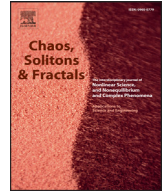




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## Patterns of trading profiles at the Nordic Stock Exchange. A correlation-based approach.



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### ABSTRACT

We investigate the trading behavior of Finnish individual investors trading the stocks selected to compute the OMXH25 index in 2003 by tracking the individual daily investment decisions. We verify that the set of investors is a highly heterogeneous system under many aspects. We introduce a correlation based method that is able to detect a hierarchical structure of the trading profiles of heterogeneous individual investors. We verify that the detected hierarchical structure is highly overlapping with the cluster structure obtained with the approach of statistically validated networks when an appropriate threshold of the hierarchical trees is used. We also show that the combination of the correlation based method and of the statistically validated method provides a way to expand the information about the clusters of investors with similar trading profiles in a robust and reliable way.

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### 1. Introduction

The price discovery process in financial markets is the result of the action of many heterogeneous investors [1–3]. Understanding how this collective task is achieved is a long standing problem in finance and econophysics. The heterogeneity of investors has been theoretically considered and empirically verified in a series of studies. For example several authors have described investors in stylized categories such as the ones of fundamentalists and chartists [4–9]. In other cases the description has been done in terms of contrarian [10] and momentum [11] investors or in terms of

informed and uninformed investors (for example see [12–15]).

Several studies have considered investment profiles of individual investors. Examples are Barber et al. [16] that investigated profits of Taiwanese individual investors, de Lachapelle and Challet [17] investigating the average transaction value and average portfolio value of individual investors, Kirilenko et al. [18] that analyzed the detailed trading decisions of single investors acting in the E-mini S&P 500 stock index futures market during the Flash Crash of May 6, 2010, Tumminello et al. [19] that introduced a network based method to characterize specific trading profiles of clusters of investors trading the Nokia stock at the Nordic Stock Exchange, Ren and Zhou [20] that investigated the order splitting of large orders of individual investors, Challet and de Lachapelle [21] presenting a robust measure of the contrarian behavior of retail investors, Bohlin and Rosvall [22] investigating the relation between investors holds and investors profile for Swedish shareholding, and

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[23] where authors study the impact of news on the trading behavior of different categories of individual investors.

Other papers [24–28] have investigated the trading behavior of market members of some exchanges such as the Spanish Stock Exchange infrastructure or the London Stock Exchange. Market members are not individual investors but often they show a specialized profile towards some category of investors.

In this paper we investigate the trading behavior of Finnish individual investors with respect to their investment towards the stocks selected to compute the OMXH25 index, i.e. the set of most capitalized and liquid stocks of the Helsinki venue of the Nordic Stock Market. Individual investors are legal entities and can be companies, financial institutions, households, governmental organizations, etc. We are able to track the individual investment decision on a daily basis and therefore our study focuses on a time scale that is a daily time scale or longer. The major observation is that the system is highly heterogeneous under many aspects. For this reason it is important to devise data mining methodologies that are robust with respect to the heterogeneity of the different investors and of their trading profiles. In Ref. [19] a method based on the concept of statistically validated networks [29] was proposed. Here, we introduce another method based on the properties of a dissimilarity measure estimated between the trading profiles of heterogeneous investors. We show that our correlation based method is able to detect a hierarchical structure of the trading profiles of heterogeneous individual investors and that the detected hierarchical structure is highly overlapping with the cluster structure obtained with the approach of statistically validated networks when an appropriate threshold of the hierarchical trees is used. We also show that the combination of the two methods provides information about the clusters of investors which is wider than the information obtained with the statistically validated network.

The paper is organized as follows. In Section 2. Database we describe the database investigated in this study, and the categorical variables used for the trading activity of the investors. In Section 3. Trading profiles of investors we introduce the correlation based approach used to detect the hierarchical structure of the trading profiles of individual investors. In Section 4. Over-expressed trading profiles, we apply the statistically validated network approach to the OMXH25 stocks and we present the results obtained. In Section 5. Comparison of clusters, we compare the clusters obtained with the two methods and propose a methodology to combine them to obtain a wider information on the structure of clusters of investors trading in a financial market. Finally, in Section 6 we briefly present our conclusions.

## 2. Database

We have access to a database maintained by Euroclear Finland (previously Nordic Central Securities Depository Finland) which is the central register of shareholdings for Finnish stocks and financial assets in the Finnish Central Securities Depository (FCSD). The register contains the shareholdings in FCSD stocks of all Finnish investors and

of all foreign investors asking to exercise their vote right, both retail and institutional. The database records official ownership of companies and financial assets on a daily basis according to the Finnish Book Entry System. The records include transactions, executed in worldwide stock exchanges and in other venues, which change the ownership of the assets. The database has associated a certain amount of metadata. Specifically, it classifies investors into six main categories: (a) non-financial corporations, (b) financial and insurance corporations, (c) general governmental organizations, (d) non-profit institutions, (e) households, and (f) foreign organizations. The database is collected since January 1st, 1995. This database has also been investigated by Grinblatt and Keloharju in a series of studies [30,31] on the trading characteristics of individual and institutional investors, and on behavioral aspects of individual investors.

In this paper we investigate investment decisions performed during the 2003 calendar year. The database covers all the stocks traded at the Helsinki venue of the Nordic Stock Exchange. Here we investigate the investment decisions concerning 23 of the 25 stocks composing the OMXH25 market index in 2003<sup>1</sup>.

For legal reasons, the database treats Finnish domestic investors (or foreign investors asking to exercise their vote right) in a different way from foreign investors. In fact, while the database contains very detailed information about the Finnish domestic investors, foreign investors can choose to use nominee registration. In this last case, the investor's book entry account provider, for example a bank, aggregates all the transactions from all of its accounts, and a single nominee register coded identity contains the holdings of several foreign investors.<sup>2</sup>

In this paper we investigate the trading decisions of investors trading the stocks included in the OMXH25 index during 2003 (a set of 253 daily records). The total number of investors is 105, 005. The trading activity of different investors is highly heterogeneous. There are many investors which are acting only a few times during the considered time period. Information about the complete set of investors is summarized in Table 1.

In the following analyses done with similarity measure, we set a limit to the minimum number of investment decisions to be executed by an investor during 2003 to analyze his trading profile. Our choice is motivated by the need to be able to estimate a similarity measure which is minimizing the discretization role associated with the presence of a very limited number of attributes. Specifically, in the similarity based tests we consider only those investors who have traded one of the OMXH25 stocks at least 5 times during 2003. The summary statistics of these investors is given in Table 2.

<sup>1</sup> We originally planned to investigate all the 25 stocks that were used to compute the index but we were not able to find the time history of stock price for two of them.

<sup>2</sup> If an institution can trade both for itself and also on behalf of nominee registered investors, we split its trading activity in two distinct IDs, one regarding its activity as a Finnish investor and one when it trades for nominee registered investors (labeled as NR).

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