Dynamics Between Equity Holdings and Returns

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Abstract

This paper investigates the interactions between changes in share ownership structure and equity returns. We jointly model price movements and trades of three different investor classes: foreign institutions, domestic institutions and retail investors on the Helsinki Stock Exchange over the period of 2000 till 2004. Consistent with Grinblatt and Keloharju (2000), we find that foreign institutions tend to engage in momentum based trading strategies, while domestic institutions and retail investors are contrarian. Foreign institutions and retail investors respond to the same day stock price movements and those in the immediately preceding intervals. Negative feedback trading by domestic institutions is evident up to lags of several days. Across all three investor classes, intraday net trade is shown to have some impact on future price movements. This appears to be due primarily to a price pressure effect, which reverses in later intervals. These findings add to the understanding of the causal relation between institutional trade and returns.

JEL Classification: TBA

Keywords: ownership structure, institutional investors, momentum, negative feedback trading

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1 INTRODUCTION

In this paper, we aim to contribute to the understanding of the causal relation between institutional equity holdings and returns. Since movements in stock prices are caused by investors' trading decisions, the characteristics of the investors making these trading decisions would be expected to have an impact on stock prices. There is a growing body of literature that seeks to document and explain the linkages between changes in the holdings of different investor classes and stock price movements. However, such studies have generally been hampered by a lack of precision in the available data. This paper examines the relation between equity holdings and returns using a unique dataset from the Helsinki Stock Exchange (HEX). Similar to Griffen, Harris and Topaloglu (2003), we study the interaction between equity returns and changes in ownership structure. Specifically, the primary objective of this study is to determine the direction of causality between these two variables of interest down to intra-day accuracy, and thus help resolve contradictions in prior research. We separately analyze each of the three following investor classes: foreign institutions, domestic institutions and retail traders.[1] A secondary research issue addressed in this study is the herd behavior within each of these classes, that is, the propensity of investors to trade in the same direction.

In recent years there has been a significant growth in the presence of institutional traders in equity markets. Consequently, the bulk of extant research is focused on institutional trading. In particular, the positive correlation between institutional trading activity and stock returns is well documented in the literature. For instance, in an early study, Klemkosky (1977) examines the impact of net institutional ownership changes on returns in the surrounding months, and finds a contemporaneous relation. More recently, Nofsinger and Sias (1999) report that, for their sample of NYSE-listed securities, there is a positive correlation between the two variables of interest, but the direction of "causation remains ambiguous". In other words, we are faced with the question of whether stock price movements drive institutional trading decisions, or vice versa. The former is commonly attributed to herding behavior, that is, certain trader classes responding in the same manner to signals. Herding in response to prior returns is known as "feedback trading," which can be positive or negative depending on the direction of trade (see, among others, DeLong, Shleifer, Summers, & Waldman, 1990; Hong & Stein, 1999). For instance, Lakonishok, Schleifer and Vishny (1992) examine the quarterly holdings for a large sample of pension funds, and report that such institutional investors do not trade in response to price changes.

[1] We do not distinguish between foreign and domestic retail traders, as the former account for a negligible percentage of shareholdings and trade.

Grinblatt, Titman and Wermers (1995) and Cai, Kaul and Zheng (2000) also analyze quarterly holdings data, but find that institutional investors employ momentum-based trading strategies. In other words, they positive feedback trade. Furthermore, this causal relationship is uni-directional, with trading activity having no impact on future price movements.

An alternative explanation for co-movements between equity holdings and returns is that certain market participants are relatively more informed, and thus influence future prices via their trades (see Glosten & Milgrom, 1985; Ke & Petroni, 2004, among others). Daniel, Grinblatt, Titman and Wermers (1997), for example, study the performance of several mutual fund portfolios over a 30-year timeframe. The findings indicate that sample fund managers are able to anticipate security price movements at least some of the time (See Chen, Jegadeesh, & Wermers, 2000; Grinblatt & Titman, 1993; Pinnuck, 2003; Wermers, 2000, among others). However, Pinnuck (2003) cautions that such findings may be driven by price pressure from institutional trading, rather than any informational effect. This may occur, for example, when there is large net institutional activity on one side of the market. Due to the demand for liquidity, prices in the contemporaneous or immediately subsequent periods may increase even in the absence of any private information. Indeed, in their investigation of quarterly institutional holdings and net trading activity, Gompers and Metrick (2001) document findings that strongly reject both the "feedback trade" and "informed trading" hypotheses in favor of the explanation that institutional trading activity exacts pressure on equity prices. Also, in contrast to many of the studies discussed above, other researchers have reported empirical evidence suggesting that causality is bi-directional, that is, both feedback trade and information/price pressure play a role in explaining the relation between the two variables of interest (for example, see Dennis & Strickland, 2002; Grinblatt & Keloharju, 2000; Sias, Starks, & Titman, 2001) .

Thus, although much research interest has been focused on this area, results from extant papers are not uniform. It is plausible that this might be due to the data constraints that have largely limited analyses to quarterly ownership data from the U.S. markets. Accordingly, several recent papers have addressed this issue using either improved methodologies or datasets. From quarterly data, Sias, Starks and Titman (2001) employ a methodology which allows them to infer the relation between institutional holdings and returns over more precise time periods. Results indicate bi-directional causality, with price pressure being of greater explanatory importance than informed trading activity. Further, almost all the quarterly covariance is attributable to intraday price changes, but the lack of data precludes any further analyses.

Empirical evidence derived using higher frequency data is sparse. An exception is Grinblatt and Keloharju (2000), who employ a unique, detailed dataset of investor holdings on the Helsinki Stock Exchange (HEX). The findings show that foreign investors, a majority of which are large overseas institutions, engage in positive feedback trading. Further, they exhibit superior performance that cannot be completely explained by momentum profits. In other words, these investors may also possess an informational advantage. Griffen et al. (2003) analyses NASDAQ transaction data over a 10-month period,[2] with broker-type identifiers for each trade side. In contrast to Grinblatt and Keloharju (2000), the analysis reveals that while institutions engage in momentum-based strategies, such trades do not influence future price movements. In summary, while prior evidence provides a strong indication that there is a positive relation between institutional trading volume and returns, the cause of this co-movement is an issue that still needs to be resolved.

It is sometimes argued that local investors are more informed due to their proximity to the market (see, for instance, Choe, Kho, & Stulz, 2005; Lin, 2006; Richards, 2005). As such, we differentiate between foreign and domestic institutions. Furthermore, although institutions form an increasingly large proportion of the equity markets in terms of both ownership and trading activity, we also consider the behavior of another important class of market participants—individuals or retail investors. Here, results are more consistent across prior studies. First, such investors tend to negative feedback trade, that is, they employ contrarian trading strategies (Grinblatt & Keloharju, 2000; Jackson, 2003; Kaniel, Saar, & Titman, 2005; Richards, 2005). Second, retail investors are relatively less informed, and tend to make less profitable trading decisions (see for example Barber, Lee, Liu, & Odean, 2004; Barber & Odean, 2000). This does not necessarily mean that the causal relationship between retail trades and stock price movements will be uni-directional. Kaniel et al. (2005), for instance, find strong empirical evidence showing that net individual trading volume drives security returns in subsequent periods. Since it is not very plausible that individuals have an informational advantage over the much larger institutional traders on the NYSE, the authors conclude that this co-relation is likely due to a temporary price pressure effect.

Herding behavior, that is, the extent to which investors are trading in the same direction, also relates to co-movements between equity holdings and returns. Note that feedback trading, the tendency of investors to react in the same way to prior returns, is itself a type of herding behavior. However, herding

[2] May 2000 to February 2001

can be due to factors other than a similar response to price movements (Froot, Scharfstein, & Stein, 1992; Sias, 2004). Both the informed and uninformed have been shown to herd, although for different reasons. As an example, fund managers may trade in the same direction based on the same set of private information (Hirshleiger, Subrahmanyam, & Titman, 1994) or to preserve their reputations (Scharfstein & Stein, 1990). Conversely, individuals may be influenced by sentiment or other psychological effects (Shiller, 1984; Shleifer & Summers, 1990).

Our paper contributes to the literature in the following four areas. First, while most extant studies only investigate either institutional or retail trading behavior, we examine the linkages between equity price movements and the trades of three different investor classes: foreign institutions (FI), domestic institutions (DI) and retail traders (RT). Second, we build on the methodology developed by Griffen et al. (2003), and apply this to a unique intra-day dataset. Our analysis differs from Griffen et al. (2003) in that while they only differentiate between institutional and individual traders, we analyze foreign and domestic institutions separately. Thus, results from this study contribute not only to academic work on institutional trade, but also to the home bias literature. Third, we help resolve the inconsistencies in prior findings by using a dataset that allows us to differentiate between two conflicting hypotheses, namely, whether stock price movements drive institutional trading decisions, or vice versa. Fourth, the models employed also allow us to document patterns in trading decisions within each investor class of interest. Specifically, we test for herding activity, at both daily and intraday level.

There are three main findings in this study: First, on a daily basis, there is evidence of feedback trade for all three investor categories of interest. Consistent with Grinblatt & Keloharju (2000), we find that foreign institutions tend to engage in momentum based trading strategies, while domestic institutions and retail investors are contrarian. Foreign institutions and retail traders appear to respond to same day stock price movements, and those in the intervals immediately preceding. On the other hand, domestic institutions' negative feedback trading is evident up to a lag of several days, suggesting that there is a lag in the response of such investors to signals contained in past returns. Moreover, with the exception of the larger foreign institutional traders, there is no evidence of intraday feedback trading. Second, the empirical evidence weakly supports the hypothesis that net daily trading activity drives returns, that is, an information advantage and/or a price pressure effect. However, this impact is almost negligible for the domestic institutions, whether on the contemporaneous or lagged trading days. Across all three investor classes, intraday net trade is shown to have some impact on future price movements. This

appears to be due primarily to a price pressure effect, which reverses in later intervals. Finally, in terms of the secondary hypothesis, we find evidence of herding behavior across all three investor classes, at both daily and intraday frequencies.

The remainder of the paper is organized as follows: Section 2 contains a description of the HEX, and datasets used are introduced in Section 3. Empirical methodology utilized is set out in Section 4, while results of the analyses are discussed in Section 5. Finally, Section 6 provides concluding remarks.

2 THE FINNISH MARKET

The Helsinki Stock Exchange (HEX) is the primary exchange in Finland. As with most major exchanges, HEX-traded securities include shares, bonds and equity derivatives such as warrants. In addition, trading activity in Finnish derivatives on the EUREX is steadily increasing. Introduced in 1999, the Euro replaced the Finnish Markka as the HEX trading currency. As of January 2006, there were 137 firms listed on the HEX.[3] Together with equity rights and seven across-listed Swedish firms, these make up 291 traded share issues, with a total market value of approximately 203 billion Euros. This figure represents a staggering increase of over 2000% from a market capitalization of 10 billion Euros in 1992. Thus, although still relatively small, it is apparent that the HEX is a steadily growing market. In line with this, trading times on the HEX have been extended from 7 to 8 hours within our sample period. The HEX is essentially an order-driven market, that is, trades are executed by matching incoming orders to ones on the opposing side of the order book, with opening and closing prices being determined by means of a single price call auction. A significant feature of the HEX is the dominance of one company—Nokia. At the extreme, securities in Nokia accounted for almost 80% of the total market capitalization. While this percentage has significantly decreased (to approximately 35% in 2005), Nokia still represents a major part of the HEX in terms of both market value and trading activity.

The HEX was chosen primarily because the richness and depth of the data available allows a thorough investigation of the research issues. Despite this, the use of Finnish data may still be open to some criticism. For example, due to the size of the market and the dominance of Nokia, results may not be seen as being as widely representative as studies utilizing US.-based datasets. Here, it is important to

[3] This has since increased to approximately 150 firms, as at May 2006.

reiterate that data availability is very much an issue. To our knowledge, it is not currently possible to obtain such data for any other major exchange, in the U.S. or elsewhere. Moreover, while the HEX in itself is still a relatively small market, there has been substantial growth in recent years. It also currently forms part of the OMX, a group of six exchanges that also includes the Copenhagen Stock Exchange and the Stockholm Stock Exchange. As of January 2006, market capitalization of the OMX was 743 billion Euros. Hence, it can be argued that the HEX is becoming a significant market in the region, if not internationally. The Finnish market is also conducive to the focus of the current research because there is a considerable amount of foreign activity. In particular, during the sample period of 2000-2004, foreign institutions account for about 20% of trading volume. At any given point within this sample period, such investors also made up a significant percentage of the ownership structure. As such, on the whole, the benefits of the dataset outweigh its disadvantages, and will aid in providing new insight into the research issues.

3 DATA

The objective of this study is to investigate the relation between changes in share ownership and price movements of shares that trade on the HEX, between May 2000 and December 2004. Two raw datasets are utilized in the initial analysis, one directly from the exchange and the other from the Nordic Central Securities Depositary (NCSD). The former comprises intraday transaction data—timestamps, prices and volumes for each trade, as well as the broker identifiers associated with each trade side. The latter records every change in share holdings—all deposits, withdrawals and adjustments that occur during the sample period. The depth of information captured facilitates a classification of trading activity according to investor-specific characteristics. Detailed descriptions of every field in the available data and explanations for the associated codes are outlined in Appendix 1. Market indices used in the analysis are obtained from the Securities Industry Research Centre of Asia-Pacific (SIRCA).

A matching process that combines relevant information from both sets of raw data (for a detailed discussion, see Linnainmaa, 2001) is then applied to obtain a final transaction-by-transaction dataset that includes investor-type information for each trade-side. In addition, further preliminary work is done to classify the investors into foreign institutions, domestic institutions and retail traders. The daily data are then analyzed to identify securities that are suitable for the study. First, since the focus of the current

empirical chapter is on traded shares, all other instruments are eliminated.[4] This leads to a sample size of 176 observations. Following this, the data are examined to identify thinly traded securities. In order to obtain results that are comparable across the three investor classes, such securities are defined as those that have at least an average of one trade per investor type per day, during the period being studied. Based on this criterion, the sample set is further reduced to 105 securities. Note that the sample still includes stocks that are not listed across the entire sample period. Where data are available, the model will be applied to these stocks within sample period. For the intraday analysis, we start with a sample of the 25 most active securities in terms of trading volume. A difficulty arises when most of the trading volume on any given day is attributable to just one investor class, as the net change in holdings will then be zero for each class. If this occurs on too many days across the sample period, there will not be sufficient observations to properly implement the intraday model. This leads to the further exclusion of 5 securities. We thus have a final sample size of 105 for the daily analysis, and 20 for the intraday model.

Transaction data for the final sample are further organized by excluding trades recorded for non-trading days[5] or outside of normal market hours. For individual stocks, a filter is also applied to remove days around[6] stock splits and secondary issues, as such events may result in the empirical models capturing a contemporaneous relation between the two variables that might not otherwise be evident. The final dataset is comprised of approximately 1,230 daily and 109,615 five-minute observations for each sample stock that is listed across the entire period.

4 METHODOLOGY

Empirical testing of the hypotheses is carried out using several vector-autoregressive (VAR) models. In the current work, the main objective is to determine the lead-lag between the net trading activity of each investor class and price movements. To accomplish this, a VAR model is built in which the variables of interest are the change in percentage ownership by each investor class and stock returns within each interval, respectively. To fully capture the dynamics of the relationship between our variables of interest, the analysis is first performed using daily data, with and without the inclusion of a contemporaneous

[4] For example, exclusions include rights issues.

[5] Non-trading days refer to days on which the market is closed, such as Easter and Christmas.

[6] Specifically, trades on the day prior to and on the day after these events are excluded.

variable, and then repeated at an intraday frequency of five minutes. All VAR models are estimated using ordinary least squares regression (OLS).

4.1 Daily VAR Model

This initial model comprises a system of two separate equations. The first has returns as the dependent variable while changes in investor-class holdings are used as the dependent variable for the second. For both equations, the independent variables are lagged returns and lagged values of the holdings change series. These are defined as follows:

$$\Delta H_{i,j,t} = \frac{BUY_{i,j,t} - SELL_{i,j,t}}{TSO_{j}}$$

Equation (1)

where $\Delta H_{i,t}$:Change in holdings over period; $BUY_{i,j,t}$: Total investor class *i* buy-side volume in stock *j,* within period *t;* $SELL_{i,j,t}$: Total investor class *i* sell-side volume in stock *j,* within period *t; TSO*$_j$: Total shares of security j on issue, as of the beginning of the day.

For comparison purposes, the model is estimated separately for each investor category. Lags are determined using a chi-squared distributed test statistic,[7] and the system is defined as follows for each investor class *j*:

$$\begin{bmatrix} \Delta H_{j,i,t} \\ RET_{j,i,t} \end{bmatrix} = \begin{bmatrix} \alpha_{j,i}^{H} \\ \alpha_{j,i}^{Returns} \end{bmatrix} + \begin{bmatrix} \sum_{k=1}^{i} \beta_{H,K} \Delta H_{j,i,t-k} \\ \sum_{k=1}^{i} \beta_{R,K} \Delta H_{j,i,t-k} \end{bmatrix} + \begin{bmatrix} \sum_{k=1}^{i} \lambda_{H,K} RET_{i,t-k} \\ \sum_{k=1}^{i} \lambda_{R,K} RET_{i,t-k} \end{bmatrix} + \begin{bmatrix} \varepsilon_{t}^{H} \\ \varepsilon_{t}^{R} \end{bmatrix}$$

Equation (2)

where l: Number of lags, set to a minimum of one and a maximum of five; ε : Error terms, which are assumed to be normally distributed with zero mean and constant variance; RET: Close-to-close returns for stock *i* .

[7] Lag lengths are also checked using the Schwartz Information Criterion.

4.2 Granger-Causality Tests

In estimating the model discussed above, as with most investigations into time series lead-lag behavior (Sias & Starks, 1997), it is difficult to find any theoretical support allowing a clear prediction of the size and direction of the coefficients at each lag. Therefore, in order to more clearly differentiate between our two conflicting hypotheses, Granger-Causality (GC) tests (1969) are employed. GC tests do not infer causality per se, but rather give an indication of the extent to which lagged values of each variable affects movements in the other. So, for example, if changes in the level of foreign institutional holdings in a particular security contain information that is useful in predicting future price movements, foreign institutional trading activity is said to "granger-cause" returns. It should also be noted that Granger-Causality can be bi-directional. Thus, in the example above, price movements can also concurrently Granger-cause foreign institutional trade. Besides allowing a clearer indication of the lead-lag relation, GC testing also facilitates easier comparison across different securities in the sample set, as well as between investor categories.

4.3 Modified Daily VAR Model

When a security is very actively traded, any such linkage may be more evident over finer time intervals. Conceptually, if investors do in fact adjust their trading decisions in response to security prices movements, they should do this on a continuous intraday basis, rather than just at the end of each trading day. In other words, any relation between the two variables of interest may be contemporaneous, that is, occur within the same trading day. To take this into account, the initial VAR model is modified as follows:

$$\begin{bmatrix} \Delta H_{j,i,t} \\ RET_{j,i,t} \end{bmatrix} = \begin{bmatrix} \alpha_{j,i}^{H} \\ \alpha_{j,i}^{\text{Re}\,turns} \end{bmatrix} + \begin{bmatrix} \delta_H RET_{j,i,t} \\ \delta_R \Delta H_{j,i,t} \end{bmatrix} + \begin{bmatrix} \sum_{k=1}^{i} \beta_{H,K} \Delta H_{j,i,t-k} \\ \sum_{k=1}^{i} \beta_{R,K} \Delta H_{j,i,t-k} \end{bmatrix} + \begin{bmatrix} \sum_{k=1}^{i} \lambda_{H,K} RET_{j,i,t-k} \\ \sum_{k=1}^{i} \lambda_{R,K} RET_{j,i,t-k} \end{bmatrix} + \begin{bmatrix} \varepsilon_t^H \\ \varepsilon_t^R \end{bmatrix}$$

Equation (3)

where l: Number of lags, set to a minimum of 1 and a maximum of 5; ε: Error terms, which are assumed to be normally distributed with zero mean and constant variance; δ: Reflects any same day relation between the two variables.

4.4 Intraday VAR Model

It is expected that, for more liquid securities, any linkage between investor trading activity and share price movements occurs contemporaneously. A preliminary analysis of the intraday data indicates that many of the sample securities are not sufficiently liquid on a minute-to-minute basis. A five-minute frequency is chosen as it is fine enough to reflect any intraday co-movements between the two variables of interest. Thus, both net trade flows and share price returns are aggregated over the chosen interval length. Further, as previously discussed, the analysis is performed on a subset of 20 actively traded stocks.

5 RESULTS, FINDINGS AND DISCUSSION

Table 1 provides summary statistics for our sample set. The percentage of total shares on issue held by each investor type and market capitalizations are calculated as of January 1 2000, while statistics on trading activity are taken across the entire sample period from January 2000 to 31st December 2004. Nokia is, by far, the leading security on the HEX. At the start of the sample period, this stock alone accounts for 68% of the sample set in terms of market capitalization. However, the dominance of Nokia declined during the sample period to 42% of total sample stock value as of December 2004. In addition, a small percentage of sample securities form a major part of the HEX, with the bulk of total market capitalization and trading activity concentrated within the top 25 sample stocks. A break-down of ownership information by investor classes indicates that foreign institutional (FI) traders appear to be the major players in the market, accounting for 70% of total shareholdings, while 10% is held by domestic institutions and 20% by retail traders. On the other hand, trading volumes are relatively evenly distributed across the three investor classes.

<Insert Table 1 about here>

Due to the fact that the model is estimated for each investor class in every sample security, full results are too cumbersome to facilitate meaningful interpretation. Summary tables are thus provided for each relevant set of results. Cross-sectional averages of the estimated coefficients and adjusted R^2s, as well as the percentage of coefficients that are significant at each lag, are presented and discussed below. Table 2 provides findings for foreign institutional trading activity, Table 3 for trades of domestic institutions,

and *Table 4* for trades of retail investors. For each table, coefficients of interest and the hypothesis tested are set out in Figure 1 below. Finally, summary results for associated Granger-Causality tests are outlined in *Table 3*. Unless otherwise stated, all references to coefficients and *p*-values indicate cross-sectional aggregate values.

	TRADE	RETURNS
TRADE	β_H (Herding)	λ_H (Feedback Trade)
RETURNS	β_R(Information/PP)	λ_R

Figure 1

5.1 Trading Activity of Foreign Institutions

When foreign institutional trading activity is modeled as the dependent variable, all cross-sectional mean λ_H coefficients are positive. However, the magnitude of coefficient means decreases from a peak of 0.16 at the first lag, to 0.02 for lag five. The proportion of the sample with significant[8] λ_H coefficients also varies inversely with lag length, from almost 30% of the individual stock $\lambda_{H,1}$s to only 8.4% for $\lambda_{H,5}$. Moreover, the *p*-values show that only $\lambda_{H,1}$ is significant at the 1% level. This indicates that there is a positive relation between lagged returns and the trading decisions of foreign institutions, that is, such traders do, at least to some extent, feedback trade by buying (selling) in response to prior upward (downward) stock movements. In other words, consistent with the findings of Grinblatt & Keloharju (2000), FI investors tend to engage in momentum-based trading strategies. As would be expected, any such reaction to past returns occurs quickly and dissipates as longer intervals are considered. On the other hand, all the cross-sectional average β_Rs are also close to zero, and *p*-values show that none are significant at the 1% level. This suggests that FI trading activity does not have any meaningful effect on future stock price movements. However, the summary GC test statistics show that returns granger-cause changes in FI holdings as well as vice versa, but the proportion of sample stocks with a significant test statistic is higher for the former. Thus, FI trading activity may influence price movements, particularly at closer lags, but any such impact will be minimal.

[8] At the 10% level of significance

Testing for contemporaneous effects reveals positive cross-sectional average δs, which are significant at the 1% level of significance. For each equation in the system, this coefficient is larger and has a higher percentage of positive and significant individual stock coefficients, as compared to either β_R or λ_H across all five lags. Thus, most co-movements occur within the same trading day. Also, the mean δ_H is much larger than that of δ_R. Taken together, such results suggest that causality is bi-directional, but provide more support for the feedback trading hypothesis over a price pressure/information effect.

Finally, cross-sectional mean λ_Hs from the intraday analysis are positive, but close to zero and insignificant across all lags. On the other hand, β_Rs are on average positive up to β_4, but this coefficient is negative at lag five. Further, the *p-values* indicate that, at the 10% level, only β_1 is empirically significant. GC tests show bi-directional causality, but greater support exists for the hypothesis that returns granger-cause changes in holdings than for vice versa. Thus, in contrast to results from the daily analysis, the price pressure/information hypothesis plays a greater role in explaining intraday co-movements between the two variables of interest. The reversal in the sign of β_R at longer lags suggests that it is more likely that this is due to a price pressure effect.

<Insert Table 2 about here>

5.2 Trading Activity of Domestic Institutions

The second investor class of interest is comprised of local Finnish institutions. Here, λ_H is negative across all five lags. None of the relevant *p*-values are significant at the 1% level, but the aggregate λ_H coefficients at the first and fifth lag are found to be empirically significant at the 10% level. These results suggest a negative relation between net domestic institutional (DI) trading activity and prior stock return movements. In other words, DI traders tend to engage in negative feedback trade (i.e., contrarian trading strategies) by buying (selling) in response to past price decreases (increases). Further, in contrast to results based on FI trades, this response does not appear to be as concentrated in the immediate subsequent interval, and may persist into longer lags. When analyzing the impact that DI trades have on share price returns in following periods, we find that none of the aggregate β_Rs are significant at even the 10% level. Moreover, these coefficients are very close to zero across all lags. Thus, the negative relation between DI trading activity and equity returns is wholly attributable to negative feedback trade. This finding is supported by the GC test statistics, which show that returns granger-cause net DI trade but not vice versa.

In addition, intraday co-movements are of relatively lesser importance when analyzing that of local Finnish institutions as the cross-sectional means of both δ coefficients are negative, and neither is significant even at the 10% level. Similarly, while all of the cross-sectional β_R or λ_H coefficients from the intraday model are negative, the p-values show that none are significant even at the 10% level. GC tests, however, show uni-directional causality from net DI trades to returns. Thus, while the intraday relation here is almost negligible, any such co-movements are attributable to a price pressure/informational effect. Since there is no evidence from previous analyses conducted that such traders have any informational advantage, the former explanation is more plausible. Such findings are in contrast to those of prior studies which suggest that local traders may have an edge (Choe et al., 2005). This may be a feature of the HEX, where foreign traders tend to be larger institutions.

<Insert Table 3 about here>

5.3 Trading Activity of Retail Traders

Retail traders form the third and final class under investigation. Cross-sectional λ_Hs are negative for the first four lag lengths considered, and significant at the 10% level for $\lambda_{H,1}$ and $\lambda_{H,3}$; β_R coefficients aggregated across the entire sample set are negative and significant from lags one to three. However, with the exception of $\beta_{R,1}$, these coefficients are on average very close to zero across all lags. GC test statistics show that returns granger-cause changes in retail holdings, as well as vice versa. Thus, it can be seen that there is a negative correlation between net retail trading activity and equity price movements, with empirical evidence supporting bi-directional causality. This contrarian trading is most distinct in the subsequent period, and is still evident up to a lag of several days, whereas any influence that such traders have on future returns is only apparent for the first lag.

Further, both δ_H and δ_R are negative and significant at the 1% level, indicating that retail trades affect returns as well as vice versa. The former coefficient is much larger in absolute value terms. Such findings have several implications, again indicating that feedback trade plays a relatively more important role in explaining these co-movements. For the intraday model, cross-sectional mean λ_Hs are negative, close to zero and insignificant across all lags. β_1, however, is negative and significant at the 5% level,

with *p-values* also indicating that this coefficient is not empirically significant at the other lags. Moreover, the sign on the coefficient reverses at longer lags, with β_4 and β_5 being on average positive. These findings indicate that, similar to the results found using FI trades, intraday correlation between individual trading activity and equity returns is due primarily to a price pressure impact.

<Insert Table 4 about here>

5.4 Further Discussion

First, evidence of feedback trading behavior is found across all three classes of interest. Feedback trading occurs in a positive direction for foreign institutional traders, and in a negative direction for DI and individual investors. In other words, the former engage in momentum-based trading strategies while the latter are contrarian. The cross-sectional mean λ_H and δ_H coefficients from the basic VAR model are largest for foreign institutions, and smallest for individuals. This indicates that the trading decisions of FI investors are the most sensitive to movements in stock prices, followed by domestic institutions. On the contemporaneous day and within the subset of highly liquid securities, however, it appears that retail investors negative feedback trade to a larger extent than DI traders. Second, while there is at least weak evidence of holdings changes driving future returns across all classes, this effect is almost negligible when considering DI trades. Surprisingly, between the remaining two investor classes, retail trading activity generally seems to contain more information about future and same day price movements. Consistent with the arguments put forward by Kaniel et al. (2005), this may be primarily due to a price pressure effect when the contrarian behavior of such traders leads to them inadvertently acting as liquidity providers, rather than any informational advantage.

In terms of our secondary hypothesis, both the VAR and GC tests provide strong empirical support for intraday herding activity across all three investor classes of interest. Specifically, all mean cross-sectional β_H coefficients are positive and significant at the 1% level. Further, GC test statistics show that net trading activity contains information relating to future trading behavior, within each investor class. It should be noted that, with the exception of FI traders, we find little evidence of intraday feedback trade, that is, herding cannot be explained by investors simply responding in the same way to signals contained in price changes. The cause of such intraday herding behavior, particularly for DI and individual traders, thus remains a question for future research.

<Insert Table 5 about here>

6 CONCLUSION

This paper examines the dynamics of the relation between trading activity and stock price movements for three different investor classes on the HEX. These investor classes are foreign institutions, domestic Finnish institutions and individual retail traders. The main findings are as follows. First, on a daily basis, there is evidence of feedback trade for all three investor categories of interest. However, while foreign institutions tend to engage in momentum based trading strategies, domestic institutions and retail investors are contrarian. Further analysis of the contemporaneous co-relation indicates that foreign institutions and individual traders appear to respond to same day stock price movements, and those in the intervals immediately preceding. On the other hand, domestic institutions' negative feedback trading is evident up to a lag of several days, suggesting that there is a lag in the response of such investors to signals contained in past returns. Moreover, analyses at a finer frequency show that, with the exception of foreign institutional traders, there is no evidence of intraday feedback trading. Second, we find weak empirical evidence in support of the hypothesis that net daily trading activity drives returns, that is, a price pressure and/or information advantage effect. However, this impact is almost negligible for the domestic institutions, whether on the contemporaneous or lagged trading days. Across all three investor classes, intraday net trade is shown to have some impact on future price movements. The findings from this intraday analysis suggest that this is primarily due to a price pressure effect, which reverses in later intervals. There are thus systematic patterns in the behavior of the investigated investor classes; As they interact, these effects reverse out over time. Finally, in terms of the secondary hypothesis, we find evidence of herding behavior across all three investor classes, at both daily and intraday frequencies.

The observed differences in trading strategy between investor classes can easily be rationalized. Domestic institutions have the most immediate access to information on domestic companies and have resources to take the role of value traders. Domestic institutions become contrarian when they trade to restore fundamental values of the securities they trade. This is consistent with our observation that domestic institutions follow negative feedback strategies with up to several days lag. Foreign institutions have less direct access to information about companies in a foreign market and may also perceive that there is a moral hazard risk in that they have little control over how a foreign company is managed. In

this situation, the most rational strategy for foreign investors is to engage in momentum trading, investing in companies that have a proven positive development in price. This is consistent with our observation that foreign institutions follow a momentum strategy where they act on short-term signals. Domestic retail traders may consist of two groups: one less informed and one better informed about asset values and order flow. Less informed retail traders tend to change their limit orders too slowly, ending up on the contra side to short intermediate term momentum traders, which is consistent with the price pressure hypothesis. Better-informed retail traders take the contra side to momentum traders when they feel that asset values have moved away from fundamental values. This line of reasoning is consistent with empirical evidence in the literature which indicate that retail traders can be profitable following a contrarian strategy. Kaniel et al. (2005), for instance, find strong empirical evidence showing that net individual trading volume drives security returns in subsequent periods.

A possible limitation of the current research is that the results obtained using data from a relatively small exchange may not improve our general understanding of the relation between equity holdings and returns. The small sample size of liquid securities may also be seen as a limitation. However, as previously mentioned, while the HEX is small compared to other global exchanges, it has become a market of importance in the European region, and some stocks are important components in a global portfolio. Further, the uniqueness and depth of the data outweigh these disadvantages. Although the analyses conducted have shed some light on the research issues, there are still questions that remain un-answered. First, we find that co-relation between net investor class specific trades and returns in the following intervals are mainly due to a price pressure effect, particularly on an intraday basis. Does this mean that none of these three investor types has an informational advantage? Future research could aim to determine the relative proportion of new information assimilated into prices by the trades of each investor class.[9] Recall also that while we find little evidence in support of intraday feedback trade, there is strong empirical support for herding activity across all three investor types of interest. Another potential issue for future research is thus determining the causes of such herding behavior. In other words, within a trading day, what is it that drives investors to trade in the same direction, if not in response to a common signal contained in prices.

[9] In other words, relative contribution to the price discovery process.

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TABLE 1: Summary Statistics

This table provides cross-sectional aggregate summary statistics for the final set of sample firms. Market Cap is the market capitalization as of 1 January 2000, the beginning of the sample period. Volume Traded is the total volume traded over the 5-year sample period. FIH, DIH and RETH refer to the percentage of total shares on issue held by foreign institutions, domestic institutions and retail investors, respectively. FI Vol, DI Vol and RET Vol refer to the percentage of total volume traded attributable to foreign institutions, domestic institutions and retail investors, respectively. FIT, DIT and RetT are the percentage of trades made by each of these investor classes. Holdings information is presented as of 1 January 2000, while all trading statistics are taken across the period from January 2000 and December 2004. Panel A gives statistics for all sample stocks; Panel B gives cross-sectional statistics excluding Nokia.

Panel A

Stats	Market Cap.	*FIH*	*DIH*	*RETH*	*Volume Traded*	*FI Vol*	*DI Vol*	*RET Vol*	*FIT*	*DIT*	*RetT*
Mean	2,160,064,455	12.92	34.53	52.01	634,097,227	36.68	30.41	32.89	31.92	67.99	0.69
Median	126,375,300	4.92	27.63	54.87	21,194,544	30.19	28.05	29.43	30.75	69.25	0.12
StDev	17,952,593,704	17.41	23.42	24.00	5,471,282,611	28.45	17.43	23.23	11.50	11.81	2.18
Max	217,748,402,968	85.94	99.98	99.99	66,407,200,376	99.97	89.31	99.66	64.51	89.80	18.41
Min	1819090	0	0.01	0.02	9047	0.00	0.01	0.02	10.20	22.03	0.00
Skew	11.95	1.91	0.89	-0.23	11.98	0.43	0.83	0.62	0.58	-0.78	5.83
Kurt	144.31	3.50	-0.03	-0.99	144.93	-1.06	0.60	-0.42	-0.28	0.65	38.39

Panel B

Stats	Market Cap.	*FIH*	*DIH*	*RETH*	*Volume Traded*	*FI Vol*	*DI Vol*	*RET Vol*	*FIT*	*DIT*	*RetT*
Mean	693,477,118	12.43	34.74	52.30	186,661,151	36.46	30.46	33.09	31.70	68.30	0.61
Median	125,031,017	4.9	27.68	55.63	20,756,770	29.76	28.38	29.74	30.44	69.56	0.12
StDev	1,998,193,389	16.38	23.37	23.83	554,587,677	28.41	17.48	23.19	11.22	11.22	1.94
Max	14,126,784,392	78.23	99.98	99.99	3,977,550,102	99.97	89.31	99.66	62.44	89.80	18.41
Min	1819090	0	0.01	0.02	9047	0.00	0.01	0.02	10.20	37.56	0.00
Skew	5.15	1.79	0.89	-0.23	5.11	0.44	0.82	0.62	0.52	-0.52	6.74
Kurt	28.40	2.77	-0.03	-0.97	28.15	-1.03	0.57	-0.42	-0.43	-0.43	53.38

TABLE 2: Foreign Institutional Trading Activity

This table provides results from each of the three models, applied to foreign institutional trading activity. Coefficients are cross-sectional means taken across all stocks in the sample. ΔH refers to the FI trading activity, and R the stock returns. β are the coefficients on lagged changes in holdings and λ those on lagged returns. In addition, adjusted R^2 re given for each regression. Panel A shows results from the daily VAR:

$$\begin{bmatrix} \Delta H_{j,i,t} \\ RET_{j,i,t} \end{bmatrix} = \begin{bmatrix} \alpha_{j,i}^{H} \\ \alpha_{j,i}^{\text{Re turns}} \end{bmatrix} + \begin{bmatrix} \delta_H RET_{j,i,t} \\ \delta_R \Delta H_{j,i,t} \end{bmatrix} + \begin{bmatrix} \sum_{k=1}^{i} \beta_{H,K} \Delta H_{j,i,t-k} \\ \sum_{k=1}^{i} \beta_{R,K} \Delta H_{j,i,t-k} \end{bmatrix} + \begin{bmatrix} \sum_{k=1}^{i} \lambda_{H,K} RET_{j,i,t-k} \\ \sum_{k=1}^{i} \lambda_{R,K} RET_{j,i,t-k} \end{bmatrix} + \begin{bmatrix} \varepsilon_t^H \\ \varepsilon_t^R \end{bmatrix}$$

Panel B gives results for the modified VAR, where δ is the coefficient on the contemporaneous variable:

$$\begin{bmatrix} \Delta H_{j,i,t} \\ RET_{j,i,t} \end{bmatrix} = \begin{bmatrix} \alpha_{j,i}^{H} \\ \alpha_{j,i}^{\text{Re turns}} \end{bmatrix} + \begin{bmatrix} \delta_H RET_{j,i,t} \\ \delta_R \Delta H_{j,i,t} \end{bmatrix} + \begin{bmatrix} \sum_{k=1}^{i} \beta_{H,K} \Delta H_{j,i,t-k} \\ \sum_{k=1}^{i} \beta_{R,K} \Delta H_{j,i,t-k} \end{bmatrix} + \begin{bmatrix} \sum_{k=1}^{i} \lambda_{H,K} RET_{j,i,t-k} \\ \sum_{k=1}^{i} \lambda_{R,K} RET_{j,i,t-k} \end{bmatrix} + \begin{bmatrix} \varepsilon_t^H \\ \varepsilon_t^R \end{bmatrix}$$

Panel C outlines findings for the intraday model. *P-values* are given in parentheses.

Panel A: Daily VAR Model

		α	β_1	β_2	β_3	β_4	β_5	λ_1	λ_2	λ_3	λ_4	λ_5	R^2
ΔH	Coefficient	0.000	0.110	0.044	0.038	0.013	0.002	0.159	0.051	0.090	0.078	0.017	0.08
	p-value	(0.84)	(0.00)	(0.00)	(0.00)	(0.19)	(0.85)	(0.00)	(0.18)	(0.26)	(0.18)	(0.66)	
	%Sig	43.81	66.67	46.67	42.27	40.51	51.67	28.57	24.76	18.56	15.19	15.00	
R	Coefficient	0.002	0.001	-0.004	0.007	-0.003	0.011	-0.092	-0.040	-0.02	-0.025	0.010	0.03
	p-value	(0.01)	(0.91)	(0.41)	(0.10)	(0.50)	(0.15)	(0.00)	(0.00)	(0.00)	(0.00)	(0.20)	
	%Sig	11.43	20.95	13.33	17.53	17.72	16.67	69.52	34.29	19.59	32.91	23.33	

Panel B. VAR with contemporaneous variable

		α	Δ	β_1	β_2	β_3	β_4	β_5	λ_1	λ_2	λ_3	λ_4	λ_5	R^2
ΔH	Coefficient	0.000	0.337	0.107	0.044	0.037	0.014	0.004	0.179	0.059	0.108	0.086	0.017	0.09
	p-value	(0.85)	(0.00)	(0.00)	(0.00)	(0.00)	(0.15)	(0.75)	(0.00)	(0.14)	(0.18)	(0.13)	(0.64)	
	%Sig	42.86	47.62	66.67	46.67	42.27	39.24	51.67	31.43	22.86	19.59	15.19	15.00	
R	Coefficient	0.002	0.043	-0.007	-0.007	0.005	-0.004	0.008	-0.097	-0.04	-0.021	-0.025	0.010	0.05
	p-value	(0.01)	(0.00)	(0.34)	(0.15)	(0.27)	(0.38)	(0.25)	(0.00)	(0.00)	(0.00)	(0.00)	(0.19)	
	%Sig	10.48	47.62	23.81	16.19	14.43	16.46	15.00	77.14	35.24	19.59	32.91	25.00	

Panel C. Intraday

		α	β_1	β_2	β_3	β_4	β_5	λ_1	λ_2	λ_3	λ_4	λ_5	R^2
		20	20	20	20	20	20	20	20	20	20	20	
ΔH	Coefficient	0.001	0.057	0.052	0.039	0.035	0.034	0.009	0.010	0.005	0.001	0.007	0.02
	p-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.14)	(0.11)	(0.26)	(0.78)	(0.19)	
	%Sig	100.00	100.00	100.00	100.00	100.00	100.00	40.00	35.00	25.00	30.00	20.00	
R	Coefficient	0.004	0.044	0.007	0.050	0.001	-0.021	-0.158	-0.074	-0.034	-0.02	-0.01	0.04
	p-value	(0.15)	(0.07)	(0.71)	(0.11)	(0.92)	(0.51)	(0.00)	(0.00)	(0.01)	(0.06)	(0.32)	
	%Sig	40.00	55.00	40.00	25.00	25.00	25.00	100.00	100.00	95.00	100.00	95.00	

TABLE 3: Domestic Institutional Trading Activity

This table provides results from each of the three models, applied to domestic institutional trading activity. Coefficients are cross-sectional means taken across all stocks in the sample. ΔH refers to the FI trading activity, and R the stock returns. β are the coefficient on lagged changes in holdings and λ those on lagged returns. In addition, adjusted R2 are given for each regression. Panel A shows results from the daily VAR:

$$\begin{bmatrix} \Delta H_{j,i,t} \\ RET_{j,i,t} \end{bmatrix} = \begin{bmatrix} \alpha_{j,i}^{H} \\ \alpha_{j,i}^{\text{Re turns}} \end{bmatrix} + \begin{bmatrix} \delta_H RET_{j,i,t} \\ \delta_R \Delta H_{j,i,t} \end{bmatrix} + \begin{bmatrix} \sum_{k=1}^{i} \beta_{H,K} \Delta H_{j,i,t-k} \\ \sum_{k=1}^{i} \beta_{R,K} \Delta H_{j,i,t-k} \end{bmatrix} + \begin{bmatrix} \sum_{k=1}^{i} \lambda_{H,K} RET_{j,i,t-k} \\ \sum_{k=1}^{i} \lambda_{R,K} RET_{j,i,t-k} \end{bmatrix} + \begin{bmatrix} \varepsilon_t^H \\ \varepsilon_t^R \end{bmatrix}$$

Panel B gives results for the modified VAR, where δ is the coefficient on the contemporaneous variable:

$$\begin{bmatrix} \Delta H_{j,i,t} \\ RET_{j,i,t} \end{bmatrix} = \begin{bmatrix} \alpha_{j,i}^{H} \\ \alpha_{j,i}^{\text{Re turns}} \end{bmatrix} + \begin{bmatrix} \delta_H RET_{j,i,t} \\ \delta_R \Delta H_{j,i,t} \end{bmatrix} + \begin{bmatrix} \sum_{k=1}^{i} \beta_{H,K} \Delta H_{j,i,t-k} \\ \sum_{k=1}^{i} \beta_{R,K} \Delta H_{j,i,t-k} \end{bmatrix} + \begin{bmatrix} \sum_{k=1}^{i} \lambda_{H,K} RET_{j,i,t-k} \\ \sum_{k=1}^{i} \lambda_{R,K} RET_{j,i,t-k} \end{bmatrix} + \begin{bmatrix} \varepsilon_t^H \\ \varepsilon_t^R \end{bmatrix}$$

Panel C outlines findings for the intraday model. *P-values* are given in parentheses.

Panel A. Daily VAR Model

		α	β_1	β_2	β_3	β_4	β_5	λ_1	λ_2	λ_3	λ_4	λ_5	R^2
ΔH	Coeff.	-0.001	0.067	0.033	0.020	0.017	-0.013	-0.093	-0.041	-0.004	-0.144	-0.093	0.04
	p-value	(0.83)	(0.00)	(0.00)	(0.00)	(0.09)	(0.28)	(0.07)	(0.38)	(0.96)	(0.18)	(0.09)	
	%Sig	20.95	53.33	35.24	34.78	31.88	37.04	26.67	8.57	16.30	18.84	14.81	
R	Coeff.	0.002	-0.004	0.000	-0.002	0.004	-0.015	-0.089	-0.038	-0.020	-0.025	0.011	0.03
	p-value	(0.01)	(0.48)	(0.94)	(0.69)	(0.50)	(0.13)	(0.00)	(0.00)	(0.01)	(0.01)	(0.22)	
	%Sig	9.52	15.24	12.38	18.48	10.14	12.96	68.57	35.24	22.83	26.09	20.37	

Panel B. VAR with contemporaneous variable

		α	δ	β_1	β_2	β_3	β_4	β_5	λ_1	λ_2	λ_3	λ_4	λ_5	R^2
ΔH	Coeff	0.000	-0.048	0.066	0.033	0.019	0.018	-0.014	-0.092	-0.037	-0.011	-0.14	-0.09	0.05
	p-value	(0.84)	(0.58)	(0.00)	(0.00)	(0.00)	(0.07)	(0.24)	(0.09)	(0.42)	(0.89)	(0.18)	(0.09)	
	%Sig	19.05	33.33	52.38	34.29	34.78	31.88	37.04	28.57	10.48	17.39	15.94	16.67	
R	Coeff	0.002	-0.009	-0.001	0.001	-0.001	0.003	-0.012	-0.091	-0.038	-0.019	-0.026	0.011	0.04
	p-value	(0.01)	(0.52)	(0.83)	(0.62)	(0.76)	(0.50)	(0.10)	(0.00)	(0.00)	(0.01)	(0.00)	(0.21)	
	%Sig	9.52	33.33	15.24	11.43	14.13	13.04	14.81	71.43	36.19	19.57	26.09	20.37	

Panel C. Intraday Model

		α	β_1	β_2	β_3	β_4	β_5	λ_1	λ_2	λ_3	λ_4	λ_5	R^2
ΔH	Coeff	-0.001	0.067	0.033	0.020	0.017	-0.013	-0.093	-0.041	-0.004	-0.144	-0.09	0.04
	p-value	(0.83)	(0.00)	(0.00)	(0.00)	(0.09)	(0.28)	(0.07)	(0.38)	(0.96)	(0.18)	(0.09)	
	%Sig	20.95	53.33	35.24	34.78	31.88	37.04	26.67	8.57	16.30	18.84	14.81	
R	Coeff	0.002	-0.004	0.000	-0.002	0.004	-0.015	-0.089	-0.038	-0.020	-0.025	0.011	0.03
	p-value	(0.01)	(0.48)	(0.94)	(0.69)	(0.50)	(0.13)	(0.00)	(0.00)	(0.01)	(0.01)	(0.22)	
	%Sig	9.52	15.24	12.38	18.48	10.14	12.96	68.57	35.24	22.83	26.09	20.37	

TABLE 4: Retail Trading Activity

This table provides results from each of the three models, applied to retail trading activity. Coefficients are cross-sectional means taken across all stocks in the sample. ΔH refers to the FI trading activity, and R the stock returns. β are the coefficient on lagged changes in holdings and λ those on lagged returns. In addition, adjusted R2 are given for each regression. Panel A shows results from the daily VAR: $$\begin{bmatrix}\Delta H_{j,i,t}\\ RET_{j,i,t}\end{bmatrix}=\begin{bmatrix}\alpha_{j,i}^{H}\\ \alpha_{j,i}^{\text{Re turns}}\end{bmatrix}+\begin{bmatrix}\delta_H RET_{j,i,t}\\ \delta_R \Delta H_{j,i,t}\end{bmatrix}+\begin{bmatrix}\sum_{k=1}^{i}\beta_{H,K}\Delta H_{j,i,t-k}\\ \sum_{k=1}^{i}\beta_{R,K}\Delta H_{j,i,t-k}\end{bmatrix}+\begin{bmatrix}\sum_{k=1}^{i}\lambda_{H,K} RET_{j,i,t-k}\\ \sum_{k=1}^{i}\lambda_{R,K} RET_{j,i,t-k}\end{bmatrix}+\begin{bmatrix}\varepsilon_t^H\\ \varepsilon_t^R\end{bmatrix}$$

Panel B gives results for the modified VAR, where δ is the coefficient on the contemporaneous variable:

$$\begin{bmatrix}\Delta H_{j,i,t}\\ RET_{j,i,t}\end{bmatrix}=\begin{bmatrix}\alpha_{j,i}^{H}\\ \alpha_{j,i}^{\text{Re turns}}\end{bmatrix}+\begin{bmatrix}\delta_H RET_{j,i,t}\\ \delta_R \Delta H_{j,i,t}\end{bmatrix}+\begin{bmatrix}\sum_{k=1}^{i}\beta_{H,K}\Delta H_{j,i,t-k}\\ \sum_{k=1}^{i}\beta_{R,K}\Delta H_{j,i,t-k}\end{bmatrix}+\begin{bmatrix}\sum_{k=1}^{i}\lambda_{H,K} RET_{j,i,t-k}\\ \sum_{k=1}^{i}\lambda_{R,K} RET_{j,i,t-k}\end{bmatrix}+\begin{bmatrix}\varepsilon_t^H\\ \varepsilon_t^R\end{bmatrix}$$

Panel C outlines findings for the intraday model. *P-values* are given in parentheses.

Panel A. Daily VAR Model

		α	β_1	β_2	β_3	β_4	β_5	λ_1	λ_2	λ_3	λ_4	λ_5	R^2
ΔH	Coefficient	0.002	0.076	0.044	0.034	0.027	0.019	-0.072	-0.026	-0.058	-0.029	0.012	0.05
	p-value	(0.23)	(0.00)	(0.00)	(0.00)	(0.01)	(0.06)	(0.03)	(0.37)	(0.06)	(0.31)	(0.70)	
	%Sig	28.57	54.29	44.76	33.71	37.50	38.00	27.62	11.43	8.99	9.72	6.00	
R	Coefficient	0.002	-0.017	-0.006	-0.004	0.001	-0.007	-0.092	-0.039	-0.018	-0.024	0.011	0.03
	p-value	(0.01)	(0.00)	(0.04)	(0.09)	(0.78)	(0.25)	(0.00)	(0.00)	(0.02)	(0.00)	(0.26)	
	%Sig	11.43	34.29	19.05	14.61	13.89	16.00	73.33	34.29	23.60	27.78	28.00	

Panel B. VAR with contemporaneous variable

		α	δ	β_1	β_2	β_3	β_4	β_5	λ_1	λ_2	λ_3	λ_4	λ_5	R^2
ΔH	Coeff	0.002	-0.252	0.072	0.045	0.034	0.028	0.019	-0.090	-0.032	-0.068	-0.035	0.011	0.06
	p-value	(0.22)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.06)	(0.01)	(0.30)	(0.03)	(0.22)	(0.72)	
	%Sig	26.67	49.52	53.33	42.86	34.83	40.28	34.00	33.33	13.33	11.24	6.94	6.00	
R	Coeff	0.002	-0.034	-0.01	-0.003	-0.001	0.003	-0.006	-0.095	-0.041	-0.019	-0.025	0.011	0.05
	p-value	(0.01)	(0.00)	(0.03)	(0.36)	(0.58)	(0.44)	(0.29)	(0.00)	(0.00)	(0.01)	(0.00)	(0.23)	
	%Sig	10.48	49.52	25.71	16.19	15.73	12.50	14.00	75.24	33.33	22.47	27.78	28.00	

Panel C. Intraday Model

		α	β_1	β_2	β_3	β_4	β_5	λ_1	λ_2	λ_3	λ_4	λ_5	R^2
ΔH	Coefficient	-0.001	0.039	0.038	0.029	0.028	0.023	-0.007	-0.009	-0.004	0.001	-0.005	0.01
	p-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.15)	(0.14)	(0.16)	(0.71)	(0.25)	
	%Sig	100.00	85.00	80.00	85.00	90.00	85.00	35.00	20.00	20.00	15.00	15.00	
R	Coefficient	0.004	-0.046	0.007	-0.055	0.017	0.035	-0.158	-0.074	-0.034	-0.020	-0.008	0.04
	p-value	(0.15)	(0.03)	(0.82)	(0.12)	(0.59)	(0.43)	(0.00)	(0.00)	(0.01)	(0.06)	(0.32)	
	%Sig	40.00	65.00	25.00	25.00	30.00	25.00	100.00	100.00	95.00	100.00	95.00	

TABLE 5: Granger-Causality Tests

This table provides the results of Granger-causality (1969) tests between net changes in holdings for each investor class and stock returns. R refers to stock returns, ΔFIH to changes in foreign institutional holdings, ΔDIH those in domestic institutional holdings, and ΔRETH those for retail holdings. Significance is indicated as follows: * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level. Panel A gives results for the daily model, and Panel B those for the intraday model.

	ΔH		*R*	
ΔH	ΔH Granger-cause ΔH		Returns Granger-cause ΔH	
R	ΔH Granger-cause Returns		Returns Granger-cause Returns	

Panel A. Daily

				R	
ΔFIH	Coefficient	17.586	***	2.388	***
	%Significant	80.95		35.24	
R	Coefficient	2.201	***	7.364	***
	%Significant	26.67		67.62	
ΔDIH	Coefficient	8.506		2.161	***
	%Significant	62.86		26.67	
R	Coefficient	1.577		7.584	***
	%Significant	24.76		68.57	
ΔRETH	Coefficient	12.542		2.169	***
	%Significant	67.62		30.48	
R	Coefficient	2.339		7.374	***
	%Significant	36.19		70.48	

Panel B. Intraday

				R	
ΔFIH	Coefficient	335.698	***	2.174	***
	%Significant	100.00		30.00	
R	Coefficient	4.201	***	739.431	***
	%Significant	75.00		100.00	
ΔDIH	Coefficient	125.097	***	1.782	
	%Significant	90.00		30.00	
R	Coefficient	3.013	***	738.271	***
	%Significant	55.00		100.00	
ΔRETH	Coefficient	237.065	***	1.557	
	%Significant	90.00		15.00	
R	Coefficient	4.080	***	739.355	***
	%Significant	60.00		100.00	

APPENDIX 1: Summary Statistics

This table provides summary statistics for the final set of sample firms. ISIN code is the stock identifier used by the HEX and the NCSD. Market Cap is the market capitalization of the firm as of 1 January 2000, the beginning of the sample period. Volume Traded is the total volume traded over the 5-year sample period. %FIH, %DIH and % RH refer to the percentage of total shares on issue held by foreign institutions, domestic institutions and retail investors, respectively. %FIV, %DIV and %RETV refer to the percentage of total volume traded attributable to foreign institutions, domestic institutions and retail investors, respectively. %FIT, %DIT and %RetailT are the percentage of trades made by each of these investor classes. Holdings information is presented as of 1 January 2000, while all trading statistics are taken across the period from January 2000 and December 2004.

ISIN Code	Market Cap.	*%FIH*	*%DIH*	*%RH*	*Volume Traded*	*%FIV*	*%DIV*	*%RETV*	*%FIT*	*%DIT*	*%RetailT*
FI0009000681	217748402968	85.94	4.47	9.65	66407200376	70.09	23.47	4.40	64.51	22.03	12.67
FI0009902530	13377894146	21.34	8.87	31.89	3977550102	90.77	5.44	3.79	29.91	70.09	0.00
FI0009005961	9231236406	78.23	5.23	16.54	3535067566	86.00	11.92	2.08	62.44	37.56	0.02
FI0009007371	14126784392	33.45	3.98	62.56	3015200686	85.99	9.99	4.02	38.47	61.53	0.00
FI0009005987	9357233148	54.81	17.41	27.72	2026943215	85.98	11.11	2.91	56.96	43.04	0.01
FI0009003305	3465413200	49.76	30.36	16.76	1426172493	74.19	13.44	12.38	45.62	54.38	0.01
FI0009007884	5849997239	28.30	21.53	49.40	1339143090	75.00	18.78	6.21	39.48	60.52	0.00
FI0009007132	3634880193	4.90	10.54	84.54	1337574508	72.29	22.07	5.64	42.88	57.12	0.01
FI0009002760	35999675	4.68	82.04	13.19	560217092	3.81	21.15	75.04	30.22	69.78	0.12
FI0009007264	451744592	30.38	27.81	41.81	531019155	29.27	37.47	33.25	26.85	73.15	0.01
FI0009000277	2551075358	56.33	27.58	16.05	526647038	88.51	9.04	2.45	52.63	47.37	0.02
FI0009002943	261333390	29.02	12.07	58.61	457885521	42.15	33.65	24.19	22.66	77.34	0.01
FI0009007835	1557752821	43.80	25.86	30.33	417281644	84.88	12.44	2.67	48.74	51.26	0.03
FI0009007918	392751784	51.29	25.82	22.89	385489127	70.50	16.36	13.15	33.53	66.47	0.02
FI0009801310	755153264	12.63	11.03	76.34	381696542	44.84	23.66	31.50	26.19	73.81	0.01
FI0009002422	1008617346	25.79	6.72	67.48	354905176	64.34	26.36	9.30	47.30	52.70	0.03
FI0009008221	1659333978	18.59	68.26	13.14	319900749	74.55	11.69	13.76	27.61	72.39	0.01
FI0009003552	513861347	7.55	16.63	75.79	318152823	56.86	30.97	12.17	44.97	55.03	0.04
FI0009002471	110008972	4.61	90.26	5.12	315201733	46.52	25.74	27.74	43.84	56.16	0.32
FI0009007637	75047927	10.97	20.48	68.55	302491371	28.65	14.38	56.97	21.47	78.53	0.01
FI0009007553	213633460	16.57	31.14	52.29	294664764	99.47	0.32	0.22	31.05	68.95	0.02
FI0009801245	104855889	10.19	42.21	47.35	261608444	32.32	43.64	24.04	38.98	61.02	0.05
FI0009801302	859036980	24.10	13.94	61.97	256133039	66.06	13.77	20.17	28.67	71.33	0.01
FI0009007819	1168464713	31.96	51.79	16.25	239982911	55.96	28.57	15.47	39.50	60.50	0.02
FI0009004824	705824000	13.65	15.12	71.22	216116696	63.74	24.30	11.96	45.39	54.61	0.06
FI0009009633	19070812	5.65	26.47	67.79	215174205	12.35	28.47	59.17	16.19	83.81	0.04
FI0009800098	13771258	0.19	76.88	22.24	199029984	14.15	16.55	69.30	15.43	84.57	0.06
FI0009000202	631457564	26.97	25.93	47.02	189169680	51.24	34.04	14.72	38.65	61.35	0.03
FI0009007751	25841729	3.45	15.87	80.68	174802346	63.70	17.79	18.52	17.38	82.62	0.02
FI0009000509	520045466	7.54	30.93	61.48	169058592	99.97	0.01	0.02	45.62	54.38	0.06
FI0009006738	639222288	41.74	16.98	41.27	165899367	76.00	15.95	8.05	35.66	64.34	0.01
FI0009900070	1155911290	17.01	8.25	74.71	158861340	66.95	21.77	11.28	43.91	56.09	0.10
FI0009006829	315631181	15.61	26.78	57.61	150613712	60.78	23.43	15.78	31.98	68.02	0.08
FI0009003727	804851940	13.32	33.77	52.80	149903613	56.36	29.40	14.24	36.48	63.52	0.02
FI0009007629	351062715	2.15	59.99	37.82	142784773	27.22	59.04	13.74	39.09	60.91	0.31
FI0009000566	1240767626	24.66	45.10	30.23	125849182	75.44	19.92	4.64	53.32	46.68	0.04
FI0009000855	200964895	14.98	17.42	67.53	120285863	51.80	7.55	40.66	28.47	71.53	0.12

FI0009800346	789236639	16.35	18.39	65.15	115824013	66.37	21.20	12.43	36.95	63.05	0.03
FI0009006951	133625385	20.71	20.38	57.79	109181462	47.54	14.74	37.72	24.16	75.84	0.02
FI0009008098	153798663	12.42	11.59	75.99	104829100	21.65	19.99	58.36	19.73	80.27	0.03
FI0009002158	712295685	15.41	51.52	33.04	102328486	63.04	27.28	9.68	55.16	44.84	0.10
FI0009800643	381967105	11.57	60.32	28.11	99870807	50.13	37.35	12.53	49.29	50.71	0.08
FI0009007728	373772250	64.06	17.51	18.43	96737391	73.55	14.55	11.90	36.03	63.97	0.04
FI0009007926	540945781	6.33	65.43	28.24	96060923	64.83	28.46	6.71	32.90	67.10	0.13
FI0009003230	377088986	8.73	8.34	82.89	90237947	66.42	17.27	16.31	31.51	68.49	0.06
FI0009000749	636709409	2.18	22.99	74.77	88009672	23.73	69.28	6.99	36.85	63.15	0.15
FI0009000285	644944572	51.69	16.74	31.50	87934741	76.32	14.33	9.35	52.07	47.93	0.06
FI0009004204	39455092	17.34	31.02	51.63	86672844	4.20	21.93	73.87	18.53	81.47	0.02
FI0009003222	477676283	11.99	65.75	21.95	76933081	55.31	27.67	17.02	31.36	68.64	0.05
FI0009007694	1748688427	1.68	25.38	72.80	72849709	46.98	34.45	18.57	37.56	62.44	0.07
FI0009005870	405000000	61.89	14.94	23.16	69199668	69.41	21.16	9.42	57.92	42.08	0.13
FI0009008122	48424211	14.93	69.36	15.71	66396719	64.89	13.08	22.02	17.45	82.55	0.03
FI0009900898	127719582	47.16	18.17	34.46	59515127	49.27	37.15	13.57	34.50	65.50	0.10
FI0009003644	359465022	11.42	58.22	30.36	59226887	48.75	37.91	13.34	47.03	52.97	0.11
FI0009901045	20675554	13.25	57.21	29.51	56144518	19.26	41.87	38.87	24.88	75.12	0.07
FI0009003651	50318146	3.10	17.86	79.02	52910696	21.13	9.34	69.52	18.07	81.93	0.12
FI0009000251	288864679	5.57	27.68	66.62	45063449	54.21	24.02	21.77	33.17	66.83	0.06
FI0009005318	190434348	15.93	49.31	34.75	43545492	79.78	14.88	5.34	44.51	55.49	0.06
FI0009900054	26238934	3.93	39.04	57.01	43495927	15.40	36.40	48.20	25.57	74.43	0.06
FI0009000145	1411096365	34.54	25.73	39.72	41696928	51.39	30.68	17.93	31.55	68.45	0.06
FI0009007355	148439557	46.40	0.38	53.22	39815350	92.63	3.84	3.53	30.44	69.56	0.38
FI0009005953	2450642746	42.77	6.93	50.30	39218916	82.76	13.10	4.14	45.86	54.14	0.17
FI0009008270	421938030	1.48	76.78	21.74	35405537	12.92	32.68	54.40	24.30	75.70	0.04
FI0009007025	185880036	11.04	30.25	58.54	34736370	61.85	23.18	14.97	46.56	53.44	0.29
FI0009007066	118098893	1.54	73.20	25.26	33382318	17.71	49.52	32.76	46.80	53.20	0.18
FI0009006308	26571443	28.33	34.50	35.93	33313737	37.26	40.85	21.89	26.87	73.13	0.08
FI0009800320	819509053	3.97	22.85	73.08	30226599	34.19	39.19	26.62	33.91	66.09	0.07
FI0009007215	380661409	16.27	28.04	55.63	26869229	20.71	46.52	32.77	34.10	65.90	0.17
FI0009009567	125031017	13.57	26.39	60.04	26666790	67.92	15.71	16.38	23.85	76.15	0.11
FI0009009054	84697975	8.20	73.00	18.80	26582323	35.53	30.81	33.66	32.73	67.27	0.12
FI0009000400	311613764	10.64	28.72	60.56	26233500	52.18	20.01	27.81	31.08	68.92	0.11
FI0009005805	321367500	2.77	22.03	75.11	25544207	53.71	31.58	14.71	33.66	66.34	0.16
FI0009007827	22961831	0.73	10.46	88.81	21672282	43.18	17.74	39.08	20.21	79.79	0.05
FI0009006381	55440250	1.82	24.22	73.97	21632317	20.98	34.52	44.50	25.85	74.15	0.07
FI0009006886	28394805	3.75	44.83	51.11	20756770	20.68	39.19	40.13	24.79	75.21	0.12
FI0009008080	299186817	22.37	30.73	46.87	20147764	44.85	33.72	21.43	39.12	60.88	0.15
FI0009008007	33453995	21.33	10.54	68.13	19525705	37.56	33.33	29.11	20.10	79.90	0.07
FI0009006696	247034448	42.82	16.91	40.27	19379305	71.94	23.71	4.35	51.05	48.95	0.52
FI0009006761	360000000	5.93	70.84	23.23	18313807	19.36	72.54	8.11	48.02	51.98	1.29
FI0009900476	46622463	17.53	30.06	52.29	18225328	54.57	17.62	27.81	24.03	75.97	0.08
FI0009801286	82000000	1.35	94.00	4.66	16775409	31.45	44.35	24.21	33.11	66.89	0.22
FI0009000137	458262847	4.59	34.09	61.19	16591055	22.50	65.52	11.98	45.57	54.43	0.50
FI0009007306	55020000	0.57	46.09	53.34	16209277	14.65	55.44	29.90	31.65	68.35	0.16
FI0009002349	16863000	0.83	59.38	38.63	14770547	5.38	72.56	22.05	52.02	47.98	1.97
FI0009006621	1980959190	59.72	21.13	19.15	14288659	61.07	30.41	8.52	41.89	58.11	0.17
FI0009007983	51303667	0.31	14.36	85.33	14061690	9.59	42.48	47.93	26.71	73.29	0.07
FI0009900682	413893200	14.42	23.53	61.97	13768520	76.99	13.69	9.32	28.33	71.67	0.11
FI0009008403	39760151	0.81	12.39	86.80	11649084	16.22	35.61	48.17	18.04	81.96	0.02

FI0009006548	28579241	2.06	38.73	58.68	11331460	15.60	40.34	44.06	21.80	78.20	0.11
FI0009007660	14070000	0.67	66.09	33.24	11301988	31.84	20.20	47.95	17.49	82.51	0.04
FI0009900336	212765625	0.62	19.01	80.29	10841800	16.14	53.06	30.80	32.46	67.54	0.16
FI0009008924	85425000	8.03	18.58	73.39	10622256	16.02	54.23	29.74	29.31	70.69	0.26
FI0009000236	278039284	3.29	26.62	70.05	10620200	66.32	13.11	20.58	34.75	65.25	0.15
FI0009004865	239043967	1.32	28.50	70.15	10296092	0.05	0.29	99.66	37.57	62.43	4.08
FI0009008072	44115192	3.75	32.87	63.35	10246868	10.99	58.15	30.86	28.08	71.92	0.13
FI0009006787	179391168	3.75	47.23	48.36	10041142	15.56	34.10	50.33	17.37	82.63	0.04
FI0009003719	274314246	2.87	48.10	48.86	9619970	22.80	48.73	28.48	31.81	68.19	0.13
FI0009005482	52609062	0.85	22.62	76.47	9174555	12.93	11.54	75.53	13.77	86.23	0.04
FI0009900377	16789500	0.38	15.93	83.66	8818062	13.67	20.62	65.72	24.55	75.45	0.15
FI0009007900	536140788	0.08	61.57	38.09	8251737	1.99	69.29	28.72	53.02	46.98	0.35
FI0009006407	17515449	0.76	85.81	13.43	8224041	2.40	42.36	55.24	27.69	72.31	0.29
FI0009900013	120634686	4.11	32.45	63.38	7915199	22.14	42.12	35.74	32.72	67.28	0.20
FI0009000939	98655073	0.26	32.62	67.09	7884616	1.68	64.12	34.20	38.10	61.90	0.33
FI0009800205	39604995	0.54	66.88	31.26	7627925	2.18	59.81	38.01	23.17	76.83	0.16
FI0009000426	132170585	7.04	34.04	58.87	6342029	25.07	27.72	47.21	25.21	74.79	0.73
FI0009006415	35544216	3.21	69.45	27.34	6051537	1.19	58.01	40.80	25.75	74.25	0.76
FI0009000160	57425964	6.37	24.29	69.10	5784748	19.52	29.32	51.16	19.66	80.34	0.11
FI0009007322	96677381	3.22	66.01	25.33	5105002	26.55	42.79	30.66	27.54	72.46	0.20
FI0009005078	83300000	6.08	4.67	89.25	5078001	8.33	37.36	54.32	18.29	81.71	0.11
FI0009900401	34329152	1.18	34.56	63.95	5043884	18.08	46.54	35.38	25.41	74.59	0.14
FI0009003859	14362000	0.72	24.05	75.10	4725592	1.24	30.15	68.62	20.98	79.02	0.16
FI0009007017	134415982	0.37	39.87	59.60	4540432	20.72	23.55	55.73	33.31	66.69	0.50
FI0009008650	21796250	2.27	18.02	79.71	3949552	17.22	29.54	53.24	31.53	68.47	0.36
FI0009008981	22842137	1.54	12.44	86.03	3885118	28.12	19.29	52.59	24.92	75.08	0.47
FI0009003503	74695427	0.35	44.65	53.85	3850580	13.50	46.47	40.03	21.91	78.09	0.20
FI0009900104	20695506	1.35	46.94	51.59	3801279	3.30	47.78	48.92	33.61	66.39	0.42
FI0009800395	86285467	0.18	7.00	90.91	3716423	6.59	28.38	65.03	16.96	83.04	0.22
FI0009003453	1819090	1.42	16.97	80.15	3639566	5.51	28.50	65.99	20.69	79.31	0.25
FI0009900658	9100580	3.10	61.15	34.77	3245320	14.66	51.64	33.70	21.30	78.70	0.33
FI0009006589	21770488	27.52	46.09	26.39	3001794	59.15	19.69	21.16	31.95	68.05	0.94
FI0009004741	22469465	0.51	14.28	85.21	2957904	0.43	36.26	63.31	25.05	74.95	0.50
FI0009900583	23624008	8.09	19.13	72.57	2884121	7.91	22.29	69.80	17.81	82.19	0.12
FI0009001127	77832647	2.17	28.57	69.22	2593372	14.96	17.93	67.11	18.39	81.61	0.13
FI0009900062	41198750	4.34	9.92	85.56	2433115	41.91	32.58	25.51	27.38	72.62	0.42
FI0009000103	90660798	0.24	52.73	46.79	2419189	2.25	55.74	42.01	23.43	76.57	0.55
FI0009005250	275202962	0.66	45.24	54.11	2311656	5.72	47.29	46.99	21.03	78.97	0.30
FI0009001879	15654892	0.82	93.04	5.95	2288206	30.62	33.65	35.72	53.85	46.15	4.19
FI0009000947	65774787	0.07	25.61	74.26	1673708	2.86	81.79	15.35	32.02	67.98	1.03
FI0009900328	9665500	1.67	16.71	81.23	1637760	38.08	18.46	43.46	18.73	81.27	0.52
FI0009900385	39058800	1.76	38.41	59.79	1494083	34.03	38.28	27.68	43.56	56.44	1.53
FI0009002026	248400000	0.00	93.33	6.66	1458624	31.59	25.13	43.28	23.26	76.74	2.70
FI0009900724	6826600	2.65	17.30	79.63	1369884	7.16	25.02	67.82	22.49	77.51	0.73
FI0009800551	20790000	5.93	14.06	77.13	1366909	29.76	19.82	50.42	29.82	70.18	0.59
FI0009007686	357595577	0.30	10.50	89.07	1112658	12.35	41.84	45.80	22.94	77.06	0.32
FI0009800296	23294572	0.05	54.68	42.13	1110868	0.93	13.90	85.18	25.03	74.97	0.24
FI0009900708	4866716	0.37	18.86	80.57	1087410	7.28	19.98	72.74	28.55	71.45	1.37
FI0009900187	3345000	4.93	49.62	45.33	1043410	11.79	20.99	67.22	23.21	76.79	2.41
FI0009004402	23040000	0.00	99.98	0.02	911580	0.14	89.31	10.55	46.22	53.78	18.41
FI0009000384	25034877	0.32	31.56	67.85	625640	6.50	34.75	58.75	23.91	76.09	2.60

FI0009003016	71884032	0.08	64.82	35.05	609737	0.12	42.34	57.54	26.17	73.83	0.66
FI0009900237	4304118	0.00	18.64	81.15	523796	0.66	26.80	72.54	21.61	78.39	1.08
FI0009900633	9990000	18.18	22.88	58.71	411103	98.18	0.84	0.97	48.63	51.37	9.53
FI0009002984	65845248	0.02	54.40	45.44	402170	4.69	41.71	53.61	23.57	76.43	1.20
FI0009800197	23624513	0.00	39.67	56.49	354693	0.00	66.71	33.29	10.20	89.80	0.39
FI0009007546	36461340	0.00	4.42	94.56	321932	7.58	10.97	81.45	11.10	88.90	0.35
FI0009002406	45370800	0.00	79.55	20.43	171302	7.72	58.64	33.65	33.19	66.81	3.63
FI0009001747	91800000	0.00	0.01	99.99	120401	0.14	7.01	92.85	16.03	83.97	1.47
FI0009900369	222014681	0.00	84.03	15.82	9047	0.00	13.85	86.15	14.56	85.44	9.21