Who Moves first? Price Discovery by Institutional and Retail Investors.

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Abstract

This paper uses a data set of 77 million trades from Finland during the period 2003 to 2009 to provide new market wide evidence on which investor category of foreign institutional or domestic retail investors contributes most to price discovery. We find the price discovery process is dominated by foreign institutional investors in our data set. Regression models are estimated to provide additional evidence as to which key determinants (including trading volume, effective spread, cross listing, capital expenditure and leverage) explain the informational contribution of foreign institutions to price discovery. Results from both buys and sells confirm that trading volume is the key factor that explains the information contribution of foreign institutions to price discovery. There is an inverse relation between trading volume and the information contribution to price discovery for buys, while volume is positively related to price discovery in sells. The outcomes of this paper contributes to our understanding of the systematic trading patterns and preferences of foreign institutional traders, and the role they play as counterparties to domestic retail traders during price discovery process in the intra-day space.

1. INTRODUCTION

The literature generally assumes that institutional investors are informed investors, which makes intuitive sense as they employ full time experienced investment professionals and have ample resources to obtain real time information and the best quality research. The literature has also until recently assumed that individual investors (household retail investors) are uninformed, which also makes intuitive sense as investing is not their main focus and they also have limited resources to obtain information about the securities they invest in. While much of the empirical evidence supports these expectations (for example, Odean 1999, Grinblatt and Keloharju 2000, Hvidkjaer 2006, 2008 and Subrahmanyam 2006), recent studies have shown that significant categories of individual investors perform better than institutions in the short run and particularly during periods of high volatility (Kaniel, Saar and Titman 2008, Griffin 2011, and Kelley and Tetlock 2013) and in the long run (Grinblatt, Keloharju and Linnainmaa 2012 and Lu, Swan and Westerholm 2014). Three main explanations for these new findings have been proposed in the literature: a) individuals are compensated for liquidity as they have a different more long term, more contrarian approach to investing than institutions, b) agency problems are more severe for institutions who invest other people's money with short term performance incentives than for individuals who invest their own money and may have a more long term view of performance, and c) a significant proportion of individuals are indeed better informed due to their insider status such as being a CEO or CFO or affiliation with companies they work for such as company aligned traders. As some of the studies focus on only subsections of investors, they may have captured a larger proportion of individuals who belong to the third category.

This paper aims to contribute new evidence to this debate using data where all institutions and all individuals can be identified for a sufficiently long time period to capture their trading

through complete market cycles of boom and bust, and using a methodology where we directly measure the contribution of the trading of the two investor categories of foreign institutional investors and domestic retail investors to price discovery.

Market microstructure is the study of the trading mechanisms used for financial securities. One of the key questions of interest to financial economists and market regulators is the impact of market information and price discovery on financial decisions and economic variables. Understanding the source of price changes in markets and how external information is incorporated into stock prices is important, because it enhances the confidence of investors in the market and improves efficiency in the pricing of risk and pooling of capital. Industry participants and regulators are interested in how different types of investors such as institutional and retail investors respond to new information and their relative contributions to the price discovery process. Generally, institutional investors are experienced and have sufficient resources and professional skills. In contrast, retail investors are relatively small and lack financial knowledge and trading skills. Financial economists tend to view institutions and individuals differently. Typically, these investor categories are viewed in the context of informed and uninformed traders. Institutions are perceived as informed investors (Kaniel, Saar and Titman 2008), while individuals are thought to have psychological and behavioural biases and are often considered as uninformed noise traders in the sense of Kyle (1985) and Black (1986). As first studied by Kyle (1985), an uninformed noise trader is a trader who trades randomly where "the random quantity traded by noise traders is distributed independently from present or past quantities traded by the insider and independently from past quantities traded by noise traders" (Kyle 1985, p.1315).

The Global Financial Crisis of 2007-2008 caused turmoil throughout global economies, and led to major reform of economic policies and financial institutions in the United States, the

Eurozone and the Asia-Pacific region. While the crisis likely reflected structural and policy distortions in different countries, foreign investors were often blamed for exerting a destabilising influence on stock prices. Global Foreign Direct Investment (FDI) flows are a key indicator of the rise of global production networks and investment liberalisation because flows are the global sum of direct investment made by all companies in overseas markets, including setting up a subsidiary in a foreign country, acquiring shares of an overseas company, and merging with overseas companies or establishing joint ventures (Hill and Jongwanich 2009). Figure 1 shows that Global FDI flows reached their peak in 2007 when the financial crisis started to emerge and was followed by a sharp decline in 2008 when the full effect of the crisis was realised in international stock markets. The same pattern was found in the dot-com bubble crash of 2000. It is also essential to see the FDI flows for our sample country (Finland). Figure 2 details the FDI inflows in Finland and its comparator economies from 2000 to 2010. In line with the global economy, the FDI of Finland hit record highs in 2007 and decreased significantly after 2008.

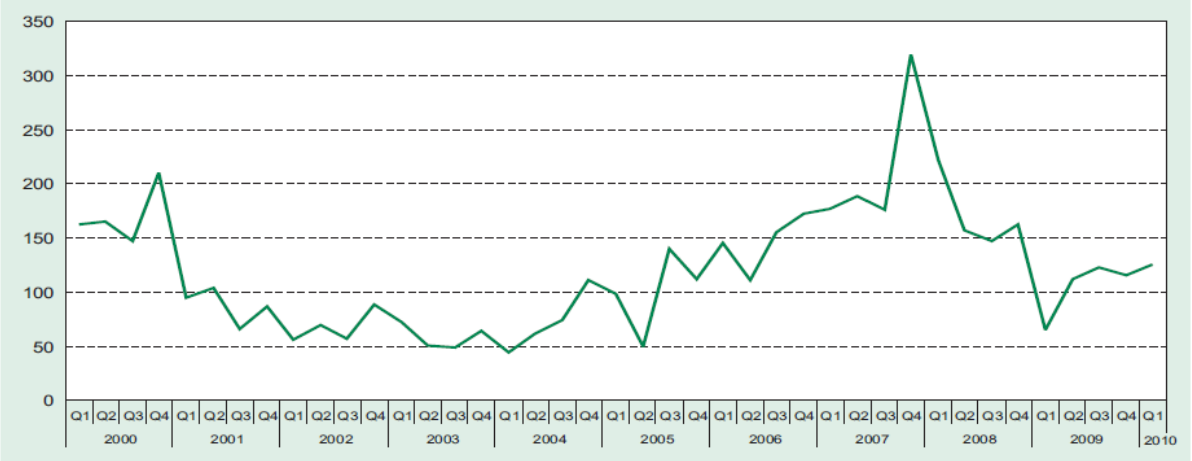


Figure 1: Global Foreign Direct Investment flows Quarterly Index, 2000 Q1-2010 Q1

Note: Billions of dollars, Base 100: quarterly average of 2005

Source: World Investment Report (United Nations Conference on Trade and Development 2010)

Economy	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Finland	8.8	3.7	8.0	3.3	2.8	4.8	7.7	12.5	-1.0	-4.5	4.3
Comparator economies											
Sweden	23.4	10.9	12.3	5	12.1	11.9	28.9	27.7	36.8	10.3	5.3
Denmark	33.8	11.5	6.6	2.7	-10.4	12.9	2.7	11.8	2.2	3.0	-1.8
Norway	7.1	2.1	0.8	3.5	2.5	5.4	6.4	5.8	10.8	14.1	11.9

Figure 2: Finland Foreign Direct Investment inflows, 2000-2010 (Billions of dollars)

Source: World Investment Report (United Nations Conference on Trade and Development 2010)

Stepanyan (2011, p.17) explains the possible impact of foreign investors as follows: "the arrival of foreign investors may enhance market efficiency and liquidity, thereby reducing the cost of equity capital and increasing the valuation of local companies" and that "individual stocks might become less sensitive to local information and more sensitive to world events, reflecting the integration of the local market and world markets". Hence, understanding how the trading behaviour of foreign institutional investors and domestic retail investors affects asset prices in the stock market is crucial for both the public sector and market practitioners in a global context. In this paper we find that the price discovery process is dominated by foreign institutional investors (except for in the two largest stocks where information is most public). We also find that investor groups with lower trading volume are the first to reflect new information and dominate price discovery of sample stocks.

The rest of the paper is structured as follows. Section 2 outlines the literature in the relevant field. Section 3 states the hypothesis. Section 4 describes the data. Section 5 details the methodology employed and presents the sample statistics and results. Section 6 reports the estimation results. A conclusion is provided in Section 7.

2. LITERATURE REVIEW

Price discovery is the dynamic process of the "impounding of new information into the security price" (Hasbrouck 1995, p.1175). Wahab and Lashgari (1993) and De Jong and Donders (1998) show that price discovery is linked to a core concept in finance theory - market efficiency. Market efficiency specifically relates to informational efficiency. Malkiel and Fama (1970, p.383) define market efficiency as follows: "a market is efficient when prices reflect all available information". In a perfectly efficient market, share price should immediately reflect all new information coming into the market. Therefore, no market participant can earn abnormal profits by exploiting current information (Taylor 1989). However, when transaction cost and behavioural bias are present, the market is no longer perfectly efficient.

Much research has been devoted to exploring the relation between trading behaviour and price discovery. There are three major approaches to the study of the price discovery in financial assets: the first approach focuses on the intraday informational contribution of the spot market and the derivatives market; the second approach focuses on the informational contribution of domestic and overseas markets in internationally cross-listing stock and derivatives markets; while the third approach focuses on the informational contribution of various traders in derivatives and other alternative markets.

2.1 First approach in the literature: Intraday informational contribution of the spot market and the derivatives market

The research approach which focuses on the informational contribution of different markets to price discovery was first studied by Garbade, Pomrenze and Silber (1979) using dually listed stocks within the United States. To investigate the informational contribution of different

markets to price discovery, research mainly focuses on examining the intraday lead-lag relation between the spot market and the derivatives market around the world. Most studies generally confirm that derivatives markets are the main source of market-wide information. In the United States, there is strong evidence that futures markets tend to lead their underlying stock indexes return as shown by Kawaller, Koch and Koch (1987), Harris (1989), Stoll and Whaley (1990), Chan (1992), Booth, So and Tse (1999), Hasbrouck (2003) and Fang and Sanger (2012). Using 137 single-stock futures (SSFs) that traded on OneChicago, Shastri, Thirumalai and Zutter (2008) have found that SSFs account for a significant proportion of the price discovery for single underlying stock.

The result is confirmed in markets in different countries. In Germany, Grunbichler, Longstaff, and Schwartz (1994) examined the lead-lag relation between the German stock index (DAX) and DAX future, and found that future prices lead spot prices. In Canada, Brockman and Tse (1995) concluded that the price discovery process in the Canadian agricultural cash market is most pronounced in futures markets by exploring their lead-lag relation. In Australia, Buhr, Li and Rose (2007) show that the price discovery of S&P/ASX200 shares price index significantly takes place in the options market by testing the lead-lag relation between the S&P/ASX200 share price index and its options traded on the Australian Stock Exchange (ASX). In India, Pavabutr and Chaihetphon (2010) state that the futures market leads the spot price of gold for both standard and mini contracts. In Hong Kong, Choy and Zhang (2010) reveal that the index futures market plays a dominant role in the price discovery of Hang Seng Index (HIS) stocks. In Thailand, Choochua, Likitapiwat and Chiyachantana (2012) prove that SET50 Index Futures contributes most in the price discovery process of stock markets. In Scandanavia, Westerholm and Mostafa (2013) analyse stock futures on Swedish and Finnish stocks and conclude that the futures market dominates the price discovery in individual stocks.

2.2 Second approach in the literature: Informational contribution of domestic and overseas markets in internationally cross-listing stock and derivatives markets

The second research approach focuses on the contribution of domestic and overseas markets to the price discovery with the rapid development of internationally cross-listing share and futures contracts. However, there is little consensus on which market dominates the price discovery process. Some studies indicate that major overseas markets play a dominant role in the price discovery of cross-listing shares. For instance, the Taiwan Index Futures price discovery primarily originates from the Singapore Exchange (Roope and Zurbruegg 2002). There is empirical evidence on the contribution of the New York Stock Exchange to the price discovery process of Canadian and Spanish cross-listing stocks (Eun and Sabherwal 2003, Pascual, Pascual-Fuster and Climent 2006, Grammig and Peter 2008). Investigating the price discovery between Chinese commodity markets and US futures markets, Liu and An (2011) show that price discovery mostly occurs in US futures markets.

By contrast, some studies conclude that home markets lead the price discovery based on the evidence from various countries. Hupperets and Menkveld (2002) report that the price discovery of US-listed Dutch stocks is mainly based on information originating in Amsterdam, The Netherlands. Covrig and Melvin (2002) identify the contribution of Japanese quotes to the yen/dollar price discovery is higher than the rest of the world. In Germany, Theissen (2002) indicate that the electronic trading system (home market) has a larger share in the price discovery process based on quote midpoints. Using high frequency data on three blue-chip German firms that listed on the New York Stock Exchange, Grammig, Melvin and Schlag (2005) show that price discovery occurs largely in Frankfurt. Su and Chong (2007) reveal that the Hong Kong Stock Exchange (SEHK) makes more contribution than New York Stock Exchange (NYSE) to the price discovery of Chinese stocks cross-listed in the United States.

When Chinese stocks are cross-listed on the Hong Kong stock market, Chinese mainland stock exchanges dominate the price discovery process (Ma, Swan and Song 2010). Kehrle and Peter (2013) show that information is mostly reflected first in Canada for US-listed Canadian stocks.

2.3 Third approach in the literature: Informational contribution of various traders in derivatives and other alternative markets

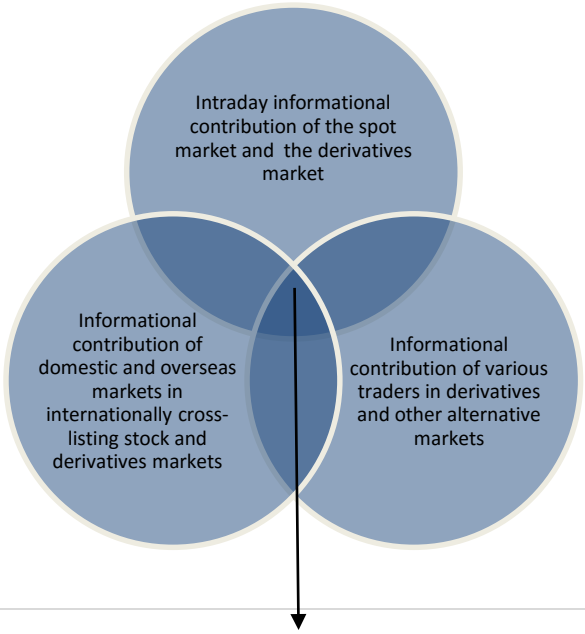
The third research approach in the price discovery process focuses on the informational contribution of various traders in derivatives markets. Most studies show that institutional traders play a dominant role in the price discovery of index futures markets, while off-exchange traders make little contribution to the price discovery (Brown and Jennings 1989, Grundy and Kim 2002, Fong and Zurbruegg 2003, Kurov and Lasser 2004, Kurov 2008, Anand and Subrahmanyam 2008, Phylaktis and Chen 2010). Compared to the other two research approaches, the third approach is still developing. Hence, it is worthwhile to pay more attention to this topic area and investigate the informational contribution of various traders in other alternative markets.

2.4 Research Gap

The first and second research approaches have focused mainly on the price discovery of one security in multiple markets by investigating the informational contribution of the spot and derivatives markets, or domestic and overseas markets. However, no previous study has brought together the insights of how different investors affect each other in one stock market, and the impact of their trading behavior on daily stock price movements, that is intraday price movements. The third research approach has shown the roles of institutional and retail traders in derivatives markets. Conversely, little research has been undertaken to show how institutional and retail traders contribute to price discovery in stock markets. As a result, the research gap is to understand the intraday informational contributions of foreign institutional

traders and domestic retail traders to price discovery in stock markets. Figure 3 demonstrates the relationship between the three existing research approaches to understanding price discovery and the research gap.

Building on previous research, this research will have two original aspects. Firstly, this research will offer an in-depth critical analysis and evaluation of how two different types of investors, foreign institutional traders and domestic retail traders, contribute to price discovery in a single stock market through an econometric approach. This study aims to capture which investor group moves first in the process of price formation. Secondly, this study is original in analysing comprehensive cross-sectional sample data over a 7-year period. Previous research used either older long term data from 1990s or recent short term high frequency data. This research will use highly detailed transaction records identified at the individual transaction level, where each trade records the detail of the trade price, trade direction (buy or sell) and the type of the trader (a domestic retail trader or a foreign institutional trader) who places the order. In addition, the sample period will include the two most prominent bubble cycles of recent decades: the Dot-com bubble crash of 2000 and the Global Financial Crisis of 2007-2008.



Research gap: Intraday informational contribution of foreign institutional traders and domestic retail traders to price discovery in stock markets

Figure 3: Existing research approaches to price discovery and the research gap

3. HYPOTHESIS

Institutions and individuals tend to be viewed differently by financial economists. Typically, these investor categories are viewed in the context of informed and uninformed traders. Institutions are perceived as informed investors (Kaniel, Saar and Titman 2008), while individuals are thought to have behavioural biases and are often considered as uninformed noise traders in the sense of Kyle (1985) and Black (1986). There is widespread support in the literature that individual investors tend to be contrarian, acting against the majority position, and tend to supply liquidity to institutions over the short and long horizon. Using data from Finland, Grinblatt and Keloharju (2000, 2001) document the contrarian behaviour of individuals in both the long term and short term. In the United States, contrarians outnumber momentum traders in index funds (Goetzmann and Massa 2002), while retail traders exhibit contrarian tendency when trading NASDAQ stocks in the short horizon (Griffin, Harris and Topaloglu 2003). Individual investors in Australia (Jackson 2003) and Korea (Choe, Kho, and Stulz 2005) demonstrate similar contrarian patterns in the short horizon. Richards (2005) investigates the trading behaviour of retail traders in six Asian markets and reports similar results on contrarian tendency in the short horizon.

However, there is less agreement on the association between individual traders, institutional traders and individual stock returns. Some research shows that domestic investors outperform foreign investors. For instance, Kang and Stulz (1997) show that foreign investors experience poor performance in Japan. Hau (2001) suggests that domestic investors are superior

performers at short term horizons in Germany, while Chan, Menkveld and Yang (2008) state domestic investors are superior performers in China. Chordia and Subrahmanyam (2004) find a strongly positive relation between individual stock order imbalances and return at a one-day horizon for New York Stock Exchange (NYSE) stocks. Kaniel, Saar and Titman (2008) document similar findings by developing a net individual investor trading model. Barber, Odean and Zhu (2009) show that retail order imbalances forecast cross-sectional US stock returns a year later. Lu, Swan and Westerholm (2014) find that contrarian household investors in Finland outperform both domestic and foreign institutions. Kelley and Tetlock (2013) state that individual investors' stock order imbalances predict monthly returns through a large sample of individual trader data for the US. However, the results of some research are contrary to the view that individual investors are superior performers. Froot, O'Connell and Seasholes (2001) show that local stock prices are highly sensitive to foreign inflows in the United States. Dvořák (2005) states that foreign investors are superior performers at horizons beyond one month in Indonesia. Hvidkjaer (2006, 2008) finds that small trades systematically underperform large trades in the United States. Barber et al. (2009) discover that foreign investors perform better than domestic investors in Taiwan. Kaniel et al. (2012) show that individual investors make informed trades around earnings announcements.

The objective of this empirical study is to test the theory of informed trading and uninformed trading by investigating the role of foreign institutional traders and domestic retail traders in stock markets and their contribution to price discovery. The foreign institutional traders are defined as informed traders, while the domestic retail traders are defined as uninformed traders in the spirit of Kyle (1985) and Black (1986). Empirical studies support that retail traders are uninformed investors on stock markets (Nofsinger and Sias 1999, Chakravarty 2001). Lakonishok and Maberly (1990), Barber and Odean (2000) and Malmendier and Shanthikumar (2007) show that retail traders have some behavioural biases in making investment decisions.

As a result, retail traders are less likely to make information contribution to price discovery on stock markets. Given the evidence that retail traders are likely to be uninformed investors, it could be assumed that foreign institutional traders play a dominant role in price discovery. The study tests the following hypothesis.

H_0: Foreign institutional traders make little contribution to the price discovery in stock markets

H_1: Foreign institutional traders play a dominant role in the price discovery in stock markets

The research aims to address the dynamic relationship between foreign institutional traders, domestic retail traders and individual stock returns to ascertain whether foreign institutional traders and/or domestic retail traders have a significant impact on price discovery and in what direction.

4. HYPOTHESIS

4.1 Finnish Data Set

The data is sourced from Finland because most previous studies have been done in the United States stock market while there is a newly established research focus on the Finnish market due to the availability of exceptionally detailed data from this market. The data is sourced from Euroclear Finland Ltd. It includes all transactions in the share depository for all 1.061 million investor accounts with holdings in 232 unique common stocks listed on NASDAQ OMX Helsinki (OMXH) Exchange, Finland. Compared to other data sets, there are several advantages of using the Finnish data. The data unambiguously assigns each transaction to a specific investor group. Based on the unique identification code assigned by the book entry

system[2], the research is able to sort all transactions by investor categories. The data also records the detail of orders including the trade direction of all transactions. The majority of the literature relies on proxies such as the Lee and Ready (1991) algorithm to assign trades as either buy or sell initiated. However, some studies show that this algorithm only correctly classifies 72.8%-80% of trades in the sample (Odders-White 2000 and Theissen 2000). Therefore, this research uses individual trades directly from the continuous intraday tick-by-tick data and divides them into buys and sells. The Finnish data set provides a sound basis to generate a price discovery measure that truly reflects the trading activity of each investor group in a single stock market.

4.2 Sample period

This paper analyses sample data over 7 years from 2 January 2003 to 30 December 2009 which provides capacity to study long term change and development of informed and uninformed trading in stock markets. In addition, the sample period includes the most prominent bubble cycles of recent decades: the Global Financial Crisis of 2007-2008, which details the role of foreign institutional traders and domestic retail traders in stock markets and their contribution to the price discovery in financial crisis.

4.3 Stock selection and descriptive statistics

To ensure that liquidity does not affect our analysis, we focus on the executed orders for the 30 stocks with the largest market capitalisation throughout the entire sample period. The sample began with the 30 largest stocks in 2003 however by the end of 2009, 9 of these were not large enough to qualify for inclusion in the top 30, leaving 21 stocks. To provide sufficient observations for intraday analysis and inference, our data consist of all the trades during the

[2] The Book Entry System requires the compulsory registration of every investor on the Nasdaq OMX Helsinki. Each investor is then allocated a unique investor identification code which identifies them as belonging to one of six investor groups: domestic households, domestic institutions, foreign nominees, foreign registered, Government and not-for-profit organisations, and residuals.

normal trading hours from 10:00 am to 6:30 pm from 2 January 2003 to 30 December 2009. It includes 1823 trading days and 76,996,666 trades which represents 88.4% of the total market capitalisation in the sample period.

Table 1 provides summary statistics for the entire sample. The sample stocks are selected from 8 different industry sectors and led by Nokia. Although the market share of each stock varies, the trading frequency of each stock is relative close. The average trading frequency for buys is about 7 minutes and for sells is about 8 minutes.

<Insert Table 1>

4.4 Investor categories

As stated earlier, the literature that focuses on the context of informed and uninformed traders primarily considers two categories of traders: institutions and individuals. In this paper, we use foreign nominees as a proxy for institutions. Grinblatt and Keloharju (2000b) and Leung, Rose and Westerholm (2012) find the behaviour of the Finnish 'foreign nominee' investor group is typical of the traditional 'institution'. Swan and Westerholm (2012) suggest foreign nominees can largely be considered foreign institutions trading through a foreign nominee account. Therefore, we not consider domestic Finnish institutions because previous studies document their behaviour to be more similar to the behaviour of individuals than typical of institutions. In addition, Finnish households often outperform the domestic Finnish institutions (Grant, Mills and Westerholm 2013). We use households as a proxy for individuals as the terms households and individuals are synonymous. Hence, we confine our analysis solely to domestic households and foreign nominees.

5. METHODOLOGY

5.1 Stationarity and Co-integration

As stated earlier, this research examines the lead-lag relation between trade prices of these two investor groups for each stock. As stated by Engle and Granger (1987), the lead-lag test requires the data series to be stationary. Therefore, prior to testing lead-lag relation between the trade prices of foreign institutional traders and domestic retail traders, it is important to test the stationarity of these two price series.

Most economic time series such as share price are non-stationary, because they follow a random pattern. Therefore, to obtain stationarity, the data needs to be transformed by using differencing. Vogelvang (2005) notes a series is said to be integrated of order one if it has to be differentiated once before becoming stationary. The Augmented Dickey-Fuller (ADF) unit root test developed by Dickey and Fuller 1981 is the most commonly used stationarity test. To run the ADF test, ordinary least squares (OLS) is used to determine a suitable specified regression equation for each time series Yt:

$$\Delta Y_{i,t} = \alpha_0 + \beta_1 Y_{i,t-1} + \sum_{i=1}^{n} \beta_i \Delta Y_{i,t-i} + \varepsilon_t$$

Where $\Delta Y_{i,t}$ denotes the logarithmic first difference of a variable at time t, n is the order of the autoregressive process, $\Delta Y_{i,t-i}$ is included to accommodate serial correlation in the errors and ε_t is the error term. To test the optimal lag number, most research has used Bayesians Information Criterion as the model selection procedure, or has alternatively assumed a fixed number of lags. This research uses the Bayesians Information Criterion (BIC) method.

The notion of co-integration was first studied by Granger (1981) and further developed by Engle and Granger (1987), Stock and Watson (1988) and Johansen (1988, 1991, 1995). Co-integration is a theory which considers long-run equilibrium relationships between variables. The long-run equilibrium is a stationary point which tends to push variables back to equilibrium

whenever they diverge from each other. If a linear combination of two non-stationary variables is stationary, these two variables are said to be co-integrated (Granger 1981).

There are three methods to examine the co-integration of variables: Granger (1981), Engle and Granger (1987) and Johansen (1991, 1995). The research will use the Johansen (1991, 1995) test to investigate the co-integration of two investor groups' price series because it introduces a new approach to identify the maximum number of co-integrating relationships existing between a set of variables. For instance, if there are q non-stationary variables, the maximum co-integrating relationships is q minus 1. The Johansen (1991, 1995) test uses the maximum Eigen values statistics to determine the number of co-integrating relationships.

5.2 Price discovery process

To examine the roles of different types of traders in the price discovery process, there are two widely used measures of price discovery for multiple markets that share a common random walk efficient price – Permanent Transitory (PT) model of Gonzalo and Granger (1995) and Information Share (IS) model of Hasbrouck (1995). The Permanent Transitory (PT) model focuses on the composition of the efficient price innovation and measures one market's contribution to price discovery by the component weight of that market in forming the efficient price innovation studies (e.g. Tse, Zietz and Greer 1998, Booth, So and Tse 1999, Chu, Hsieh and Tse 1999, Ding et al. 1999, Tse 1995, 2000, Harris, McInish and Wood 1996, 2002). In contrast, the Information Share model focuses on the variance of the efficient price innovation and defines one market's information share as the proportion of the efficient price innovation variance attributable to that market [3] (Brockman and Tse 1995, Martens 1998, Tse 1999, Huang 2002). Both approaches use co-integration (Garbade and Silber 1979) to constrain multiple

[3] A special issue of the *Journal of Financial Markets* provides detailed discussion of the Hasbrouck and Gonzalo–Granger models (see Baillie et al. 2002, de Jong 2002, Harris, McInish and Wood 2002a, 2002b, Hasbrouck 2002 and Lehmann 2002).

market prices to share a common efficient price, and use a reduced form vector error correction model (VECM) for estimation purposes. The IS model is preferable to the PT model because it arises from random-walk decomposition with limited identification restrictions and assumes that traders can update their expectations when new information enters the market (Hasbrouck 1995). The IS model is based upon each trader's reactions to price movement, with their contribution to the price discovery being defined as the variation in efficient price innovations attributable to each investor category. De Jong (2002) shows that only the information share takes into account the variability of the innovations in each market's price. Hasbrouck (2002) points out that the permanent component of the PT model need not be a random walk to be forecastable which violates the condition the efficient price should be martingale. Only the IS model provides information on the relative informativeness of individual markets – the information share ratio of one market is higher if it incorporates more new information (Yan and Zivot 2007). Putnins (2013) indicate that IS is an unbiased measure of a prices series' contribution to impounding new information if the price series being compared have an equal level of noise. Price series may different in noise due to different bid-ask spreads, various microstructure frictions, trading mechanism and contract specification. This study compares the informational contribution of two types of traders in the same market and their bid-ask spread is very similar (see Table 6), therefore, it satisfies this additional condition (equal level of noise) of applying IS model. Therefore, to capture "who moves first" in one market, this paper adopts Hasbrouck's Information Share model to find out the common random walk term that is shared by households and foreign nominees in the buys and sells.

The following estimation approaches for the model are mainly adapted from Hasbrouck (1995) and Baillie et al. (2002). The Information Share model starts from the estimation of the following VECM:

$$\Delta Y_{i,t} = \alpha\beta' Y_{i,t} + \sum_{j=1}^{k} \emptyset_j \Delta Y_{i,t-1} + \varepsilon_t \quad (1)$$

assume the two price quotes to be I (1) process, $Y_t = (y_{1t}, y_{2t})'$ with the differential being the error correction term $z_t = \beta' Y_t = y_{1t} - y_{2t}$, where β is the co-integration vector, α is the error correction vector and e_t is a zero-mean vector of serially uncorrelated innovations with covariance matrix **Ω**：

$$\Omega = \begin{pmatrix} \sigma_1^2 & \rho\sigma_1\sigma_2 \\ \rho\sigma_1\sigma_2 & \sigma_2^2 \end{pmatrix}$$

σ_1^2, σ_2^2 is the variance of e_{1t} , e_{2t} , ρ is the correlation coefficient. The VECM has two parts: the first part, $\alpha\beta' Y_{t-1}$, represents the long-run or equilibrium dynamics between the price series, and the second part, $\sum_{j=1}^{k} \emptyset_j \Delta Y_{i,t-1}$, shows the short-term deviation induced by market imperfections.

Hasbrouck (1995) transforms equation (1) into the vector moving average:

$$\Delta Y_t = \Psi(L) e_t \quad (2)$$

And in an integrated form:

$$Y_t = \Psi(1) \sum_{s=1}^{t} e_s + \Psi^*(L) e_t \quad (3)$$

where $\Psi(L)$ and $\Psi*(L)$ are matrix polynomials in the lag operator, $\Psi(1)$ is the sum of the moving average coefficient matrices.

If we denote $\psi = (\psi_1, \psi_2)$ as the common row vector in $\Psi(L)$, equation (3) becomes：

$$Y_t = l\psi \sum_{s=1}^{t} e_s + \Psi^*(L) e_t \quad (4)$$

where $l = (1,1)'$ is a column vector of ones

Hasbrouck (1995) states that the increment Ψe_t in equation (4) is the component of the price change that is permanently impounded into the price and is presumably due to new information, where:

$var(\psi e_t) = \psi \Omega \psi'$.

If Ω is diagonal (e.g. the market innovations are uncorrelated), then $\psi \Omega \psi'$ will consist of n terms, each of which represents the contribution to the random-walk innovation from a particular market. The proportion of this for market j relative to the total variance is defined as market j's information share:

$$S_j = \frac{\psi_j^2 \sigma_j^2}{\psi \Omega \psi'} \qquad (5)$$

If Ω is not diagonal and the equation (5) will not be appropriate. Hasbrouck (1995) uses Cholesky factorization $\Omega = MM'$ to eliminate the contemporaneous correlation, where

$$M = \begin{pmatrix} m_{11}, & 0 \\ m_{12}, & m_{22} \end{pmatrix} = \begin{pmatrix} \sigma_1, & 0 \\ \rho\sigma_2, & \sigma_2(1-\rho^2)^{1/2} \end{pmatrix}$$

The information share of market j is given by:

$$S_j = \frac{([\psi M]_j)^2}{\psi \Omega \psi'} \qquad (6)$$

where $[\psi M]_j$ the j^{th} element of the row matrix ψM

The Cholesky factorisation provides an upper (lower) bound for a market's information share by placing that market first (last) in Ψ and Ω. If price innovations are significantly correlated

across prices, the upper and lower bounds are very far apart. The most informative market may therefore exhibit the widest spreads (Hasbrouck 1995). The average of upper and lower bounds is a reasonable estimation of one market participant's contribution to the price discovery (Baillie et al. 2002).

6. RESULTS

6.1 Stationarity

Before testing for the co-integration of variables, it is essential to determine the order of integration for each of the variables in logarithmic form using the Augmented Dickey-Fuller (Dickey and Fuller 1979, 1981) unit root test. We run the ADF test with a linear trend on level and first differences of spreads up to ten lags in order to control for serial correlation for each stock's buys and sells. For each variable, an initial lag length of ten is used to test the presence of a unit root. If the t-statistic for the largest lag is insignificant, the lag length is reduced successively until a significant lag length is obtained. The Bayesian Information Criterion (BIC) was used to determine the optimal number of lags for the tests.

Table 2 presents the ADF test results. The results show that the ADF t-statistics do not reject the null hypothesis of a unit root for all the variables, implying that the prices of each stock are not stationary at levels, but they become stationary after the first differencing is performed as the MacKinnon (1996) one-sided p-values are significant at the 5% level. These results suggest that the trade price of households and foreign institutions are integrated in order one (I (1)) for both buys and sells, therefore, an error correction model can be estimated in the next section.

<Insert Table 2>

6.2 Co-integration

The Johansen test is carried out to examine co-integration. Table 3 presents the results from the Johansen test and reports the number of co-integrating relationships among variables. At the 5% level of significance, both the trace and maximal eigenvalue test statistics indicate that all 21 stocks have at least one long-run co-integrating relationship among the trade price of households and foreign institutions.

<Insert Table 3>

6.3 Price discovery

Table 4 summaries the results of information shares for the trade price of households and foreign institutions for our 21 sample stocks (both buys and sells). Results indicate that during the period 2003 to 2009, in two widely held top capitalisation stocks Nokia and Stora-Enso, price discovery is led by individual investors, while in the other top capitalisation stocks, institutional investors dominate price discovery. This is mainly due to the fact that information is most public in these two top capitalisation companies while foreign institutional investors may have more insider information about other smaller companies.

<Insert Table 4>

To investigate these two exceptions, we explore the relation between trading volume and price discovery contribution of households and foreign institutions for each stock. The results in Table 5 show that the investor group which has the lower trading volume is the first to reflect new information and dominate price discovery of both buys and sells. For Nokia, households have lower trading volumes than foreign institutions for both buys and sells, but the price discovery process is led by households.

<Insert Table 5>

Figure 4 and Figure 5 outline the association between information share and trading volume of each investor group for both buys and sells of 21 sample stocks. The trading volume is presented as a value-weighted percentage which is the proportion of each individual investor group's trading volume in relation to the total trading volume for each stock.

<Insert Figure 4 and Figure 5>

Empirical microstructure studies provide evidence that informed trades are the main cause of stock price changes. Security prices fully and immediately reveal information possessed by informed traders (Grossman 1976). As a result, the private information is transmitted from informed to rational uninformed traders, leading to increased price efficiency (Easley and O'Hara 2004). Our results show that information share is most strongly correlated with medium size trades, which are consistent with existing literature that informed trades concentrate on trades of medium-size (Barclay and Warner 1993, Barclay and Hendershott 2003).

6.4 Regression analysis

6.4.1 Baseline model

As indicated earlier, during the period 2003 to 2009, the price discovery process is dominated by foreign institutional investors in our sample stocks. The regressions are estimated to provide additional evidence as to which key determinants explain the informational contribution of foreign institutions to price discovery. Since the value of information share is within the range of 0 to 1, Tobit model is used due to the fact that our dependent variables is censoring but not data on the regressors (Long 1997, 188). It is inappropriate to use OSL model, because it assumes linearity of continues data and it will provide inconsistent estimates of censored data. Greene (2003) points out that tobit and probit models are similar in many ways but there is more information in the tobit model and the estimates is more efficient.

The regressions start with market microstructure related variables which measure liquidity and integration with world capital market including the trading volume, effective spread and the number of cross-listing exchanges.

The structure of the regression is presented as follows:

$$IS_{Buy\_FI} = \alpha_0 + \alpha_1 Vol_t + \alpha_2 ESpread_t + \alpha_3 Crosslisting_t + u_t$$

$$IS_{Sell\_FI} = \beta_0 + \beta_1 Vol_t + \beta_2 ESpread_t + \beta_3 Crosslisting_t + \varepsilon_t$$

There are 147 observation based on 21 stocks across 7 years. The dependent variable is the informational contribution of foreign institutions for buys and sells of each stock (IS_Buy_Foreign Institutions and IS_Sell_Foreign Institutions).

The independent variables are market microstructure related variables:

1. *Trading volume*: Trading volume is defined as the number of shares traded for each stock in their euro amount in the domestic market of Helsinki. Maher et al. (2008) indicate that when predicting the liquidity impact on price discovery, trading volume can serve as a strong instrument. To the extent that information is incorporated into prices through trading, we would expect to see a relation between price discovery and trading volume of foreign institutions.

2. *Effective spread*: The spread is a measure of trading costs, and informed traders may be attracted by narrower spreads, which would suggest an inverse relation between price discovery and spreads (Chakravarty et al. 2004). On the other hand, if market makers set wider spreads in fear of informed trading, this might induce a positive relation (Lee and Yi 2001, Kaul et al. 2002). Therefore, we would expect to see a relation between price discovery and trading costs of foreign institutions.

3. *The number of cross-listing exchanges*: Integration with global capital markets and liquidity from the foreign market is crucial for performing arbitrage trading because it brings prices to fundamental values and keeps markets efficient (Shleifer and Vishny 1997). It is likely that a source of liquidity in the trading of cross-listed stocks comes from their foreign counterparts, where traders seek the cheapest trading location or price advantages. Therefore, including the number of cross-listing exchanges captures the cross-listing effect on price discovery efficiency.

6.4.2 Control variables and dummy variables

Stock market size and firm-specific factors may affect the contribution to price discovery, therefore, to address this problem, we re-estimate our previous regression models with the inclusion of controls for a number of firm characteristics and add dummy variables for price discovery and industry effect.

The structure of the regression is presented as follows:

$$IS_{Buy\_FI} = \alpha_0 + \alpha_1 Vol_t + \alpha_2 ESpread_t + \alpha_3 Crosslisting_t + \alpha_4 In(Size)_t + \alpha_5 Analyst\_coverage_t + \alpha_6 Capex_t + \alpha_7 Leverage_t + \alpha_8 Dummy\_PD_t + \alpha_9 Dummy\_Industry_t + u_t$$

$$IS_{Sell\_FI} = \beta_0 + \beta_1 Vol_t + \beta_2 ESpread_t + \beta_3 Crosslisting_t + \beta_4 In(Size)_t + \beta_5 Analyst\_coverage_t + \beta_6 Capex_t + \beta_7 Leverage_t + \beta_8 Dummy\_PD_t + \beta_9 Dummy\_Industry_t + \varepsilon_t$$

There are four control variables:

1. *In (Size): Market capitalisation* represents the company's value in the market place. To control for the firm size, we use the natural logarithm of firm's market capitalisation at the end of each year (Brennan et al. 1998).

2. Analyst coverage: Analyst coverage is the number of analysts who follow the stock. The overall level of information available about the firm also influences the price discovery process. In particular, heavier analyst coverage is associated with faster and more complete price adjustment. Stocks with greater analyst coverage react faster to market-wide common information compared to those with less analyst coverage (Brennan et al. 1993). Elgers et al. (2001) find that the price response to value-relevant information in analyst earnings forecasts is less complete for firms with lower levels of analyst coverage.

3. Size of capital expenditure: Prior research suggests that a positive relationship is expected between the size of the capital expenditure and any abnormal returns, that is, announcements of increases (decreases) in planned capital expenditures are associated with significant positive (negative) excess stock returns (McConnell and Muscarella 1985, Burton, Lonie and Power 1999 and Brailsford and Yeoh 2004).

4. *Leverage:* Debt can mitigate against managerial inefficiency (Jensen 1986, 1989, Hart and Moore 1990 and Stulz 1990), when leverage is sufficiently large, as managers are unlikely to make wealth-destroying investment decisions because they are under legal obligations to service debt payments. Since long term continued employment is generally considered to be a management objective (Shleifer and Vishny 1989), when the debt level is sufficiently high, managers are reluctant to make non-value-maximising investment decisions. Hence, it is expected that an increase in a firm's debt level will attract more foreign investment due to a reduction in agency problem. We use the leverage ratio of each stock to measure debt level.

There are two dummy variables:

1. Price Discovery dummy: We use 0 or 1 dummy variables for price discovery. We assign 1 if the price discovery process is dominated by foreign institutions and 0 if the price discovery process is dominated by households.

2. Industry dummy: There are 8 industry sectors in our sample: IT, Materials, Utilities, Financials, Industrials, Telecommunication Service, Consumer Discretionary and Consumer Staples. To control for the industry effect, we assign 1 if the company belongs to one of these industry sectors and 0 otherwise. To avoid a non-singular matrix, we include 7 industry sectors out of 8.

6.4.3 Descriptive statistics

Table 6 provides descriptive statistics for our main variables. On average, the information share of foreign institutions is much higher than households which represent the fact that the price discovery process is dominated by foreign institutions in both buys and sells. Although the trading volume of foreign institutions are significant larger than the households, the effective spread are relative close. Therefore, we can expect that the effective spread may not have a significant impact on the information contribution of each investor category given the similar trading costs, while trading volume will. The firm-specific characteristics are same for both foreign institutions and households.

<Insert Table 6>

To avoid problems with multicollinearity in the variables, we did not include highly correlated variables, that is, variables that are expected to measure similar features, in the same regression equation. Table 7 presents a correlation matrix of all variables employed in our main analysis. Even though the correlation between stock size and cross listing is 0.716, the correlation between analyst coverage and cross listing is 0.771, the correlation between stock size and

analyst coverage is 0.81, we still include cross listing, stock size, analyst coverage as variables, because large size stocks are always listed in oversea markets with high media attention and attract a higher number of foreign investors.

<Insert Table 7>

6.4.4 Results

We estimate various regression models of the information contribution of foreign institutions as a function of market structure related variables and a number of control and dummy variables. Log likelihood ratios have been compared with Chi-Square and all models are significant at 5% level. Table 8 reports the coefficient estimates for the information contribution of foreign institutions to price discovery for buys. The dependent variable is the information share of foreign institutions for buys. Model 1 is our baseline regression model which only considers the effect of liquidity and integration with the world capital market on price discovery. The results show that there is a negative association between the trading volume and the information contribution of foreign institutions. The coefficient between trading volume and price discovery is -6.84 and significant at 1% level. The coefficient between effective spread and price discovery is -17.526 and significant at 1% level. The cross-listing does not have much impact on the information contribution. In the remaining models of Table 8, we include firm-specific factors and dummy variables. In model 2 to model 7, after including additional control variables, the coefficient of the trading volume and effective spread are still negative and statistically significant (the average coefficient of trading volume is -3.193 and the average coefficient of effective is -12.475). The price discovery dummy variable is positive and statistically significant at 1% level. The average coefficient of price discovery dummy is 0.302 which implies that the difference between the information contribution of foreign institutions and households is significantly higher and foreign

institutions dominate the price discovery process. The industry dummies are insignificant which means that the variation of industry sectors does not have an impact on price discovery of foreign institutions. Model 8 and model 9 include controls for the price discovery dummy interacted with the trading volume, effective spread, cross-listing, size, analyst coverage, capital expenditure and leverage. The findings are consistent with previous models, that is, the trading volume is negatively related to the information contribution of foreign institutions and part of the contribution can be explained by an increase in the firm size (the average coefficient is 0.0575).

<Insert Table 8>

We repeat the same models for sells and Table 9 reports the association between the informational contribution of foreign institutions and factors explaining the magnitude of the reaction. The dependent variable is the information share of foreign institutions for sells.

Model 1 show that there is a negative association between the trading volume and the information contribution of foreign institutions. The coefficient between trading volume and price discovery is -3.7 and significant at 1% level. The coefficient between cross-listing and price discovery is -0.012 and significant at 1% level. The impact of effective spread on the information contribution is statistically insignificant. In model 2 to model 7, after including additional control variables, the coefficient of the trading volume becomes positive and statistically significant (the average coefficient of trading volume is 6.202). The coefficient of CAPEX is negative and significant at 1%, with an average of -0.06. The price discovery dummy variable is positive and statistically significant at 1% level, the average coefficient of price discovery dummy is 0.403, which confirms the same findings from buys. The impact of effective spread on the information contribution is still statistically insignificant. In contrast to buys, the variations of industry sectors have an impact on price discovery of foreign

institutions. The industry dummies are negative and significant for four industry sectors (IT, Materials, Utilities and Consumer Discretionary). Model 8 and model 9 include controls for the price discovery dummy interacted with other variables. The results of the impact of industry sectors on price discovery are consistent with previous models. However, the trading volume is statistically insignificant and effective spread has a positive impact on the informational contribution of foreign institutions. The contribution now can be explained by an increase in the number of cross-listing exchanges (the average coefficient is 0.05) and leverage (the average coefficient is 0.218).

<Insert Table 9>

Results from both buys and sells confirm that trading volume is the key factor that explains the information contribution of foreign institutions to price discovery. After controlling for firm-level factors and industry effects, although the degree of statistical significance varies somewhat across specifications, our results indicate that foreign institutions make a significant contribution compare to households and dominate the price discovery process. Compare with the coefficient of trading volume and price discovery dummy for buys and sells, it suggests that trading volume has a negative (positive) impact on price discovery in buys (sells) and foreign institutions move the price more quickly in sells. Although the effective spread are relative close for buys and sells, the effective spread is negative related to price discovery for sells. While stock size, firm's capital expenditure and industry sectors have significant negative impact on price discovery for sells.

7. CONCLUSION

Little evidence is available in the literature to examine price discovery by the two different investor groups of foreign institutions and domestic retail investors and how informed trading occurs in a single stock market. We investigate the informational contribution of households

and foreign institutions to price discovery using data from the Finnish stock market. From January 2003 to December 2009, the price discovery process has been shown to be dominated by foreign institutional investors in our sample stocks except for the two largest stocks where information is most public. We find that on average the informational contribution of each investor group is negatively correlated to its yearly total trading volume. The regressions are estimated to provide additional evidence as to which key determinants explain the informational contribution of foreign institution traders to price discovery and when informed traders trade. Results show that trading volume is the key factor that determines the level of information contribution of foreign institutions to price discovery, that is, the investor group which has lower (higher) trading volume is the first to reflect new information in buys (sells) and dominate price discovery of sample stocks. While trading costs, stock size, other firm specific factors and industry sectors have significant negative impact on price discovery in sells**.**

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Table 1: Summary statistics for 21 sample stocks in Finland, 2003 to 2009

Table 1 reports summary statistics for the 21 sample stocks in Finland over the entire study period from 2 January, 2003 to 30 December, 2009. Market capitalisation and trading frequency are calculated as the average of seven years' market capitalisations and trading frequencies. The sample stocks are selected from 8 different industry sectors and led by Nokia. Although the market share of each stock varies, the trading frequency of each stock is relative close. The average trading frequency for buys is close to 7 minutes and for sells is about 8 minutes.

Company	Industry Classification	Market capitalisation			Trading frequency	
		Average Market Cap (Million Euro's)	% of Sample	% of Market	Buys (minutes)	Sells (minutes)
NOKIA CORP	Communications Equipment	272,769.46	76.86%	67.94%	0.44	0.51
STORA ENSO OYJ	Paper Products	20,172.69	5.68%	5.02%	3.96	4.33
FORTUM OYJ	Electric Utilities	14,782.09	4.17%	3.68%	1.82	2.33
SAMPO OYJ	Multi-line Insurance	7,813.36	2.20%	1.95%	5.37	6.25
TIETO CORP	IT Consulting and Other Services	7,762.23	2.19%	1.93%	12.94	14.04
UPM-KYMMENE CORP	Paper Products	7,490.54	2.11%	1.87%	2.64	3.16
METSO OYJ	Industrial Machinery	2,998.76	0.84%	0.75%	1.98	2.46
OUTOKUMPU OY	Steel	2,796.13	0.79%	0.70%	4.47	5.30
RAUTARUUKKI OYJ	Steel	2,530.90	0.71%	0.63%	2.20	2.79
ELISA CORP	Integrated Telecommunication Services	2,212.73	0.62%	0.55%	4.40	3.70
SANOMA CORP	Publishing	2,071.12	0.58%	0.52%	12.38	15.35
NOKIAN TYRES OYJ	Tires and Rubber	1,707.55	0.48%	0.43%	2.13	2.94
WARTSILA OYJ ABP	Industrial Machinery	1,577.41	0.44%	0.39%	6.16	7.88
POHJOLA BANK PLC	Other Diversified Financial Services	1,417.68	0.40%	0.35%	9.44	10.90
KEMIRA OY	Diversified Chemicals	1,357.96	0.38%	0.34%	6.54	9.09
KESKO OYJ	Food Retail	1,184.35	0.33%	0.30%	4.32	5.32
HUHTAMAKI OYJ	Paper Packaging	1,070.94	0.30%	0.27%	7.01	10.54
AMER SPORTS CORP	Leisure Products	926.01	0.26%	0.23%	16.96	20.10
KONECRANES PLC	Industrial Machinery	881.80	0.25%	0.22%	4.20	4.69
FINNAIR OY	Airlines	707.70	0.20%	0.18%	15.53	19.00
STOCKMANN AB	Department Stores	671.98	0.19%	0.17%	22.99	25.58
Mean		16,900.16	4.76%	4.21%	7.04	8.39
Sum		354,903.42	100.00%	88.40%		

Table 2: Augmented Dickey-Fuller Unit Root Tests for the trade price of households (HH) and foreign institutions (FI) for 21 sample stocks (both buys and sells)

Table 2 presents the Augmented Dickey-Fuller (ADF) test results. HH represents households and FI represents foreign institutions. The Bayesian Information Criterion (BIC) was used to determine the optimal number of lags for the tests. The results show that the prices of each stock are not stationary at levels, but they are stationary after the first differencing is performed as the MacKinnon (1996) one-sided p-values are significant at the 5% level. These results suggest that the trade price of households and foreign institutions are integrated in order one (I (1)) for both buys and sells.

Company	Buys - HH		Buys - FI		Sells - HH		Sells - FI	
	P-value	BIC	P-value	BIC	P-value	BIC	P-value	BIC
NOKIA CORP	0.2507	-8.6476	0.4654	-8.8622	0.3068	-8.1584	0.3962	-8.7965
D(NOKIA CORP)	0.0001	-8.6476	0.0001	-8.8623	0.0001	-8.1584	0.0001	-8.7967
STORA ENSO OYJ	0.5863	-7.9600	0.7690	-8.2290	0.6209	-7.7816	0.7486	-8.2508
D(STORA ENSO OYJ)	0.0001	-7.9601	0.0001	-8.2291	0.0001	-7.7817	0.0001	-8.2504
FORTUM OYJ	0.1028	-7.1344	0.2424	-6.7843	0.1028	-7.1344	0.2424	-6.7843
D(FORTUM OYJ)	0.0001	-7.1346	0.0001	-6.7843	0.0001	-7.1346	0.0001	-6.7843
SAMPO OYJ	0.3468	-6.7477	0.0690	-6.2046	0.3468	-6.7477	0.0690	-6.2046
D(SAMPO OYJ)	0.0001	-6.7478	0.0001	-6.2045	0.0001	-6.7478	0.0001	-6.2045
TIETO CORP	0.4643	-5.6200	0.4921	-5.0971	0.4550	-5.4801	0.5370	-5.2095
D(TIETO CORP)	0.0001	-5.6201	0.0001	-5.0973	0.0001	-5.4799	0.0001	-5.2094
UPM-KYMMENE CORP	0.1603	-7.0577	0.2128	-6.6502	0.1742	-6.7538	0.1917	-6.6369
D(UPM-KYMMENE CORP)	0.0001	-7.0576	0.0001	-6.6505	0.0001	-6.7538	0.0001	-6.6352
METSO OYJ	0.6243	-6.5374	0.6242	-5.7858	0.6243	-6.5374	0.6242	-5.7858
D(METSO OYJ)	0.0001	-6.5374	0.0001	-5.7861	0.0001	-6.5374	0.0001	-5.7861
OUTOKUMPU OY	0.3756	-6.3292	0.4597	-5.5309	0.4274	-6.1412	0.5543	-5.4824
D(OUTOKUMPU OY)	0.0001	-6.3293	0.0001	-5.5309	0.0001	-6.1413	0.0001	-5.4825
RAUTARUUKKI OYJ	0.4955	-6.6267	0.5689	-5.5071	0.4828	-6.3782	0.5880	-5.5198
D(RAUTARUUKKI OYJ)	0.0001	-6.6267	0.0001	5.5072	0.0001	-6.3783	0.0001	-5.5198
ELISA CORP	0.2259	-6.7591	0.2161	-6.4425	0.2501	-6.9987	0.2572	-6.6547
D(ELISA CORP)	0.0001	-6.7594	0.0001	-6.4424	0.0001	-6.9990	0.0001	-6.6547
SANOMA CORP	0.5963	-6.0451	0.6117	-4.9695	0.5527	-5.7343	0.4460	-5.0035
D(SANOMA CORP)	0.0001	-6.0452	0.0001	-4.9699	0.0001	-5.7344	0.0001	-5.0038
NOKIAN TYRES OYJ	0.0020	-3.4917	0.0020	-2.1723	0.0020	-3.4917	0.0020	-2.1723
D(NOKIAN TYRES OYJ)	0.0001	3.4917	0.0001	-2.1721	0.0001	-3.4917	0.0001	-2.1721
WARTSILA OYJ ABP	0.2651	-4.6892	0.2369	-3.8513	0.2651	-4.6892	0.2369	-3.8513
D(WARTSILA OYJ ABP)	0.0001	-4.6892	0.0001	-3.8514	0.0001	-4.6892	0.0001	-3.8514
POHJOLA BANK PLC	0.2513	-6.2729	0.1870	-5.1751	0.2394	-6.1466	0.1743	-5.2131
D(POHJOLA BANK PLC)	0.0001	-6.2729	0.0001	-5.1710	0.0001	-6.1467	0.0001	-5.2123
KEMIRA OY	0.2651	-4.6892	0.2369	-3.8513	0.3705	-6.7653	0.4962	-6.0182
D(KEMIRA OY)	0.0001	-4.6892	0.0001	-3.8514	0.0001	-6.7654	0.0001	-6.0184
KESKO OYJ	0.6367	-5.9908	0.6748	-5.2365	0.6813	-5.7435	0.6724	-5.4122
D(KESKO OYJ)	0.0001	-5.9908	0.0001	-5.2366	0.0001	-5.7436	0.0001	-5.4123

HUHTAMAKI OYJ	0.5824	-7.5219	0.5417	-7.0034	0.5845	-7.2739	0.6712	-6.3575
D(HUHTAMAKI OYJ)	0.0001	-7.5220	0.0001	-7.0035	0.0001	-7.2740	0.0001	-6.3569
AMER SPORTS CORP	0.6331	-3.4786	0.0038	-3.3005	0.4667	-3.3395	0.0034	-2.9836
D(AMER SPORTS CORP)	0.0001	-3.4788	0.0001	-3.3004	0.0001	-3.3397	0.0001	-2.9770
KONECRANES PLC	0.0020	-4.6044	0.0110	-3.4494	0.0020	-4.6044	0.0110	-3.4494
D(KONECRANES PLC)	0.0001	-4.6061	0.0001	-3.4496	0.0001	-4.6061	0.0001	-3.4496
FINNAIR OY	0.5285	-6.3316	0.7545	-5.4916	0.5997	-6.2275	0.7943	-5.6353
D(FINNAIR OY)	0.0001	-6.3319	0.0001	-5.4923	0.0001	-6.2279	0.0001	-5.6359
STOCKMANN AB	0.4854	-4.3731	0.5630	-2.2798	0.5034	-4.0796	0.6869	-24.7736
D(STOCKMANN AB)	0.0001	-4.3733	0.0001	-2.2810	0.0001	-4.0799	0.0001	-2.4300

MacKinnon (1996) one-sided p-values

Significance at the 5% level

The lag value is determined by the Bayesian Information Criteria (BIC)

Table 3: Johansen co-integration test for the trade price of households (HH) and foreign institutions (FI) for the 21 sample stocks (both buys and sells)

Table 3 presents the results from the Johansen test and reports the number of co-integrating relationships among variables for each of the 21 price series over the entire study period from 3 January, 2003 to 29 December, 2009. There are results for buys and sells. The first column after Company in Table 3 is the number of co-integrating relationships under the null hypothesis which is stated no co-integrating relationship exists for buys. The second column is the ordered eigenvalues of the matrix. The third column is the trace statistic and the last column is the 5% critical values. The four columns are then repeated for sells. The results indicate there is one co-integrating relationship among the trade price of households and foreign institutions at 5% significant levels.

Company	Buys- HH and FI				Sells - HH and FI			
	No. of CE(s)	Eigenvalue	Trace statistic	5% Critical value	No. of CE(s)	Eigenvalue	Trace statistic	5% Critical value
NOKIA CORP	0	0.01	51811.06	15.34	0	0.00	15478.02	15.34
	1	0.00	8.47	3.84	1	0.00	4.83	3.84
STORA ENSO OYJ	0	0.02	5799.58	15.34	0	0.01	4213.99	15.34
	1	0.00	1.14	3.84	1	0.00	1.08	3.84
FORTUM OYJ	0	0.03	23244.96	15.34	0	0.02	14158.93	15.34
	1	0.00	12.65	3.84	1	0.00	8.17	3.84
SAMPO OYJ	0	0.05	12314.42	15.34	0	0.05	9921.02	15.34
	1	0.00	5.59	3.84	1	0.00	5.87	3.84
TIETO CORP	0	0.04	2801.83	15.34	0	0.03	2346.29	15.34
	1	0.00	2.59	3.84	1	0.00	2.25	3.84
UPM-KYMMENE CORP	0	0.02	13476.17	15.34	0	0.02	9820.59	15.34
	1	0.00	20.22	3.84	1	0.00	20.58	3.84
METSO OYJ	0	0.03	23282.05	15.34	0	0.03	23282.05	15.34
	1	0.00	4.90	3.84	1	0.00	4.90	3.84
OUTOKUMPU OY	0	0.04	11557.57	15.34	0	0.03	7370.71	15.34
	1	0.00	5.14	3.84	1	0.00	4.15	3.84
RAUTARUUKKI OYJ	0	0.03	15947.03	15.34	0	0.03	15232.22	15.34
	1	0.00	6.76	3.84	1	0.00	5.19	3.84
ELISA CORP	0	0.03	9128.75	15.34	0	0.02	6778.39	15.34
	1	0.00	7.61	3.84	1	0.00	6.78	3.84
SANOMA CORP	0	0.04	2190.83	15.34	0	0.03	1434.79	15.34
	1	0.00	1.99	3.84	1	0.00	2.91	3.84
NOKIAN TYRES OYJ	0	0.02	11492.70	15.34	0	0.02	11492.70	15.34
	1	0.00	21.80	3.84	1	0.00	21.80	3.84
WARTSILA OYJ ABP	0	0.03	6680.31	15.34	0	0.03	6680.31	15.34
	1	0.00	6.47	3.84	1	0.00	6.47	3.84
POHJOLA BANK PLC	0	0.03	2699.69	15.34	0	0.03	2183.76	15.34
	1	0.00	4.82	3.84	1	0.00	5.01	3.84

KEMIRA OY	0	0.03	6680.31	15.34	0	0.02	2210.15	15.34
	1	0.00	6.47	3.84	1	0.00	2.86	3.84
KESKO OYJ	0	0.02	5599.30	15.34	0	0.03	5904.87	15.34
	1	0.00	3.41	3.84	1	0.00	3.23	3.84
HUHTAMAKI OYJ	0	0.03	3775.97	15.34	0	0.03	2241.48	15.34
	1	0.00	1.74	3.84	1	0.00	1.59	3.84
AMER SPORTS CORP	0	0.02	753.78	15.34	0	0.04	1201.39	15.34
	1	0.00	8.44	3.84	1	0.00	8.67	3.84
KONECRANES PLC	0	0.02	6156.44	15.34	0	0.02	6156.44	15.34
	1	0.00	16.05	3.84	1	0.00	16.05	3.84
FINNAIR OY	0	0.04	1071.82	15.34	0	0.04	1031.83	15.34
	1	0.00	1.17	3.84	1	0.00	1.03	3.84
STOCKMANN AB	0	0.03	819.33	15.34	0	0.04	778.43	15.34
	1	0.00	2.09	3.84	1	0.00	1.88	3.84

Significance at the 5% level

Table 4: Information share of households (HH) and foreign institutions (FI) for the 21 sample stocks (both buys and sells)

Table 4 summarises the results of information shares for the trade price of households and foreign institutions for our 21 sample stocks (both buys and sells). Results indicate that during the period 2003 to 2009, in two widely held top capitalisation stocks Nokia and Stora-Enso, price discovery is led by individual investors, while in the other top capitalisation stocks, institutional investors dominate price discovery. This is mainly due to the fact that information is most public in these two top capitalisation companies while foreign institutional investors may have more insider information about other smaller companies.

Company	Buys		Sells	
	HH	FI	HH	FI
NOKIA CORP	50.28%	49.72%	50.89%	49.11%
STORA ENSO OYJ	51.92%	48.08%	56.37%	43.63%
FORTUM OYJ	48.86%	51.14%	45.92%	54.08%
SAMPO OYJ	37.13%	62.87%	35.81%	64.19%
TIETO CORP	30.83%	69.17%	39.16%	60.84%
UPM-KYMMENE CORP	47.60%	52.40%	46.57%	53.43%
METSO OYJ	35.96%	64.04%	27.96%	72.04%
OUTOKUMPU OY	24.40%	75.60%	30.27%	69.73%
RAUTARUUKKI OYJ	35.86%	64.14%	28.29%	71.71%
ELISA CORP	39.30%	60.70%	37.96%	62.04%
SANOMA CORP	40.71%	59.29%	35.29%	64.71%
NOKIAN TYRES OYJ	43.88%	56.12%	47.28%	52.72%
WARTSILA OYJ ABP	33.28%	66.72%	23.86%	76.14%
POHJOLA BANK PLC	31.88%	68.12%	33.77%	66.23%
KEMIRA OY	31.78%	68.22%	33.78%	66.22%
KESKO OYJ	31.99%	68.01%	36.80%	63.20%
HUHTAMAKI OYJ	28.65%	71.35%	30.34%	69.66%
AMER SPORTS CORP	41.92%	58.08%	42.61%	57.39%
KONECRANES PLC	38.64%	61.36%	38.60%	61.40%
FINNAIR OY	25.09%	74.91%	34.44%	65.56%
STOCKMANN AB	24.15%	75.85%	28.31%	71.69%

Significance at the 5% level and R-squared equals to 0.99

Table 5: Trading volume and information share of households (HH) and foreign institutions (FI) for the 21 sample stocks (both buys and sells)

The results in Table 5 show that the investor group which has lower trading volume is the first to reflect new information and dominate price discovery for both buys and sells. For Nokia, households have lower trading volumes than foreign institutions for both buys and sells, but the price discovery process is led by households.

Company	Buys				Sells			
	Information Share		Total Trading Volume		Information Share		Total Trading Volume	
	HH	FI	HH	FI	HH	FI	HH	FI
NOKIA CORP	**50.28%**	49.72%	**5,580,146,967.14**	18,441,514,538.43	**50.89%**	49.11%	**5,580,771,224.44**	18,229,317,254.71
STORA ENSO OYJ	**51.92%**	48.08%	**358,403,916.92**	723,160,882.50	**56.37%**	43.63%	**361,805,073.14**	736,454,564.52
FORTUM OYJ	48.86%	**51.14%**	970,215,690.43	**863,900,845.15**	45.92%	**54.08%**	913,241,740.95	**844,954,053.84**
SAMPO OYJ	37.13%	**62.87%**	420,116,784.30	**372,141,936.47**	35.81%	**64.19%**	**388,108,944.14**	389,800,795.67
TIETO CORP	30.83%	**69.17%**	119,719,983.63	**109,103,498.62**	39.16%	**60.84%**	124,870,512.05	**111,917,926.40**
UPM-KYMMENE CORP	47.60%	**52.40%**	795,622,881.22	**666,752,603.73**	46.57%	**53.43%**	763,476,148.19	**702,008,388.85**
METSO OYJ	35.96%	**64.04%**	718,197,832.27	**419,070,013.16**	27.96%	**72.04%**	667,422,251.73	**392,331,341.12**
OUTOKUMPU OY	24.40%	**75.60%**	347,369,064.84	**234,286,090.27**	30.27%	**69.73%**	338,451,221.97	**206,389,865.75**
RAUTARUUKKI OYJ	35.86%	**64.14%**	551,361,020.41	**218,287,290.57**	28.29%	**71.71%**	549,747,575.73	**218,839,252.25**
ELISA CORP	39.30%	**60.70%**	252,610,025.08	**202,611,546.67**	37.96%	**62.04%**	298,366,234.11	**255,013,421.76**
SANOMA CORP	40.71%	**59.29%**	77,516,727.05	**21,461,841.75**	35.29%	**64.71%**	57,853,362.22	**25,675,215.60**
NOKIAN TYRES OYJ	43.88%	**56.12%**	496,956,452.57	**208,073,688.50**	47.28%	**52.72%**	445,505,193.50	**209,139,067.07**
WARTSILA OYJ ABP	33.28%	**66.72%**	248,115,288.05	**183,906,783.63**	23.86%	**76.14%**	244,922,391.80	**116,324,453.80**
POHJOLA BANK PLC	31.88%	**68.12%**	94,501,840.46	**32,050,572.07**	33.77%	**66.23%**	91,773,938.07	**37,381,684.02**
KEMIRA OY	31.78%	**68.22%**	127,065,378.12	**36,080,144.40**	33.78%	**66.22%**	104,055,895.66	**40,833,895.96**
KESKO OYJ	31.99%	**68.01%**	325,865,156.41	**136,511,950.98**	36.80%	**63.20%**	298,968,043.67	**149,583,568.32**
HUHTAMAKI OYJ	28.65%	**71.35%**	106,980,379.74	**38,113,624.06**	30.34%	**69.66%**	94,456,131.20	**33,481,837.57**
AMER SPORTS CORP	41.92%	**58.08%**	66,070,661.59	**57,598,606.40**	42.61%	**57.39%**	59,401,499.84	**35,925,501.60**
KONECRANES PLC	38.64%	**61.36%**	262,056,636.12	**83,206,347.13**	38.60%	**61.40%**	245,705,998.46	**82,452,556.53**
FINNAIR OY	25.09%	**74.91%**	28,633,761.17	**12,615,643.09**	34.44%	**65.56%**	30,354,529.86	**16,958,782.99**
STOCKMANN AB	24.15%	**75.85%**	37,222,238.47	**7,673,332.47**	28.31%	**71.69%**	34,785,179.25	**8,340,566.32**

Figure 4: Information share versus trading volume for buys for households (HH) and foreign institutions (FI)

Figure 4 shows the trading volume and information share of households and foreign institutions to price discovery of each of the 21 sample stock for buys. HH_IS is the information share of households. FI_IS is the information share of foreign institutions. HH_Trading volume is the trading volume of households for each stock. FI_Trading volume is the trading volume of foreign institutions for each stock. The trading volume is presented as a value-weighted percentage which is the proportion of each investor group's trading volume in relation to the total trading volume for each stock. Clearly, there is an inverse relation between the trading volume and information share, that is, the investor group which has the lower trading volume is the first to reflect new information and dominate price discovery of buys.

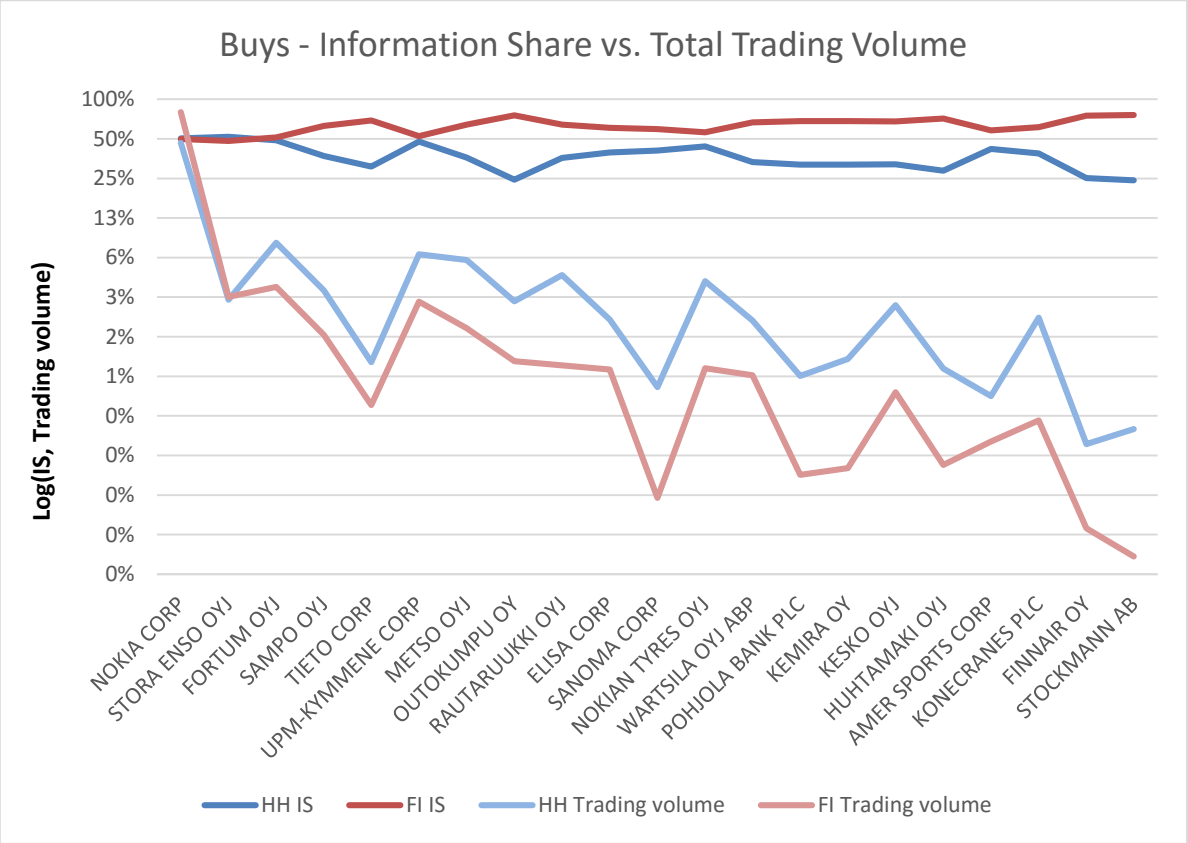

Figure 5: Information share versus trading volume for sells for households (HH) and foreign institutions (FI)

Figure 5 shows the trading volume and information share of households and foreign institutions to price discovery each of the 21 sample stock for sells. HH_IS is the information share of households. FI_IS is the information share of foreign institutions. HH_Trading volume is the trading volume of households for each stock. FI_Trading volume is the trading volume of foreign institutions for each stock. The trading volume is presented as a value-weighted percentage which is the proportion of each investor group's trading volume in relation to the total trading volume for each stock. Clearly, there is an inverse relation between the trading volume and information share, that is, the investor group which has the lower trading volume is the first to reflect new information and dominate price discovery of sells.

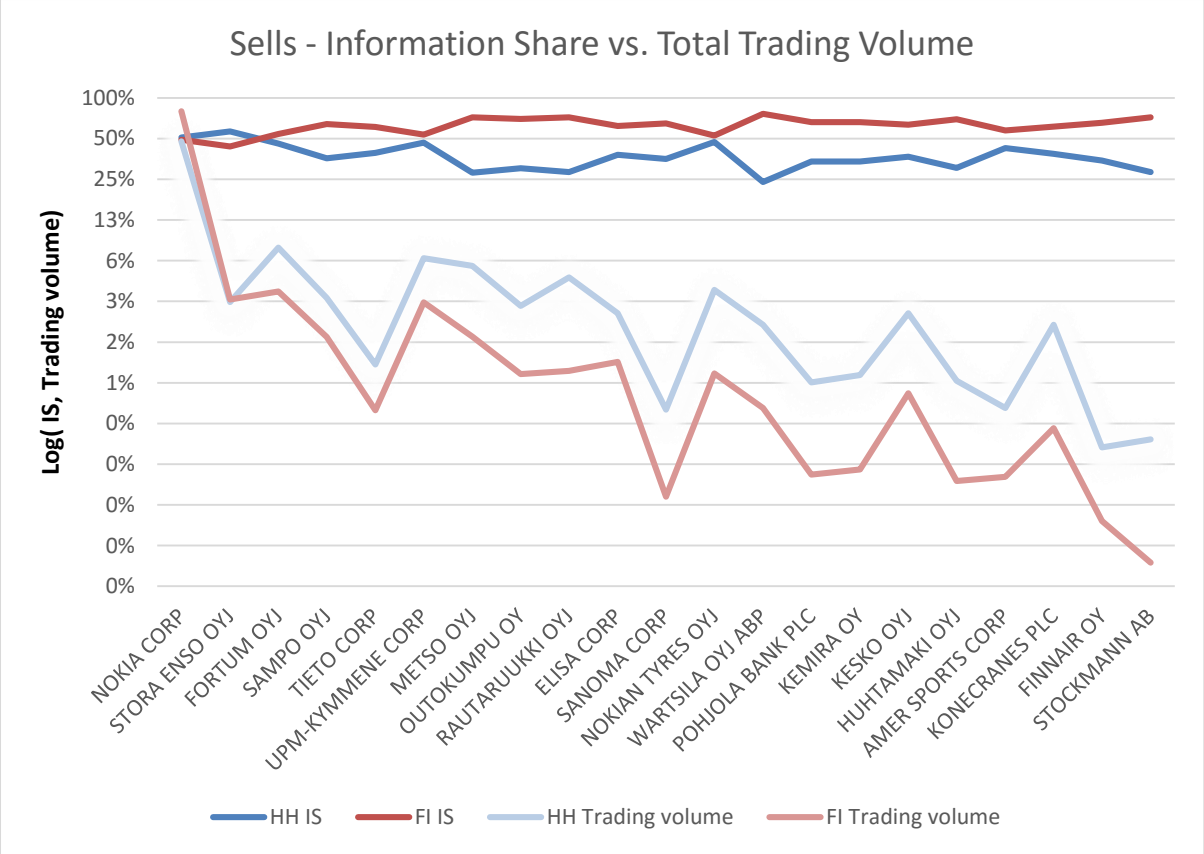

Table 6: Descriptive statistics for regression variables

The sample consists of 147 observations (21 stocks across 7 years). There are two sets of summary statistics, the first one is for foreign institutions and the second one is for households. *IS_Buy* is the information share of foreign institutions (households) for buys, *IS_Sell* is the information share of foreign institutions (households) for sells. *Trading volume_Buy* is the number of shares traded for each stock in their euro amount (trillions) in domestic market of Helsinki for buys. *Trading volume_Sell* is the number of shares traded for each stock in their euro amount (trillions) in domestic market of Helsinki for sells. *Effective Spread_Buy* is the price difference between trade price for buys and mid-point of bid and ask price. *Effective Spread_Sell* is the price difference between trade price for sells and mid-point of bid and ask price. *Crosslisting* is the number of cross-listing exchanges for each stock. *Ln(Size)* is the natural logarithm of each firm's market capitalization. *Analyst_coverage* is the number of analysts following the stock. *Capex* is the size of capital expenditure for each stock and *Leverage* is the leverage ratio for each stock.

Summary Statistics (Foreign Institutions)

	Mean	Standard deviation	Median	25th perc	75th perc
IS_Buy	0.697	0.140	0.736	0.609	0.797
IS_Sell	0.739	0.160	0.772	0.667	0.843
Trading Volume_Buy	1.098	5.402	11.595	0.009	0.328
Trading Volume_Sell	1.088	5.295	0.070	0.009	0.285
Effective Spread_Buy	0.003	0.002	0.002	0.002	0.003
Effective Spread_Sell	0.003	0.002	0.002	0.002	0.003
Cross listing	5.000	3.364	4.000	4.000	5.000
Ln(Size)	21.740	1.466	21.411	20.763	22.451
Analyst Coverage	25.190	14.053	21.000	16.000	29.000
CAPEX	0.078	0.485	0.000	-0.193	0.291
Leverage	0.622	0.361	0.598	0.354	0.839

Summary Statistics (Households)

	Mean	Standard deviation	Median	25th perc	75th perc
IS_Buy	0.303	0.140	0.264	0.203	0.391
IS_Sell	0.261	0.160	0.228	0.157	0.333
Trading Volume_Buy	0.571	1.608	0.173	0.063	0.473
Trading Volume_Sell	0.557	1.557	0.163	0.065	0.498
Effective Spread_Buy	0.003	0.002	0.002	0.002	0.004
Effective Spread_Sell	0.003	0.002	0.002	0.002	0.004
Cross listing	5.000	3.364	4.000	4.000	5.000
Ln(Size)	21.740	1.466	21.411	20.763	22.451
Analyst Coverage	25.190	14.053	21.000	16.000	29.000
CAPEX	0.078	0.485	0.000	-0.193	0.291
Leverage	0.622	0.361	0.598	0.354	0.839

Table 7: Correlation matrix

Table 7 present the correlation matrix of all variables employed in the regression models.

Foreign Institution_Buys

	IS_BUY_FI	Trading Volume	Effective Spread	Cross listing	In(Size)	Analyst Coverage	Leverage	CAPEX
IS_BUY_FI	1.000							
Trading Volume	-0.271	1.000						
Effective Spread	-0.223	-0.169	1.000					
Cross listing	-0.153	0.545	-0.322	1.000				
In(Size)	-0.124	0.551	-0.569	0.716	1.000			
Analyst Coverage	-0.125	0.594	-0.408	0.771	0.810	1.000		
Leverage	0.077	-0.176	0.065	-0.089	-0.157	-0.086	1.000	
CAPEX	-0.046	0.017	-0.013	-0.060	0.015	-0.051	-0.024	1.000

Foreign Institution_Sells

	IS_SELL_FI	Trading Volume	Effective Spread	Cross listing	In(Size)	Analyst Coverage	Leverage	CAPEX
IS_SELL_FI	1.000							
Trading Volume	-0.255	1.000						
Effective Spread	0.089	-0.187	1.000					
Cross listing	-0.308	0.550	-0.342	1.000				
In(Size)	-0.341	0.556	-0.604	0.716	1.000			
Analyst Coverage	-0.305	0.599	-0.446	0.771	0.810	1.000		
Leverage	0.045	-0.179	0.073	-0.089	-0.157	-0.086	1.000	
CAPEX	-0.153	0.018	0.032	-0.060	0.015	-0.051	-0.024	1.000

Table 8: Determinants of informational contribution of foreign institutions to price discovery for buys

Table 8 reports coefficient estimates for the cross-sectional regression model for buys. Heteroscedasticity consistent standard errors are reported under the coefficients in brackets. All control variables are defined in Table 6. *Dummy_PD* is the dummy variables for the information share of foreign institutions: it takes the value of 1 if the price discovery process is dominated by foreign institutions and 0 if the price discovery process is dominated by households. *I_IT, I_Materials, I_Utilities, I_Financials, I_Industrials, I_Telecommunication Service and I_Consumer_Discretionary* are the industry dummies that are defined based on the Global Industry Classification Standard (GICS). Significance at 1%, 5%, and 10% is indicated next to the coefficients by ***, ** and * respectively.

IS_FI_BUY (dependent)	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Intercept	0.778***	0.471***	0.634***	0.660**	0.650**	0.620**	0.256	1.893***	0.421**
	0.026	0.028	0.226	0.269	0.269	0.275	0.370	0.403	0.434
Trading Volume	-6.840***	-3.650**	-3.210**	-3.310**	-3.260**	-3.070*	-2.660	13.600***	14.400***
	2.470	1.540	1.640	1.630	1.630	1.660	1.810	0.843	0.678
Effective Spread	-17.526***	-11.007***	-12.801***	-12.825***	-12.825***	-12.758***	-12.637***	-27.927**	-21.022**
	4.910	2.545	3.641	3.663	3.669	3.682	4.206	11.023	10.449
Cross listing	-0.004	-0.003	-0.001	-0.002	-0.002	-0.002	-0.002	-0.034	-0.041*
	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.024	0.025
Ln(Size)			-0.007	-0.009	-0.008	-0.007	0.014	-0.055***	-0.029
			0.010	0.013	0.013	0.013	0.017	0.016	0.021
Analyst Coverage				0.000	0.000	0.000	-0.001	0.001	0.002
				0.001	0.001	0.001	0.001	0.005	0.005
CAPEX					-0.010	-0.010	-0.020	-0.149***	-0.095**
					0.013	0.013	0.013	0.039	0.047
Leverage						0.016	0.018	-0.056	-0.010
						0.021	0.020	0.040	0.043
Dummy_PD		0.304***	0.300***	0.300***	0.300***	0.300***	0.307***	-1.143***	-1.101*
		0.023	0.022	0.022	0.022	0.022	0.023	0.499	0.585
Trading Volume x Dummy_PD								-18.400***	-19.000***
								1.320	1.260
Effective Spread x Dummy_PD								15.834	10.194
								11.798	11.524
Cross listing x Dummy_PD								0.032	0.038
								0.024	0.025
Ln(Size) x Dummy_PD								0.056***	0.059**
								0.021	0.026
Analyst Coverage x Dummy_PD								-0.001	-0.004
								0.005	0.005
CAPEX x Dummy_PD								0.138	0.071

			0.041	0.049
Leverage x Dummy_PD			0.075	0.029
			0.046	0.050
I_IT		-0.048		-0.080
		0.058		0.062
I_Materials		-0.032		-0.041
		0.045		0.046
I_Utilities		-0.025		-0.059
		0.063		0.066
I_Financials		-0.032		-0.052
		0.051		0.053
I_Industrials		0.024		0.019
		0.049		0.049
I_Telecommunication Service		0.044		0.029
		0.064		0.069
I_Consumer_Discretionary		0.006		-0.002
		0.045		0.046

Table 9: Determinants of informational contribution of foreign institutions to price discovery for sells

Table 9 reports coefficient estimates for the cross-sectional regression model for sells. Heteroscedasticity consistent standard errors are reported under the coefficients in brackets. All control variables are defined in Table 6. *Dummy_PD* is the dummy variables for the information share of foreign institutions: it takes the value of 1 if the price discovery process is dominated by foreign institutions and 0 if the price discovery process is dominated by households. *I_IT, I_Materials, I_Utilities, I_Financials, I_Industrials, I_Telecommunication Service and I_Consumer_Discretionary* are the industry dummies that are defined based on the Global Industry Classification Standard (GICS). Significance at 1%, 5%, and 10% is indicated next to the coefficients by ***, ** and * respectively.

IS_FI_SELL (dependent)	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Intercept	0.806***	0.400***	0.917***	0.870***	0.782***	0.761**	0.220	1.682*	1.523
	0.034	0.051	0.257	0.300	0.293	0.303	0.529	0.955	1.083
Trading Volume	-3.700***	4.730**	6.060***	6.280***	6.620***	6.770***	6.750***	0.468	0.407
	1.400	2.110	1.960	1.910	1.880	1.940	1.970	1.430	1.590
Effective Spread	-1.403	4.261	-2.552	-2.590	-1.511	-1.465	1.420	-37.491**	-34.560
	9.839	5.520	7.085	7.045	6.706	6.600	7.021	18.528	21.585
Cross listing	-0.012***	-0.011***	-0.006	-0.005	-0.006	-0.006	-0.007	0.043**	0.057**
	0.004	0.004	0.004	0.005	0.005	0.005	0.006	0.021	0.025
Ln(Size)			-0.024**	-0.021	-0.017	-0.016	0.006	-0.071*	-0.062
			0.012	0.014	0.014	0.014	0.017	0.040	0.046
Analyst Coverage				-0.001	-0.001	-0.001	-0.001	0.000	-0.002
				0.001	0.001	0.001	0.002	0.003	0.004
CAPEX					-0.057***	-0.057***	-0.067***	-0.057	-0.042
					0.013	0.013	0.014	0.093	0.099
Leverage						0.011	0.021	0.206**	0.229**
						0.023	0.024	0.102	0.114
Dummy_PD		0.409***	0.399***	0.400***	0.403***	0.404***	0.403***	-0.583	-0.910
		0.051	0.050	0.051	0.049	0.049	0.048	1.003	1.117
Trading Volume x Dummy_PD								-4.210	-4.460
								2.680	2.730
Effective Spread x Dummy_PD								40.862**	42.353*
								19.293	22.303
Cross listing x Dummy_PD								-0.049**	0.057**
								0.021	0.025
Ln(Size) x Dummy_PD								0.058	0.075
								0.043	0.048
Analyst Coverage x Dummy_PD								-0.001**	0.001
								0.003	0.004

CAPEX x Dummy_PD			0.004	-0.022
			0.094	0.100
Leverage x Dummy_PD			-0.210**	-0.225*
			0.104	0.116
I_IT		-0.150***		-0.167***
		0.052		0.053
I_Materials		-0.106***		-0.106***
		0.038		0.037
I_Utilities		-0.118*		-0.121**
		0.061		0.058
I_Financials		-0.063		-0.069
		0.044		0.043
I_Industrials		-0.044		-0.061
		0.045		0.044
I_Telecommunication Service		-0.071		-0.072
		0.056		0.056
I_Consumer_Discretionary		-0.079**		-0.071*
		0.039		0.038