and the outcome of the second decision being determined in the evening. Imagine that the current time is morning. First, examine both decisions, and then indicate the alternative you prefer.

[3]Casual examples of predefined rules to curb temptations for excessive consumption are numerous and rich in variety. For example, a relative of the author makes it a rule to withdraw only EUR 20 at a time from his bank account—even when this means several visits to an ATM on the same day. The relative motivates this behavior by arguing that "the money simply does not stay in my hands, any excess cash in my wallet leads to extremely stupid excessive consumption."

First decision:

A. a sure gain of $2,400

B. 25% chance to gain $10,000 and 75% chance to gain nothing

Second decision:

C. a sure loss of $7,500

D. 75% chance to lose $10,000 and 25% chance to lose nothing

Most people will choose A and D, which is suboptimal. If the problems are aggregated, choosing A and D is equivalent to a gamble with a 25% probability of winning $2,400 and a 75% probability of losing $7,600. In contrast, choosing B and C results in a gamble with a 25% probability of winning $2,500 and a 75% probability of losing $7,500—an option which unambiguously dominates the choice of A and D.

The example above illustrates both framing and mental accounting. First, we are inclined to think of the decisions as separate, although they both occur on the same day. Compartmenting the two decisions is in this case suboptimal, although a relatively simple aggregation would yield a better outcome. Second, if we were given the same problem framed as combinations of the gambles (AC, AD, BC, and BD), only very few would choose A and D, because this option would be explicitly dominated by a choice of B and C.

The relevance of mental accounting extends from choices between simple gambles to investor behavior in the stock market. Perhaps the most widespread financial market application of mental accounting is the disposition effect, originally formulated in Shefrin and Statman (1985). Shefrin and Statman argue that investors are more reluctant to sell the losing stocks in their portfolio than the winning ones, at least partly because they separately track the gains and losses from individual stocks rather than considering their total wealth. The disposition effect has received strong empirical support. Odean (1998), Grinblatt and Keloharju (2001a), Shapira and Venezia (2001), and Kaustia (2005) find strong evidence that both individual and professional investors are reluctant to realize a position at a loss. In particular, the findings of Kaustia (2005) support the interpretation that mental accounting is the key driver of the disposition effect.

Some scholars suggest that mental accounting influences not only investor behavior, but also asset prices. Barberis and Huang (2001) show that in an economy where agents have a mental accounting system with narrow framing and loss aversion individual stocks have a higher risk premium and a higher volatility than in an economy with portfolio level accounting. Grinblatt and

Han (2005) argue that the asset pricing implications of mental accounting extend to explaining momentum: stocks held by investors with large unrealized gains continue to increase in value.

2.3. Investor sophistication and investment decisions

Behavioral biases may lead to less than optimal investment decisions, as discussed earlier. However, it is possible to go one step further and ask which investors are more likely to behave rationally, and correspondingly, which investors are most prone to gross errors in their investment decisions.

One way to study investor sophistication is to examine their trading behavior in the stock market. Grinblatt and Keloharju (2001b) document evidence that stockholdings and trades are influenced by the physical and cultural distance of the company. Finnish investors tend to hold and trade stocks of companies located close to their home and which have the same cultural origin, but this effect is smaller for institutional investors and investors with more diversified portfolios. Using the same data, Grinblatt and Keloharju (2000) find that institutional investors, and particularly foreign institutions, follow momentum investment strategies and tend to outperform domestic households.

With data on individual investor trading records from the United States, Barber and Odean (2000, 2001) document evidence that individual investors, especially males, trade too much. The results of Odean (1999) and Barber and Odean show that because of excessive trading, individuals end up with smaller returns, and they would be better off following a simple buy and hold strategy. The findings of Odean and Barber and Odean are consistent with the model of Gervais and Odean (2001), which predicts that initial success in the stock market prompts investors to regard themselves as skillful traders. This self-attribution bias leads to overconfident estimates of future investment performance and to excessive trading.

In addition to the stock market, finance scholars have also investigated investor sophistication in the options market. The options market is particularly suitable for studying investor sophistication, because a contingent claim derives its value directly from some other security, and it is often possible to identify unambiguously irrational investment decisions. One such irrational decision is the early exercise of American call options. Early exercise of American call options may be optimal only if the stock is going ex-dividend or if there are market frictions. Otherwise, investors are better off selling the options in the open market or delaying exercise until maturity.

Using data from the S&P 100 index options market, Diz and Finucane (1993) find that 20% of the exercises are early, and over 12% of the early exercises can be explained by neither market frictions nor by the ex-dividend day. Finucane (1997) reports similar results for equity call options in the United States, and Engström (2002) for Swedish equity call options. Poteshman and Serbin (2003) report that customers of discount and full-service brokers act irrationally by exercising call options early, whereas large investment houses have zero irrational early exercises.

Yet another avenue for investigating differences in sophistication is to study investor behavior when the stock market valuations reach very high levels. The idea is relatively simple: if the stock market is occasionally mispriced, the most rational investors should be able to detect at least the grossest over- and undervaluations. Vissing-Jørgensen (2003) uses survey data to assess whether investor sophistication is correlated with wealth. The findings of Vissing-Jørgensen indicate that wealth is somewhat correlated with sophistication, but show that the very wealthy investors did not get out of the stock market at the turn of the Millennium, even if they considered the market overvalued in the survey. Similarly, Lakonishok, Lee, and Poteshman (2004) show that clients of full-service brokers and firm proprietary traders did not purchase put options at the stock market peak to benefit from the downturn. However, there seems to be at least one investor group which is sophisticated enough to take advantage of gross mispricings. Brunnermeier and Nagel (2004) document evidence that hedge funds were successful in riding the technology bubble until its peak and in reducing their holdings before the sharp downturn.

Some authors investigate how differences in investor sophistication influence stock prices. Chakravarty (2001) documents evidence that trades by institutional investors cause a bigger price impact than trades by individual investors. Similarly, Linnainmaa (2003) reports that trades originating from brokers with proportionally larger institutional investor clienteles are more likely to cause a permanent price impact. Furthermore, Bartov, Radhakrishnan, and Krinsky (2000) propose that the post-earnings announcement drift is partially driven by investor sophistication.

3. Summary of the three essays

3.1. Essay 1: Ex-dividend day trading: who, how, and why?

The first essay of this thesis studies tax- and arbitrage-motivated trading around the ex-dividend day by all investors in the Finnish stock market. During the sample period of 1995-2002, there were considerable distinctions in dividend and capital income taxation across the

various investor categories. Domestic taxable investors were not effectively taxed on dividend income, but they were taxed on capital gains. In contrast, foreign investors were not entitled to the imputation tax credit and, in most cases, had to pay a withholding tax. Because of these differences in taxation, domestic taxable investors had a preference for dividend income, and foreign investors had a preference for capital gains. Thus, foreign investors could generate tax savings by selling shares just before the ex-dividend day, and correspondingly, domestic taxable investors could reduce their tax burden by buying shares just before the ex-dividend day. In addition, nontaxable institutional investors, such as mutual funds, were able to profit from trading around the ex-dividend day if the share price did not fall by exactly the amount of the dividend.

The first main result of this essay is that differences in tax rates prompt investors to trade around the ex-dividend day at the expense of the government, as predicted by the dynamic tax-clientele models (Michaely and Vila, 1995, 1996; Dhaliwal and Li, 2006). Domestic individuals and nonfinancial corporations buy shares before the ex-day, and foreign investors are on the sell side. Furthermore, mutual funds profit from short-term trading around the ex-dividend day because the share price does not on average fall by exactly the amount of dividend.

The essay also provides evidence on factors influencing investor trading decisions around the ex-dividend day. First, the results from an investor level analysis show that idiosyncratic risk influences trading decisions around the ex-dividend day. Investors tend to trade stocks which they do not own and which have low idiosyncratic volatility. Second, analyses of tax arbitrage activity indicate that transaction costs and dividend yield also drive trading around the ex-dividend day: ex-day trading activity increases in stocks with high dividend yield and low transaction costs.

3.2. Essay 2: Do investors reinvest dividends and tender offer proceeds?

The second essay investigates the extent to which investors reinvest the funds they receive from the stock market. I consider two types of cash flows: dividends and tender offer proceeds. Dividends are a highly predictable flow of funds from corporations to investors. Tender offers, in contrast, are rare portfolio liquidations resulting from a corporate takeover. In a tender offer, the acquiring firm makes a bid to buy all outstanding shares, and usually the shareholders have no other option than to sell, sooner or later.

The first main result of the second essay is that dividends are not reinvested, at least in the short-term. Household investors reinvest probably less than 1% of dividends, and under no circumstances do they reinvest more than 8.1% within two weeks of receiving the cash flow. In contrast, households reinvest at least 8.3% of the tender offer proceeds within two weeks. The

results are similar for institutional investors, except for mutual funds. Mutual funds promptly redirect at least 13.3% of their dividend stream back to the stock market. Thus, on average, investors do not reinvest dividends, and reinvest only a small fraction of tender offer proceeds.

To explain the difference in reinvestment ratios, I take the view of Shefrin and Statman (1984) by arguing that investors do not treat dividends and tender offer proceeds equally, but rather label the cash flows either as capital assets or dividend income. Consistent with this labeling argument, I propose that dividends belong to the mental account of current income, and are spent along with salary, social security payments, and small windfall gains, rather than being reinvested. Correspondingly, portfolio liquidations resulting from tender offers are assumed to be in the mental account of capital assets. In the case of tender offer proceeds, an investor may feel that capital should not be touched, and that the proceeds should be returned to the stock market.

The interpretation that dividends and tender offer proceeds are in different mental accounts is robust to several alternative empirical specifications. I report that unconditional reinvestment ratios are higher for tender offer proceeds than for dividends. This result is unchanged in a matched sample test, in a dynamic regression, and in a multivariate logit regression. In conclusion, investors seem to follow, at least to some extent, the rule of thumb "consume dividends but leave the capital intact".

3.3. Essay 3: Which investors are irrational? Evidence from rights issues

In the third essay, I study how rationally individual and institutional investors behave in rights issues. In a rights issue, shareholders are given short-lived subscription rights which they can use to subscribe additional shares at a discount to the current market price. Alternatively, the shareholders can sell the rights to other investors.

Rights issues offer a convenient research setting to study investor rationality, because there are several possible ways to go wrong. Exercising rights too early, selling rights at excessively low prices, or doing nothing with the rights are all suboptimal decisions.

In the sample period, 1995-2002, the results show that investors lost at least EUR 150,000 by exercising rights too early, and a detailed analysis indicates that households are more likely to exercise rights prematurely than institutions. In the sample of households, investors with experience and a long tradition in stock market investing exercise rights closer to maturity.

The essay also documents the amount of wealth transfer resulting from subscription right trades. On average, initial shareholders sold their rights at excessively low prices, which resulted

in an aggregate wealth transfer of MEUR 6.5. Financial institutions are active in the market, and buy subscription rights at discounted prices.

Finally, the essay shows that thousands of investors did nothing with their subscription rights. This is perhaps the most irrational thing to do in a rights issue. Provided that the current stock price is above the subscription price, an investor should always sell or exercise the subscription rights, but never fail to exercise or sell them. Investors who left rights irrationally unexercised lost in aggregate at least MEUR 3.2. Furthermore, the essay reveals that investors who live abroad, are not native speakers of either of the two official languages, trade infrequently, and have small portfolios, are more likely to forfeit their subscription rights without compensation.

4. Implications for policymakers and practitioners

The findings in this thesis also provide relevant implications for practitioners and policymakers. Some of the implications are discussed below.

The results in the first essay indicate that investors reduce their tax burden by trading around the ex-dividend day. As a result of trading, the government ends up collecting fewer taxes. Currently, there is no explicit law in Finland banning short-term trading around the ex-dividend day. In the United States, on the other hand, the tax law creates disincentives for short-term ex-day trading.

The Finnish Tax Reform Act of 2005 brought the tax preferences of various investors closer to each other, and thus reduced the attractiveness of ex-day trading. As dividends are generally no longer tax-free for domestic taxable investors, these investors have less of an incentive to buy shares cum-dividend and sell ex-dividend than under the old system, which was effective until the end of 2004. However, this does not mean that there are no profit opportunities around the ex-dividend day. In particular, corporations with more than 10% ownership of a listed company do not have to pay dividend tax but are subject to capital gains tax. Hence, for blockholders, opportunities for dividend capturing still exist, especially if the average ex-day ratio will be

below unity.[4] Similarly, nothing will prevent mutual funds from doing arbitrage in the future. It is also important to remember that tax laws change relatively frequently, and it is possible that investor tax preferences will become more heterogeneous in the future.

The results of the second essay support the argument that investors do not lump together all their wealth, but instead have separate mental accounts for different types of cash flows. This result is particularly relevant to the marketing of financial instruments. As an example, consider two investors, one who owns bonds and another who owns stocks. Also assume that the bonds will mature and that dividends for the fiscal year will be paid in two days' time. The results from the analysis in the second essay indicate that it would be easier to persuade the bondholder than the stockholder to reinvest the upcoming funds. The principal of the bond is in the mental account of capital assets and is more likely to be reinvested. In contrast, dividends are in the mental account of current income and are more likely to be spent.

The third essay documents evidence that thousands of investors, especially households, forfeit their rights without compensation. The obvious remedy for investors wanting to avoid wealth loss is to keep a closer eye on their portfolios. Alternatively, portfolio management can be delegated to mutual fund managers who do not leave rights unexercised. In other words, if an investor has better things to do than to worry about rights issues and other corporate events, paying a fee for portfolio management by investing in mutual funds may be a viable option.

The third essay also finds that, on the whole, rights are traded at excessively low prices. The implication for an investor considering selling the subscription rights is straightforward. If the market for rights is not liquid and efficient enough to guarantee pricing close to fair value, the investor should exercise the rights and sell the shares instead of selling the rights.

[4]As a numerical example, consider a corporation with ownership above the 10% threshold in the target company. Also assume that the target company pays a EUR 1 dividend per share and that the share price drops 0.9 times the value of the dividend on the ex-dividend day. If the corporation above the ownership threshold buys 10 million shares on the last cum-dividend day and sells the shares on the ex-dividend day, it ends up with a profit of (1-0.9) x MEUR 10 = MEUR 1. In addition, the corporation has generated a MEUR 1 deductible capital loss for the fiscal year.

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ESSAY 1:

Ex-dividend day trading: who, how, and why?

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ABSTRACT

This study examines ex-dividend day trading behavior of all investors in the entire Finnish stock market. Consistent with the dynamic dividend clientele theories, investors with a preference for dividend income buy shares cum-dividend and sell ex-dividend; the reverse is true for investors with the opposite preferences. Investors also engage in overnight arbitrage, earning on average a 2% return on their invested capital. Studying trades at the level of an individual investor shows idiosyncratic risk to be an important determinant in the choice of stock subject to short-term ex-day trading. Furthermore, analysis of the volume of short-term trades as a fraction of the total trading volume on the ex-day reveals that transaction costs and dividend yield jointly determine whether the volume of short-term trading activity is nonzero.

JEL classification: G35

Keywords: ex-dividend day, tax arbitrage, dividend clientele

1. Introduction

Very few overnight share price changes convey as much fundamental information as stock returns on the ex-dividend day. Elton and Gruber (1970) introduced the idea that ex-day returns could be used to test if personal taxes affect security prices and to infer the identity of the marginal investor. In more than three decades, hundreds of studies have examined the ex-day price behavior of stocks to find out the identity of the marginal investor. There is a consensus that taxes affect security prices (Allen and Michaely, 2004), but the identity of investors trading around the ex-day and their degree of price impact is still debatable.

An ideal starting point for an analysis on who trades and sets security prices around the ex-day is to study investors' trading records. However, until very recently, researchers have had limited access to such information, and they have had to resort to various techniques to infer the identity of the marginal investor from price and volume data.[1] Thus, our knowledge on the marginal investor comes largely from studies examining share price changes and the aggregate trading volume on the ex-dividend day. Nevertheless, it is unlikely that on any given ex-day, the market would be populated by only one particular group of traders, an issue that complicates inference from aggregate data. Instead, the ex-day price and the total trading volume are likely to be driven by several trading clienteles.

To overcome the obvious shortfall of studying only price and volume data, this paper takes a direct look at trades that take place around the ex-dividend day. High-quality data consisting of the trading records of *all* market participants allow for a close examination of investor behavior around the ex-dividend day in virtually every listed stock. Access to not only the identity of traders in the entire market, but also to detailed investor level data such as capital gains, portfolio values, and portfolio composition facilitates a direct test of whether investors actually behave as described by the dynamic dividend clientele theories (Kalay, 1982; Boyd and Jagannathan, 1994; Michaely and Vila, 1995; Michaely, Vila, and Wang, 1996). In addition to the availability of high-quality data, Finland is an especially suitable market to study ex-day trading on two accounts. First, in contrast to the United States, for example, where dividends are paid quarterly, they are paid once a year in Finland. As dividends are on average larger, stock price discreteness (Bali and Hite, 1998) is less of an issue in the Finnish stock market. Second, capital income preferences vary substantially across investor categories. While US-based mutual funds trading in the Finnish market are indifferent between a EUR 1.00 dividend and a EUR 0.85 capital gain,

[1]The empirical work is voluminous and includes contributions by Lakonishok and Vermaelen (1986), Karpoff and Walkling (1988), Kato and Loewenstein (1995), Lasfer (1995), Green and Rydqvist (1999), Naranjo, Nimalendran, and Ryngaert (2000), Bell and Jenkinson (2002), and Callaghan and Barry (2003), to name a few.

domestic taxable investors are indifferent between EUR 1.00 in dividend income and up to EUR 1.41 in capital gains. Large dividends combined with considerable differences in relative taxation of capital gains and dividends create ample opportunity for mutual gain by ex-day trading.

By using comprehensive investor level data to study the trades around the ex-day, I make three contributions to the literature. First, by disaggregating the trading volume around the ex-day, I document who trades, how much, and in which direction around the ex-dividend day. The results strongly suggest that tax status drives investors to change the direction of their trades around the ex-dividend day. Households and nonfinancial corporate traders, who have a preference for dividend income in the Finnish tax environment, switch from buys to sells after the ex-day. Correspondingly, foreigners who are taxed more heavily on dividend income, switch from sells to buys on the ex-dividend day. Second, the data also show that investors engage in overnight arbitrage trading around the ex-day according to their tax status. Domestic taxable investors buy shares cum-dividend and sell ex-dividend, while mutual funds and foreigners sell shares cum-dividend and buy ex-dividend. On average, arbitrageurs engaging in short-term trading, earn an overnight return of 2% after transaction costs. Third, I provide empirical evidence on the determinants of short-term trading around the ex-dividend day by domestic taxable investors. These investors are found to engage in tax arbitrage in stocks with low beta, low idiosyncratic risk, and in which they have small or no position previously. Furthermore, high dividend yield and low transaction costs are a prerequisite for the arbitrageurs to enter the market on the ex-day, as argued by Boyd and Jagannathan (1994). On aggregate, however, the magnitude of short-term trading activity is rather low, only a small percentage of the total trading volume on the ex-day.

The remainder of the paper is organized as follows. The next section reviews literature on dynamic dividend clienteles. Section 3 explains the relevant features of capital income taxation in Finland and how this affects the research design. Section 4 describes the data. Section 5 investigates the size of the ex-day ratio; direction and magnitude of trading around the ex-day by investor category; timing and profitability of short-term ex-day trades; and the determinants of trading activity. Finally, Section 6 concludes and suggests avenues for further research.

2. Dynamic dividend clienteles

Unless every agent in the economy has the same tax rate on dividend income and capital appreciation, investors can realize mutual gains at the expense of the government by trading with one another around the ex-dividend day. Investors valuing dividends most relative to capital gains

hold and buy stocks cum-dividend, and investors who would be disadvantaged to receive dividends are on the sell-side. These trades are subsequently reversed on the first ex-day. The tax heterogeneity leading to differential valuation of dividends is the key argument of dynamic dividend clientele models (Michaely and Vila, 1995; Michaely et al., 1996), which also propose that the ex-day ratio is not driven by any single group of investors, but by the interplay of trading decisions by investors with different tax statuses. In addition to taxes, dynamic dividend clientele models incorporate risk and transaction costs.

According to Michaely and Vila (1995, 1996), risk influences trading decisions around the ex-dividend day. The authors argue that an investor engaging in tax arbitrage will trade only as long as the advantage from the expected short-term gain outweighs the disadvantage of being too heavily invested in the traded stock. This argument is consistent with Heath and Jarrow (1988), who show that an investor cannot make riskless profits simply because of the variation in the ex-day ratio. A similar argument on idiosyncratic risk is formalized in the model of Michaely et al. (1996).

Transaction costs can also have an influence on ex-day prices and trading volume. Kalay (1982) incorporates transaction costs in a model of ex-day trading, which predicts an equilibrium ex-day ratio of unity, plus or minus a proportion attributable to transaction costs. This is because short-term arbitrageurs will enter the market and drive the ex-day ratio close to one, to the point where profit opportunities no longer exist. Boyd and Jagannathan (1994) point out that arbitrageurs will enter the market only if the transaction costs are low and dividend yield high enough, a factor among a host of others that complicates the inference of ex-day price data. Michaely et al. (1996) combine transaction costs and their interplay with market and idiosyncratic risk in a model of ex-day trading volume. Not only do they demonstrate that transaction costs decrease trading volume around the ex-day, but they also propose that when transaction costs are nonzero, idiosyncratic risk has a more negative impact on trading volume than market risk.

Dynamic dividend clientele theories have gained empirical support in studies using price and volume data. Trading volume on the ex-day is found to increase with tax heterogeneity (Michaely and Murgia, 1995; Michaely and Vila, 1995, 1996; Dhaliwal and Li, 2006) and dividend yield (Michaely and Murgia, 1995; Michaely and Vila, 1995, 1996), and shown to decrease with transaction costs (Michaely and Murgia, 1995; Michaely and Vila, 1996) and risk (Michaely and Vila, 1995), particularly idiosyncratic risk (Michaely and Vila, 1996). Hence, trading volume evidence is consistent with the notion that investors are exploiting differences in relative taxation

of dividends and capital gains, especially around the ex-day events where potential gains are high and risks low.

Recent research has been able to directly examine ex-dividend day trading volume by investor category, and the evidence broadly conforms to the dynamic dividend clientele literature. Koski and Scruggs (1998) examine NYSE audit file data and find evidence consistent with the idea that differences in tax rates drive investors to trade around the ex-day. Felixson and Liljeblom (2004) also provide direct evidence on trading around the ex-day by investor tax category. Furthermore, Graham and Kumar (2006) investigate the trades of individual investors at a large discount brokerage house, finding evidence of taxes driving trading decisions.

However, the studies of Koski and Scruggs (1998), Felixson and Liljeblom (2004), and Graham and Kumar (2006) either cannot pinpoint exactly the tax status of investors in the market, or they consider only a small subset of the trading population. For these two reasons, the ex-dividend day literature is missing a detailed examination of the investor and stock characteristics that drive tax- and arbitrage-motivated trades. This study bridges the gap by performing a throughout analysis on the level of the market, the firm, and the investor with data on all trades by every investor in an entire stock market.

3. Capital income taxation in Finland

Capital income taxation was relatively straightforward in Finland during the sample period of 1995-2002. In particular, two major characteristics in the capital income tax laws substantially simplify research design. First, there are no differences in capital income tax rates of domestic investors within an investor category. Hence, once the legal status of an investor is identified, the tax status is also known, along with the applicable nominal tax rate (if any) on capital gains and dividends. Second, the dividend and capital income tax rate is independent of the holding period of a security.

3.1. Dual income tax system

During the sample period, labor income and capital income were taxed separately for all sources of income, with the exception of private companies. However, labor income, which is unobservable in this study, never influences the marginal tax rate on capital income from publicly listed corporations, and hence the propensity of an investor to engage in ex-dividend day trading is unaffected.

3.2. Statutory tax rates and dividend imputation system

Finland's imputation system of dividends is similar to the system in France, Germany, Italy, and Spain, but less complicated. Both retained corporate profits and dividends are taxed at the firm level at the same flat tax rate, and all investors, except for nonprofit institutions and mutual funds, are subject to capital income and dividend taxes at the investor level. The statutory rate for capital income equaled the statutory rate for dividend income during the sample period, although the tax rate changed twice. Until the end of 1995, the tax rate was 25%; it was raised to 28% at the beginning of 1996, and to 29% at the beginning of 2000. Despite the statutory tax rate of 25-29% on dividend income, dividends were fully imputed via a tax credit system that guarantees an effective dividend tax rate of zero percent for domestic investors.[2]

To illustrate how the full imputation system functions, consider a domestic investor who receives EUR 1,000 dividend income in a fiscal year. On the tax form, the domestic investor declares EUR 1,000 dividend income, EUR 290 dividend tax, and EUR 290 imputed dividend tax credit. The EUR 290 dividend tax and the EUR 290 tax credit are netted out, and subsequently the domestic taxable investor does not have to pay any tax on the dividend income of EUR 1,000. In essence, the full imputation system can be viewed as a smokescreen which helps quell political criticism that dividends are not taxed; they are in principle, but not in effect taxed at the investor level.

The imputation system does not generally apply to foreigners, who may have to pay an additional withholding tax of up to 29%, depending on the tax treaty between Finland and the country of residence of the foreign investor. For investors resident in the United States and the United Kingdom, the withholding tax is 15%. Domestic nontaxable institutions such as mutual funds and nonprofit foundations do not receive the imputation tax credit, as they do not pay taxes. Hence, they are indifferent between capital gains and dividend income.

3.3. Taxation of capital gains

Capital gains are taxed on realization at a flat rate, which was equal to the corporate tax rate during the sample period. An investor realizing capital gains has the option to calculate the gain on 20% of the sale price rather than on the purchase price.[3] Thus, realized capital gains can be calculated using the formula Min (sale price – purchase price, sale price x 80%), which applies to

[2]There are two minor exceptions. In 1996 and 2000, capital income tax rates were raised, but dividends were imputed at the previous year's tax rate. The effective tax rate on dividends was 4.0% in 1996 and 1.4% in 2000.
[3]Prior to fiscal year 1999, the alternative capital gains tax basis was 30% of the sale price.

all domestic investors subject to taxes. In addition, realized capital losses can be deducted from realized capital gains in taxation without an upper limit, and carried forward for up to three years. For these reasons, the ex post realized capital gains tax rate can differ from the nominal tax rate. Kukkonen (2000, p. 150) estimates an effective capital gains tax rate of 15% in 1995 for a sample of wealthy individuals living in Helsinki.

Finnish tax law does not generally differentiate between and short- long-term capital gains. The capital gain for a share held overnight is taxed at exactly the same rate as for a share held for up to ten years. Furthermore, the tax law does not explicitly ban the dynamic tax avoidance strategy where an investor creates capital losses by buying shares cum-dividend and selling the shares ex-dividend. Thus, in contrast to the United States, where there are holding period requirements for qualified dividends, there are no explicit legal restrictions under Finnish tax law banning tax avoidance by ex-dividend day trading. Although the tax authorities can levy a tax on any transaction deemed to have a tax avoidance rather than economic purpose, they did not exercise this option during the sample period.[4]

3.4. Dividend preference of domestic taxable investors

The key implication of the effective zero tax rate on dividend income is that Finnish domestic investors to prefer dividends to capital gains. Because of the full deductibility of capital losses, the magnitude of dividend preference depends on the net amount of realized capital gains.

A domestic taxable investor who does not expect to pay capital gains tax for the fiscal year, in essence an investor who has realized large capital losses in the fiscal year or who has tax loss carry forwards from previous years, is indifferent between EUR 1 in dividend income and EUR 1 in capital gains. This is because the investor does not benefit from receiving EUR 1 in nontaxable dividend income instead of a capital gain of the same size, as the investor would not be subject to capital gains tax in the fiscal year anyway.

For an investor who has realized, or anticipates realizing capital gains, and who thus expects to pay capital gains tax for the fiscal year, EUR 1.00 in dividend income yields the same after-tax

[4]The Supreme Administrative Court of Finland resolved a precedent case in 2004 (KHO: 2004:8, 2725/2/02) for the deductibility of capital losses in an intraday transaction, where the same shares were sold to and bought from the same broker during the same trading day. The court deemed that no capital loss deduction could be made for shares bought back within the same day. This decision was handed down 15 months after the end of the sample period and did not concern a transaction in which shares were held overnight. Hence, it is unlikely the investors considered short-term ex-dividend day trading to have potential legal implications.

cash flow as EUR 1.00-1.41 in pretax capital appreciation.[5] For such an investor, buy/sell tax arbitrage around the ex-day is possible unless the ex-day price drop is more than 1.33-1.41 times the dividend paid.[6] Table 1 illustrates the profitability of this activity.

Table 1
Illustration of tax arbitrage by domestic taxable investors
This table illustrates how a domestic taxable investor is able to profit from trading around the ex-dividend day under two scenarios. The example is based on Finnish tax laws effective in 2001-2002 when the capital gains and dividend tax rate were 29% and the dividend tax credit was fully imputed. This yields a dividend preference ratio of 1.41 to domestic taxable investors with realized capital gains.

Price drop equals dividend		Price drop equals 1.41 times the dividend	
Realized capital gains	141	Realized capital gains	141
Tax due on capital gains	0.29 x 141 = 41	Tax due on capital gains	41
Buy 50 shares at EUR 10 paying EUR 2 dividend	-500	Buy 50 shares at EUR 10 paying EUR 2 dividend	-500
Dividend	100	Dividend	100
Sell shares ex-dividend	400	Sell shares ex-dividend	359
Net cash outflow	0	Net cash outflow	
Deduction from tax-bill	0.29 x 100 = 29	Deduction to tax-bill	0.29 x 141 = 41
Net tax arbitrage profit	29	Net tax arbitrage profit	0

3.5. Summary and implications of capital income taxation by investor category

Implications for the ex-dividend day trading incentive for each investor category can be summarized as follows:

- Nontaxable domestic investors, such as nonprofit institutions, government entities, and mutual funds have equal preferences for EUR 1 in dividend income and EUR 1 in capital gains. They have an incentive to engage in short-term trading as long as the price drop on the ex-dividend day does not equal the value of dividend.
- All other domestic investors, households, nonfinancial corporations, and financial corporations, have identical nominal tax rates on capital income. With the imputation system, the investor level tax rate for dividends is zero percent and 25-29% for capital gains. At most,

[5]The Finnish capital gains tax rate changed twice during the sample period. From 1993 to 1995, the tax rate was 25%, effectively imposing a 1/(1-0.25) = 1.33 upper limit to the dividend preference ratio. The capital gains tax rate in 1996-1999 was 28% and 29% in 2000-2002. This yielded a maximum dividend preference ratio of 1.39 and 1.41, respectively.

[6]For a more detailed discussion of the boundaries of ex-dividend day tax arbitrage in a country with a dividend imputation system, see MacDonald (2001) for a German example and Liljeblom, Löflund, and Hedvall (2001) for a Finnish one.

EUR 1 in dividend income is equally preferred to EUR 1.33-1.41 in capital gains. Domestic taxable investors with capital gains to be sheltered have an incentive to buy shares cum-dividend and sell ex-dividend, unless the price drop is greater than 1.33-1.41 times the dividend paid.

- Most foreign investors do not receive the imputation tax credit, and they may be subject to a withholding tax. For a foreign investor, EUR 1 in capital gains is, in most cases, preferred to EUR 1 in dividend income. The majority of foreign investors, mainly US- and UK-based nontaxable mutual funds, have an incentive to sell shares cum-dividend and buy ex-dividend, unless the expected price drop on the ex-dividend day is significantly less than 1.[7]

4. Data

The bulk of the data comes from the Finnish Central Securities Depositary (FCSD), which maintains an electronic and official register of all securities transactions in Finland for virtually all companies listed on the Helsinki Exchanges (HEX). The data comprise daily trading account records of all Finnish investors. The sample period runs 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, 2001).[8]

For the purposes of this study, the most significant advantage of the FCSD data is that they provide information on the institutional and legal type of each investor, which unambiguously defines the investor's exact tax status. Furthermore, all transactions are tagged with a unique investor identification number that makes it possible to compute portfolio value, number of shares in the portfolio, and position in every stock for each domestic investor in the entire market on every day. All trades of an investor are aggregated on a daily basis by summing up all buys and sells in the same stock during the trading day. Hence, the daily change in the position of a stock is treated as one observation in the investor level analyses.

Grinblatt and Keloharju (2001) divide the FCSD data into six investor categories: domestic households, domestic nonfinancial corporations, financial institutions, general government bodies, other nonprofit institutions, and foreigners. I follow this grouping with two exceptions. First, because mutual funds have a different tax status from other financial institutions, I put these investors into a category of their own. Second, I combine general government and other nonprofit

[7]In the particular case of a US or UK based mutual fund, the dividend preference ratio is (1-0.15)/(1-0) = 0.85. See Liljeblom et al. (2001) for a more detailed discussion on the dividend preference of foreign investors in Finland.
[8]The data in Grinblatt and Keloharju (2000, 2001) are for 1995-1996.

institutions, given their relatively modest share of the trading volume in the Finnish stock market and slight differences in their behavior, as documented in Grinblatt and Keloharju (2001).

The aggregate group of foreigners, which consists primarily of large institutional investors, such as foreign mutual and pension funds, accounts for 40-50% of the total trading volume of HEX. Foreigners trading in the Finnish stock market have the option to either register in their own name or execute trades via a domestic financial institution nominee account. Their trades appear in the data under the nominee institutions investor identification number, but with a separate flag for a nominee account trade. It is impossible to perform an investor level analysis on foreign investors not registered under their own name. As only 1.8% of all trades by foreign investors are executed by registered foreigners, I pool all foreigners in the market level empirical analyses. However, in the investor level analyses, I use data separately for registered foreigners.

While the portfolio contents are observable for every domestic investor and registered foreigner on every trading day, the purchase price is unknown for all shares acquired prior to January 1, 1995 and for shares acquired during the sample period by means other than an open market purchase, equity offering, or merger. Computing total capital gains tax liability for an investor requires information on the cost basis for all shares sold during the fiscal year. Thus, if information on total capital gains is required, and an investor sells shares for which no purchase price is available, all observations for that investor for the remainder of the fiscal year are lost. Capital gains for a subsample of observations are calculated consistent with the tax law on a trade-by-trade basis by correcting for splits, rights offerings, mergers, and bonus issues. Investor level capital gains are used in the analysis of Section 5.5., where the total capital gains tax liability is available for a subsample of 2,653 observations from the full sample of 31,961.

The FCSD data on securities transactions are supplemented with dividend and stock price data from the HEX. Altogether, there are 926 ex-dividend day events. HEX share price data for open, close, bid, and ask prices are combined with the HEX Portfolio Yield Index[9] logarithmic returns, and 12-month Helsinki Interbank Offered Rate (HELIBOR, until the end of 1998) or 12-month EURIBOR (from the beginning of 1999) data to compute betas from past returns for each stock. I estimate betas from weekly data with a three-year historical window by using the HEX Portfolio Yield Index as the market portfolio in a single-factor model. Financial statements data

[9]Nokia has had a disproportionately large weight since the end of the 1990s, and the stock constituted 70% of the total market capitalization of HEX when the share price peaked at the beginning of May 2000. For this reason, I use the HEX Portfolio Yield Index (HPYI) with a 10% value weight restriction, where available. HPYI is available only since January 1, 1996. Before that, I use the value-weighted HEX General Yield Index instead.

for the book value of assets is retrieved from Thomson/Datastream, and augmented from annual reports.

The initial sample of 926 ex-dividend day events is cut down to 672 events (referred to as the broad sample) for two reasons. First, in 244 events, price data for the stock going ex-dividend are either missing or the stock did not trade either on the last cum-dividend day or on the first ex-dividend day. Second, I also exclude ten ex-day events for stocks which did not belong to the FCSD registry. Equal-weighted statistics on the broad sample of 672 stocks are shown in Table 2. Finally, for a firm level analysis in Section 5.6., there are 479 events (referred to as the narrow sample) when information on beta and book value of assets is required.

Table 2
Descriptive statistics on the broad sample
This table reports equal-weighted statistics on the broad sample of stocks. *Dividend yield* is the absolute value of dividend divided by the share price on the last cum-dividend day, *volatility* the annual standard deviation in the fiscal year of the observation calculated from weekly data, and *bid/ask spread* is defined as 2(ask-bid)/(bid+ask). *Average volume* is computed from daily volumes in the fiscal year of the ex-day event. *Beta* is calculated from weekly three-year historical observations by using HEX Portfolio Yield Index as proxy for the market portfolio.

Variable	Min	Max	Mean	Skew-ness	Kurtosis	St. dev.	Median	N
Dividend yield	0.00	0.39	0.04	5.24	42.37	0.00	0.03	672
Volatility	0.14	1.64	0.43	1.87	6.98	0.01	0.37	672
Average volume	370	625,000,000	4,889,851	13.35	188.59	1,573,637	298,266	672
Volume on the cum-dividend day, EUR	980	635,000,000	6,457,861	12.92	180.64	1,632,752	328,260	672
Volume on the ex-dividend day, EUR	980	522,000,000	5,495,895	12.44	170.04	1,350,126	261,176	672
Bid/ask spread on cum-dividend day	0.00	0.17	0.02	2.49	11.36	0.00	0.01	661
Bid/ask spread on ex-dividend day	0.00	0.20	0.03	2.17	8.53	0.00	0.02	652

5. Empirical Analysis

5.1. Ex-dividend day ratio

I begin the empirical analysis by estimating the realized ex-day ratio. Assuming that the expected ex-day ratio equals the realized ex-day ratio in my sample, analysis of the average realized ratio helps us to see which investor categories have an incentive to trade around the ex-day.

Table 3 reports the results for eight regressions, where excess return (stock return – HEX Portfolio Yield Index Return) on the ex-day is regressed on a constant and dividend yield by using specifications similar to Boyd and Jagannthan (1994). I experiment by using ex-dividend day open and close prices for computing returns, by correcting for heteroskedasticity, by dropping all but the main list and high-dividend yield companies from the sample, and by letting the dividend yield coefficient vary over time.

Point estimates vary from a price drop of 1.107 to 1.181 times the dividend paid in the six single-factor regressions, and the price drop in each case is significantly different from unity at the 5% level. The traditional interpretation (Elton and Gruber, 1970; Kalay, 1982) would suggest that domestic taxable investors are the marginal investors, but their effective tax rate is lower than the nominal rate. For example, the coefficient for dividend yield in year 2002 in specification 4 translates to an effective capital gains tax rate of 20.8%.

Some authors argue that using the ex-day ratio to make inference on the investors trading around the ex-day, and to compute implicit tax ratios is not without complications. Boyd and Jagannathan (1994) and Bali and Hite (1998) propose that the ex-day premium may be at least partially driven by stock price discreteness rather than merely by taxes. However, there are three factors that undermine this explanation. First, Bali and Hite (1998) explain why the ex-day ratio may be less than the dividend, but not why the ex-day ratio is higher than one, as is observed in Table 3. Second, Liljeblom et al. (2001) have shown that the tick size restriction was not binding in the Finnish ex-dividend day returns during the partially overlapping period of 1994-1996. They find that in only 15 of 122 ex-dividend day events was the price change less than two ticks above or below the dividend. Third, since the beginning of 1999, all stock prices have been quoted in Euros, with a uniform tick size of 0.01. This further diminishes the price discreteness effect, if any, in the latter part of my sample. Furthermore, few authors share the view that the microstructure explanations are not sufficient to fully explain the variation in ex-dividend day ratios (Graham, 2003; Graham, Michaely, and Roberts, 2003; Allen and Michaely, 2004).

Table 3
Ex-day price drop in Finland from 1995 to 2002
This table reports the magnitude of ex-dividend day price drop in Finland for various econometric specifications. The dependent variable is excess return on the ex-dividend day, [(P(ex) – P(cum))/P(ex)] – HEX Portfolio Yield Index return. Standard errors for coefficient estimates are reported in parentheses. Specification 1 yields results from the specification of Boyd and Jagannathan (1994) (BJ), where the ex-day price drop is regressed on dividend yield and a constant using cum- and ex-day closing prices. In specifications 2 to 8, observations are scaled with estimated standard deviation of daily share price changes from the window [-241, -40] to compute a heteroskedasticity corrected estimate. In specifications 4 and 5, the coefficient is allowed to vary over time. Specifications 6 and 7 include only HEX main list companies, whereas specification 8 reports results estimated from a sample of HEX main list companies with dividend yield higher than 2%. From the initial sample of 926 ex-dividend dates, in 672 cases the stock traded on both last cum-day and ex-day and the price data is identical in both HEX and FCSD files. One observation is dropped from the data in specifications 2-8 due to lack of return data to estimate standard deviation. Standard errors for coefficient estimates are reported in parentheses.

	Simple BJ and heteroskedasticity corrected						Annual estimations				HEX main list company estimations					
Specification	BJ close-close		Heteroskedasticity corrected close-open		Heteroskedasticity corrected close-close		Annual close-open		Annual close-close		Main list close-open		Main list close-close		Main list close-open high yield	
	1		2		3		4		5		6		7		8	
Intercept	-0.011	(0.002)	-0.514	(0.104)	-0.400	(0.118)	-0.433	(0.113)	-0.357	(0.129)	-0.524	(0.110)	-0.419	(0.110)	-0.644	(0.110)
D/P	1.178	(0.043)	1.107	(0.043)	1.120	(0.049)					1.115	(0.045)	1.109	(0.045)	1.181	(0.045)
1995*D/P							0.784	(0.138)	0.777	(0.158)						
1996*D/P							1.074	(0.114)	0.996	(0.130)						
1997*D/P							0.981	(0.126)	1.113	(0.144)						
1998*D/P							1.014	(0.151)	1.153	(0.172)						
1999*D/P							0.974	(0.132)	1.074	(0.151)						
2000*D/P							1.101	(0.062)	1.090	(0.071)						
2001*D/P							1.078	(0.064)	1.109	(0.073)						
2002*D/P							1.233	(0.074)	1.262	(0.084)						
R^2	0.53		0.50		0.44		0.51		0.45		0.51		0.43		0.47	
F-test statistic	745.41		663.80		523.40		85.00		66.96		617.84		450.74		402.18	
N	672		671		671		671		671		602		602		447	

5.2. Who trades around the ex-dividend day?

I perform three market level analyses to document the identity of investors trading around the ex-dividend day. The first analysis documents the relative trading volumes by investor category, and the second changes in the direction of trades. Finally, the third analysis studies the number and size of overnight trades around the ex-day.

In the first analysis, I compute gross and net trading volumes around the ex-day for each investor category. To prevent giving too much weight to Nokia (the most traded stock in HEX during the sample period, see Footnote 9) in the analysis, I first calculate the gross proportion of the daily trading volume for each investor category i in each event j, and then take the arithmetic average over all 916 ex-dividend day events. Formally, the gross proportion of investor category i, at event date t, with six investor categories k, is defined as:

$$Gross\ proportion_{i,t} = \frac{1}{916}\sum_{j=1}^{916}\frac{(Volume\ of\ buys_{i,j,t} + Volume\ of\ sells_{i,j,t})}{\sum_{k=1}^{6}(Volume\ of\ buys_{i,j,t} + Volume\ of\ sells_{i,j,t})} \quad . \qquad (1)$$

Correspondingly, net proportion is defined as:

$$Net\ proportion_{i,t} = \frac{1}{916}\sum_{j=1}^{916}\frac{(Volume\ of\ buys_{i,j,t} - Volume\ of\ sells_{i,j,t})}{\frac{1}{2}\sum_{k=1}^{6}(Volume\ of\ buys_{i,j,t} + Volume\ of\ sells_{i,j,t})} \quad . \qquad (2)$$

I choose an event window of 22 days for the initial analysis. The window consists of the last cum-dividend and the first ex-dividend day plus 10 days on either side. This selection is consistent with the hypothesis that some investors time their trades around the ex-dividend day within a broader window than would be predicted under the assumptions of a perfect capital market and fully rational investors. The results for both gross and net volumes are reported in Table 4.

Table 4 indicates that foreign investors dominate the market around the ex-dividend day: they account for over 40% of the gross trading volume. The second-largest category is domestic households (26%), followed by nonfinancial corporations, with a 16% share of the total volume. Mutual funds account for roughly 2.5% of the gross volume in the Finnish stock market, but they double their share on the last cum-dividend and the first ex-dividend day. I also perform robustness checks by using the proportional number of trades, instead of proportional volume,

Table 4
Gross and net trading volume by investor category
The table reports the average gross and net relative trading volume around the ex-dividend date. The proportion of gross volume is defined as the average of the buys and sells by the investor category divided by total trading volume. The net proportion of the trading volume for each investor category is calculated as (Volume of buy transactions – Volume of sell transactions) / Total volume. Event-date 0 corresponds to the last cum-dividend day and event-date 1 to the first ex-dividend day. The total number of observations is 2,527,996.

Panel A: Gross volume

Event-date	Domestic taxable investors			Domestic nontaxable investors		Foreigners
	Nonfinancial corp.	Households	Financial corp.	Mutual funds	Nonprofit institutions	
-10	0.113	0.276	0.090	0.028	0.042	0.451
-9	0.130	0.248	0.098	0.026	0.038	0.459
-8	0.126	0.290	0.096	0.022	0.031	0.434
-7	0.118	0.296	0.090	0.025	0.033	0.435
-6	0.115	0.287	0.086	0.027	0.034	0.449
-5	0.133	0.268	0.098	0.029	0.038	0.434
-4	0.119	0.281	0.088	0.026	0.034	0.451
-3	0.123	0.280	0.088	0.025	0.038	0.446
-2	0.122	0.286	0.082	0.026	0.036	0.447
-1	0.131	0.282	0.085	0.029	0.029	0.444
0	0.158	0.262	0.089	0.052	0.031	0.406
1	0.155	0.256	0.105	0.050	0.028	0.407
2	0.119	0.298	0.094	0.021	0.035	0.430
3	0.118	0.270	0.097	0.018	0.035	0.456
4	0.115	0.270	0.083	0.026	0.027	0.478
5	0.113	0.272	0.081	0.024	0.033	0.476
6	0.110	0.268	0.087	0.026	0.033	0.474
7	0.120	0.275	0.101	0.025	0.037	0.442
8	0.125	0.284	0.087	0.029	0.039	0.436
9	0.122	0.281	0.094	0.026	0.038	0.438
10	0.114	0.295	0.085	0.023	0.046	0.436
11	0.116	0.299	0.094	0.021	0.039	0.431

Panel B: Net volume

Event-date	Domestic taxable investors			Domestic nontaxable investors		Foreigners
	Nonfinancial corp.	Households	Financial corp.	Mutual funds	Nonprofit institutions	
-10	0.008	0.009	-0.009	-0.008	0.003	-0.006
-9	0.019	0.015	0.001	-0.009	-0.002	-0.023
-8	0.015	0.006	-0.011	-0.005	-0.001	-0.011
-7	-0.004	0.016	0.007	-0.007	0.003	-0.018
-6	-0.012	0.042	0.008	-0.008	-0.005	-0.024
-5	-0.017	0.037	0.003	-0.005	0.003	-0.015
-4	-0.010	0.027	-0.003	-0.009	0.003	-0.004
-3	-0.015	0.026	0.004	-0.003	-0.006	-0.017
-2	0.003	0.036	-0.006	0.002	-0.005	-0.028
-1	-0.011	0.047	0.016	-0.019	0.002	-0.028
0	0.101	0.057	-0.009	-0.065	-0.010	-0.069
1	-0.098	-0.059	0.022	0.062	0.009	0.064
2	-0.031	-0.005	0.012	0.005	0.011	0.006
3	-0.029	0.012	0.012	0.004	0.005	-0.001
4	-0.004	-0.049	0.012	0.000	0.016	0.014
5	-0.005	-0.032	0.015	-0.002	-0.005	0.016
6	-0.018	-0.027	0.016	0.010	0.001	0.007
7	-0.027	-0.024	0.022	-0.011	0.018	0.022
8	0.000	-0.035	0.008	-0.003	0.004	0.015
9	0.019	-0.061	0.007	0.012	-0.002	0.014
10	-0.007	-0.050	0.011	0.009	0.019	0.012
11	0.002	-0.032	0.022	-0.005	0.014	-0.001

and by dividing ex-day events to quintiles by dividend yield. However, these alternative unreported specifications do not change the previous conclusions on the relative importance of different investor groups trading around the ex-day.

Next, I complement the analysis of trading volume by investigating within-group changes in trading behavior around the ex-dividend day. The buy/sell ratio for each investor category *i* for each event day *t* is computed as:

$$Buy/sell\ ratio_{i,t} = \frac{1}{916}\sum_{j=1}^{916}\frac{Number\ of\ buy\ \ transactions_{i,j,t}}{Number\ of\ buy\ transactions_{i,j,t} + Number\ of\ \ sell\ transactions_{i,j,t}} \quad . \qquad (3)$$

The buy/sell ratio in essence describes whether the median investor in a particular category is on the buy-side or on the sell-side of the market. Figure 1 plots the ratios by investor category for all events and for the highest and lowest dividend yield quintiles. Furthermore, Table 5 reports by investor category and dividend yield quintile *t*-test statistics for the equality of buy/sell ratios on the last cum-dividend day and the first ex-dividend day.

The results for buy/sell ratios in Figure 1 and Table 5 are well in line with the gross and net volume changes and they are also consistent with the dynamic tax clientele explanation. Domestic investors with a preference for dividend income accelerate their buys before a stock goes ex-dividend and increase sells after the stock has gone ex-dividend. Foreigners with a preference for capital gains sell shares cum-dividend and buy ex-dividend. A closer look at the data reveals that the domestic financial corporations are rather active in ex-day trading, but the graph is flat in Figure 1, because these investors trade in both directions in almost equal magnitude. Of 14,764 trades by domestic financial corporations around the ex-dividend day, in 1,296 cases shares bought cum-dividend were sold ex-dividend within the 22-day window, whereas in 1,330 cases a financial corporation sold shares cum-dividend and bought ex-dividend within the 22-day window.[10]

[10]There are three reasons why financial corporations appear to be rather inactive around the ex-day. First, financial corporations act as market makers trading in both directions, even around the ex-dividend day. Second, corporations cannot utilize the tax loss from a buy/sell trade without having to book in a corresponding reduction of profit in the income statement. Third, Finland experienced a banking crisis at the beginning of 1990s, which caused major financial corporations to have substantial tax loss carry forwards, which could be deducted in corporate taxation for up to ten years. Because of the existing tax loss carry forwards, financial corporations generally had no incentive to engage in buy/sell trading to generate additional losses. My evidence is consistent with Grinblatt and Keloharju (2004) who find that Finnish financial corporations do not usually engage in wash sales around the turn of the year.

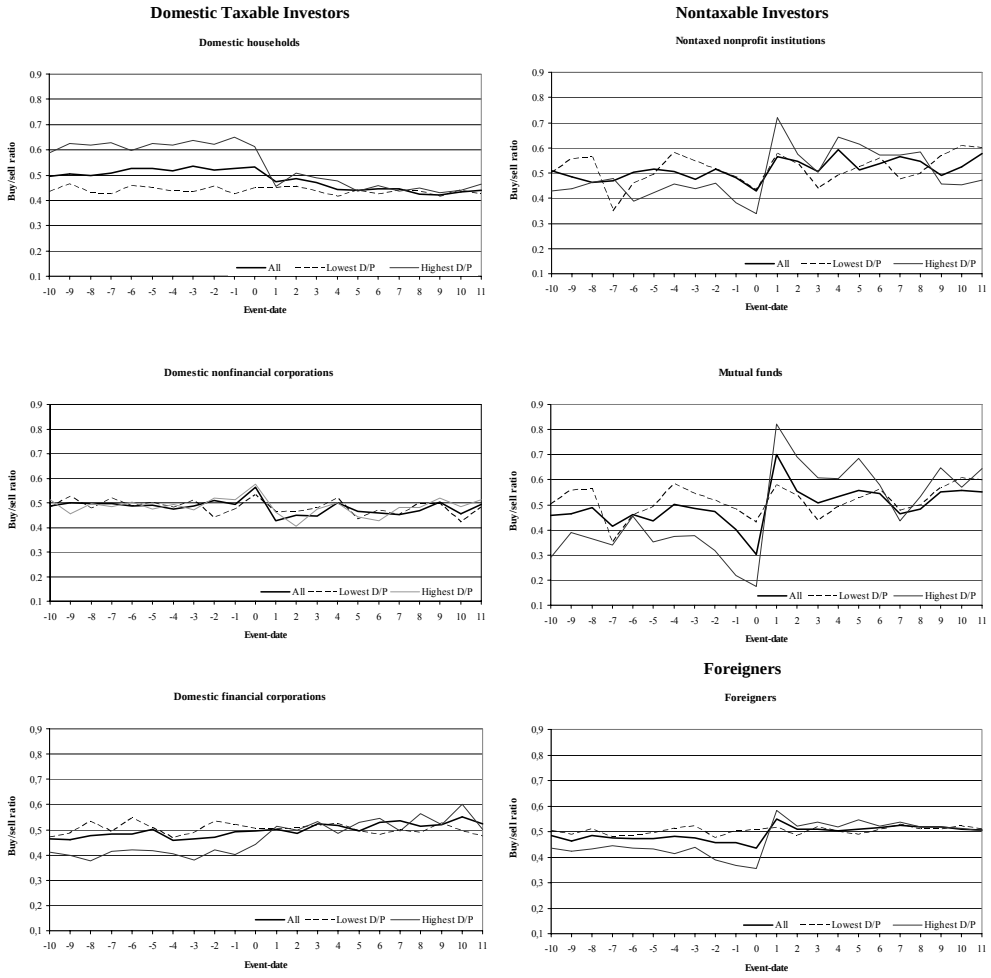


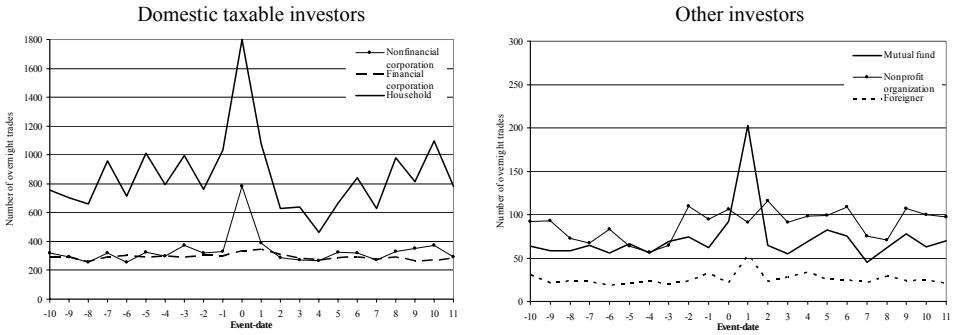
Fig. 1. Trading around ex-dividend day by investor category. The figures plot the relative frequencies of buy and sell transactions by investor group around the ex-dividend day. The buy/sell ratio for an investor category is defined as (# of buy transactions)/(# of buy transactions + # of sell transactions) and is plotted on the y-axis, weighting each ex-dividend day event equally. The results are based on the full sample of 916 ex-dividend events. Event date 0 corresponds to the last date a stock trades cum-dividend and event date 1 to the first date the stock trades ex-dividend. Results are reported for all events as well as for the lowest and the highest dividend yield quintile. The results are based on the full sample of 916 ex-day events. The total number of trades to compute the averages is 2,527,996.

Table 5
t-test for equality of means in buy/sell ratio on event dates 0 and 1
Panel A reports the change in buy/sell ratio between the last cum-dividend day and the first ex-dividend day by investor category and dividend yield quintile. Buy/sell ratio is defined as (# of buy transactions) / (# of buy transactions + # of sell transactions). Two-tailed *t*-statistics are reported in Panel B. The null hypothesis is that buy/sell ratios on the last cum-dividend and the first ex-dividend days are equal.

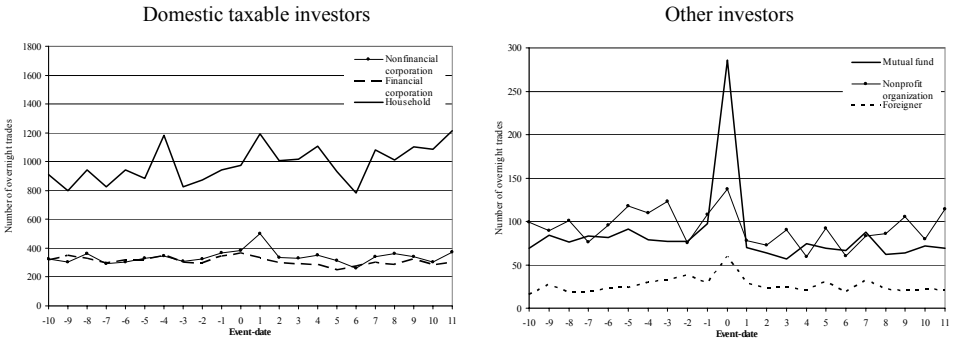
	Domestic taxable investors			Domestic nontaxable investors		Foreigners
	Nonfinancial corporations	Households	Financial corporations	Mutual funds	Nonprofit institutions	
			Panel A: Difference in buy/sell ratio			
D/P quintiles:						
Lowest	-0.072	0.002	-0.004	0.148	-0.025	0.009
2	-0.139	0.011	-0.108	0.440	-0.027	0.056
3	-0.235	-0.063	0.005	0.439	0.161	0.160
4	-0.139	-0.093	0.076	0.416	0.197	0.153
Highest	-0.114	-0.157	0.070	0.650	0.382	0.229
All	-0.137	-0.061	0.006	0.400	0.135	0.113
			Panel B: *t*-values			
D/P quintiles:						
Lowest	-1.91	0.07	-0.12	2.10	-0.36	0.38
2	-2.84	0.29	-2.37	6.23	-0.31	2.03
3	-5.16	-1.75	0.10	6.51	2.05	5.91
4	-2.94	-2.98	1.46	4.93	2.27	4.59
Highest	-2.70	-5.57	1.59	9.95	4.99	6.81
All	-6.94	-4.22	0.28	12.23	3.78	8.76

The change in the buy/sell ratio is especially pronounced for mutual funds, which are selling stocks cum-dividend and buying ex-dividend. In particular, the change in the buy/sell ratio for mutual funds is most extreme in the highest dividend yield quintile, with an overnight change from 0.82 to 0.17. Nonprofit institutions such as municipalities, foundations, and religious institutions also trade around the ex-day, but the change in the buy/sell ratio is less pronounced for this group. This difference between mutual funds and nonprofit institutions in the magnitude of trade direction shift is likely to be explained by differences in regulatory risk and incentives. By law, nonprofit institutions cannot engage in for-profit activities without jeopardizing their tax-exempt status. A mutual fund, on the other hand, is by law bound to act in the best interest of its shareholders, and its status as an untaxed entity does not depend on its trading behavior.

Panel A: Number of overnight buy/sell trades around the ex-day



Panel B: Number of overnight sell/buy trades around the ex-day



Panel C: Trade size of overnight trades by investor category

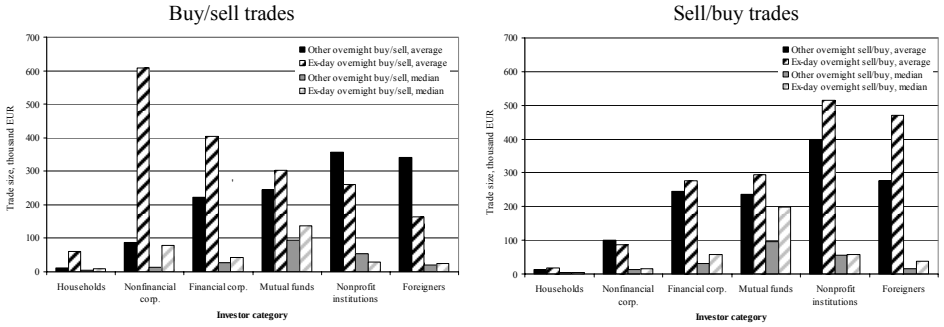


Fig. 2. Number and size of overnight trades. Panel A depicts the number of overnight buy/sell and Panel B the number of sell/buy trades around the ex-dividend day. Panel C illustrates the size of ex-day trades compared with other overnight transactions. The value of position is calculated by multiplying the number of shares traded by the daily close price. The number of observations are 32,588 (domestic taxable investors) and 4,116 (other investors) in Panel A. The corresponding figures are 35,937 and 4,489 for Panel B. In total, there are 494,474 observations in Panel C. For the category of foreigners, only registered investors are included in the analysis.

Moreover, the incentives to perform in the mutual fund industry are likely to be considerably greater than those in the nonprofit sector.

To put the magnitude of ex-day trading into another perspective, I next investigate the number of overnight trades around the ex-dividend day. An overnight buy/sell (sell/buy) trade is defined as a roundtrip transaction in which an investor first buys (sells) shares on a given trading day and then sells (buys) the same shares on the following trading day. For an observation to qualify as an overnight trade, the number of shares traded does not need to be equal on both trading days. For example, if an investor buys 2,000 shares on the cum-dividend day and sells 500 shares on the ex-day, the overnight investment is classified as an overnight buy/sell transaction.

Panels A and B in Figure 2 graph the number of overnight trades around the ex-dividend day, and the size of ex-day trades in comparison with other overnight trades is shown in Panel C. As shown in Panels A and B, the number of overnight transactions increases sharply on the cum-dividend day; especially mutual funds are active in short-term sell/buy trading around the ex-day when they more than double the number of overnight transactions. Furthermore, Panel C in Figure 2 shows that the short-term traders also take larger positions around the ex-dividend day. While the median value of an overnight position held by a household is EUR 9,524 in cases where a stock is going ex-dividend, the median value of an overnight position is only EUR 4,480 on other trading days. Correspondingly, for a mutual fund, the median value of a trade is EUR 198,125 for a sell/buy transaction around the ex-day, and EUR 96,902 on other trading days.

Taken together, there are two broad conclusions that can be drawn from the market level results. First, the composition of trading volume, buy/sell ratios, and number of overnight trades indicate that nonfinancial corporations and households sharply shift from the buy-side on the last cum-dividend day to the sell-side on the first ex-dividend day. The reverse is true for foreign investors and for mutual funds. Both observations are consistent with the dynamic tax clientele explanation (e.g., Michaely and Vila, 1995), which predicts that differences in tax rates drive trading behavior around the ex-dividend day. Second, the observed active short-term trading behavior of mutual funds is consistent with Kalay (1982), who argues that investors with an equal preference for dividends and capital gains facing low transaction costs should engage in trading around the ex-dividend day, as long as the price drop on the ex-day does not equal the value of the dividend.

But do the trading clienteles have an impact on the ex-dividend day premium? Michaely and

Vila (1995) show that the expected ex-day premium is the sum of two components. The first component is the average dividend preference ratio of all agents trading around the ex-dividend day, weighted by the tax-adjusted risk aversion of each investor. The second component adjusts for the risk involved in ex-day trading. Assuming constant absolute risk aversion across investors, as in Michaely and Vila (1995, p. 180), the first component of the expected premium can be expressed as a linear combination of the proportions of the various investor categories trading on the ex-day. In an unreported analysis, I regress ex-dividend day premium on both relative proportions of trading volume and ownership, but find no robust evidence that trading or holding clienteles would have an impact on the ex-day premium. This finding is at odds with Graham and Kumar (2006), who find modest evidence of a tax-induced clientele effect being compounded in stock prices. The controversy is most likely to be explained by the difference in statistical power: Graham and Kumar (2006) find a price impact with data on 10,000 ex-day events, whereas my sample is limited to 672 events.

5.3. Profitability of overnight trading

In the previous section, it was shown that the number of overnight transactions increases around the ex-dividend day. On the one hand, as the tax code creates opportunities for mutually beneficial trading around the ex-day at the expense of the government, the trades may generate considerable overnight returns. On the other hand, returns from the overnight risky arbitrage are constrained by transaction costs.

I compute absolute returns from overnight trading around the ex-day in three different scenarios. First, I calculate returns without transaction costs and assume zero tax deductibility of capital losses generated by buy/sell trading, which is the case when an investor does not have enough capital gains to utilize the generated losses. Second, I assume that losses from buy/sell trading are not deductible, but investors must pay transaction costs. In the third scenario, I assume that investors must pay transaction costs, and losses are fully deductible.

Domestic financial corporations that are members of HEX face the lowest transaction costs. These investors pay HEX a variable 0.00244% commission, which is capped to a maximum of EUR 75. Due to investor anonymity, it is impossible to identify which financial corporations are members of HEX, or achieve very low transaction costs for other reasons (e.g., an insurance company trading through a broker belonging to the same group). As a result, I compute transaction costs for all financial corporations as if they were members of HEX.

During the sample period, brokers typically charged 0.15-0.25% for the value of a trade from their institutional investor clients, and 0.2% without a fixed component was the most common commission. Consequently, I use 0.2% for all institutional investors other than financial corporations.

Retail investors pay the highest trading commissions. The most inexpensive online broker charged EUR 8.25 + 0.2% during the sample period, while the clients of the most expensive broker had to pay 1% for the value of a trade with a minimum of EUR 27. Because the investors trading around the ex-dividend day represent the very active part of the general investor population, as reported in descriptive statistics in Table 7, they are likely to be cost conscious. For this reason, I use the lowest fee of the online broker to calculate transaction costs for registered foreigners (of which the majority are private investors), domestic households, and nonfinancial corporations.

Table 6 reports results for the profitability of overnight trading around the ex-day. The results indicate that nontaxable investors and foreigners, who mostly engage in sell/buy trading, are successful in generating positive returns, even after transaction costs. For domestic households and nonfinancial corporations, the conclusion on profitability depends on whether the investor is able to utilize the capital losses generated by buy/sell trading. If the capital loss generated by an overnight buy/sell transaction can be fully utilized, short-term ex-day trading is profitable, on average, even after transaction costs. However, if the investor is unable to utilize the capital loss generated from an overnight buy/sell transaction, short-term ex-day trading is unprofitable.

In Figure 3, I demonstrate the yield to capital invested overnight by dividing the average and median trading profit by the value of overnight position. The return on overnight investment is considerable: on aggregate, an overnight risky arbitrage trade around the ex-day yields a 2% return after tax deduction and transaction costs. Nontaxable investors and registered foreigners achieve the highest returns, although this finding could be influenced, at least partially, by the rather modest number of observations. In contrast, households and nonfinancial corporations have below average returns, a result which can be explained in two ways. First, even though domestic households and nonfinancial corporations have the same tax status as domestic financial corporations, they generate smaller returns before transaction costs. Hence, domestic households and nonfinancial corporations are less likely to trade around the ex-day events, which from their perspective, have the most favorable ex-day ratio. Second, higher transaction costs of retail investors further bring down their net returns.

Table 6
Profitability of overnight trading around the ex-day
This table reports the profitability of overnight ex-dividend day trading. The sample includes all overnight buy/sell transactions (an investor buys shares on the last cum-dividend day and sells on the ex-day) and sell/buy transactions (an investor sells shares on the last cum-dividend day and buys on the ex-day) around the ex-day between years 1995 and 2002. The columns *Tr. costs* and *Tax-ded.* indicate whether transaction costs and tax-deduction are included in the calculation of trading profit. Transaction costs are calculated by assuming a EUR 8.25 + 0.2% commission (smallest commission charged by an online broker) for households, nonfinancial corporations, and registered foreigners; 0.2% commission (most common commission agreement for institutional investors) for mutual funds and nonprofit institutions; and 0.00244% commission with maximum of EUR 75 (fee charged from brokers members of HEX) for financial corporations. Tax deduction is calculated for buy/sell transactions as MIN(Transaction price on the cum-day – Transaction price on the ex-day)*(Volume of shares traded) x Tax rate, 0). If an investor has multiple trades on the same trading day, volume-weighted price is used. Furthermore, if the transaction volumes are not equal on cum- and ex-dividend day, the trading profit is calculated for the smaller transaction volume. All values reported below are in EUR.

Trading profit from overnight buy/sell or sell/buy transaction										
	Tr. costs	Tax-ded.	Mean	Median	St. dev.	Skew.	Kurt.	Min	Max	N
Panel A: Taxable domestic investors										
Household	No	No	-509.10	19.00	7,332	-5.72	188.52	-144,253	118,313	1,484
	Yes	Yes	1,594.94	177.10	8,581	7.05	93.77	-78,636	124,909	1,484
	Yes	No	-824.54	-38.21	7,972	-6.97	182.84	-161,896	117,040	1,484
Nonfinancial corporation	No	No	-18,085.60	-0.03	472,618	-29.01	844.39	-13,800,000	185,900	850
	Yes	Yes	-6,402.31	485.84	334,026	-28.91	840.70	-9,712,376	200,446	850
	Yes	No	-20,241.13	-346.32	476,494	-28.99	843.76	-13,900,000	184,428	850
Financial corporation	No	No	8,533.67	119.89	51,819	13.74	238.43	-51,426	973,000	522
	Yes	Yes	10,058.68	498.68	51,760	13.68	237.50	-48,885	972,784	522
	Yes	No	7,939.44	64.84	51,816	13.74	238.70	-51,543	972,784	522
Panel B: Nontaxable investors and foreigners										
Mutual fund	No	No	13,594.95	6,264.99	22,364	4.06	24.70	-20,576	190,080	324
	Yes	No	13,544.70	6,248.02	22,347	4.07	24.74	-21,632	189,978	324
Nonprofit institution	No	No	13,387.23	3,827.82	40,526	1.07	9.52	-127,440	173,800	52
	Yes	No	11,283.71	3,528.40	41,794	0.12	10.67	-161,155	165,273	52
Foreigner	No	No	20,285.01	1,374.00	56,580	3.65	16.34	-4,617	310,310	54
	Yes	No	17,776.89	1,230.36	51,420	3.74	17.05	-10,954	284,917	54

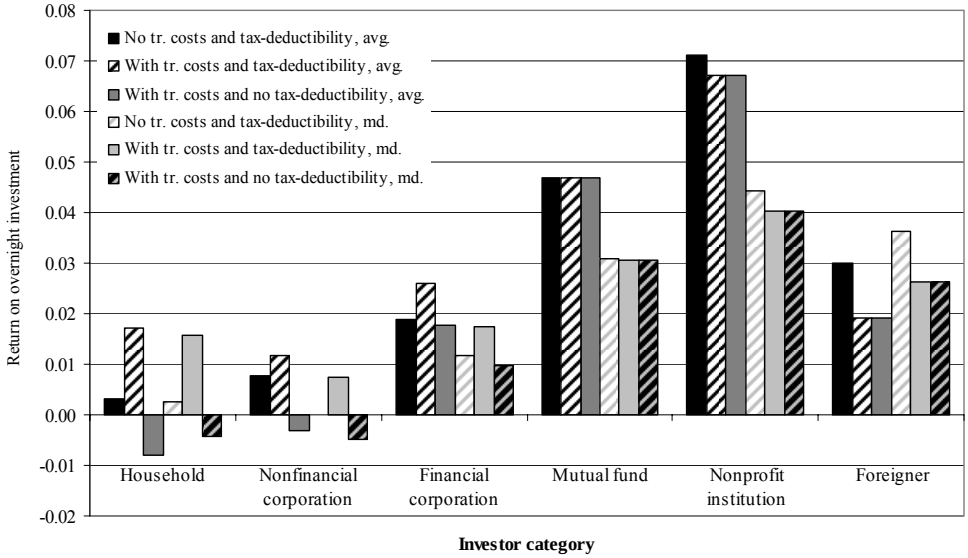


Fig. 3. The figure depicts the yield to invested capital from an overnight arbitrage transaction around the ex-day. The data are the same as in Table 6, and trading profit or loss from an overnight transaction is divided by the value of shares traded on the cum-dividend day. The figure charts average (*avg.*) and median (*md.*) overnight trading profits for six investor categories. The total number of observations is 3,286. For the category of foreigners, the sample includes only registered investors.

5.4. Timing of ex-day trades

Not all traders who make a roundtrip transaction around the ex-day are necessarily overnight traders. In fact, Allen and Michaely (2004) attribute the abnormal returns around the ex-dividend day in Eades, Hess, and Kim (1984) to investors who trade several days before and after the ex-dividend day rather than trading only on the last cum-dividend and the first ex-day. To find out if investors indeed start trading several days before the ex-day, I next investigate how investors time their trades around the ex-dividend day. To this end, I examine all observations in which an investor has a strictly positive change in the position of a stock going ex-dividend in the 11-day window before the ex-day, and an offsetting strictly negative change in the position in the 11-day window after the ex-day. Figure 4 plots the distribution for the timing of buy cum-dividend sell ex-dividend transactions by all domestic investors and registered foreigners.[11]

[11] I perform the same analysis separately for different investor categories, and find the results to be qualitatively similar. Plots of the same graph for trades by investors selling cum-dividend and buying ex-dividend transactions reveal an identical overnight spike in the timing of trades.

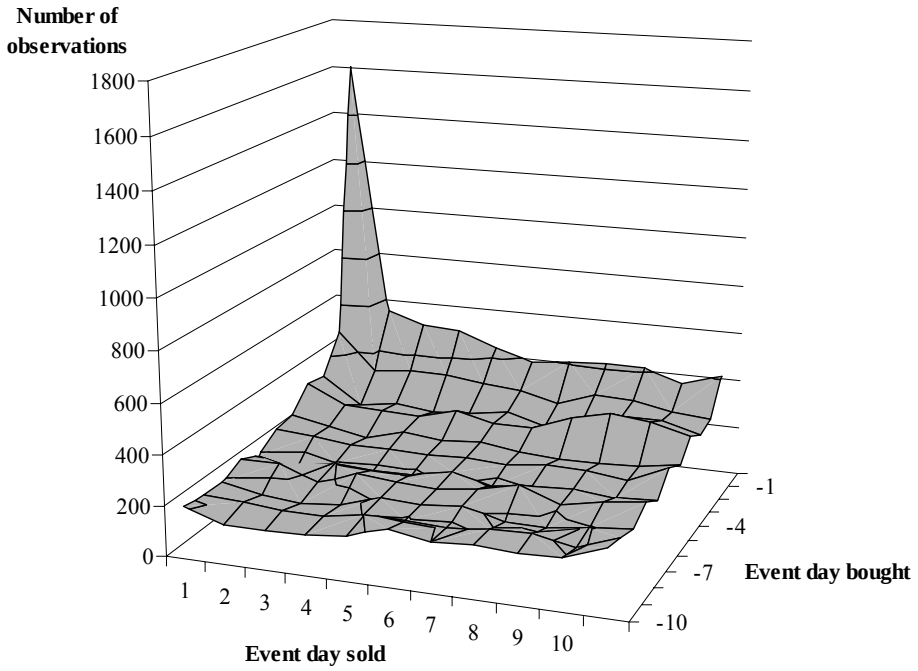


Fig. 4. Timing of trades around the ex-dividend day. This figure depicts the distribution of trades around the ex-dividend date in the full sample of 916 ex-dividend day events in FCSD data. The sample includes all observations in which an investor accumulates a position in a stock cum-dividend and subsequently reduces the position in the same stock ex-dividend in the [-10, 11] (inclusive) day window around the event. Z-axis represents the day the investor first increased position in the stock before ex-dividend date, X-axis the last day the investor reduced position in the stock after ex-date, and Y-axis the number of observations. If the investor buys the same stock cum-dividend or sells ex-dividend in several days around an ex-dividend day event, one buy and one sell are selected at random. The number of observations is 32,012.

As can be observed from the spike at the far-left comer of Figure 4, short-term trades are heavily concentrated on the last cum-dividend and the first ex-dividend day. For future analysis, I single out the overnight trades by domestic taxable investors, because these investors have the strongest incentive to engage in buy/sell trading, and they were shown earlier to accelerate buys cum-dividend and sells ex-dividend. This overnight selection is also consistent with the assumption that very few investors are likely to hold shares going ex-dividend overnight on the last cum-dividend day for other than tax reasons, while this might not be the case in a broader event window.

5.5. Determinants of ex-dividend day trading: investor level analysis

The theoretical work in the ex-day literature concentrates primarily on the influence of taxes on trading incentives around the ex-day. However, some authors, such as Heath and Jarrow (1988), Michaely and Vila (1995), and Michaely et al. (1996), argue that factors other than differential tax rates, such as risk and transaction costs, have an impact on trading decisions. To investigate the relevance of these factors, this subsection employs an investor level analysis to document which stocks investors choose for overnight tax arbitrage around the ex-day. For this purpose, I use the overnight buy/sell trades, in essence those which primarily contribute to the spike in Figure 4, and a control group of observations.

I model the choice of tax arbitrage stock by domestic taxable investors with logit regression by coding overnight buy/sell tax arbitrage trades as ones and the control group overnight trades as zeros. For the control group, I pick all overnight trades not related to ex-dividend day trading by the investors in my sample. Hence, I am comparing the determinants of ex-day trades against other overnight trades by the very same investors. The sample consists of 31,961 (initially 48,882) trades by nonfinancial corporations and households, and 37,042 (initially 48,592) trades by financial corporations. The unavailable observations are mostly explained by the lack of past returns to compute betas.

Table 7 reports descriptive statistics for the final sample. The investor level variables include the logarithm of market value for all shares in the portfolio one day before the trade, and the percentage weight of the traded stock in the portfolio one day prior to the trade. The variable for capital gains is defined as:

$$\text{Capital gains} = \frac{\text{Realized capital gains year to date}}{|\text{ Realized capital gains year to date }| + \text{Value of portfolio}}. \qquad (5)$$

The variable measures the expected capital gains tax liability of an investor in the fiscal year of the trade, normalized by the investor's portfolio value. To avoid very high variation in the variable, the absolute value of capital gains is included in the denominator. For reasons described in Section 4, capital gains cannot be calculated for all observations, and the remaining subsample consists of 2,653 out of 31,961 observations for domestic households and nonfinancial corporations. For financial corporations, the subsample comprises only 193 observations, and the results for a regression including the capital gains variable are not reported.

Table 7
Descriptive statistics of the sample of tax arbitrage trades
This table reports descriptive statistics on the sample of tax arbitrage and other overnight (control observation) trades by domestic taxable investors. The investor level statistics in Panel A are based on equally weighted data, where one investor is treated as one observation. The rest of the statistics are based on trade-weighted statistics, one trade (aggregated on a daily basis) representing one observation. Statistics in Panel B and Panel C are reported for the combined sample of household and nonfinancial corporate investors with results reported in column 1 of Table 8.

	Mean	Median	Std. Dev.	Skewness	Kurtosis	Min	Max	N
Panel A: Investor level statistics								
Nonfinancial corporate investors								222
Financial corporate investors								48
Household investors								760
- of which males								623
- of which females								137
Age	42.98	42.00	13.31	0.10	0.27	2.00	91.00	760
Nonfinancial corporations								
Portfolio value, million euros	8.64	0.81	19.22	4.21	34.97	0.00	375.82	18,512
Weight in target stock	0.07	0.10	0.18	0.06	13.66	-1.00	1.00	18,512
Capital gains	0.02	0.00	0.34	0.34	6.74	-1.00	1.00	789
Number of trades	1318.49	794.00	1555.33	1.32	3.13	1.00	4431.00	18,512
Number of shares in portfolio	22.67	13.00	25.13	1.59	4.55	0.00	108.00	18,512
Financial corporations								
Portfolio value, million euros	41.70	9.85	77.10	3.44	20.48	0.00	1090.00	37,042
Weight in target stock	0.06	0.01	0.19	1.09	14.72	-1.00	1.00	37,042
Capital gains	0.05	0.02	0.10	1.65	13.34	-0.48	0.51	193
Number of trades	3274.51	3020.00	2249.42	0.44	2.09	3.00	7215.00	37,042
Number of shares in portfolio	41.32	37.00	22.64	0.74	3.09	1.00	107.00	37,042
Households								
Portfolio value, million euros	0.38	0.05	2.10	8.67	81.81	0.00	30.40	13,449
Weight in target stock	0.36	0.28	0.37	16.30	1277.61	-12.27	23.94	13,449
Capital gains	0.06	0.03	0.30	0.45	7.09	-1.00	1.00	1,864
Number of trades	145.95	81.00	145.02	1.13	3.22	1.00	574.00	13,449
Number of shares in portfolio	8.75	5.00	12.99	6.75	87.46	0.00	250.00	13,449
Panel B: Firm level statistics								
Dividend yield	0.04	0.02	0.06	6.66	63.28	0.00	0.91	31,961
Bid/ask spread	0.01	0.00	0.01	6.24	90.96	0.00	0.40	31,961
Beta	1.12	1.01	0.58	0.25	2.14	-0.27	2.54	31,961
Idiosyncratic risk / St. dev. of market	2.02	1.93	0.69	2.13	17.99	0.00	9.16	31,961
Panel C: Other								
Daily standard of market index	0.03	0.03	0.03	14.24	347.12	0.00	0.78	31,961

The set of firm level variables consists of dividend yield (dividend from the last fiscal year divided by the current market price of the stock), bid/ask spread [defined as 2(ask – bid)/(ask + bid)], beta (3-year historical weekly rolling beta), and idiosyncratic risk (standard deviation of the residual term of beta estimation regression divided by the standard deviation of the market index during the same period). Variable for standard deviation of the market index is estimated from daily market returns around the trade, using a window of [-10, 10], inclusive. I control for year, gender, investor age, and the investor's log-number of overnight trades in the sample.[12] The reason for including the last variable is the sample construction method. An investor can engage in overnight ex-day arbitrage in a given stock only once a year, while the control observations are from all other trading days. This limited window for ex-day trading the probability of ex-day trading to also be a function of trading activity in my sample, which must be controlled for.

As shown in Table 7, the average and median values for the number of shares and for portfolio value clearly indicate that the sample consists of rather wealthy and well-diversified investors. For example, the median portfolio value at the end of 1998 for all Finnish investors (roughly the time series midpoint of the FCSD data) was EUR 5,638 for nonfinancial corporations and EUR 2,224 for domestic households, while the respective figures are EUR 808,253 and EUR 45,870 for the overnight tax arbitrageurs. Furthermore, the median household and nonfinancial corporate investor holds only one stock in the complete FCSD data, whereas the median household tax arbitrageur holds five, and the median nonfinancial corporate tax arbitrageur thirteen stocks.

The results for the investor level determinants of tax arbitrage activity are reported in Table 8. The overall impression of the results in Table 8 is that investors' propensity to engage in tax arbitrage is positively related to dividend yield, and negatively related to transaction costs. The hypothesis on higher risk deterring ex-dividend day traders (Michaely and Vila, 1995; Michaely et al., 1996) also gains strong support in the data.

Volatility of the market, beta risk, and idiosyncratic risk all diminish the probability that an investor will engage in overnight tax arbitrage.[13] Based on inference from unreported marginal

[12] Although correlated with portfolio size ($\rho = 0.47$), including log-number of trades in the analysis does not signal on serious multicollinearity problems. The highest variance inflator factor statistics (VIFs) have values well under 5, where 10 is typically considered a critical value.

[13] Using risk measures estimated from the national market index assumes that international capital markets are fully segmented. As a robustness check, I rerun all analyses by using Datastream Europe Total Return Index and Datastream World Total Return Index as the market portfolio. The results are not sensitive to the change in market index.

Table 8
Choice of arbitrage stock: stocks bought on last cum-day and sold on first ex-day
This table reports the results for the choice of tax arbitrage stock. The binary dependent variable has the value of 1 if an investor accumulates position in a stock going ex-dividend on the last cum-dividend day and subsequently reduces position in the same stock on the first ex-dividend day. The control group coded as zeros consists of all other overnight transactions by the same investors. *Beta* is estimated from weekly historical returns over a period of 3 years. *Idiosyncratic risk* is the residual term from the regression of *beta*, scaled with standard deviation of the market index. *Dividend yield* is the cash dividend per share divided by last closing price, whereas *bid-ask spread* is defined as 2(ask-bid)/(ask+bid). *Ln* (*portfolio value)* is the natural logarithm of the portfolio value by an investor on the day before the trading day. *Nonfinancial corporation* dummy has the value of 1 if the investor is a nonfinancial corporation, 0 if a household. *Weight in target stock* is the value of holdings in the traded stock divided by total portfolio value one day before the transaction. *Capital gains* is defined as (realized capital gains year to date) / (|realized capital gains year to date| + value of portfolio). *Ln* (*number of trades)* is the natural logarithm of the number of overnight trades the investor has in the sample. *Standard deviation of market index* is the daily standard deviation of HEX Portfolio Yield Index calculated from [-10, 10] window around the trade. Specification 1 is a logit regression with all observations for households and nonfinancial corporations. Specification 2 includes only households and specification 3 includes only nonfinancial corporations. Specification 4 includes only financial corporations. Specification 5 includes household and nonfinancial corporation observations for which the realized capital gains for the fiscal year are known. The reported results are estimated coefficients of probability density function. There are no observations from year 1995 in specification 4. *t*-values are reported under coefficient estimates. *, **, and *** denote significance at 10%, 5%, and 1% levels, respectively.

Dependent variable		Binary: 1 if investor arbitrages a stock going ex-dividend				
		Logit				
Specification	Expected sign	HH and Nonf. corp.	Household	Nonfinancial corporation	Financial corporation	Capital gains available
		1	2	3	4	5
Constant	+/-	3.42***	4.00***	3.40***	-1.34**	4.71***
		16.80	*12.21*	*11.65*	*-1.99*	*9.41*
Nonfinancial corporation	+/-	0.25***				0.45***
		3.49				*2.67*
Ln (portfolio value)	+	0.05***	0.03*	0.07***	0.03	0.07***
		5.49	*1.89*	*4.79*	*1.20*	*3.11*
Weight in target stock	-	-1.04***	-0.09	-1.89***	-0.69	-1.68***
		-5.15	*-0.32*	*-6.48*	*-1.27*	*-3.09*
Capital gains	+					-0.06
						-0.26
Ln (number of trades)	-	-0.91***	-0.81***	-1.01***	-0.42***	-1.31***
		-43.85	*-28.01*	*-32.11*	*-8.14*	*-18.76*
Dividend yield	+	4.53***	4.08***	4.75***	1.71**	8.53***
		14.92	*7.80*	*12.16*	*2.39*	*7.81*
Bid/ask spread	-	-20.77***	-11.72**	-27.88***	-12.42*	-15.18**
		-6.24	*-2.51*	*-5.86*	*-1.70*	*-2.37*
Beta	-	-0.62***	-0.54***	-0.64***	-0.21	-0.53***
		-7.22	*-3.54*	*-5.97*	*-1.06*	*-3.23*
Idiosyncratic risk	-	-0.78***	-0.95***	-0.70***	-0.04	-0.54***
		-9.35	*-6.21*	*-6.91*	*-0.22*	*-4.39*
Standard deviation of market index	-	-59.08***	-82.50***	-43.01***	-47.45***	-81.35***
		-8.09	*-6.88*	*-4.46*	*-2.94*	*-4.15*
Year dummies						
1995		-0.63***	-0.73***	-0.63*	0.12	-1.82**
		-3.75	*-3.60*	*-1.76*	*0.38*	*-2.15*
1996		-0.25**	-0.43**	-0.35	-0.14	-0.10
		-1.97	*-2.56*	*-1.50*	*-0.51*	*-0.28*

Table 8 - *Continued*

1997	-0.31**	-0.19	-0.92***	-0.33	-0.41
	-2.49	*-1.17*	*-4.04*	*-1.29*	*-1.16*
1998	-0.17	-0.27	-0.23	-0.21	-0.07
	-1.43	-1.54	-1.28	-0.82	*-0.29*
1999	-0.52***	-0.91***	-0.33**	-0.29	-0.83***
	-4.39	*-4.19*	*-2.29*	*-1.20*	*-2.75*
2000	0.22**	0.05	0.19	0.31	-0.06
	2.04	*0.26*	*1.40*	*1.28*	*-0.20*
2001	-0.11	-0.19	-0.16	-0.04	-0.32
	-1.04	*-0.97*	*-1.24*	*-0.19*	*-1.22*
Individual investor characteristics					
Female		0.00			
		0.60			
Age - 15		0.66**			
		2.22			
Age 16-25		0.31			
		1.56			
Age 26-35		-0.10			
		-0.83			
Age 46-55		-0.17			
		-1.50			
Age 56-65		-0.13			
		-1.01			
Age 66 -		-0.05			
		0.26			
McFadden´s pseudo R^2	0.335	0.273	0.368	0.029	0.506
Chi-square statistic	4,222.85	1426.78	2612.03	85.32	1,262.02
Number of observations	31,961	18,512	13,449	37,042	2,653

effects at the sample means, the results in all specifications indicate consistent with Michaely et al. (1996) that idiosyncratic risk more strongly discourages trading than beta risk. There is also evidence that investors are less likely to trade around the ex-day a stock in which they already have a position, a finding which further supports the argument by Michaely and Vila (1995, p. 178) and Michaely et al. (1996) that idiosyncratic risk is a determinant of ex-day trading activity.

In addition to risk, transaction costs influence the investor's propensity to engage in overnight ex-day trading, a conclusion which has also been drawn from aggregate volume data by earlier research (e.g., Michaely and Murgia, 1995; Michaely and Vila, 1996). The coefficient of bid/ask spread is negative and significant at least at the 5% level in all regressions, except in the sample of financial corporations. This finding for bid/ask spread conforms to the prediction of Boyd and Jagannathan (1994), who argue that transaction costs have an influence on the arbitrageur's decision to undertake ex-day trading, and also with Michaely et al. (1996) who show ex-day volume to be a decreasing function of transaction costs.

The wealthier and arguably more sophisticated investors are more likely to engage in overnight ex-dividend day trading, as shown by the positive coefficient of portfolio value for both domestic households and nonfinancial corporations. Age dummies exhibit almost a monotonic pattern; young investors tend to be financially savvier and trade more around the ex-dividend day. Gender has no significant impact on the probability that an investor will engage in tax arbitrage.

Nonfinancial corporate investors tend to trade more around the ex-day than domestic households. There is also evidence that they are less risk-averse: the results for beta and idiosyncratic risk, as well as for current holdings, are stronger for households than for corporations. For financial corporations, however, the results are rather modest. For the risk and transaction cost variables, the coefficients are much weaker, approximately one-third to one-half of the magnitude in the sample of nonfinancial corporations and households. As financial corporations are trading very frequently (the sample median is 3,020 trades a year), it may be difficult to disentangle their motives for ex-day trades from the constant flow of transactions.

The last column in Table 8 reports the results from a regression that includes a variable for capital gains in the sample of nonfinancial corporations and households. An investor with large realized capital gains would be expected to have a greater incentive to generate tax-deductible losses by ex-dividend day trading than an investor with no or negative realized capital gains. However, the capital gains variable does not capture this expectation: the coefficient is negative, but not statistically significant at conventional levels.

To sum up, the results in this subsection provide strong support for the dynamic dividend clientele theories (Boyd and Jagannathan, 1994; Michaely and Vila, 1995; Michaely et al., 1996): transaction costs, dividend yield, beta risk, and especially idiosyncratic risk influence trading decisions around the ex-day. Another way to investigate the determinants of ex-day trading is to study which firms attract the most tax arbitrage activity as a fraction of the total trading volume. This requires an analysis from the firm level perspective, which is what I do next.

5.6. Determinants of ex-dividend day trading: firm level analysis

To explain which firms attract short-term trading on the ex-day, I use as a dependent variable the volume of short-term trading activity (buy/sell or sell/buy trades) divided by the total trading volume on the ex-day. In essence, this measure indicates what proportion of total trading volume is related to overnight trading (either buy/sell or sell/buy) by domestic investors and registered foreigners. The variable for the proportion of short-term trading has an average of 4%

(buy/sell) and 1% (sell/buy), varies from zero to 100%, and is nonzero in 278 (buy/sell) and 276 (sell/buy) of 479 cases. Further descriptive statistics for the narrow sample of 479 stocks are given in Table 9.

Table 9
Descriptive statistics on the narrow sample
This table reports equal-weighted statistics on the narrow sample of stocks with results reported in Table 10. *Dividend yield* is the absolute value of dividend divided by the share price on the last cum-dividend day, and *bid/ask spread* is defined as 2(ask-bid)/(bid+ask). *Beta* is calculated from weekly three-year historical observations by using HEX Portfolio Yield Index as proxy for the market portfolio, and *book value of assets* is measured at the beginning of the year. *Number of buy/sell* (*sell/buy*) *trades* is the number of overnight transactions with a buy (sell) on the last cum-dividend day and a sell (buy) on the ex-day. Correspondingly, *volume of buy/sell* (*sell/buy*) *trades* is the total volume of buy/sell and sell/buy transactions. *Proportion of buy/sell* (*sell/buy*) *trades* is the volume of corresponding overnight trades divided by the total trading volume.

Variable	Min	Max	Mean	Skew-ness	Kurtosis	St. dev.	Median	N
Dividend yield	0.00	0.39	0.04	5.16	34.91	0.04	0.03	479
Bid/ask spread	0.00	0.20	0.03	2.18	5.95	0.03	0.02	479
Beta	-0.17	2.06	0.62	0.85	1.04	0.38	0.56	479
Book value of assets, MEUR	10.62	50,243.28	2,644.07	4.68	29.55	5,408.06	910.82	479
Number of buy/sell trades	0.00	93.00	3.28	6.89	58.72	8.76	1.00	479
Number of sell/buy trades	0.00	36.00	1.97	4.05	29.40	3.23	1.00	479
Volume of buy/sell trades, EUR	0.00	3,208,400.00	71,889.11	7.50	65.42	275,766.85	1,000.00	479
Volume of sell/buy trades, EUR	0.00	5,796,400.00	145,613.35	6.49	49.58	534,109.85	1,240.00	479
Proportion of buy/sell trades	0.00	1.00	0.0399	6.06	43.40	0.11	0.00	479
Proportion of sell/buy trades	0.00	0.02	0.0102	0.95	0.37	0.00	0.01	479

A priori, there are strong grounds for expecting the degree of short-term trading activity to be non-normally distributed. This is because the expected ex-day ratio of firms that attract a nonzero degree of tax arbitrage activity should lie inside the no-arbitrage boundaries, which are determined by dividend yield and transaction costs (Kalay, 1982). Similarly, there should also be many ex-day events with absolutely no short-term trading, as arbitrageurs would not expect to make a profit because of excessively high transaction costs and too low dividend yield. This requirement for a non-negative level of tax arbitrage activity is consistent with Kalay, and creates a potential self-selection bias, which I correct for modeling the proportion of tax arbitrage activity

Table 10
Firm level regressions on volume of tax arbitrage
This table documents results for the degree of overnight tax arbitrage activity as a fraction of total trading volume. The results are reported for overnight buy/sell and sell/buy trading activity. The dependent variable is binary in specifications 1, 3, 4, and 6, taking the value of 1 if there is any overnight trading around the ex-dividend day, zero otherwise. Specifications 2 and 5 report results from the second step of Heckman's (1979) two-step estimation procedure, with a continuous dependent variable defined as ex-dividend day overnight tax arbitrage trading volume divided by the total trading volume. In specifications 3 and 6, all observations are grouped to 25 groups according to their dividend yield and bid/ask spread with a dummy for each group except for one. *Ln* (*assets)* is the natural logarithm of the total assets from the last reported fiscal year. All other variables are specified as in Table 8. *t*-values are reported under coefficient estimates. Asterisks mark significance at standard levels (***, **, and *, for 1%, 5%, and 10%, respectively).

Dependent variable:		Tax arbitrage activity on cum-dividend day					
		Proportion of buy/sell tax arbitrage			Proportion of sell/buy tax arbitrage		
Specification	Exp. sign	Probit	Heckman 2nd stage	Probit w/ dummies	Probit	Heckman 2nd stage	Probit w/ dummies
		1	2	3	4	5	6
Constant	+/-	-0.46	-0.04	0.65	-0.35	-0.05	0.68
		-1.01	*-1.15*	*0.95*	*-0.72*	*-0.42*	*0.97*
Bid/ask spread	-	-16.39***	-0.75		-20.76***	-0.004	
		-5.59	*-1.17*		*-6.02*	*-0.002*	
Dividend yield	+	4.56**	0.25		5.20***	0.14	
		2.51	*1.56*		*2.72*	*0.28*	
Beta	-	0.56**	-0.01	0.58**	1.25***	-0.01	1.29***
		2.11	*-0.30*	*2.04*	*4.07*	*-0.08*	*4.04*
Idiosyncratic risk	-	-0.24	0.01	-0.07	-0.40**	0.02	-0.38*
		-1.44	*0.79*	*-0.37*	*-2.08*	*0.31*	*-1.88*
Ln (assets)	+	0.11**		0.11**	0.12**		0.13**
		2.27		*2.24*	*2.46*		*2.55*
Standard deviation of market index	-	12.14	-0.54	-4.33	12.29	9.41	3.68
		0.49	*-0.25*	*-0.17*	*0.44*	*1.23*	*0.13*
Year dummies							
1995		-0.19	0.01	0.10	-0.27	-0.03	-0.19
		-0.60	*0.30*	*0.29*	*-0.78*	*-0.31*	*-0.50*
1996		0.56**	0.05**	0.83***	0.12	0.16**	0.24
		1.97	*2.11*	*2.78*	*0.41*	*2.29*	*0.77*
1997		0.85***	0.06**	1.30***	0.56*	-0.02	0.72**
		2.77	*2.07*	*3.77*	*1.76*	*-0.30*	*2.05*
1998		0.29	0.03	0.53*	0.35	-0.03	0.45
		1.15	*1.52*	*1.91*	*1.27*	*-0.36*	*1.48*
1999		-0.30	0.04*	-0.36	-0.56*	0.02	-0.53*
		-1.12	*1.71*	*-1.25*	*-1.93*	*0.24*	*-1.73*
2000		-0.02	0.01	0.29	-0.85*	-0.11	-0.61
		-0.04	*0.22*	*0.63*	*-1.74*	*-0.76*	*-1.20*
2001		-0.22	0.02	0.02	-0.70*	-0.06	-0.58
		-0.63	*0.61*	*0.05*	*-1.85*	*-0.55*	*-1.48*
Lambda			0.10**			-0.02	
			1.98			*-0.18*	

Table 10 - *Continued*

D/P and Bid/ask quintile dummies						Reported in Table 11
Pseudo R^2	0.199		0.257	0.311		0.341
Adjusted R^2		0.095			-0.009	
Chi-square statistic	129.76	55.54	167.57	203.26	25.35	222.83
F-statistic		3.24			0.82	
Number of observations	479	278	479	479	276	479

using Heckman's (1979) sample selection specification. I also include a firm size variable in the first stage to control for the fact that the smallest and most illiquid stocks generally do not attract any ex-day trading. The firm size variable is removed from the second stage of the Heckit estimation to ensure model identification.

The results, reported in Table 10, corroborate the findings from the previous investor level regressions. Transaction costs are negatively related to the probability that a firm attracts a strictly positive volume of overnight transactions on the ex-day, and dividend yield, along with firm size, is positively related. In the second stage of the Heckit model, the degree of short-term trading activity is not driven by any of the first-stage explanatory factors. The only unexpected result is the coefficient on beta in the first-stage probit estimates, which is positive and significant.

In columns 3 and 6 of Table 10, a nonlinear specification is introduced to model the relation between dividend yield, transaction costs, and short-term trading activity. This specification is motivated by the functional form of no-arbitrage boundaries derived in Kalay (1982), which are determined by the quotient of dividend yield and proportional transaction costs, rather than by their linear combination. To estimate the nonlinear specification, I divide observations into 25 groups according to dividend yield and bid/ask spread, assign a dummy for each group, except for one, and re-estimate the first-stage probit regression. As shown in Table 11, the dummy coefficients decline almost monotonically from the highest dividend yield and lowest bid-ask spread quintiles to the lowest dividend yield and highest bid-ask spread quintiles. Hence, the joint effect of high dividend yield and low transaction costs, rather than an extreme value in either of the variables alone, generates short-term trading activity around the ex-day.

Table 11
The effect of bid/ask spread and dividend yield on tax arbitrage
This table represents the coefficients of regressions 3 and 6 in Table 10. Lowest bid/ask and highest D/P quintile is the reference level with no dummy. Asterisks mark significance at standard levels (***, **, and * for 1%, 5%, and 10%, respectively).

Panel A: Coefficient estimates–buy/sell tax arbitrage

D/P quintile	Bid/ask quintile				
	5 (Highest)	4	3	2	1 (Lowest)
5 (Highest)	-1.35**	-1.15*	-1.68***	-0.32	Omitted
4	-1.58***	-1.57**	-1.47**	-0.96	-0.36
3	-2.56***	-1.46**	-1.89***	-1.62***	-0.64
2	-2.02***	-2.00***	-1.76***	-1.71***	-1.81***
1 (Lowest)	-2.39***	-2.74***	-2.54***	-1.99***	-2.04***

Panel B: *t*-values–buy/sell tax arbitrage

D/P quintile	Bid/ask quintile				
	5 (Highest)	4	3	2	1 (Lowest)
5 (Highest)	-2.18	-1.77	-2.62	-0.46	Omitted
4	-2.61	-2.52	-2.33	-1.57	-0.54
3	-4.12	-2.32	-3.24	-2.71	-1.03
2	-3.22	-3.37	-3.07	-2.70	-2.91
1 (Lowest)	-3.73	-4.24	-3.78	-3.40	-3.38

Panel C: Coefficient estimates–sell/buy tax arbitrage

D/P quintile	Bid/ask quintile				
	5 (Highest)	4	3	2	1 (Lowest)
5 (Highest)	-1.19*	-0.72	-1.16*	-0.63	Omitted
4	-1.01	-0.86	-1.22*	-0.92	-1.04*
3	-1.60***	-1.21*	-1.08*	-1.38**	-0.97
2	-1.47**	-1.78***	-2.31***	-2.48***	-1.05*
1 (Lowest)	-2.29***	-2.85***	-2.13***	-1.93***	-1.88***

Panel D: *t*-values–buy/sell tax arbitrage

D/P quintile	Bid/ask quintile				
	5 (Highest)	4	3	2	1 (Lowest)
5 (Highest)	-1.89	-1.05	-1.67	-0.96	Omitted
4	-1.59	-1.26	-1.89	-1.47	-1.71
3	-2.58	-1.92	-1.82	-2.29	-1.61
2	-2.29	-2.97	-3.88	-3.52	-1.65
1 (Lowest)	-3.53	-4.13	-3.14	-3.23	-3.03

Overall, the firm level results are consistent with the earlier investor level evidence. In particular, the analysis shows that a high dividend yield combined with low transaction costs are necessary to attract a strictly positive amount of short-term trading. Otherwise, consistent with the prediction of Boyd and Jagannathan (1994), the short-term traders do not enter the market.

However, the variation in the proportion of short-term trades as a fraction of total trading volume (Heckman's second-stage OLS) is not correlated with any of the variables explaining whether the volume of short-term trading activity is nonzero (Heckman's first-stage probit). This result could be driven by the low fraction of volume related to short-term trading: the total trading volume (dependent variable denominator) dominates the variation in the volume of short-term trading activity (dependent variable numerator).

6. Conclusions

This study documents which investors trade around the ex-dividend day and what determines their trading behavior. In addition to demonstrating that investors change the direction of their trades around the ex-day according to their tax status, I also show that investors engage in overnight trading around the ex-day if transaction costs are low and dividend yield high enough. Domestic taxable investors engage primarily in overnight buy/sell tax arbitrage, and nontaxable institutions are active in selling stocks cum-dividend and buying ex-dividend. Both trading strategies are profitable, even after transaction costs. This is exactly what should happen in a market with differential tax rates on capital income and with no short-term capital loss deductibility restrictions.

However, even in a country with few legal restrictions on ex-day trading, the majority of investors fail to understand the potential tax savings achievable by ex-day trading, because only a small percentage of the total trading volume on the ex-day is attributable to short-term traders. This finding is consistent with earlier studies on individual trading decisions with respect to taxes. Evidence from the same market in Grinblatt and Keloharju (2001, 2004), as well as from the United States (Barber and Odean, 2003; Graham and Kumar, 2006), indicates that although taxes matter in trading decisions, individual investors do not necessarily behave in a tax-optimal way.

Dynamic dividend clientele models do a fairly good job in predicting the trading behavior of domestic taxable investors. Market risk, dividend yield, transaction costs, and, in particular, idiosyncratic risk explain well what stocks investors trade. The relevance of idiosyncratic risk also extends beyond the ex-day literature. Whether idiosyncratic risk affects security prices is debatable (see, e.g., Bali, Cakici, Yang, and Zhang, 2005), but my results suggest that it has at least an impact on investor trading decisions.

My analysis shows that several investor groups take advantage of the differences in tax rates by trading around the ex-dividend day. Although foreigners dominate the total trading volume,

the realized ex-day ratios would not suggest they are the marginal investors. In the light of these results, a search for one group of marginal investors may be too restrictive, or even misleading. So far, there is very little theory or empirical evidence of the interaction of various investor groups trading around the ex-day, although the work in Michaely and Vila (1995) and Dhaliwal and Li (2006) are steps in this direction. A natural extension of this study would be an analysis of the behavior of the various trading clienteles in the order book on the ex-dividend day. This could shed more light on which investors set the market price when investors have different preferences for pretax dividend income and capital gains.

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ESSAY 2:

Do investors reinvest dividends and tender offer proceeds?

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ABSTRACT

This study documents how much investors reinvest dividends and tender offer proceeds. I find that households reinvest only a small proportion of funds within two weeks, less than 1% of cash-dividends and around 10% of tender offer proceeds. Tender offer proceeds are more likely to be reinvested, even when the investor and size of the cash flow are kept constant. This finding is consistent with the idea that investors have separate mental accounts for dividends and capital assets.

JEL-classification: G35, D12, G34

Keywords: Dividend reinvestment, dividend payment, self-control, mental accounting, tender offer

1. Introduction

"The Microsoft payment, which affected 4.6 million shareholders, was nearly as large as the $38 billion federal income-tax rebate paid in the summer of 2001. But unlike the rebate, which many Americans spent, economists said the dividend will have a smaller impact on spending because much of it will be reinvested in stocks or left in brokerage accounts."

Wall Street Journal
February 1, 2005

In 1999, US firms alone paid USD 222 billion in cash dividends (Grullon and Ikenberry 2000; Grullon and Michaely, 2002). While there has been a lot of research on why dividends are paid at all and how dividend policies are determined (for a review, see Allen and Michaely, 2004), very little is known about what happened to the 222 billion dollars cash in dividends after they left corporate treasuries. Some of it could have been reinvested, yet how much and by which investors are open questions.

Dividends are not the only flows from firms to investors which may be reinvested. Investors also receive substantial sums of cash when they sell shares to a bidder in a tender offer. In a sale resulting from a tender offer, the whole position is liquidated at once and for good, whereas in the case of a dividend payment, only a small fraction of corporate assets is typically distributed to shareholders. Despite the differences, these two liquidations of equity share an important common characteristic. Unless an investor holds a controlling interest in the company, the cash disbursement is exogenous.

After payments of dividends or tender offer proceeds, investors must decide whether to re-invest the funds in the financial market. For an individual investor, the obvious alternative is consumption. However, the source of income may make a difference in the decision between consuming versus reinvesting, especially in the case of individual investors. Dividends and proceeds from tender offers may be in different mental accounts: dividends are generally regarded as income, an annual cash flow to be used for consumption (Shefrin and Statman, 1984). In contrast, when forced to sell stocks, an investor may feel guilty about consuming the proceeds instead of reinvesting. Likewise, foundations and endowments often have rules forcing expenses and donations to be covered by dividends rather than proceeds from the sale of securities.

Earlier literature on the psychology of dividends lacks systematic empirical evidence on investor behavior. The purpose of this study is to fill this gap and contribute to the discussion on payout policy. I do this by answering two questions. First, are dividends and tender offer proceeds reinvested in the stock market? Second, do investors treat them differently? The

opening quotation hints that investors reinvested *much* of the dividends paid by Microsoft, but research has not yet shown whether dividends are reinvested at all, let alone *how much* of them is reinvested.

There are four reasons why Finland is an exceptionally good test-laboratory for studying reinvestment of dividends and tender offer proceeds. First, high-quality daily data on all trades by every market participant facilitates a detailed analysis of what investors do with dividends and the tender offer proceeds they receive. The data allow identifying, on a daily basis, which domestic investors receive dividends and tender offer proceeds and how they trade after having received these cash flows. Second, the strict rules of the Finnish Central Securities Depositary (FCSD) and electronic transfer of funds guarantee that dividends and tender offer proceeds are paid to investors within one trading day. As a result, the exact day that an investor has access to the funds can be identified. Third, dividends are paid only once a year rather than quarterly, which means that, on average, they are larger and transaction costs are less of an issue than in countries such as the United States, where dividends are paid quarterly. Fourth, dividend reinvestment plans are unknown in Finland. This ensures that the observed reinvestments are self-initiated rather than automatic. These four considerations also differentiate this study considerably from a related concurrent paper by Baker, Nagel, and Wurgler (2006) who study dividend reinvestment by a segment of retail investors at monthly frequency.

I document evidence that the proportion of dividends and tender offer proceeds reinvested in the stock market is rather small. My analyses show that households reinvest probably less than 1% of the dividends within two weeks of the payment, and under no circumstances do they reinvest more than 8.1%. There is also strong evidence that households are more likely to reinvest proceeds from tender offers than dividends. This result holds even when I control for the identity of the investor, the size of the cash flow, and the extraordinary nature of tender offer proceeds payment. The result can be understood in terms of mental accounting: investors label corporate cash disbursements to mental accounts of capital assets and dividend income, and tend more to reinvest the former.

Institutional investor's propensity to reinvest is also very low, with the exception of mutual funds. There is also weak evidence that the institution's propensity to reinvest tender offer proceeds is higher than the propensity to reinvest dividends. For institutions, this result can be understood more as evidence on following predetermined rules (see e.g. Shefrin and Thaler, 1988) rather than as evidence on the existence of mental accounts to control consumption.

I also consider the possibility that the difference in reinvestment ratios is driven by rational factors. However, the evidence does not indicate that households would have constructed their portfolios to achieve a predetermined dividend stream or that the wealth effect of tender offers made at a premium would be driving the difference in reinvestment ratios. Neither the unexpectedness and larger size of tender offer proceeds, taxes, nor the small average size of dividends can explain the difference.

There are two caveats worth considering at the outset of this paper. First, as I investigate reinvestment by *all* stock market participants it is self-evident that not all investors can have a strictly positive flow to the stock market after a corporate cash disbursement. Nevertheless, even given the market clearing condition, it is still possible that corporate cash disbursements cause excess liquidity to some particular investor group, such as households, who then decide to reinvest. Therefore, the reinvestment ratio of a particular investor category, let alone the aggregate group of investors who receive dividends on a particular day, could be positive. In addition, the market clearing condition does not influence the interpretation of the main result that tender offer proceeds are more likely reinvested than dividends.

Second, while the flows to direct stock market investments are fully covered by the data, flows to other asset classes, such as mutual funds, are not observed. However, based on evidence complementary to the results reported in this paper, it is unlikely that the unobserved flows to other asset classes would explain the difference in reinvestment ratios. Baker et al. (2006) show that the higher propensity to consume, rather than to reinvest, dividends is present in the CEX consumption survey data. The Finnish households would have to be very different from their US counterparts for the unobserved flows to have an impact on the main conclusions of this paper. To alter the conclusions, the Finnish households would have to reinvest a large proportion of their dividend income, but not tender offer proceeds, to other assets than stocks of domestic firms.

The remainder of this paper is organized as follows. The next section reviews literature on the psychology of dividends and develops a testable hypothesis. Section 3 explains the relevant data features and institutional details of dividend payments and tender offers in Finland. Section 4 presents descriptive statistics on reinvestment activity and empirical evidence on the determinants of reinvestment decision. Section 5 concludes and discusses the implications of the findings.

2. The psychology of dividends

When individual investors receive dividends or proceeds from a tender offer, they face a choice of either reinvesting or consuming; they are, in essence, making a saving decision.

Focusing on this decision entwines this study with the literature on saving, and the research hypothesis is drawn from theory on the psychology of saving.

The literature on household saving has traditionally relied on the assumption of rational agents maximizing their lifetime utility by consumption smoothing. The life-cycle model of consumption was first formally derived in Modigliani and Brunberg (1954), who state that the young should borrow against their future income, the middle-aged save for retirement, and the elderly dissave their wealth. Although the life-cycle model has been enriched by adding components such as uncertainty, liquidity constraints, and habits, reconciling the empirical evidence with the idea of intertemporal consumption optimization has not been particularly successful. As Browning and Lusardi (1996, p. 1850) put it in a survey on household saving, "more problems remain than have been satisfactorily answered."

Although criticizing the assumptions of neoclassical economic theory is hardly a novel idea, proponents of behavioral economics argue that this is exactly what must be done to truly understand the saving behavior of households. Thaler (1990, 1994, 1999) argues that the behavioral concepts of self-control and mental accounting are necessary to capture the essence of a household saving decision. Recently, a number of other scholars have accepted the notion that it is essential to take into account behavioral factors to fully understand all aspects of the empirical data in studies on saving (Levin, 1998; Bernheim, Skinner, and Weinberg, 2001; Gross and Souleles, 2002).

Introducing the concept of mental accounting enables the assumption that the labeling of cash flows may influence investor behavior. The key ingredient of this argument is that wealth is nonfungible. Home equity, stockholdings, money in savings account, and current income are in separate mental accounts (Thaler 1990, 1999) and spent accordingly, in contrast to the life-cycle theory assumption that wealth is perfectly fungible. An exemplifying implication of this argument is that an unexpected bequest of EUR 1,000 in the form of a securities portfolio has virtually no impact on consumption, whereas a bequest of the same size in cash is almost always consumed outright. The relevance of mental accounting also extends to issues beyond consumption and saving. Shefrin and Statman (1985), Odean (1998), Haigh and List (2005), and Kaustia (2005) argue that mental accounting influences investor trading behavior in the equity market.

Why do people have separate mental accounts rather than pooling all wealth as a neoclassical agent would do? Some authors suggest that the main reason for this is a lack of self-control. People may agree that they should save more, but they lack the willpower and fail to

behave as predicted by the life-cycle theory. Shefrin and Statman (1984) argue that dividends, despite bearing a higher tax burden, offer a convenient solution to combat self-control problems. Individuals want dividends because establishing a rule of consuming dividends but leaving capital intact helps to control consumption. This argument is formalized in the behavioral life-cycle (BLC) model of Shefrin and Thaler (1988), who borrow the notion of an internal conflict from their related work in Thaler and Shefrin (1981). Instead of solving a problem of optimal consumption over a lifetime, the economic agent must first solve an internal one of being exposed to constant temptation to consume. Solving the internal conflict requires that cash flows are labeled to different mental accounts, and labeling leads to different marginal propensities to consume depending on the origin of funds. The different marginal propensity to consume is in contrast with the traditional life-cycle theory, according to which all funds should be treated equally.

In the BLC model, Shefrin and Thaler (1988) suggest that to cut excess spending, individuals create mental accounts for themselves with predefined, unambiguous rules of consumption, such as "consume dividends and never touch the principal." Saving dividends on a case by case basis without a predefined rule will not work, because the human will is weak and the psychic cost of using willpower is greater than the increased utility from more optimal consumption in the future. Not touching the principal is formalized by assuming a psychic cost, or guilt, for liquidations from the asset account.

However, it is justified to ask whether there is a penalty for invading the asset account and thus not reinvesting the proceeds from a liquidation of tendered shares when the liquidation is forced rather than self-initiated. The argument here is that in a tender offer, just as in the case of dividends, liquidation of holdings is externally initiated.

There are thus two forces driving the decision to reinvest: mental accounting and externality of the decision. Whichever of these dominates is a matter of empirical investigation. If an external decision to liquidate holdings removes the psychic cost of invading the asset account, I would expect there to be no difference in the propensity to reinvest. However, if there is a psychic penalty for invading the asset account, even in the case of an external decision, I would expect that the propensity to reinvest tender offer proceeds is greater than the propensity to reinvest dividends, *ceteris paribus*.

3. Data and institutional setting

In this section, I review relevant institutional details of the dividend payment process, lag between last cum-dividend and payment date, and tender offers in Finland.

3.1. Data

The bulk of the data come from the Finnish Central Securities Depositary (FCSD), which maintains an electronic and official register of all securities transactions in Finland for virtually all companies listed on the Helsinki Exchanges (HEX, nowadays a part of OMX Group, Plc). The data comprise daily trading account records of all Finnish investors. The sample period runs 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 are tagged with a unique investor identification number enabling computation of the portfolio value, the position in every stock, and the value of trades for each domestic investor in the entire market on every day. Trades are aggregated at investor level by summing up the signed value of all buys and sells in the open market during the same trading day. Hence, the unit of observation is the net daily flow to the stock market by a single investor.

I group investors into the following six investor categories: nonfinancial firms, financial corporations, mutual funds, nonprofit organizations, households, and foreigners. This grouping is consistent with Grinblatt and Keloharju (2001), except that it treats mutual funds as a separate category and pools the general government category with other nonprofit organizations.

Foreigners 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, as their trades appear in the data under the name of the nominee institution with a separate flag for a nominee account trade. As all my subsequent analyses are at the investor level, I use data only from registered foreigners.

The FCSD data on securities transactions are supplemented with dividend and stock price data from HEX. There are 926 dividend payments by Finnish-listed companies during the sample period. There are no investor level data available for ten dividend events because five companies joined the FCSD electronic registry after the beginning of the sample period. The final sample hence consists of 916 dividend payments, and depending on the year, the data represent 97-100% of the total stock market capitalization.

3.2. Payment systems in Finland

Finnish interbank and retail payment systems are among the most highly sophisticated and efficient in the world (Iivarinen, 2002). All domestic banks and foreign bank branches executing fund transfers are members of two fully automated interbank payment systems. Small interbank payments are settled twice a day, and depending on the method of wiring (i.e., order of transfer on paper versus electronic order through the Internet), the payment is normally in the receiver's account within zero to two days. Checks are very rare and make up less than 0.1% of all payments.

3.3. Dividend payment process in Finland

In Finland, cash dividends are paid once a year, typically at the end of March or at the beginning of April. None of the listed corporations had a dividend reinvestment plan, although they are not explicitly prohibited by Finnish law.

The board of directors proposes the size of the cash dividend to the annual general meeting. The dividend proposal is announced simultaneously with the corporate earnings for the fiscal year. In practice, the size of the dividend is very seldom changed at the annual general meetings of publicly listed corporations. Therefore, there is very little uncertainty regarding the value of cash dividend after the dividend proposal has been publicly announced.

The electronic ownership records of the FCSD determine to whom the dividends are paid. A shareholder does not have to do anything to receive the dividend; the company transfers the funds directly to the investor's bank account. An investor who has bought shares no later than on the last cum-dividend day ($t + 0$) is entitled to a dividend. Because of a settlement lag, ownership of shares is determined by the ownership records on the registration day, which is the third trading day after the last cum-dividend day ($t + 3$). The FCSD has strict rules for the payment of dividends; these rules guarantee that the bank accounts of shareholders are credited on the reported dividend payment day.

There is one exceptional situation in which a shareholder with a right to the dividend has no access to the funds on the payment day. This exception occurs when the settlement of shares is delayed on a trade that took place prior to the ex-dividend day and should have been settled within the conventional three-day settlement lag. Hence, if an investor buys shares on the last cum-dividend day and the settlement of shares is delayed until $t + 4$ or later, the investor is not paid on the reported dividend payment day. In this case, the dividend is manually corrected by the FCSD and paid to the buyer with delay.

According to the FCSD, manual corrections are a function of trading activity and account for only a small fraction of the dividend payments. As an example, Nokia (the most traded stock on HEX) had approximately 25,000 shareholders when dividends for fiscal year 1996 were paid. For this dividend payment, there were 84 manual payment corrections, causing a delay to less than 0.4% of the shareholders. As the number of corrections is relatively small, delayed payments are not an issue.

3.4. Lag between last cum-dividend and payment day

Compared with the United States, where dividends are paid several months after the ex-day, the lag between ex-day and payment day in Finland is relatively short, only a few weeks. Given this institutional feature, it is important to differentiate between trades related to ex-dividend day trading and reinvestment of dividends. To make sure that the ex-day trading related transactions do not confuse the analysis of reinvestment, I next investigate the length of the lag between the last cum-dividend day and payment day.

During the sample period, the FCSD did not regulate the day of dividend payment, but most companies followed the stock exchange norm of setting the payment day for the fifth trading day ($t + 8$) following the registration day ($t + 3$). This observation is confirmed in Table 1 and Figure 1 in which I calculate the lag between the last cum-dividend day and the payment day for all 916 dividend payments in the sample. Figure 1 peaks at the lag of 8 trading days, which is also the sample median. There are eight cases where a company had a lag of fewer than three trading days. These are companies that joined the FCSD register prior to their initial public offering (IPO) and paid dividends for previous fiscal year to pre-IPO shareholders.

Is the median lag of eight days sufficiently long to avoid confusion between trades related to reinvestment of dividends and trades related to ex-day tax arbitrage? By utilizing the same data as in this study, Rantapuska (2006, Fig. 4.) shows that the majority of short-term ex-day trades are concentrated on the last cum-dividend and the first ex-dividend day, rather than within a broader event window. In fact, the study shows that the number of short-term trades starts to rise five days before the last cum-dividend day, and the number returns to the same level five days after the last cum-dividend day, at $t + 5$. Given the median of eight days between the last cum-dividend day and the payment day, trades related to ex-dividend day trading are unlikely to affect the analysis on reinvestment activity.

Table 1
Distribution of lag between last cum-dividend and payment day, trading days

Min	1.00
Max	150.00
Average	7.74
Median	8.00
Mode	8.00
Standard deviation	6.15
Skewness	16.86
Kurtosis	344.62
Number of observations	916.00

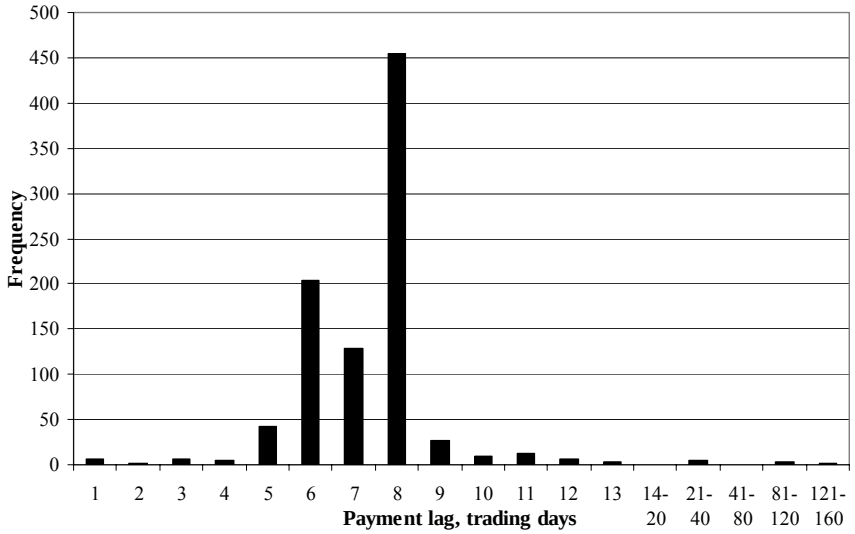


Fig. 1. Distribution of lag between last cum-dividend and dividend payment day

3.5. Rules for a tender offer

The rules for a tender offer in Finland differ from those in the United States in the following way. First, two-tier offers promising a higher return for tendering shareholders are not allowed. Second, the governing rules depend on the fraction of shares owned by the bidder. If the bidder owns less than two-thirds of the shares outstanding, she is free to make offers for any number of shares at any price. If the bidder owns more than two-thirds, she is by law obliged to make an offer for the remaining shares outside her control. Finally, if the ownership exceeds 90%, the

bidder also has to make a demand for all outstanding shares held by minority investors. However, she also has the right to compulsory acquisition of any shares not tendered at this stage.[1]

Earlier empirical evidence from the same market (Karhunen, 2002) shows that in almost all takeovers, the bidder is successful in acquiring full control and tendering is thus only a matter of time. Based on this evidence, payments of tender offer proceeds are assumed to be exogenous throughout this study. In other words, I assume that investors do not *choose* to exchange their holdings for cash, but tender because they *have to*.

3.6. Cash disbursement from a tender offer

After an investor has accepted a tender offer, the tendered shares are not sold instantly. Instead, the shares remain in the investor's account until the end of the offer period and cannot be transferred to any party other than the bidder. After the offer period is over, the bidder executes trades via the HEX trading system and acquires control of the tendered shares. Cash from the sale of shares is available to the investor on the settlement date. Because this study concentrates on cash disbursements that are exogenously initiated, rather than self-initiated, shares sold in the open market during the tender offer period are excluded from the analysis.[2]

4. Empirical results

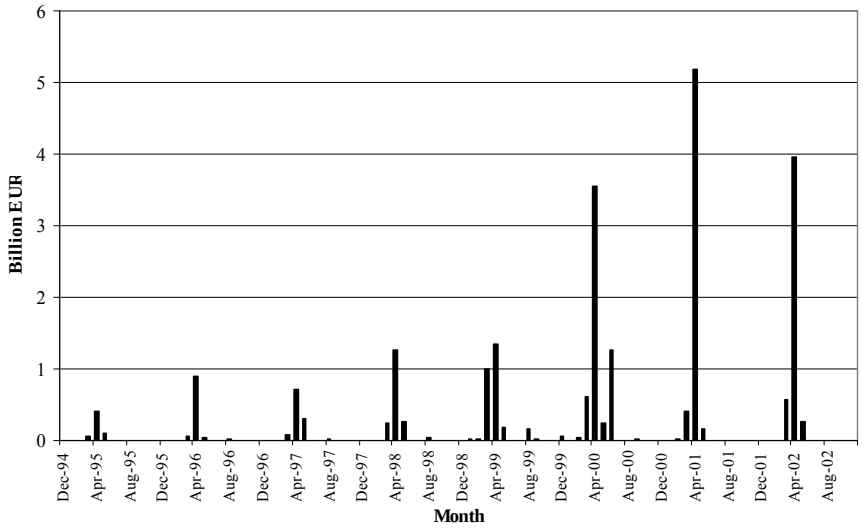
4.1. Descriptive statistics

There were 916 cash dividend distributions between 1995 and 2002 by companies that are members of the FCSD registry. The vast majority of dividends are paid in the spring, as shown in Panel A of Figure 2. Panel B in the same figure shows that the total value of dividends paid increased significantly during the sample period. The upward trend is due to an increase in the number of listed companies, rising profits, and a higher propensity to distribute net profits as dividends. Panel B also shows that the flow of dividends to foreign shareholders increased significantly during the sample period, reflecting the growth of foreign ownership from 33% in 1995 to 67% in 2002.

[1]Although the bidder has a right to any remaining shares held by the minority, the Finnish corporate law allows dissenting shareholders not to surrender their shares without litigation. An arbitrator appointed by the Central Chamber of Commerce sets the price for the shares, which may be higher than the offer price. See Karhunen (2002) for further institutional details.

[2]I make one exception, the second offer for the shares of Hartwall. In this offer, the bidder bought shares in the open market for a price that was higher than in the tender offer. Because of the higher price, the majority of investors sold their shares in the open market instead of tendering.

Panel A: Monthly distribution of dividends paid



Panel B: Annual value of dividends received by investor category

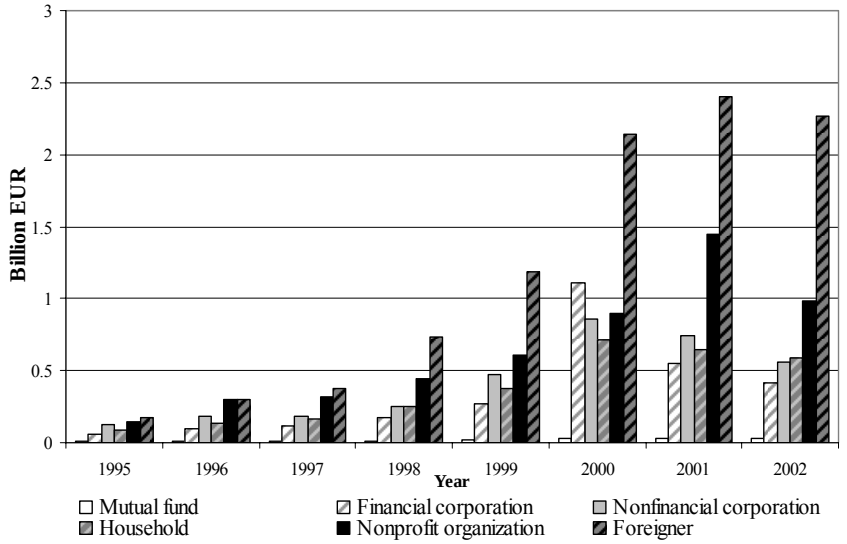


Fig. 2. Descriptive statistics on dividend payments. Panel A shows the gross value of cash dividends paid on each month of the sample period. Panel B shows the distribution of dividends received by investor category. The data include 8,861,622 cash dividend payments to domestic and foreign (registered and unregistered) shareholders.

Table 2
Descriptive statistics on the full sample of dividends and tender offer proceeds
The table shows the distribution of dividend and tender offer proceed payments in the full sample of 916 dividend payments and 44 tender offers. Reported *minimum*, *maximum*, *mean*, and *median* values are in EUR. Statistics for the category *foreigner* are based on registered foreigners only. MDIV is a measure of the minimum amount of cash required to make a direct investment in the stock market and is defined in Section 4.1.

Investor category	Minimum	Maximum	Mean	Median	Std. deviation	Skew-ness	Kurtosis	N
Full sample								
Panel A: Dividends								
Nonfinancial corporation	0.01	66,302,556	14,079	235	381,784	84	9,702	193,726
Financial corporation	0.07	80,366,048	107,040	2,960	1,389,863	35	1,522	23,834
Mutual fund	2.17	668,800	21,387	7,380	42,298	5	46	6,391
Nonprofit organization	0.03	155,531,104	46,618	1,473	1,083,918	89	10,540	85,488
Household	0.01	13,281,246	579	76	13,751	495	376,700	3,049,410
Foreigner	0.07	31,558,502	13,486	183	290,653	74	7,151	21,434
Total								3,380,283
Panel B: Tender offers								
Nonfinancial corporation	0.50	424,585,049	466,860	3,328	10,000,679	33	1,234	2,922
Financial corporation	0.07	41,580,000	611,157	6,328	2,990,456	9	98	574
Mutual fund	7,381.42	4,647,600	607,807	260,334	974,627	3	7	57
Nonprofit organization	10.33	75,946,608	359,248	11,446	3,016,192	17	358	1,751
Household	0.88	162,257,480	18,372	1,602	795,990	147	27,885	63,431
Foreigner	17.60	2,459,120,670	4,737,364	2,737	102,656,144	24	571	576
Total								69,311
Sample of cash flows greater than MDIV								
Panel C: Dividends								
Nonfinancial corporation	900.00	66,302,556	71,368	4,318	864,648	37	1,890	37,566
Financial corporation	900.00	80,366,048	188,364	19,000	1,841,249	27	865	13,520
Mutual fund	900.00	668,800	26,677	11,400	45,940	5	39	5,087
Nonprofit organization	900.00	155,531,104	94,691	6,300	1,547,837	63	5,169	41,844
Household	900.00	13,281,246	6,964	2,599	55,808	123	23,137	182,526
Foreigner	900.00	31,558,502	79,645	3,921	708,569	30	1,204	3,570
Total								284,113
Panel D: Tender offers								
Nonfinancial corporation	900.00	424,585,049	668,777	7,719	11,967,091	27	861	2,039
Financial corporation	949.00	41,580,000	865,972	32,550	3,530,252	8	69	405
Mutual fund	7,381	4,647,600	607,807	260,334	974,627	3	7	57
Nonprofit organization	1,127	75,946,608	437,260	19,545	3,323,387	15	294	1,438
Household	900.00	162,257,480	34,179	4,302	1,094,321	107	14,754	33,546
Foreigner	900.00	2,459,120,670	7,068,940	5,862	125,389,283	20	383	386
Total								37,871

Altogether, there are 8,861,622 dividend payments to domestic shareholders and registered foreigners. I narrow down the sample for two reasons. First, very passive investors are not particularly interesting: 69% of households in the data did not execute a single trade in the year of dividend payment. Hence, I first filter out completely inactive 'buy and hold' investors who did not trade at all in the calendar year during which they received a dividend.[3] Excluding passive investors leaves a sample of 3,380,283 dividend payments. Second, dividends paid to the same investor on the same trading day are aggregated. This further reduces the sample to 2,857,221 observations.

For the sample of tender offer proceeds, I select cash disbursements from offers in which there was a cash payment to investors tendering voluntarily. Following this criterion, I include cash disbursements from offers in which an investor could choose between cash and shares as well as from offers in which the investor had no other option than cash. However, I exclude compulsory acquisitions of stock that were preceded by a stock swap tender offer with no option for cash. Altogether, there are 44 tender offers qualifying for the sample. As in the case of dividend payments, I perform daily aggregation, remove inactive investors, and end up with 29,029 observations for tender offer proceeds.

The majority of dividend payments are rather small, as illustrated in Panel A of Table 2. It is a valid argument that studying reinvestment of very small dividends and tender offer proceeds is less sensible, because minimum lot size restrictions prevent the reinvestment of negligible funds altogether, or transaction costs make at least this activity relatively costly. For the purposes of subsequent analyses, I construct a subsample of dividends and tender offer proceeds which are large enough to be invested as such. To this end, I calculate for each sample year a measure of minimum direct investible value, MDIV. This measure indicates how much cash in hand an investor has to have to be able to make the smallest possible direct investment in a listed company. To compute the MDIV for each sample year, I first multiply lot size by close price on the first trading day of the year for all listed shares. Finally, I use the median of these values at the beginning of the year. The MDIV has a median of EUR 1,724 and varies from EUR 900 to EUR 3,835. Descriptive statistics for the sample of dividends and tender offer proceeds exceeding the MDIV are reported in Panels C and D of Table 2.

[3]This decision to restrict the number of observations is innocent. Reinvestment ratios for the full investor population can be estimated simply by multiplying the reinvestment ratio of the active investor population (reported in Table 3) by the fraction of active investors in the full population (the fraction of active households is 31% and the fraction of active institutions is 58%). In addition, all but one of the subsequent analyses are symmetric with respect to buys and sells. Hence, the decision to leave out investors who neither buy nor sell stocks during the fiscal year does not systematically bias the estimated results to either direction.

4.2. Unconditional reinvestment ratios

The most obvious way to measure the degree of cash flow reinvestment is to divide net investment in the stock market by the value of cash disbursement. Two major shortcomings make this simple measure rather unpractical for the purposes of this study. First, many investors do not reinvest after a cash disbursement but sell instead. This often makes the aggregate reinvestment ratio of an investor category negative, which is hardly an equilibrium outcome. Second, the reinvestment measure varies considerably, making extreme values challenging to interpret. For example, if an investor receives a EUR 10 dividend and subsequently invests EUR 50,000 in the stock market, it is debatable whether this should be considered a 5,000% reinvestment.

To overcome these two problems, I measure reinvestment activity by computing two slightly modified ratios. First, I assume that the reinvestment ratio of an investor is bounded by zero and one, inclusive. Hence, a negative net investment in the stock market after a corporate cash disbursement is considered as a zero reinvestment. Defining the variable to be between zero and one is consistent with Grinblatt and Keloharju (2004), who use the same range for measuring the amount of repurchase activity associated with wash sales around the turn of the year. However, disallowing negative values causes this reinvestment ratio to be upward biased and positively related to the degree of trading activity, and both factors must be accounted for when interpreting the results. For example, an investor who has a 50% probability of buying and a 50% probability of selling stocks on any given day has a 50% probability of having a strictly positive reinvestment ratio on any given day. Correspondingly, an investor with a 10% probability of both buying and selling has a one out of ten chance of having a strictly positive reinvestment ratio.

Second, I introduce a symmetric reinvestment ratio by bounding the reinvestment ratio within the range of [–1, 1]. If, on aggregate, there is no reinvestment by a given investor category, the second ratio will reflect this by being close to zero, or even negative. In addition, this measure does not suffer from the bias caused by differences in trading activity.

I introduce two different lags for reinvestment and compute the value reinvested on the day of cash disbursement and over a period of ten subsequent days. As will be shown in Section 4.4., after ten days the link between corporate cash disbursements and investor trading fades away. Throughout this paper, I define reinvestment as the net flow to the entire stock market rather than to individual shares.

Computing reinvestment ratios on the day of payment is straightforward. However, when I allow a 10-day period for reinvestment, net investment in the stock market cannot be simply divided by the value of cash disbursement. This is because most dividend payments are clustered,

causing observations to be nonindependent. To account for the clustering, I aggregate all dividends or tender offer proceeds which are paid within ten trading days of one another and received by the same investor. Furthermore, I assume that the reinvestment period begins on the day of the last dividend payment and ends on the tenth trading day following the last payment. This is equivalent to assuming that investors wait until the last clustered dividend before they start reinvesting. For example, if an investor receives a dividend on trading days t, $t + 6$, $t + 12$, and $t + 54$, dividends paid on days t, $t + 6$, and $t + 12$ are aggregated into a single observation, and the reinvestment period is assumed to run from trading day $t + 12$ to trading day $t + 22$. Correspondingly, the dividend on day $t + 54$ is treated as a single observation with a reinvestment period from $t + 54$ to $t + 64$. If payment of tender offer proceeds enters the dividend clustering or reinvestment period (or vice versa) of an investor, both observations are excluded from the sample. In terms of the previous example, if the investor receives proceeds from a tender offer on any trading day between $t - 10$ and $t + 22$ or between $t + 44$ and $t + 64$, the overlapping observations are discarded. Similarly, in the 1-day specification, I exclude all observations in which both types of cash flows are paid to the same investor on the same trading day.

Another possible way to perform the aggregation is to assume that the investor starts reinvesting as soon as the first dividend is paid. In the previous example, this would mean that the investor starts to reinvest the clustered dividend on trading day t instead of trading day $t + 12$. The truth is probably somewhere between these two methods of aggregation: some investors may choose to invest every dividend separately, while others probably always wait until the last dividend before they start reinvesting. I also re-estimate the results in Tables 3, 4, and 6 by assuming that the investors start reinvesting as soon as they receive the first cash flow. The results are qualitatively insensitive to the method of aggregation, and available upon request from the author.

Investors receiving dividends could be systematically different from those who receive tender offer proceeds. To account for this potential difference, I compare the reinvestment ratios of investors who received both payments. For this comparison, I first calculate the average tender offer proceeds reinvestment ratio for each investor and then compute the average dividend reinvestment ratio for that same investor. Finally, I compute average unconditional reinvestment ratios for all six investor categories and for the two reinvestment periods. These results are reported in Table 3.

Panel A in Table 3 reveals that the average reinvestment ratios are very close to zero. Households reinvest less than 1% of dividends and this point estimate climbs to only 4.4% when

I use the more aggressive measure [0, 1] and a 10-day reinvestment period. Mutual funds have the highest propensity to reinvest, and depending on the measure, they reinvest up to 39% of dividends within two weeks of payment. While this finding may be driven by small sample size, a possible explanation is that mutual funds have target cash positions and they promptly return excess funds from dividends to the stock market.

The reported reinvestment ratio for mutual funds contains another useful piece of information. Because mutual funds invest on behalf of other investors, they should not accumulate excess cash reserves in the long term but rather reinvest all dividends they receive. Consider a mutual fund which reinvests 100% in the long term, and assume that the reinvestment ratio, with a range of [–1, 1], is an unbiased estimate for the propensity to reinvest within two weeks (13.3%). These calculations would imply that the long-term reinvestment ratio for mutual funds is 7.5 times higher than the reported 10-day reinvestment ratio. Although this estimate may be used as a rough multiplier for interpolating long-term reinvestment ratios for other investor categories, the results should be taken with grain of salt due to the small sample size used to estimate the multiplier.

Overall, the univariate results in Panel A of Table 3 give preliminary support to the hypothesis that the propensity to reinvest is greater for tender offer proceeds than for cash dividends. This finding is especially pronounced for households and nonprofit organizations. However, it is important not to push this argument too far as the reinvestment ratio is unconditional and for example does not account for the fact that most dividends are too small to be reinvested. Next, I investigate how much the small size of most dividends contributes to the reinvestment ratios.

Minimum lot size requirements and transaction costs make it difficult for investors to reinvest very small dividends in the stock market. In the full sample, 88% of the dividends paid to domestic households were smaller than EUR 1,000. To investigate whether the reinvestment ratios differ for payments that are sufficiently large to be reinvested as such, I remove from the full sample of dividends and tender offers all (clustered) payments that are smaller than the MDIV (see definition in Section 4.1.).

Table 3
Unconditional reinvestment ratios
This table reports reinvestment ratios for all investors in the sample who received both dividends and proceeds from tender offers. The reinvestment ratio is defined as Net flow to the stock market/Value of corporate cash disbursement. In the leftmost columns, the reinvestment ratio has a range of [0, 1], and a value of 0 (1) is assigned if the ratio is below (above) zero (one). Correspondingly, the ratio has a range of [−1, 1] in the rightmost columns. Reinvestment ratios are calculated by first computing the average reinvestment ratio for each investor and then averaging over each investor category. The 10-day reinvestment ratio is calculated by aggregating to a single observation all cash disbursements of the same type clustered within ten days of one another. When cash disbursements are aggregated, net flow to the stock market for the subsequent ten days is calculated from the day of the last dividend payment to the 10^{th} day after the last dividend payment. The MDIV is defined in Section 4.1., and corresponds to the minimum value of funds required to make a direct investment in the stock market. The number of observations in the 10-day window is smaller because of a smaller number of independent observations.

	Reinvestment ratio range [0, 1]						Reinvestment ratio range [−1, 1]					
Period	Payment day			Payment day + 10 days			Payment day			Payment day + 10 days		
Type of cash flow	Div	Tender	N	Div	Tender	N	Div	Tender	N	Div	Tender	N
Panel A: All dividends and tender offers												
Nonfinancial corporation	0.015	0.037	1,288	0.070	0.163	1,285	0.055	0.013	1,288	-0.033	0.079	1,285
Financial corporation	0.048	0.114	131	0.123	0.217	131	-0.005	0.009	131	-0.036	-0.078	131
Mutual fund	0.084	0.152	26	0.375	0.349	26	-0.059	0.012	26	0.133	0.112	26
Nonprofit organization	0.011	0.044	566	0.040	0.122	566	-0.001	0.007	566	-0.040	0.013	566
Household	0.007	0.020	20,201	0.044	0.129	20,174	-0.001	0.011	20,201	-0.020	0.083	20,174
Foreigner	0.008	0.014	150	0.043	0.138	149	0.016	-0.006	150	-0.030	0.079	149
Panel B: Dividends and tender offers greater than MDIV												
Nonfinancial corporation	0.035	0.032	738	0.118	0.156	837	-0.001	0.012	738	-0.023	0.053	837
Financial corporation	0.077	0.098	103	0.144	0.255	102	-0.004	0.021	103	-0.042	-0.023	102
Mutual fund	0.187	0.152	26	0.388	0.349	26	0.035	0.012	26	0.157	0.112	26
Nonprofit organization	0.022	0.030	485	0.066	0.131	494	0.003	0.009	485	-0.020	0.025	494
Household	0.017	0.014	7,309	0.081	0.132	9,010	0.003	0.009	7,309	0.005	0.091	9,010
Foreigner	0.012	0.008	82	0.059	0.143	89	-0.003	-0.009	82	-0.037	0.082	89

Panel B in Table 3 reports results for cash disbursements greater than the MDIV. Reinvestment ratios are still low, but generally higher than the full sample averages. With a 10-day reinvestment window and a reinvestment ratio of [–1, 1], the reinvestment ratio is *negative* for households in the full sample and only 0.5% for dividends exceeding the MDIV. Even if I calculate the imputed long-term investment ratio based on the earlier discussion on reinvestment by mutual funds, the propensity to reinvest dividends is less than 4%. This observation corroborates my earlier argument that households have a very low propensity to reinvest dividends in general, while the propensity is somewhat higher for larger dividends.

4.3. A matched sample test for the degree of reinvestment

On average, the propensity to reinvest is smaller for dividends than for tender offer proceeds, but the propensity must be conditioned before drawing final conclusions. There are two plausible factors—unrelated to any behavioral theories—which could explain why the unconditional reinvestment ratio is higher for tender offer proceeds than for dividends. First, tender offer proceed payments are much larger and often constitute a significant fraction of an investor's portfolio. Indeed, the median dividend received by a household investor is EUR 76.2, while the median tender offer proceeds are EUR 4,721.3. Second, rational dividend clienteles could have chosen their portfolio composition to guarantee a certain annual dividend flow to finance consumption. If they are forced to liquidate some of their holdings in a tender offer, they can simply reinvest the proceeds to rebalance their portfolios, while an expected dividend payment of the same size does not cause a similar need for rebalancing.

I perform two experiments to investigate whether either of these claims has any merit. First, I test whether an ordinary dividend and a tender offer proceeds payment of the same size have equal reinvestment ratios. This test answers the question whether the difference in reinvestment ratios between the two cash flows is simply a size issue. Second, I perform the same test for special dividends. Corporations sometimes pay special dividends on top of the regular annual dividend, usually in the second half of the year while regular dividends are paid in the first half of the year. Special dividends are rather rare: in my sample of 916 dividend events, there are only 11 special dividends. However, these dividends are fairly large (median EUR 281 in the household sample) because they are driven by an accumulation of surplus cash reserves resulting from cash events such as a demerger or the sale of excess marketable securities. On three respects, special

dividends are very similar to tender offer proceeds: they are rare, unexpected, and result in a large flow to investors. By comparing tender offer proceeds and special dividends, it is possible to investigate the validity of the claim that tender offer proceeds are more likely to be reinvested because they are more unexpected and unwanted portfolio liquidations than ordinary dividends.

Investors might label special dividends as 'dividends', rather than principal due to framing (Kahneman and Tversky, 1984). This argument is based on the fact that special dividends are referred to as 'dividends', and their payment to investors follows exactly the same process as ordinary dividends. Therefore, if investors put special dividends in the current income account (rather than in the asset account) in terms of the BLC, the propensity to reinvest special dividends should be smaller than the propensity to reinvest tender offer proceeds. Alternatively, if investors have mental accounts and they label special dividends as principal, or if investors do not have a system of mental accounts, there should be no difference in the propensities to reinvest tender offer proceeds and special dividends. Either way, evidence on smaller propensity to reinvest special dividends than tender offer proceeds can be interpret as evidence in favor of special dividends being in the current income account and against the hypothesis that rational dividend clienteles rebalance their portfolios after an unexpected cash flow.

To test as cleanly as possible whether there is a difference between reinvestment of dividends and tender offer proceeds, I compare cash flows of the same size paid to the same investor. For this purpose, I first construct a value-matched sample of dividends and tender offer proceeds and then use Wilcoxon's signed rank test to compare reinvestment ratios in these two groups.

For each payment of tender offer proceeds, I pick a dividend paid to the same investor with the closest value. However, tender offer proceeds are generally larger than dividends, causing the median value of dividends to be considerably smaller. Hence, I discard every observation in which the matched dividend is less than 50% the size of the corresponding tender offer proceeds. I also experiment by changing the threshold value of 50%; the results, however, are qualitatively insensitive to any reasonable changes.

I compare the reinvestment ratios of the remaining observations using Wilcoxon's signed rank test to account for the non-normal distribution of reinvestment ratios. Furthermore, I pool all investors, except for domestic households, to a single group labeled *institutions* and perform the signed rank test separately for ordinary and special dividends. Finally, I report the results for the symmetric measure [–1, 1] with 1-day and 10-day periods.

The results of the Wilcoxon's signed rank test are presented in Table 4. The table shows that households' propensity to reinvest tender offer proceeds within 10 days is greater than that of institutions, even when accounting for the size of the cash flow (results for ordinary dividends in Panel C) and when simultaneously controlling for the size and nature of the cash flow (results for special dividends in Panel D).

Table 4
Test for the equality of unconditional reinvestment ratios between tender offer proceeds and dividends
This table reports Wilcoxon's signed rank test *Z*-values for the difference in reinvestment ratios of tender offer proceed payments and (special) dividends. The null hypothesis for the test is that median of *reinvestment ratio*$_{tender}$ − *reinvestment ratio*$_{dividend}$ in the matched sample equals zero. Reinvestment ratio definitions are as in Table 3. All tender offer proceeds must be greater than the MDIV (see Section 4.1.) and they are value-matched with the (extra) dividend paid to the same investor. The value of the matched dividend must also be at least 50% the value of the corresponding tender offer proceeds. All investors, other than domestic households, are aggregated to a single group labeled *institutions*. The three rightmost columns report statistics for the size of the cash flow. *Z-value* is the Wilcoxon's test statistic, *tender offer > dividend* (*dividend > tender offer*) number of cases when the reinvestment ratio is greater for tender offer (dividend), and N is the total number of observations in the sample. *Median dividend* and *median tender offer proceeds* are matched sample median cash flow values. *Dividend > tender, % of cases* corresponds to the percentage of cases where the matched-pair dividend is greater than the tender offer proceeds. Asterisks mark statistical significance at conventional levels (** for 5% and *** for 1%, respectively).

Period	Wilcoxon's paired sample test statistics				Sample median values, EUR		
Payment day	Z-value	Tender offer > dividend	Dividend > tender offer	N	Median dividend	Median tender offer proceeds	Dividend >tender, % of cases
Panel A: Reinvestment ratios with range [−1, 1], tender offer versus matched dividend							
Households	0.22	65	60	1,679	2,442	3,007	42.2 %
Institutions	2.82***	58	31	323	5,512	6,400	46.4 %
Panel B: Reinvestment ratios with range [−1, 1], tender offer versus matched special dividend							
Households	3.38***	60	27	915	5,000	3,200	52.0 %
Institutions	-0.60	49	38	268	14,853	6,609	66.4 %
Payment day + 10 days							
Panel C: Reinvestment ratios with range [−1, 1], tender offer versus matched dividend							
Households	10.11***	1,393	950	6,443	3,619	9,660	35.8 %
Institutions	3.47***	358	270	1,287	16,805	16,200	54.7 %
Panel D: Reinvestment ratios with range [− 1, 1], tender offer versus matched special dividend							
Households	2.30**	219	179	914	5,000	3,200	52.0 %
Institutions	3.11***	89	52	268	14,853	6,609	66.4 %

There is also evidence that the propensity to reinvest tender offer proceeds within 10 trading days is higher for institutions. However, at this stage, speculating with this finding would not be justified as the subsample of institutions is relatively small and consists of various investor types. In summary, the results for 10 trading days indicate that tender offer proceeds are more likely to

be reinvested than dividends, a finding which is consistent with the results for unconditional reinvestment ratios reported in Table 3.

With the 1-day specification, the results are somewhat weaker. There is a statistically significant difference between tender offer proceeds and ordinary dividends for institutions, but not for households. The reverse is true for special dividends. The lack of a consistent difference in the 1-day window is most likely due to a lack of statistical power because of the smaller sample size.

I also check that these results are not driven by time variation in the number of tender offers and dividend payments. In fact, there were 13 tender offers in 2001 whereas in 1995 there was only one tender offer. Although they increase over the sample period, the annual number and gross value of dividend payments are more stable. If the propensity to reinvest is very high when the takeover market is active, the propensity to reinvest tender offer proceeds will be higher in the pooled data. To see whether time variation in reinvestment ratios is an issue, I re-estimate the results for Panel C (the only case where there are enough remaining observations for a statistical test with a reasonable sample size) reported in Table 4 by setting an additional requirement that the matched dividend was paid in the year of the tender offer. The results (unreported) are qualitatively similar for both windows: households and institutions still have a higher propensity to reinvest tender offer proceeds in the 10-day window.

4.4. A dynamic approach

This subsection introduces a dynamic approach to study how payments of dividends and tender offer proceeds drive stock market investments. By investigating reinvestment activity with a lagged variable regression specification, it is possible to confirm earlier results and to verify whether the selected lag of ten days is a sufficiently long period to capture the impact of corporate cash disbursements on investor trading. I model the trades of an investor around the dividend and tender offer proceeds payments as a simple dynamic system with the following autoregressive distributed lags (ARDL) specification:

$$x_{i,t} = \alpha + \sum_{n=0}^{20} d_{i,t-n} + \upsilon_{i,a} + \varepsilon_{i,t}. \quad (1)$$

In the equation above, x_t refers to net investment in the stock market by investor i on day t and d_{t-n} indicates a payment of dividends or tender offer proceeds on the same day (n = 0) and preceding days (n = 1, 2, … , 20). The equation is estimated using ordinary least squares with

investor fixed effects and six annual dummies, $\upsilon_{i,a}$.[4] Hence, the specification can be understood as a system of current investment responding to impulses of current and past cash flows.

Considerable variation and extreme values cause problems in estimating Equation 1 without variable transformations. I make the model behave better by using a simplification similar to Hasbrouck (1991) and replace the net value of investment on day *t* with an indicator function taking values –1, 0, and 1. In other words, I only consider the sign of net investment. For dividends, I use log-transformed values.

Table 5 reports results for the ARDL specification by using all domestic investors and registered foreigners in the data. On the left-hand side of the table, I report results for dividends, and correspondingly, for tender offers on the right-hand side. In both samples, I use a 20-day lag and require the cumulative value of corporate cash disbursement within the lag period to be greater than MDIV (see definition in Section 4.1.) for the observation to enter the sample. The latter restriction is imposed to consider only the cases in which the minimum lot size restriction is not binding, and hence the investor could have invested the cash disbursement as such in the stock market. In summary, there is one observation for every trading day in which an investor has received cash disbursement(s) at least worth the MDIV during the preceding 20 trading days.

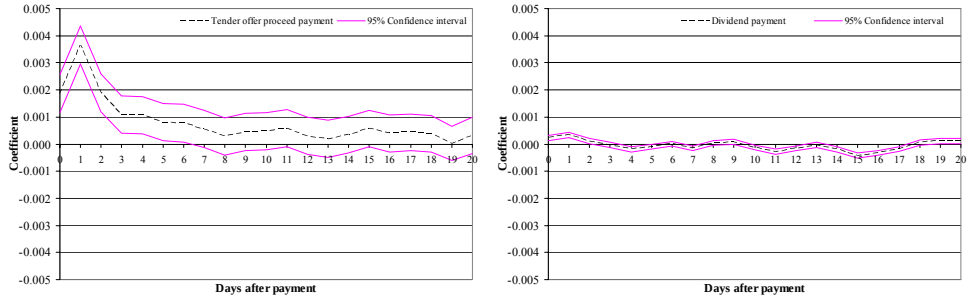
The results in Table 5 unambiguously indicate that the impact of receiving a tender offer proceeds payment is larger for households than the impact of receiving a dividend. This finding is visually demonstrated in Figure 3 for estimated coefficients. Clearly, there is a difference between dividends and tender offer proceeds for households, while the cash flow coefficients behave erratically around zero in the sample of institutions. The decay of coefficients in Figure 3 suggests that the initially selected 10-day period is enough to capture the impact of a corporate cash disbursement on investor trading. Household investors who reinvest corporate cash disbursements do so relatively quickly, although not immediately: both dividend and tender offer proceeds coefficients peak at $t-1$. The cash disbursement coefficient is no longer significant at $t-3$ for dividends and at $t-7$ for tender offer proceeds.

[4] Unreported analysis confirms that the results in Table 5 remain qualitatively unchanged when the parameters are estimated by using ordered probit approach without fixed effects. An ordered probit with fixed effects is not estimable for reasons discussed in Greene (2004).

Table 5
The effect of corporate cash disbursement on net flow to the stock market
This table reports results from regressing investor trading activity on past trades and payments of dividends and tender offer proceeds. The dependent variable is an indicator function of trade and has a value of 1 if an investor has a positive net flow to the stock market on day 0, –1 if negative, and zero otherwise. Contemporary and lagged values for dividends are log-transformed values. The observations include all trading days when an investor received corporate cash disbursements exceeding the MDIV (see Section 4.1) over a period of past 20 days. All specifications include year dummies and the specifications are estimated by using ordinary least squares with investor level fixed effects. All reported unstandardized coefficient values correspond to original values multiplied by 1,000. Asterisks mark statistical significance at conventional levels (* for 10%, ** for 5%, and *** for 1%, respectively).

	Dividends						Tender offers					
	Households			Institutions			Households			Institutions		
	Coeff.	*t*-value		Coeff.	*t*-value		Coeff.	*t*-value		Coeff.	*t*-value	
Intercept	-0.19	-0.14		0.32	0.14		-45.16	-1.74	*	51.26	2.57	**
Cash disbursement at $t+0$	0.23	4.78	***	-0.48	-3.38	***	1.87	5.28	***	-0.88	-0.91	
$t-1$	0.35	7.30	***	0.15	1.07		3.67	10.43	***	0.65	0.68	
$t-2$	0.11	2.24	**	0.23	1.60		1.89	5.41	***	1.55	1.66	*
$t-3$	-0.04	-0.77		-0.05	-0.37		1.09	3.14	***	0.42	0.46	
$t-4$	-0.19	-4.19	***	-0.17	-1.17		1.07	3.09	***	-0.63	-0.68	
$t-5$	-0.10	-2.11	**	0.45	3.15	***	0.81	2.34	**	-1.52	-1.67	*
$t-6$	0.01	0.25		-0.22	-1.58		0.77	2.23	**	-1.20	-1.32	
$t-7$	-0.16	-3.42	***	-0.07	-0.51		0.56	1.63		-1.12	-1.26	
$t-8$	0.05	1.09		0.07	0.50		0.28	0.82		-2.40	-2.70	***
$t-9$	0.08	1.82	*	0.34	2.42	**	0.44	1.29		-1.07	-1.22	
$t-10$	-0.12	-2.64	***	0.63	4.43	***	0.48	1.41		-0.86	-0.98	
$t-11$	-0.28	-6.17	***	-0.21	-1.47		0.59	1.72	*	-0.08	-0.09	
$t-12$	-0.16	-3.44	***	-0.20	-1.41		0.30	0.89		-0.77	-0.90	
$t-13$	-0.03	-0.74		-0.31	-2.20	**	0.19	0.55		-0.45	-0.52	
$t-14$	-0.19	-4.24	***	-1.01	-7.05	***	0.35	1.03		0.43	0.50	
$t-15$	-0.42	-9.22	***	-0.94	-6.53	***	0.57	1.67	*	0.84	0.98	
$t-16$	-0.32	-6.87	***	-0.95	-6.62	***	0.40	1.17		-0.50	-0.58	
$t-17$	-0.18	-3.81	***	0.03	0.22		0.43	1.27		-1.70	-1.99	**
$t-18$	0.06	1.31		0.54	3.76	***	0.37	1.10		0.12	0.14	
$t-19$	0.12	2.43	**	0.18	1.26		0.03	0.08		-0.02	-0.02	
$t-20$	0.11	2.33	**	0.38	2.60	***	0.32	0.95		-0.07	-0.08	
F-test statistic	49.69			11.89			15.35			1.82		
R^2 (overall)	0.0004			0.0004			0.0014			0.0001		
Number of observations	3,556,739			835,356			282,850			35,475		

Panel A: Households



Panel B: Institutions

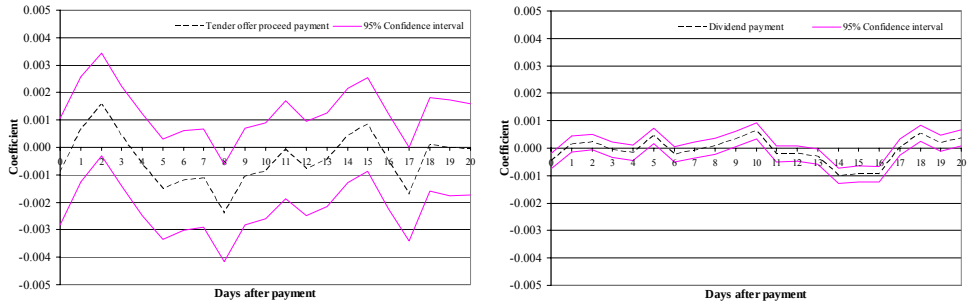


Fig. 3. Visual representation of cash disbursement coefficients from Table 5

4.5. What drives the decision to reinvest?

Up to this point, this study has documented results for unconditional reinvestment ratios and parsimonious empirical tests. The evidence so far points toward the conclusion that the propensity to reinvest is greater for tender offer proceeds than for dividends. Although keeping the most important factors constant, these analyses have not yet simultaneously controlled for all possible determinants of the propensity to reinvest. The purpose of the analysis in this subsection is to test whether the propensity to reinvest is greater for tender offer proceeds than for dividends, while simultaneously controlling for factors such as size of the cash payment, past return and size of the investor's portfolio, and investor age.

Slightly altering the methodology used in Grinblatt and Keloharju (2001), I run a buy/sell logit regression separately for all households and institutions in the data by coding strictly positive investments in the stock market as ones and strictly negative investments as zeros. Grinblatt and Keloharju (2001) use individual transactions as the dependent variable, while I use net daily flows to capture the direction of total reinvestment activity rather than individual trades.

Table 6
Determinants of the propensity to buy versus sell after a corporate cash disbursement
This table reports the results for an investor's choice to reinvest a cash dividend or proceeds from a sale of tendered stock. The dependent variable takes the value of 1 if an investor has positive net investment in the stock market after a dividend or tender offer proceeds payment, and 0 if the net investment is negative. The two leftmost specifications report results for the day of cash disbursement, the two rightmost for the day and subsequent 10 days. The sample includes all investors who traded after a cash disbursement, and the value of cash disbursement is required to be greater than the MDIV, as described in section 4.1. Dividends or tender offer proceeds payments clustered within 10 days are aggregated as described in Section 4.2. *12 month portfolio return* is calculated with monthly data and measured at the beginning of the month. The *tender offer* dummy has a value of 1 if the cash disbursement is tender offer proceeds, 0 if a dividend. The other three dummies are for three stages of tender offers as described in Section 3.5. A tender offer with a bidder owning less than 2/3 is the reference level, and has no dummy variable. *Special dividend* is a dummy for an additional dividend paid by the company on top of the regular annual dividend. *Financial corporation*, *mutual fund*, *nonprofit organization*, and *foreigner* are dummies for the representative investor categories, the dummy for the category *nonfinancial firm* is omitted in the sample of institutions. *Ln (portfolio value + 1)* is the natural logarithm of portfolio value one day prior to first cash disbursement and *Ln (value of cash disbursement)* the log value of cash dividend or tender offer proceeds. In the case of clustered dividends, the value of *special dividend* and the value of portfolio are determined by the day of the last cash disbursement. Past market index returns (not reported) are defined consistent with Grinblatt and Keloharju (2001), and correspond to arithmetic returns of the HEX Portfolio Index prior to the (last) day of the cash disbursement. Age and sex dummies (not reported) are 7 binary variables for age and one for sex. All specifications include 7 year dummies (not reported). Asterisks mark the statistical significance at conventional levels (* for 10%, ** for 5%, and *** for 1%, respectively).

Dependent variable	Binary: 1 if the investor has a positive cumulative net investment in the stock market after a cash disbursement, 0 if negative			
Specification	Logit			
Reinvestment lag	Day of payment		Day of payment + 10 days	
Sample	Households	Institutions	Households	Institutions
Constant	0.46	0.95***	0.35**	-0.05
	1.01	*3.08*	*2.01*	*-0.31*
12 month portfolio return	-0.07	-0.07	0.001	0.004
	-1.61	*-1.61*	*0.21*	*0.41*
Variables for the type of cash disbursement				
Tender offer	0.87***	0.62*	0.90***	0.14
	4.70	*1.92*	12.90	*1.30*
Mandatory bid at 2/3 ownership	0.39	0.99**	0.38***	0.36**
	1.62	*2.05*	*4.09*	*2.50*
Right for compulsory acquisition at 90% ownership	0.12	-1.69*	-0.27**	0.41*
	0.37	*-1.91*	*-2.05*	*1.67*
Forced redemption	-2.13**	a)	-0.69***	-0.31
	-2.28		*-2.61*	*-0.82*
Special dividend	0.34	0.01	-0.25***	0.03
	0.63	*0.02*	*-2.82*	*0.23*
Size variables				
Ln (portfolio value + 1)	-0.01	-0.05***	-0.11***	-0.02*
	-0.81	*-3.06*	*-11.51*	*-1.70*
Ln (value of cash flow)	0.05*	-0.06**	0.11***	-0.005
	1.81	*-2.51*	*8.89*	*-0.38*
Investor category dummies				
Financial corporation		0.19*		-0.01
		1.78		*-0.14*
Mutual fund		0.20		0.53***
		1.00		*5.51*
Nonprofit organization		0.11		0.02
		1.49		*0.37*
Foreigner		-0.08		-0.03
		-0.42		*-0.26*
Age and sex dummies	Included		Included	
Past market index returns	Included	Included	Included	Included
Year dummies	Included	Included	Included	Included
McFadden's pseudo R^2	0.032	0.027	0.044	0.020
Chi-square statistic	342.76	173.04	2229.63	343.10
Number of observations	8,124	4,574	36,488	12,531

a) No observations in the sample.

As in the previous analyses, I report results for two different lags, and further break the sample down to institutions and households. In addition, to not let the very small dividends to influence the results, I discard cash disbursements smaller than the MDIV (see Section 4.1).

The explanatory variables in the buy/sell regression can be divided to cash disbursement and control variables. Cash disbursement variables include a dummy for special dividends, a dummy for tender offers, and three dummies for the stage of tender offer as described in Section 3.5. If an investor receives several dividends or tender offer proceeds on the same trading day, I aggregate these cash flows to a single observation. Correspondingly, in the 10-day specification, all dividend payments or tender offer proceeds clustered within 10 days are aggregated, as described in Section 4.2. Control variables include dummies for each investor category (nonfinancial firm dummy omitted in the sample of institutions), the natural logarithm of portfolio value, the log value of cash disbursement, and the investor's cumulative gross portfolio return for the previous 12 months. I define the portfolio variable return consistent with Barber and Odean (2001) and calculate it at the beginning of each month. I also control for past market returns with 11 variables consistent with Grinblatt and Keloharju (2001), and include a full set of year dummies. In addition, there are seven dummies for age and one for sex in the sample of households.

Both 1-day and 10-day specifications have their own strengths and limitations. The strength of the 1-day specification is that the cash disbursement occurs on the same trading day as the measured net investment. In contrast, in the 10-day specification, cash flows and trades are aggregated over a 10-day period, which may cause some loss of precision: this is because the longer the reinvestment period, the less traceable is the link between cash flow and investment. On the other hand, 10-day samples are larger and do not rely on the rather stringent assumption that investors react immediately and trade on the day of the cash disbursement. I therefore report results for both lags.

The coefficient for portfolio value is negative and significant, and this finfing is especially pronounced in the 10-day specification for households. Hence, in a large portfolio, a cash disbursement has a smaller probability of being reinvested than in a small portfolio. There are two plausible explanations for this. First, if a EUR 1,000 dividend is paid to an investor with a EUR 1,000,000 portfolio, the dividend is probably far too small to cause much action, whereas the same dividend paid to a less affluent investor may trigger a reinvestment. Second, the number of stocks in a portfolio is correlated with portfolio value. Given the difficulty of short selling in the Finnish market, an investor with several stocks in a portfolio has several candidates for a sale, whereas an investor with no stocks in the portfolio can only buy.

In the 10-day specification for households, the special dividend dummy is negative and significant with *t*-value of -2.84. This finding, coupled with the earlier matched sample test result in Table 4 that tender offer proceeds are more likely to be reinvested than special dividends, would suggest that special dividends are framed more as dividends than principal. The fact that Finnish households do not reinvest special dividends is at odds with Baker et al (2006) who find that special dividends are more likely to be reinvested than ordinary dividends, conjecturing that special dividends are treated as principal. Hence, the question of whether special dividends are in terms of the BLC hypothesis in the current income (treated as 'dividends') or in the asset account (treated as 'principal') is perhaps not so straightforward, and could warrant a further examination with new data.

In addition to the BLC interpretation, the finding for special dividends in Table 6 is consistent with the earlier argument that the difference in reinvestment ratios for dividends and tender offer proceeds cannot be fully explained by the fact that tender offers are unexpected and constitute a larger fraction of an investor's portfolio. If this alternative argument were to gain support in the data, special dividends would have a higher probability of reinvestment because they are more unexpected and larger than ordinary dividends. This is not the case, however.

Results for the different stages of tender offers indicate that households who tender their shares early are more likely to reinvest the proceeds than those who tender only after the bidder has acquired 90% ownership; the *forced redemption* dummy is positive and significant in both 1-day and 10-day specifications. One potential explanation is that investors couple the decisions of tendering and reinvesting. Perhaps, investors who tender in the initial stage of a takeover do so because they have also decided where to invest the proceeds. In contrast, in the later stage of a takeover, there may be several investors who have not decided what to do with the funds, but are nevertheless forced to tender.

The results for control variables provide a means to compare the results of Table 6 with the earlier analyses in this paper as well as with the results from earlier literature. There are four findings worth pointing out here. First, in the sample of institutions, the positive and significant mutual fund dummy in the 10-day specification indicates that mutual funds have a higher propensity to reinvest. This result is also confirmed by the high unconditional reinvestment ratios in Panel B of Table 3. Second, the coefficients of unreported age dummies form declining pattern similar to the results in Grinblatt and Keloharju (2001), indicating that rational life-cycle considerations also play a role in the reinvestment decision. The elderly are most likely to sell rather than buy, whereas the behavior of the young investors is exactly the opposite. This finding

is also broadly consistent with Graham and Kumar (2006) who find evidence of age being a determinant for dividend preferences. However, it must be emphasized here that even if life-cycle considerations are relevant in the reinvestment decision, they fail to explain why there is a difference between reinvesting dividends and reinvesting tender offer proceeds.[5] Third, unreported coefficients for past market returns are generally negative and thus consistent with the results of Grinblatt and Keloharju (2001). In particular, households have a higher propensity to buy than to sell if the market has gone down less than 20 days prior to a cash disbursement. Fourth, the coefficient for the past return of the investor's portfolio is neither significant for households nor for institutions. For institutions, the result for this control variable is perhaps not that surprising, but for households it would not be unreasonable to expect this variable to be positive and significant because of a wealth effect. Especially when a tender offer is made at a significant premium, standard economic theory would suggest that investors should be more likely to reinvest a larger fraction of the tender offer proceeds. However, the past return of the household investor's portfolio is nevertheless insignificant in both 1-day and 10-day regressions. Neither does a variable for tender offer premium show up as significant in an unreported alternative specification. Poterba (2000) points out that the marginal propensity to consume from stock market gains is probably only in the order of a few percent. Therefore, not observing a wealth effect in the reinvestment decision is perhaps not that surprising.

I also perform a robustness check to control for the value of corporate cash disbursement as a fraction of portfolio value. In all four specifications of the logit model with results reported in Table 6, there are separate variables for cash flow size and portfolio value. However, including an additional variable for the fraction of portfolio value would be susceptible, because this variable would, by definition, be correlated with the cash flow size and portfolio value variables. For this reason, I re-estimate the results in Table 6 by replacing portfolio value and size of the cash flow with a single variable, size of the cash flow divided by portfolio value. Nevertheless, the results (unreported) remain qualitatively similar.

Overall, the findings in this section give additional evidence on households being more likely to reinvest tender offer proceeds than dividends, even when controlling for a host of factors. I argue that investors are more likely to reinvest tender offer proceeds, because they label corporate cash disbursement as dividends and principal. In the subsequent final empirical analysis

[5] It is important to note that the BLC model is at odds with the *assumptions*, but not with all the *predictions* of the rational life-cycle model. It is possible that economic agents exhibit behavior consistent with both rational and behavioral life-cycle models. Hence, even if there is evidence in favor of the BLC model, this does not imply complete rejection of the rational life-cycle model.

and the concluding section, I discuss whether the difference in reinvestment ratios can be rationalized with an explanation other than mental accounting.

4.6. Have investors constructed an optimal portfolio?

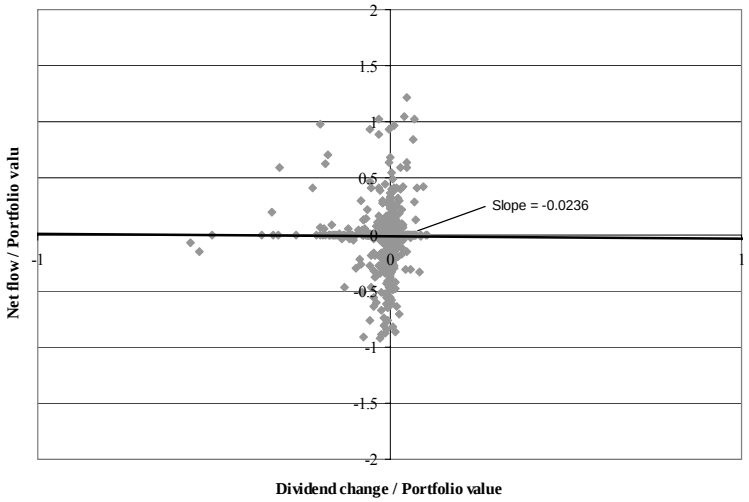
This paper has already argued in Section 4.3. that, given the lower propensity to reinvest special dividends than tender offer proceeds, the near zero reinvestment of dividends cannot be rationalized by the notion that households have optimized their intertemporal consumption path. According to this competing rational dividend clientele hypothesis, an expected cash disbursement, such as dividend, will not trigger reinvestment, whereas an unexpected cash disbursement, such as payment of tender offer proceeds, will induce reinvestment due to portfolio rebalancing.

The purpose of this subsection is to provide further evidence that the difference between the reinvestment of dividends and tender offer proceeds cannot be explained by the existence of rational household dividend clienteles. If there are rational dividend clienteles optimizing their future dividend stream, it would also be reasonable to expect that they react to dividend changes, and at the investor level, dividend changes and net flows to the stock market are positively correlated.

Especially, households who experience a major decline in their annual dividend income would have an incentive to sell stocks to finance consumption. I next investigate the behavior of investors who have experienced the most dramatic negative shock in their dividend income, namely investors whose portfolio dividend yield (defined as the value of dividends in a fiscal year divided by the value of portfolio at the beginning of fiscal year) has dropped from a strictly positive amount to zero. Furthermore, to exclude investors who have made a complete exit from the stock market in the second year, and for whom the too small size of dividends could hinder reinvestment, I restrict the analysis to households with dividends larger than MDIV in year one, and strictly positive portfolio value at the beginning of year two.

In Figure 4, I plot the decline in dividend income from year one to year two by the net value of trades in year two, both variables normalized by the investor's portfolio value. For comparison purposes, I also report the results for a random sample of households. If the households with extreme declines in dividend income compensate the lost dividend income by selling an offsetting amount of shares in the second year, the fitted line in Panel A of Figure 4 should have a slope of unity. In addition, one would expect the same relation to be prevalent, albeit perhaps to a lesser extent, in the random sample of households in Panel B.

Panel A: Households with dividend decline to zero



Panel B: Random sample of households

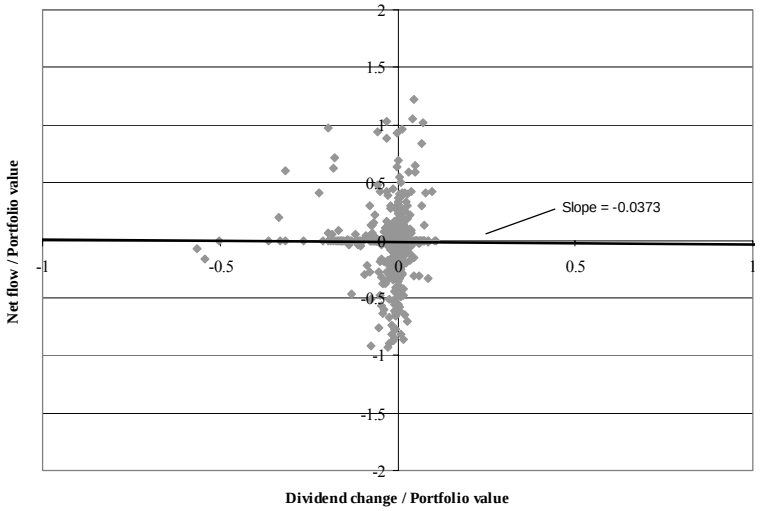


Fig. 4. Scatterplot on annual net flows and dividend changes. Panel A plots the relation between annual net flows (Gross value of buys – Gross value of sells) and dividend changes for household investors, whose dividend income in the year of observation has gone down to zero from an amount greater than MDIV (see Section 4.1.) in the previous year. In Panel B, the same graph is plotted for a random sample of households with dividends greater than MDIV in year one. Furthermore, in both graphs it is required that the investor has not liquidated her entire portfolio in year two. Portfolio values are computed at the beginning of the second year. The sample size for both Panel A and Panel B is 932 (initially 970) after excluding 1% outlier observations at both ends for both variables. The slope of the fitted regression line is –0.0236 in Panel A and –0.0373 in Panel B. In both cases they are statistically insignificant at conventional levels.

In both Panel A and Panel B, the fitted regression line between relative dividend change in the investor's portfolio and net flow to the stock market is nearly flat. The slope of the fitted line is –0.0236 in Panel A, and –0.0373 in Panel B. Neither in the sample of households with extreme dividend declines, nor in the random sample of households, is there any apparent relation between household's portfolio dividend yield and net flows to the stock market. In other words, not even households who have experienced the sharpest fall in their dividend income are creating home-made dividends by selling stocks in the year of dividend decline. The evidence is consistent with the famous case of Consolidated Edison, (see Shefrin and Statman, 1984) where shareholders were very reluctant to sell shares to finance consumption.

5. Conclusions

This study examines the extent to which investors reinvest dividends and tender offer proceeds in the stock market. Because the market must clear, and almost all investors receive dividends in the long-term, the long-term reinvestment ratio aggregated over all investors is zero. However, not every investor receives dividends on every trading day. It is therefore possible that investors with excess liquidity buy stocks in the short-term, and their reinvestment ratio would be positive.

The results show that households reinvest only a very small fraction of dividends in the short-term. Institutional investors are not reinvesting either, with the exception of mutual funds. I estimate that households probably reinvest less than 1% of dividends within two weeks of the payment. Even with a very aggressive measure, households reinvest no more than 8.1% of the dividends. Yet, these figures do not include the most passive investors, which would further bring down the estimated reinvestment ratios.

The market clearing condition does not prevent individual investors from treating dividends and tender offer proceeds differently in their mental calculus. I hypothesize that households in particular may segregate dividends and capital assets into different mental accounts and that they would be more likely to reinvest tender offer proceeds that belong to the capital asset account. In fact, this is what I find in the data. The propensity to reinvest tender offer proceeds is higher than for dividends, and this result is robust when controlling for the size and unexpectedness of receiving tender offer proceeds. There is also similar, but weaker, evidence for institutions.

There are several potential explanations as to why the overall reinvestment activity in the short-term is so low. Finding out what really drives the low reinvestment activity is beyond the scope of this study, but some of the potential explanations are discussed below.

Status quo bias (Samuelson and Zeckhauser, 1988; Baker, Coval, and Stein, 2006) offers an interpretation for why investors only infrequently reinvest dividends and tender offer proceeds: when the bank account of an investor is credited, reinvesting the funds requires a self-initiated action, and not reinvesting is the default choice. The status quo bias is very prevalent in the investor population: 69% of dividend payments to Finnish households were received by investors who did not trade at all in the fiscal year. If we assess the results of this paper and complementary evidence, the status quo explanation would seem to be consistent with the overall evidence. This paper and Baker et al. (2006) both support the view that households do not reinvest their cash dividends, unless the investor participates in a dividend reinvestment plan. Moreover, the Dutch household survey respondents in Dong, Robinson, and Veld (2005) report that they only consume a small portion of their cash dividends. Hence, it seems that, rather than consuming dividends in full, household investors left a large fraction of dividends untouched at bank accounts, at least in the short-term.

Although perhaps intuitively appealing, the status quo interpretation does not explain why household investors are more likely to reinvest tender offer proceeds than dividends, all other things being equal. Hence, even though status quo bias may be relevant for interpreting the aggregate finding of a low propensity to reinvest dividends and tender offer proceeds in the short-term, it does not explain a difference in the way these two income sources are treated.

One potential interpretation of the low propensity to reinvest is that household investors want cash disbursements at regular intervals to minimize transaction costs and the capital gains tax resulting from the sales of securities.[6] However, this explanation is inconsistent with the finding that tender offers and special dividends of the same size—both unexpected and large cash flows—are treated differently. Furthermore, the analysis in Section 4.6. also shows that households with extreme dividend declines are not creating home made dividends by selling stocks. These two facts indicate that the small absolute degree of dividend reinvestment and the difference in reinvestment of tender offer proceeds and dividends cannot be explained by the existence of rational dividend clienteles.

Taxes might also influence the reinvestment decision. In Finland, the effective tax rate for dividends is zero for domestic taxable investors, but capital gains on tendered shares are taxed. However, taxes work against the alternative hypothesis. If investors consider taxes when they

[6]In Finland, capital gains were taxed at 25-29% during the sample period. In contrast, the imputation system guaranteed an effective tax rate of 4% for dividends in fiscal year 1996, 1.4% in fiscal year 2000, and zero in fiscal years 1995, 1997-1999, and 2001-2002.

make the decision to reinvest, they should leave some of the tender offer proceeds uninvested to pay taxes later. In contrast, dividends can be fully reinvested because they are effectively not taxed.

Overall, my results are consistent with the argument that the labeling of cash flows can influence investor behavior (e.g., Thaler, 1999). My findings have at least two practical implications. First, a dividend paid to the investor's account is unlikely to be returned to the stock market. Individuals for whom transaction costs are not an issue and who are willing to increase saving, could consider an agreement with their stockbroker to reinvest dividends promptly. This proposed course of action is consistent with Benartzi and Thaler (2004), who argue that due to self-control problems, it is often optimal for an individual's long-term welfare to make pre-commitments for saving. Second, when financial instruments are marketed to retail investors, it may make a difference whether a certain cash flow is labeled as a return of principal, rather than interest or dividend.

Although household investors tend to reinvest tender offer proceeds than dividends, the fraction of reinvested tender offer proceeds is surprisingly small. While it seems that households do consider the source of income when deciding whether to reinvest or not, they do not always follow the rule of thumb "never touch the principal." The relatively small propensity to reinvest tender offer proceeds suggests that touching the principal is allowed at least when it has already been forcefully touched by the bidder.

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ESSAY 3:

Which investors are irrational?

Evidence from rights issues

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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

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; Goetzmann and Kumar, 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.

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

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.

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. This is also the case in the issue of Sonera, a major company with a dual listing on the NYSE. [2] 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. For issues with compensating interest, I conservatively classify early exercises capturing the interest as rational.

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]

[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 interesting 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.

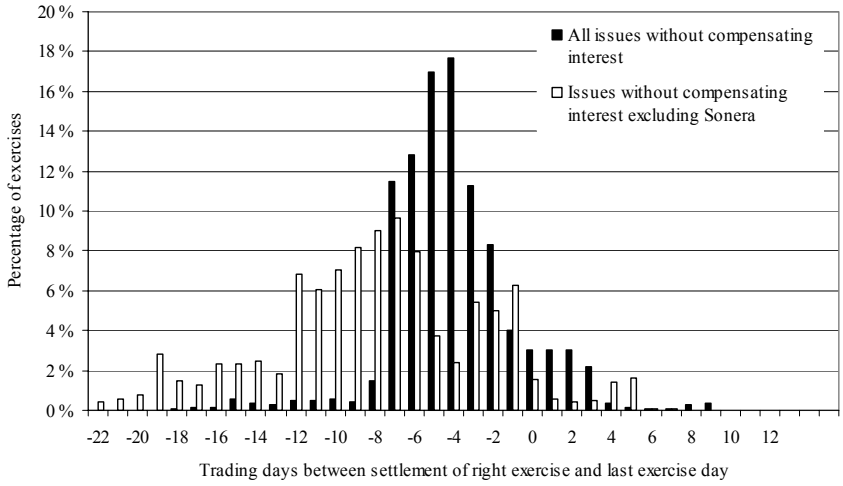


Fig. 1. Distribution of rights exercises in issues without compensating interest. The figure above plots the distribution of settlement dates for subscribed shares in eight issues (all issues since the beginning of year 1999 listed in Table 1) without compensating interest. The distribution of settlement 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.

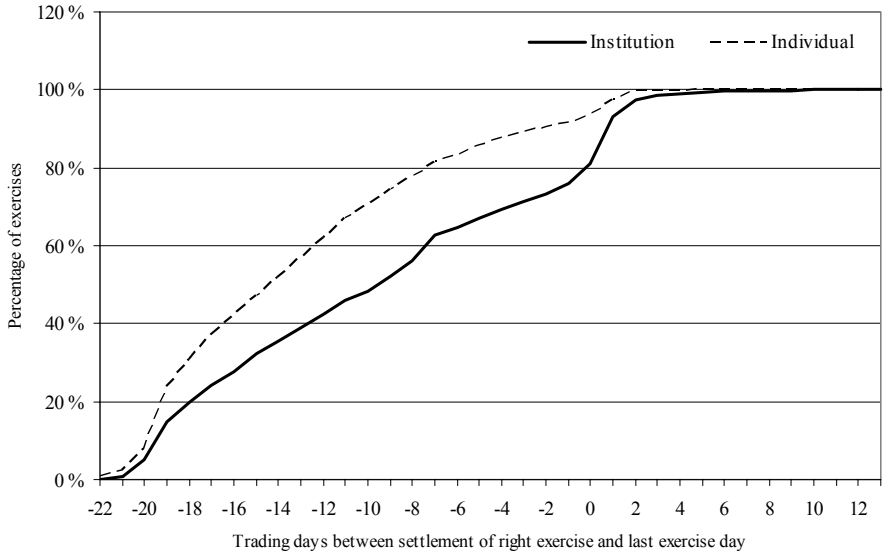


Fig. 2. Cumulative distribution of right exercises in non-interest paying issues: institutions versus individuals. The figure above plots the volume weighted distribution of right exercise settlement dates in all 8 rights issues (all issues since the beginning of year 1999 listed in Table 1) which paid 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

[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.

mostly to exercise rights early. I further study early exercises in the next subsection, which investigates the factors contributing to exercise timing.

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.

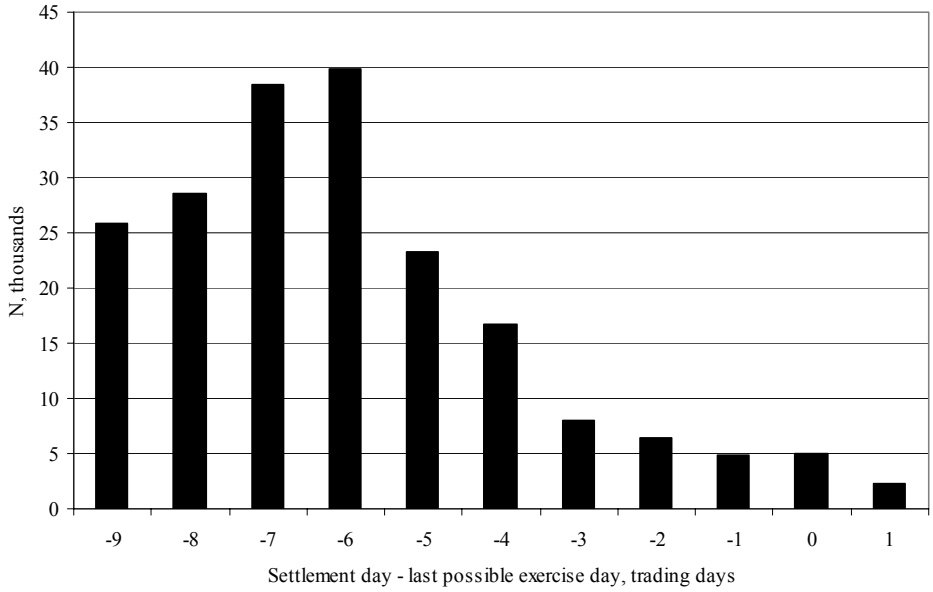


Fig. 3. Distribution of settlement dates in the rights issue of Sonera.
The figure plots the distribution of share settlement dates in the rights issue of Sonera. The number of trading days between the settlement day and the last possible exercise day is on the x-axis. For example, day zero corresponds 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.

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

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-

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.

[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.

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, $\lambda(t)= \lambda^{1/\gamma}t^{1/\gamma-1}/ \gamma[1+(\lambda t)^{1/\lambda}]^2$, 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 μ=xβ. 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

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 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

[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.

[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.

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

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]

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

[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.

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 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.

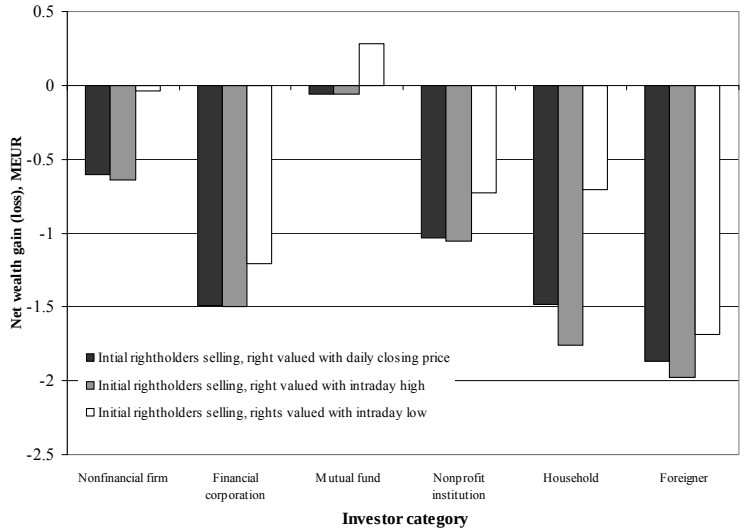
I compute the cumulative wealth transfer separately by using the daily close, high, and low prices of the underlying stock.[16] This ensures that intraday price variations will not affect any conclusions made from closing prices. Calculating the intrinsic value of a right by using the intraday low price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

[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.

Panel A: Initial rightholders selling



Panel B: All investors

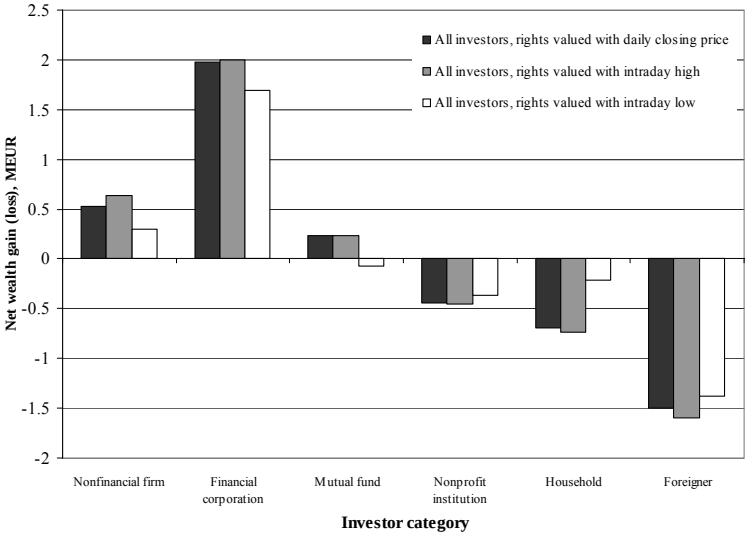


Fig. 4. Net wealth transfer resulting from trades of subscription rights by investor category. The graph in Panel A (*Initial rightholders selling)* shows the net wealth transfer to initial rightholders subsequently selling all or some of their rights in the open market. Panel B (*All investors*) shows 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.

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]

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.

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

[17] See details of investor level capital gains taxation in Section 3.3.

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

[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.

(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.

(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.

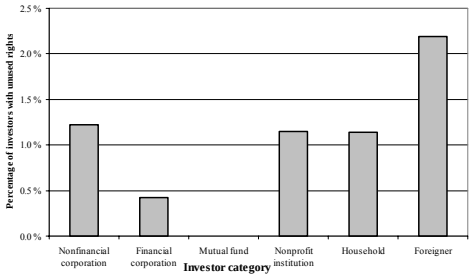
Table 8
Wealth loss resulting from unexercised rights
This table documents conservative estimates for the amount of wealth loss suffered by investors who fail to exercise or sell their subscription rights. Panel A assumes a strategy of selling the rights in the open market on the last trading day for 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

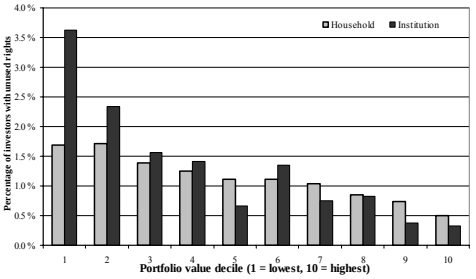
4.6. What drives investor irrationality in a rights issue?

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

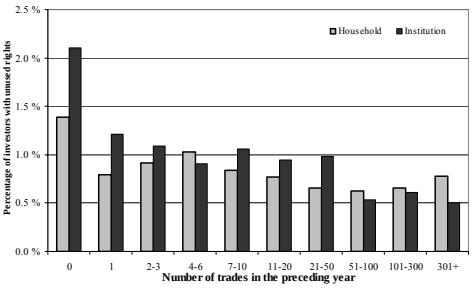
Panel A: % of unexercised rights by investor category



Panel B: % of unexercised rights by portfolio value



Panel C: % of unexercised rights by trading activity



Panel D: % of unexercised rights by language and domicile

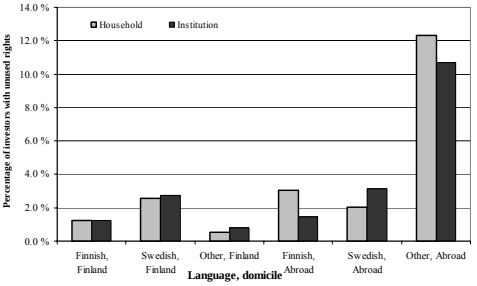


Fig. 5. Univariate distributions for unexercised rights
The graphs plot the relation between investor characteristics and the percentage of investors acting irrationally in failing to exercise or sell rights. When an investor fails to exercise or sell rights, the observation is classified as irrational 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.

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%.

Next, I pool all domestic investors except for households into a single group labeled *institutions*, and report the percentage of irrationally unexercised rights by portfolio value decile. Perhaps not surprisingly, Panel B indicates that the proportion of household and institutional

investors acting irrationally decreases almost monotonically with portfolio value.[19] 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. Both the result for portfolio value and trading activity are broadly consistent with recent studies finding investors higher income and net worth to be savvier in their investment decisions (e.g. Grinblatt and Keloharju, 2000; Agnew, 2005; Calvet, Campbell, and Sodini, 2006; Goetzmann and Kumar, 2006).

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 signifi-

[19] I also plot the relative frequency of unexercised rights by the number of stocks in the investor's portfolio. The graph (unreported) is almost identical to the graph in Panel B.

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

cant 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.

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.

[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.

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

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 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.

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

These findings can be interpreted in two different ways. The first explanation is strict irrationality: 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 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, an untabulated analysis indicates that 14% of households and 11% institutions who left subscription rights irrationally unexercised, traded stocks (of the issuing or some other company) during the subscription period. In other words, more than 10% of the investors left subscription rights unexercised, even though they actively participated in the stock market at the same time. It is difficult to reconcile this finding with the transaction cost explanation.

The strict irrationality hypothesis is also supported by the fact that some of the wealth losses are quite large. 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.[22] Provided that the talk lasts an hour, it must be that there are at least some unambiguously 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.

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

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 that seemingly irrational decisions are often potentially explained by transaction and opportunity costs, but sometimes the wealth loss is simply too large to be reconciled with these considerations.

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