"Other People's Money": Mum and Dad Investors vs the Professionals*

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Abstract

We utilize seventeen years of comprehensive daily portfolio and trading data identified at the level of every Mum and Dad investor to analyze the relative trading performance of the population of Finnish households making their own decisions, all domestic financial institutions, and the global population of foreign delegated institutions investing other people's money. We utilize a new methodology we dub the "holding-period-invariant" (HPI) portfolio approach. The conventional calendar-time portfolio approach imposes a heroic assumption that all investors mechanically realize (i.e., trade) their portfolio at specified intervals corresponding to an assumed horizon. By contrast, our methodology is free of such bias and allows for the endogenous nature of investment timing decisions made by numerous informed households. Adopting a random informationless trading benchmark, we find that the households who choose to trade for themselves are economically and statistically superior traders, achieving an impressive internal rate of return of 42.84% p.a., or 0.0288% of traded value, with foreign institutions, is consistent with the predictions of Hayek (1945). Our finding is contrary to some of the existing empirical literature on Mum and Dad investors derived from calendar-time portfolios. We also show that utility maximizing household and domestic institutional trading can be explained by their receipt of a daily private signal of fundamental value derived from the entire past history of informed trades and prices, statistically rejecting the nested noisy partially revealing rational expectations equilibrium hypothesis.

Keywords: Households, Institutional investors, Calendar-time, Horizon-invariant, Trading performance

JEL Classification: G11, G12, G14

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"Other People's Money" 1991. Danny DeVito's character: "I love money. ... There are only three things in this world with ... unconditional acceptance: dogs, doughnuts and money. Only money is better. You know why? Because it don't make you fat and it don't poop all over the living room floor. There's only one thing I like better. Other people's money."

1. INTRODUCTION

With a few exceptions (e.g., Kaniel, Saar, and Titman, (2008), Kaniel, Liu, Saar, and Titman, (2012), and Kelley and Tetlock (2013)), nearly all research contrasting the performance of amateur, or Mum and Dad investors, and professional investors finds that delegated money managers outperform (e.g., Grinblatt and Keloharju (2000) and see Barber and Odean's (2013) excellent survey). By contrast, Hayek (1945) in his classic article highlighted the impossibility of delegating private information by pointing out that every individual possesses unique information that provides him with an advantage, but only if he is left to make his own critical decisions free of agency issues.[5] Thus, following Hayek (1945), one would expect that collectively individuals who possess private information about future stock performance would choose to act on it themselves to maximize utility over their lifetime and not delegate to professional investors (or at least not entirely).

Individuals who determine their own portfolios as principals should thus perform better than do delegated institutional investors investing other people's money over longer-term horizons. In fact, it would be quite surprising if individuals who choose to trade for themselves and thus self-select into what they are relatively good at do not outperform. Institutional investors that relatively outperform within the class of institutional investor will presumably survive even when collectively household clients of such investors lose many billions of dollars when markets turn from bull to bear. Moreover, institutional investors will presumably act as agents of relatively uninformed individuals that are reluctant to trade on

[5] In his classic best-seller, *The Road to Serfdom* (1944), Hayek argued the benefits of economic freedom and markets over central planning, essentially because markets are better aggregators of individual information than are central planners and statisticians.

their own behalf as Brennan and Cao (1996) point out, and for those that have no choice. Thus, one might expect inferior delegated performance in the long-run as most lose other people's money rather than their own. There is no clear market mechanism to penalize delegated money managers when they all make losses due to trend following in a herding equilibrium whereas individuals who lose their own money are naturally weeded out.

In this paper, we find strong empirical support for Hayek's vision when utilizing the collective individual daily trade portfolio of hundreds of thousands households in Finland and the corresponding matched portfolios of all domestic and all foreign institutional investors using a new Holding Period Invariant (HPI) methodology. As an indication that these long-term performance differences are not trivial, we find that domestic households trading directly with foreign institutional investors outperform by EUR 4.92 Billion in just one stock alone (Nokia) over a 17-year period. This represents a remarkable internal rate of return (IRR) of 42.8% pa. for households trading with foreign delegated money managers (i.e., foreign nominees). Had households simply bought over the entire period with realization only at the end, the counterfactual "BuyOnly IRR" would have been exceedingly lower with a loss-making return of -25.15% pa. This indicates the grossly misleading nature of "buy and hold" portfolio analyses that ignore the actual timing of trades.

Similarly, domestic households outperform domestic institutional investors by EUR 354 Million, generating a lower IRR of 13.18% pa., and these same domestic institutional investors outperform foreign nominees by a massive EUR 14.1 Billion over the same period with an even higher IRR of 51.79% pa that exceeds the household performance with the same counterparty.[6] Because trading is a zero sum game, a negative return almost identical in

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[6] The reason that these numbers for Nokia are so large is not just Nokia's huge size but, more importantly, its performance as one of the world's greatest "bubble" stocks, rising in value by over 50 fold during the "hi-tech bubble" period prior to its collapse.

magnitude[7] applies to the counterparties of domestic households and domestic institutional investors such as foreign nominees.

We confirm the statistical significance of these findings at the 0.001 probability level based on 10,000 Monte Carlo simulations utilizing a random trading direction benchmark.[8] The reason that these numbers for Nokia are so large is not just Nokia's huge size but, more importantly, its performance as one of the world's greatest "bubble" stocks, rising in value by around 50-fold during the "hi-tech bubble" period prior to its collapse.[9] Adding another 32 major Finnish stocks raises these magnitudes, but not hugely. Consequently, not only is there clear evidence of the influence of agency issues affecting delegated portfolio managers as households outperform domestic institutions but, additionally, there is also evidence of the better known 'home informational bias'[10] as foreign institutions collectively lose EUR 20,809 Million to domestic institutions and households in just 33 top Finnish stocks over our data period.

Could the trading policy giving rise to sustained long-term trading losses incurred by foreign delegated money managers simply represent rational actions by these agents acting fully in the interests of their principals, namely households? We can only answer this from the perspective of counterparty trading as we cannot rule out the possibility that foreign investors gained diversification benefits that might have outweighed trading losses. The noisy partially revealing rational expectations literature originating with Hellwig (1980), Kim and Verrecchia (1991, a, b), Wang (1993, 1994), Brennan and Cao (1996, 1997), Orosel (1998), Spiegel (1998), and Watanabe (2008) contends that such equilibria can exist even when one

[7] The reason there can be minor differences is because of differential transaction costs.
[8] We thank Michael Brennan for suggesting this test.
[9] Heterogeneous Agent Models (HAM) have had some success explaining the boom-bust cycle. See Hommes (2006) for a survey and Boswijk, Hommes, and Manzan (2007) and Hommes and Daan in 't Veld (2014) for applications to stocks.
[10] See, for example, Coval and Moskowitz (1999), and for an application to real estate, Chinco and Mayer (2014).

counterparty is far more informed than the other. We both test and reject this hypothesis for the various matched counterparties we consider. Each informed party appears to receive a private signal of expected fundamental value that differs significantly from the rational expectations equilibrium in which all past prices are fully discounted. The daily trading pattern of collective buys and sells is not compatible with rational expectations, further supporting our contention that delegated money managers suffer from severe agency problems.

Our main findings are based on new HPI methodology that precisely computes cumulative daily trading profits and losses regardless of the horizon and stock turnover rates of aggregated investor-types on the mutual trade portfolio precisely tying together the two investor-types. By contrast, Barber and Odean (2013) provide a survey of the existing literature based largely on Calendar-Time (C-T) portfolios, or related methods, many of which impose specified investor horizons. They conclude that, "as a group, many individual investors seem to have a desire to trade actively coupled with perverse security selection ability."

Taking first this supposed desire to trade actively, Barber and Odean (2001, Table II) find for their sample of US households, based on a single large discount brokerage firm, that households turn over their portfolios every 1.38 years, on average. While they do not compare the turnover rate of these households with institutional investors, turnover rates are relatively low compared to average US turnover rates and thus compared with US institutional investors. Their US household turnover rate is just slightly lower than for Finnish households that turn over their portfolios every 1.5 years, approximately. Table 2 below summarizes our Finnish dataset, 1995 to 2011, inclusive. It indicates that the average daily trade value of domestic financial institutions is the lowest of our three investor groups at EUR 1.29 million, the households' trade value is 39% higher, and foreign nominees', a remarkable 149 times higher. Thus foreign investors, inclusive of US institutional investors, are far more active than either Finnish households or Finnish domestic institutions, casting doubt on the contention that households are particularly active traders, for this dataset at least.

Doubt is also cast on the second prong of the Barber and Odean (2013) survey findings, namely that households have perverse stock selection ability, as the household trading performance with each class of institutional investor displays far superior stock selection and timing ability, as one would expect given that households self-select into individual portfolio choice and stock trading.

In practice, do private information and agency considerations matter when considering investment performance? Griffin, Harris, Shu, and Topaloglu (2011) conclude that the most “sophisticated market participants”, largely hedge funds, “actively purchased technology stocks during the (high-tech) run-up and quickly reversed course in March 2000, driving the collapse”. These investors presumably suffer from two agency issues is particular: First, they cannot directly access collective private information signals received by the many hundreds of thousands of household accounts in our sample who conduct their own trades and, second, they lost other people’s money, not their own. This is important, as there is natural attrition of households that lose their personal wealth via trading and may learn that they would be better off delegating but loss-making institutional investors may continue trading as long as they relatively outperform other institutional investors. Similarly, DeVault, Sias, and Starks (2014) subject the standard assumption that institutional investors’ represent “smart money” to close scrutiny by showing that to the contrary, institutions, not households, destabilize markets by irrational sentiment-based demand shocks.

Is investment behavior different when individuals trade utilizing their own unique information with their own money at stake? These investors employ no agents and thus, by definition, suffer no agency problems but could, nonetheless, be naïve, unsophisticated noise traders, unprofessional, and ignorant of private information, as their critics allege. This paper sets out to address this agency question by analyzing trades exclusively between agentless household traders and two classes of delegated portfolio managers, one local and the other international. Additionally, trades between domestic and international delegated portfolio managers are investigated with both types subject to similar agency issues.

What distinguishes our approach from earlier contributions is: (i) a dramatically improved methodology for assessing investor strategies, (ii) use of exceeding detailed and extensive data on trader identities and portfolios unavailable to the majority of researchers, and, (iii) the ability to test a mechanism by which informed investors receive a daily signal of the expected fundamental stock value. We conclude that while informed investors do heavily discount stock prices generated by counterparty trend-following behavior, the informational decay rates range from 24 to 41 percent per week. Crucially, these highly economically and statistically discounts fall far short of the 100 percent discount required if the noisy partially revealing rational expectations equilibria were to be capable of explaining investor behavior.

We believe ours is the first to focus deliberately on an 'apples with apples' comparison over relevant time-periods without imposing the straightjacket of mandated investor horizons and implied stock turnover rates that have limited or no applicability to these collective investor-types. This means we overcome the problem that two investor-type groups might have similar portfolio alphas based on factor models assuming a fixed investment horizon but in exceedingly volatile markets may earn entirely different realized trading profits due to one having better private market timing ability and information than the other. Since market timing is endogenous rather than mechanical and exogenous, and is also reliant on both the incentives and information base of the trader, any comparison of agent-type performance requires a performance measure that both recognizes and rewards stock-timing ability.

Moreover, rather than being dependent on some particular, and perhaps unrepresentative 'discount broker', for data provision such that the analysis is potentially partial and one-sided with no knowledge of the precise counterparty, our analysis takes account of every trade in every market in the world in which our sample of stocks is traded, utilizing trader identities for all classes of investor but possess far more detail on both domestic household and institutional investors who are required to conduct all trades through unique individual identifiers even when using multiple brokers. Conventional analysis in most countries including the United States suffers from the problem that clients often have accounts with multiple brokers, making findings problematic. Additionally, our dataset is extensive as it includes every listed stock in Finland. However, in order to find adequate foreign nominee counterparties we restrict our sample to 33 major stocks inclusive of Nokia. For every one of these stock we identify trade counterparties for households matched with foreign nominees, households matched with domestic institutions, and domestic institutions matched with foreign nominees, for every day over an extended and unprecedented seventeen-year window from January 3, 1995 until December 30, 2011.

Our analysis of data from Finland includes time-windows split into four sub-periods: First, January 3, 1995 to December 31, 1996, which is the period analyzed by Grinblatt and Keloharju (2000). Second, is the period, January 1, 1997 to July 3, 2003, which is an extended hi-tech bubble period of a "bull" followed by a "bear" market. The third period, July 4, 2003 to March 6, 2009, is the boom prior to the financial crisis including the subsequent collapse following the demise of Lehman Brothers, and the fourth, March 7, 2009 to December 30, 2011, is the post financial crisis recovery. Finally, we analyze the entire period, 1995 to 2011, inclusive. Thus our period of analysis includes two "bull-bear" sequences plus the lead-up, and the post financial crisis of 2007/2008 environment.

The reason for splitting the sample into several completed “bubble” i.e., cyclical, periods is to make valid comparisons between investor groups. Since foreign nominees are trend followers and households contrarian, foreign nominees will invariably perform better during any given up-swing or down-swing. Valid comparisons require an entire cycle, otherwise short-term trend followers will normally dominate.

2. LITERATURE REVIEW

There has been a long history of findings based on the C-T portfolio approach that purports to show that, in terms of trading ability, households (i.e., individual investors) significantly underperform. The survey by Barber and Odean (2013) provides an excellent summary of this C-T portfolio and related literature. Using the trading records of 10,000 accounts from a discount brokerage house over the seven-year period, 1987-1993, Odean (1999), with imposed horizons of four months, one year, and two years, examines the difference between equally-weighted C-T portfolio buy and sell returns to obtain a raw return difference of -23 basis points per month or 2.76% pa. Their methodology imposes forced uniform holding periods for all investor categories in the sense that positions are assumed to no longer be held after the applied set holding period. Apart from the problems induced by imposing counter-factual realizations, this C-T methodology suffers from an additional problem in that the buy and sell portfolios record the presence of trades but not their magnitude. Thus, a value-weighting approach along the lines of the present contribution possesses advantages over an equal-weighting approach.

Barber and Odean (2000) examine trading from 78,000 accounts for a discount brokerage over the six-year period ending in January 1997. They conclude that household accounts underperform the market, largely due to transaction costs of 4%. Broker fees and spread costs of this magnitude seem high for clients of discount brokers. In common with Odean (1999), they conclude that household investors are overconfident insofar as transaction costs incurred as a result of trading reduce returns below index returns that assume, counterfactually, that they can be matched without portfolio rebalancing. Neither study of discount broker client trades is in a position to know who the counterparties of these household trades are and thus how they relatively performed. Consequently, these studies do not tell us if institutional investor trading performance is any better or worse than this relatively limited household experience that can only be compared with an index that requires some costly trading to replicate.

If there truly is a dichotomy between our findings for Finnish households and that of some US individual clients of a discount broker, it could be due in part to differences in the educational systems. The educational attainments of Finnish students in test scores is the second highest in the OECD whereas the USA is at the OECD mean (OECD, 2010).

Grinblatt and Keloharju (2000) analyze the first two years of detailed Finnish trading data when it became available, namely 1995-1996, to conclude that foreign institutional investors in Finnish stocks outperform what they term "unsophisticated" Finnish households. They only focus on a short six-month horizon to derive their results which unlikely to capture the performance of longer-horizon largely household traders. Their methodology imposes forced holding periods on these two groups ranging from one day to six months. When we repeat their analysis for their two-year period with essentially identical data but without imposing fixed horizons we find, to the contrary, that households outperform their foreign investor counterpart. For the entirety of 1996 Finnish households outperform foreign nominees in trading Nokia with a modest cumulative gain of about Euros 3 Million and a corresponding cumulative loss by foreign investors, such that by the end of Grinblatt and Keloharju's (2000) sample period these gains more than overcome household losses during 1995.

However, their most valuable finding from our perspective is that household trading is what they term “contrarian”, meaning that they buy when prices are falling and sell when prices are rising. In the noisy, partially revealing, rational expectations model of Brennan and Cao (1996) contrarian trading is a natural consequence of informational advantage. We not only confirm this behavior over seventeen years of Finnish data but also show that it can be seen as a consequence of households being in receipt of a daily private signal forecasting the stock’s fundamental value. Households buy if the forecast value exceeds the actual price and sell if it is lower, with the implication that buys follow a price fall and sells a price increase. Thus, it is consistent with an informational advantage such that Finnish households collectively buy when stocks are underpriced and sell when overpriced.

Barber and Odean (2001) do not adopt a C-T approach. Rather, utilizing the same discount brokerage house data as Barber and Odean (2000), they use as their benchmark the household’s own annual buy-and-hold return counterfactual return. Sizeable turnover fees more than absorb any gain from higher-yielding investments. Moreover, lacking institutional data, no comparison is made with any other investor class.

Barber, Lee, Liu, and Odean (2009b) analyze five years of Taiwanese households and foreign investors commencing in 1995 using the C-T methodology and forced acquisition-disposal horizons ranging from one day to six months. Despite the inability of households to exercise timing ability due to the mandated horizons, the authors’ conclude that households suffer material losses. In contrast, Kaniel, Saar, and Titman (2008) conclude that individuals earn relatively high returns over fairly short horizons, consistent with liquidity provision.

Kelley and Tetlock (2013) utilize a large sample of individual trader data for the US to show that individual investors’ order imbalances predict monthly returns without mean reversion and contribute to market efficiency. Kelley and Tetlock (2013) are the first to show that when one examines individual investors as a crowd, it appears that they generate a powerful signal of valuable information that affects the pricing of securities over the relatively short-term.

The noisy, partially revealing, rational expectations equilibrium models of Hellwig (1980) and Wang (1993) provide a platform for examining the effect of asymmetric information on both stock prices and trading behavior. These noisy rational models derive from a theory of equilibrium price formation in which only some traders receive an informed signal and stock prices are not fully revealing. Traders who receive an informed signal will appear to be contrarian, as do the households we investigate, and traders devoid of private information will appear to be positive feedback traders, as are the institutional traders we investigate.

Kim and Verrecchia (1991, a, b), Wang (1993, 1994), Brennan and Cao (1996, 1997), Orosel (1998), Spiegel (1998), and Watanabe (2008) extend the rational expectations approach. Importantly, the model of Brennan and Cao (1996) can account for high volumes of trading as participants with information of differing precision adjust portfolios in response to news, with absolute price changes and trade volume positively associated. Following on from their 1996 model, Brennan and Cao (1997) show that if good (bad) news leads to a price rise (fall), then less informed foreign investors will upwardly (downwardly) revise their expectations by more than better informed domestic investors, leading to prices rising (falling) further and domestic investors selling (buying) more to (from) the foreign investors. Brennan and Cao (1997) argue that there is a dichotomy between foreign and domestic investors with the latter being more informed. We find much stronger evidence for the Brennan and Cao (1996, 1997) hypotheses based on the actual trading profits of all foreign institutional investors and domestic household and institutional traders on a daily basis over a lengthy 17 years – data that was inaccessible to Brennan and Cao (1997).

However, there is an obvious downside to the use of these rational models in our context of trade between households and institutional investors as they cannot explain why relatively uninformed institutional investors lose vast sums of depositor money in the longer term. These losses seem to exceed likely possible benefits earned by institutional investors from risk sharing gains but we cannot rule this possibility out. In recent years the Kyle (1985) model has become popular, perhaps because it assumes an apparently irrational group of "noise traders" that systematically lose money to informed traders, rather than postulating that both counterparties are fully rational.

3. HOLDING-PERIOD-INVARIANT TRADER METHODOLOGY

The C-T approach has been widely applied in research on the performance of private investors (e.g., Odean 1999, Barber and Odean, 2000, 2002; Seasholes and Zhu, 2010; Ivkovic, Sialm, and Weisbenner, 2008; Kumar and Lee, 2006; and Barber, Lee, Liu, and Odean, 2009). Additionally, it has been applied to many other areas of finance including long-run stock performance, insider trading and the relative performance of mutual and hedge funds. The C-T approach applied to groups of traders consists of two steps: In step 1 an aggregate portfolio of buy trades for the group is constructed on (say) a daily basis and then either the return or the excess return is computed over a given horizon such as one month or one year. Similarly, a portfolio of sells by the same group is constructed with the difference in return or excess return between the buy and sell portfolios over the same given horizon being recorded. Trading prowess is greater the more positive is the net difference in return. The method is then reapplied from scratch for the next month or year, depending on the assumed horizon. These aggregate period-by-period portfolio return differences are then regressed on a set of market factors with the intercept interpreted as the performance alpha.

If the comparison is between two agent-types then it would normally be assumed that each has the same exogenously-given investment horizon which is derived from some average turnover rate. An obvious weakness in this by now standard approach is that the holding period is far from constant and will in part reflect the very timing and trading skills that one wishes to model. Holding periods vary, in part because traders are not pre-programmed mechanical robots and better informed investors will display superior timing skills giving rise to endogenous variation in the holding period.

We proceed as follows: Since trading skill is most meaningful in comparison between two agent-types in the same market over identical periods, mark both agents' portfolio value to market on the initial day with sufficient holdings to ensure non-negative holdings in future. Initially include only net buys or sells between the two agent-types since this is the most relevant comparison. Trades made with third-parties without the two agents trading with one another may simply imply some commonality in belief (and trading direction) that is irrelevant to the initial comparison.

Suppose the signed net buys (trades) of agent-type A with type B Trader A that trades stock $i \in (1,...,n)$ of the n stocks that are traded in common on at date t, $j \in (1,...,t)$, are denoted by $x_{i,j}^{A}$, and for type B, $x_{i,j}^{B} = x_{i,j}^{A}$. The type-A agent cumulative net buys in stock units across all stocks in the trade portfolio until the close of business on the previous evening is denoted $X_{i,t-1}^{A} = \sum_{j=1}^{j=t-1} x_{i,j}^{A}$ and constitutes type-A agent's pre-existing trade portfolio. For simplicity, we focus on just the current period's continuously compounded return (i.e., the logarithm of the price relative in stock i over the current period, $p_{i,t}$, as compared to the previous period), as given by $r_{i,t} = Ln\left(\frac{p_{i,t} + D_{i,t}}{p_{i,t-1}}\right)$, where $D_{i,t}$ represents the dividend and the bracketed term is the price relative. Henceforth, prices reflect reinvested dividends. The use of the arithmetic return yields almost identical results. We ignore transaction costs and other frictions for now. The total profit/loss, P_t^A, recorded for agent type-A for all stocks in the agent-type trade portfolio on date *t* is

$$P_t^A = \sum_{i=1}^{n} r_{i,t} p_{i,t-1} X_{i,t-1}^A , \tag{1}$$

so that the entire pre-existing trade portfolio of each agent-type is marked to market according to the closing price at the end of each period (e.g., day). In essence, this new methodology simply takes snapshots of the value of each investor-type's trade portfolio at (say) daily intervals but does not counterfactually assume regular realizations. In the absence of transaction costs the cumulative trade profit/loss of one agent-type, that we dub the holding-period invariant (HPI) amount, is identical to that of the other after taking account of the sign difference:

$$HPF_t^A \equiv CP_t^A = \sum_{i=1}^{n} \sum_{j=2}^{j=t} r_{i,j} p_{i,j-1} X_{i,j-1}^A \equiv -CP_t^B \equiv -HPF_t^B = -\sum_{i=1}^{n} \sum_{j=2}^{j=t} r_{i,j} p_{i,j-1} X_{i,j-1}^B . \tag{2}$$

Accumulating each trader profit account over any interval provides an exact value of the net trading gain to agent-type A and exactly opposite gain/loss for agent-type B. Moreover, the sum of the trading profits over both parties is always zero, as it should be. Unlike the C-T methodology, the profit or loss as measured by HPI captures precisely the timing ability of each party to foresee future price movements without imposing arbitrary assumptions about endogenous trader horizons on either or both groups. In this framework, the profitable agent-type with the greatest foresight is the type that systematically buys (sells) followed by a positive (negative) return and the profits of the two types on their trade portfolios are always the mirror image of each other.

Adding in additional stocks does not change the nature of the argument, with the C-T approach promoting the idea that incorporating multiple stocks in a portfolio increases the robustness of that methodology and therefore also the HPI methodology. While, of course, it is possible to adjust HPI estimates to include only abnormal returns, it is pointless if the aim is to simply compare trading prowess as identical adjustments are made to both the buyer and seller return. Even adjusting for transaction costs is largely unnecessary if both agent-types incur the same costs but the usual presumption is that households incur higher transaction costs per trade than do either domestic or foreign institutional investors. Conventionally, in the second stage of the C-T methodology, the returns computed over a specified horizon are regressed on market risk factors to obtain a risk-adjusted comparison of trading prowess. However, unless there is a benchmark that would need to be in common for both agent-types, it is not clear what purpose risk adjustment serves if the idea is to measure pure trading ability with the presumption that either each agent-type is risk-neutral or that there are negligible risk differences between investor types.

What benchmark should one adopt to assess both the economic and statistical significance of the trading ability of participants? The conventional approach in asset pricing is to introduce a market portfolio benchmark but, as Diacogiannis and Feldman (2013) and the associated literature cited therein point out, portfolios are never mean-variant efficient making inferences difficult if not impossible. Grinblatt and Titman (1993) propose an innovative method that bypasses the need for a conventional market benchmark and hence much of the controversy within the asset pricing literature. They compute the difference between the realized return on a particular portfolio and the expected return they would have achieved had the portfolio manager been uninformed.

We utilize this insight and make it applicable to our problem by carrying out Monte Carlo simulations. For any given sequence of daily trades over any given interval between two types of participants, here collective households and foreign nominee institutional investors, we can only observe one outcome corresponding to the realized wealth gain to one party and corresponding loss to the other on the trade portfolio. While *ex post* it is clear that one investor-type achieved a better outcome then the other, the favorable outcome may simply have been due to chance rather than superior knowledge, information, and trading ability no matter how great the wealth gain to one party at the expense of the other. How can one tell? Using 10,000 trials and the actual trades in every stock traded on every day, we randomize the trade direction of the two participants to compute randomized wealth gains and corresponding losses that simulate informationless trading. By examining the proportion of times one investor category either achieves the same or better outcome purely by chance, we attach statistical probabilities to each actual outcome based on this random benchmark.[11]

According to Seasholes and Zhu (2010), the main benefit of aggregating each the entire trades of each agent-type within the C-T methodology is to take into account the cross-sectional correlation of stock returns that might otherwise bias the statistical significance of agent-type returns if a pooled cross-section time-series regression methodology were to be employed. When net buyer and net seller portfolios based on C-T are formed, and horizons imposed that are inconsistent with the trading data used to construct the buyer and seller portfolios, this introduces measurement errors that may bias findings towards one particular agent-type. Certainly, as a minimum, both sizeable and unnecessary measurement error is introduced. For example, with an imposed one year horizon, the error in measuring cumulative profit and loss for foreign nominee trades with households ranges from plus Euro 2,388 Million to minus Euro 3,045 Million (see Figure 7 below for a graphical representation and also Figure 8). These errors are sizeable. One can far more easily and reliably construct the actual trader profit or loss using the cumulative profit/loss on a mark-to-market HPI

[11] We thank Michael Brennan for suggesting this extension of Grinblatt and Titman's (1993) insight.

method described above without imposing possibly arbitrary and or contradictory holding periods and turnover rates on the aggregate trades of each agent-type.

The standard justification for adopting a specific holding period, whether it be (say) one day, one month, one year, or two years, is that the individual trade data displays some type of average turnover rate. However, these individual trades include trades within each agent-type, as well as between agent types, and at the level of the aggregate type there may be no meaningful turnover rate of fixed duration. For example, over the seventeen year period in Finland between January 1995 and 2011, inclusive, households collectively largely sell the main stock, Nokia, to foreign nominee institutional investors when the stock price is rising and buy when it is falling with these price movements most likely due to the order imbalance of foreign nominee investors. These price movements do not occur based on any mechanical pattern such as a horizon of a month or a year. Moreover, the findings of the current paper suggest that the household pattern of trading is based on fundamental information as to whether the stock is either under- or over-priced and, as such, is endogenous.

To explain in more detail how the C-T approach imposes implicit trade reversal at the specified horizon length, *N*, denote the net buy-sell number of shares bought and sold in stock *i* by the two trader types on date t as $x_{i,t}^{A} \equiv -x_{i,t}^{B}$ for the two trading types. For a horizon of N periods the buy and hold return commencing at period t is denoted by $r_{i,t}^{N} p_{i,t-1}$, where $r_{i,t}^{N} = Ln\left(\frac{p_{i,t} + D_{i,t}}{p_{i,t-N}}\right)$ is the continuously compounded “buy and hold” return over this period. The cumulative buy and hold return over the horizon N commencing at time *t* for agent type-*A* is identical to minus the same return for agent-type B:

$$CR_{t+N}^{A} = \sum_{i=1}^{n} \sum_{j=t}^{j=t+N} x_{i,j}^{A} r_{i,j}^{N} p_{i,j} \equiv -\sum_{i=1}^{n} \sum_{j=t}^{j=t+N} x_{i,j}^{B} r_{i,j}^{N} p_{i,j-1} = -CR_{t+N}^{B} . \quad (3)$$

At time $t+N$, by the implicit assumption underlying the C-T approach, all trades undertaken N periods earlier at time t are reversed (i.e., expunged from the investor's portfolio) at the end of the horizon. Hence:

$$x_{i,t}^{A} \equiv -x_{i,t+N}^{A} \text{ and } -x_{i,t}^{B} \equiv x_{i,t+N}^{B} \;, \tag{4}$$

over the next horizon, and are then reversed again to yield a stable turnover rate with the entire portfolio turning over every N periods. Thus the portfolio performance within any given interval, *N*, depends entirely on trades made during that interval since earlier holdings that the trader-type actually retains have been counterfactually removed.

However, since it is unlikely that agent-type A and agent-type B will have identical turnover rates, or even relatively stable turnover rates at all, and thus the same horizon of N periods, the C-T approach will only give the same profit/loss as the HPI method if equation (4) is precisely satisfied, i.e., the C-T turnover assumption is precisely satisfied. Thus computing the cumulative return over the first buy and hold horizon, as in equation (3), and for each additional horizon, will only give the correct HPI solution in the unlikely event that the horizons of the two agent-types firstly exist, secondly are identical, thirdly, that the horizon assumption made in the calculations is correct. By contrast, the HPI solution provides the exact answer, regardless of the horizon, or even in the absence of any horizon.

In defense of the current method employed to compute profitability for any given horizon, one might argue that in order to carry out statistical tests on the difference in trading abilities it is necessary to compute returns for some interval required for these statistical tests with the best interval being the investment horizon chosen. No. If (say) monthly returns represent the appropriate interval, then simply accumulate the trade portfolio returns over this interval.

4. DATA

4.1 *Source of investor level transactions*

Our data source is the well-established database from Euroclear Finland Ltd (formerly Finnish Central Securities Depository) that includes all transactions in the share depository for all 1.061 million investor accounts (classified into 994,937 households, 722 institutions, 96 foreign investor nominee accounts and 65,010 others) with holdings in 232 unique common stock listed on the Nasdaq OMX Helsinki Exchange, Finland. In this paper, we focus on the three main groups of investors: households, domestic institutional investors, and foreign investor nominee accounts, including all transactions for these accounts in Nokia and in 32 other major Finnish stocks, as of January 1, 1995 carrying the analysis through to December 31, 2011, a period of 17 years.

Table 1 summarizes our basic household data over the 17 years of our study. On average, there are 493,272 household accounts of which only about 42% are active each year with one or more trades. Over the full period of the data, the value of these accounts has approximately doubled, with a commencement value of around EURO 16 Billion. However, at the height of the Nokia bubble period in 1998 the value temporarily rose to a staggering EURO 63 Billion. While the mean household portfolio value is about EURO 60.7 Thousand over the entire period, the median value is far lower at only EURO 4.3 Thousand, showing that the distribution of shareholder wealth is highly skewed. Over the period the mean number of stocks per household account has risen from only 1.9 to 3.4 with the median value remaining at one stock for most of the period, while recently increasing to a modest two stocks per household account. Consequently, with some exceptions pertaining to a small number of wealthy households possessing hundreds of stocks, there is little evidence of any desire by the typical Finnish household investor to diversify and hence they appear willing to bear risk.

Finally, and perhaps surprisingly, female-headed accounts make up a sizeable 34% of the total.

<< Insert Table 1 about here>>

To describe entire cycles of boom and bust, we split up our entire data period into four sub-periods: the Grinblatt and Keloharju (2000) period of analysis consisting of just two years, 01/03/1995 - 12/31/1996; the hi-tech boom and collapse period, 01/01/1997 - 07/03/2003; the pre-GFC boom to post the Lehman Brothers bust, 07/04/2003 - 03/06/2009, the post GFC period, 03/07/2009 - 12/30/2011; and we also analyze the entire 17 year period for which data is available, 03/01/1995 - 30/12/2011[12].

4.2 *Data steps*

From our dataset we compute the daily buys and sells undertaken by every household individually and foreign nominee institutional investors, in every market that conducts trades in Finnish stocks over the seventeen years of our daily data. On eliminating on a daily basis trades between households, between domestic institutions, and between foreign nominees, we are left with the daily net buys and sells of the three groups, (i) households and foreign nominees; (ii) households and domestic institutions, and (iii) domestic institutions and foreign nominees. While many trades between these three groups can be matched at the level of individual trades, this is not possible for all trades. However, since we have the entire population of trades by households, domestic institutions, and foreign nominees' institutional investors, we solve for the unique allocation of trades that equates daily buys and sells between each of the three groups.

The initial holdings of our three groups are inferred from backward induction by the requirement that the holdings of households and domestic mutual funds cannot be negative,

[12] We perform various verifications in Appendix to demonstrate that the raw dataset collected from Euroclear Finland Ltd is robust with respect to our results.

given the daily sequences of matched buys and sells for each participant group and the marking to market of each investor groups entire portfolio on the last day of each event period as well as on the last day of the dataset.

Table 2 summarizes our three samples of HPI portfolio trades, 1995-2011, and the overall traded value of our three investor groups, households, domestic, and foreign institutions.

<< Insert Table 2 about here>>

We pick 33 leading Finnish firms based on two criteria. The first one is the leading firms from the sample of approximately 100 firms that survive and have an average market capitalization larger than 100 million Euro, sorted by average traded value per day during the entire sample period. The other one is the ranked top 50 of the proportion made up of foreign nominees' trade and their value traded from 1995 to 2011. We then combine these two ranking filters with a limit of 33 firms. Our method implies a "look ahead" bias in the choice of the 33 stocks to analyze but counts against our findings in that our stock sample is precisely chosen on the grounds that foreign institutional investors chose to trade these relatively large stocks due to a self-selection process in which this investor class chose these stocks in which they expected to outperform.[13] Details concerning these stocks are presented in Table A.3.

5. RESULTS

We focus on the largest Finnish stock, Nokia, within the group of 33 major Finnish firms and presents trading profits and losses of each agent type and their counterparts in Tables 3(a) to 3(c) for Nokia.

[13] We are grateful to Michael Brennan for alerting us to this potential problem.

<< Insert Table 3 about here >>

Once the net trade flows in Nokia between the various agent-types, household and foreign nominees, households and domestic institutions, and domestic and foreign institutions, have been computed, the HPI methodology set out in equations (1) and (2) above is applied to trades between households and foreign nominees, trades between households and domestic institutional investors, and, finally, between domestic institutional investors and foreign nominees in Tables 3(a) to 3(c), respectively.

These tables, as well as the remaining tables included, present the results when transaction costs are considered but they indicate that differences arising from transactions costs are not great. To account for transaction costs we apply realistic average brokerage costs that representative retail and institutional investors are expected to pay. Since it has been shown in the literature, e.g. Linnainmaa (2010), that household investors are likely to use limit orders that are executed on the initiation of other (institutional) traders we do not impose a bid ask spread transaction cost component on household investor trades. We also do not impose a negative effective spread that would be a result of the above observation since a significant proportion of retail trades would still be executed using marketable limit orders that exhibit positive effective spreads. We also assume that household orders are not affected by market impact as their order size is typically below average trade size. We hence do not adjust for spread and market impact and apply a brokerage fee of 0.5% or 50 basis points for households, which corresponds to what an average online or active phone customer would pay in brokerage fees.

Institutional trades are likely to be impacted both by the bid ask spread, typically the at the minimum tick size EURO 0.01 during most of the trading day, and by market impact. As these metrics are difficult to measure in a reliable way across a large sample of transactions and over a long time-period, and since it might put institutions at an unfair disadvantage vs.

households in our comparison, we also do not adjust the institutional transaction costs for spread or market impact. For institutions, we apply a transaction cost of 0.1% or 10 basis points, which corresponds to what an active large institution would pay in brokerage fees. Some of the literature on transaction costs tends to assume that the difference in transactions costs between households and institutions is even higher than the five-fold we apply. Our argument is that in today's highly liquid automated market, transaction costs are a relatively small factor that is unlikely to explain the results. In unreported work we simulate imposing very high transaction costs on households and extremely low transaction costs on institutions and this does not alter our main findings.

Figures 1 to 4 graph the cumulative daily profit and loss for households and foreign nominees in Nokia over our four periods of analysis, together with the Nokia stock price. Figure 5 shows the daily cumulative net purchases of Nokia by households and foreign nominees over our entire sample period while Figure 6 displays the cumulative profit and loss for households and foreign nominees over the entire period. It can be seen that foreign nominee cumulative daily profit almost perfectly tracks the Nokia stock price over the entire period. This is because foreign nominees almost perfectly follow the trend in the price of Nokia over the entire period, consistent with the noisy rational expectations literature, e.g., Brennan and Cao (1996), in which foreign investors are relatively uninformed.[14]

<< Insert Figures 1 to 6 about here >>

5.1 *Period 1: 2nd January 1995 to 30th December 1996*

Grinblatt and Keloharju (2000) conclude from trading evidence based on an assumed six-month trading horizon over this period in the major industrial stocks that foreign nominee

[14] In personal correspondence, Masahiro Watanabe argues against this interpretation on the grounds that relatively uninformed investors would not trade in the apparently aggressive style used by foreign nominees. However, given that foreign nominees are trading in the world market for Nokia and the Finnish economy is negligible in size relative to the world economy, it is not surprising that foreign nominees dominate the Finnish market for Nokia and appear highly aggressive even though they appear to lack information.

institutional investors "significantly outperform" and households "underperform" such that foreign investors appear "sophisticated" and "smart" (to use their terminology) compared with households. Apart from the assumption of a fixed horizon common to all investors, they construct buy ratios for individual trades inducing a possible cross-sectional bias in their statistical findings. An inspection of cumulative profit and loss in Figure 1 shows that households lost significantly with respect to their trades in Nokia with foreign nominees over the first year, 1995, but more than made up for these losses during 1996 to finish with a EUR 3.24 Million profit gain for households and a corresponding loss for foreign nominees of 3.68, as shown in Table 2(a) above, where P&L is measured net of transaction costs.

5.2 *Period 2: 3rd January 1997 to 3rd July 2003*

Households did not commence significant trading with foreign nominees until halfway through the period in January 2001 when Nokia had almost reached its peak. Households continued to sell for another two years before commencing modest purchases. Over this period, Figure 2 shows they continued to reap large gains at the expense of foreign nominees, ending up with significant accumulated profits of EUR 2,663 Million at the expense of foreign nominees at the end of the hi-tech bubble period on their net trade portfolio, as shown by Table 2(a). Since households gain largely due to superior trade timing ability that is fully reflected in the HPI methodology, the imposition of mechanical investment horizons, as in the C-T methodology, severely adversely affects the measured trading performance of households.

Could the apparent informational advantage of households be due simply to "luck" as a result of portfolio rebalancing as they divested Nokia to gain diversification benefits once Nokia became a world stock?[15] This represents an implausible scenario as individual Finnish

[15] Michael Brennan raised this point in correspondence and proposed the "BuyOnly IRR" tests.

households typically held only one stock for most of our sample period with little indication of seeking diversification benefits. We test the "luck" hypothesis by computing the internal rate of return (IRR) to households by simply buying and never selling until the end. The "BuyOnly IRR" yields a return of minus 25% instead of the plus 43.84% of their actual IRR over the entire period (see below). The failure of this "buy and hold" methodology to approximate the actual IRR is not surprising as such a "BuyOnly IRR" methodology represents an extreme form of the C-T methodology with the household actual sales ignored, other than the notional sales at the end of the period.

5.3 *Period 3: 4th July, 2003, to 6th March, 2009*

In the post hi-tech boom period that was prior to the GFC collapse, households purchased the leading stock, Nokia, from foreign nominees until November of 2004, after which they continued to sell for the next three years until December 2007 when they commenced purchasing again. Their cumulative trades are almost precisely the mirror image of Nokia's price movements over this period while, of course, foreign nominee cumulative trades almost exactly match Nokia price movements in the opposite direction. Thus households buy Nokia when it is a recent loser, i.e. its price is falling and they hold on to their existing inventory, and sell Nokia when it is a recent winner, i.e., when its price is rising. Much of the extensive literature on the "disposition effect" surveyed by Barber and Odean (2013) might infer that household investors in Nokia are subject to this psychological problem when in fact they appear to be successful traders or speculators. Figure 3 shows that households made significant accumulated losses as they heavily sold Nokia until it reached its peak but more than recouped these losses once the full force of the GFC collapse was evident. In fact, Table 2(a) shows that households significantly profited by EUR 580.2 Million net of transaction costs, at the expense of foreign nominees, by the end of the GFC bubble period.

5.4 *Period 4: 09th March, 2009, to 30th December, 2011*

Households continued to purchase from foreign nominees over this entire period while Nokia continued to fall in price. Figure 4 and Table 2(a) shows that, within this data period, this acquisition strategy is yet to pay off with a significant accumulated loss of EUR 613.2 Million but events past the cut-off date suggest that this has nonetheless proved to be a winning strategy.

5.5 *Entire Period 4th January 1995 to 30th December 2011*

Figure 5 shows that, since approximately 2008 when the price of Nokia began to fall, households have been net buyers of Nokia from foreign nominees but over much of the earlier period households have been net sellers, especially when Nokia was rising in price. Nokia, having risen rapidly in value from a little over a EUR to about EUR 63 in April 2000, fell to about EUR 3.5 by the end of 2011. It is especially in this latter period that Figure 6 and Table 2 shows that after transaction costs, households collectively made significant trading gains at the expense of foreign nominees that totaled EUR 4,922.5 Million even after deducting the "loss" of EUR 580 Million made during the last two years of the 17-year period. The net loss to foreign nominees was EUR –4,927.6 Million for institutions with the EUR 5 Million difference due to differential transaction costs. Hence transaction costs, while not a deciding factor, affect the profits of households more than for institutions due to the five times higher costs paid by households.

5.6 *The magnitude of the measurement error induced by Calendar-Time Portfolios*

The C-T portfolio profit and loss for horizons ranging from one month to one year is computed using the buy and hold formula given by equations (3) and (4) above. In Figure 7, the error in measuring cumulative profit and loss for foreign nominee direct trades with households ranges from plus EUR 2,388 Million to minus EUR 3,045 Million. These errors are more severe, the longer is the imposed investor horizon. Figure 8 shows that the C-T approach correctly indicates the direction of the trading profit change only 51% of the time. Such is the magnitude of the errors in variables problem induced by the use of the C-T methodology that trading portfolio alpha regression estimates found after controlling for market risk factors become highly questionable. These regressions are typically carried out in the second stage of C-T applications.

<< Insert Figures 7 and 8 about here >>

5.7 Extension to 33 major Finnish stocks

In Tables 4(a) to 4(c) we extend our findings for Nokia for our three investor groups and four time periods plus the entire sample period to our main sample of 33 major Finnish stocks, inclusive of and excluding Nokia. Our findings are very similar to our earlier results just for Nokia. Households outperform both institutional investor groups and domestic institutions outperform foreign nominees. However, the magnitude of the additional trading profit earned by including an additional 32 major Finnish stocks is not great because these remaining stocks are much smaller than Nokia and were not subject to such extreme valuation fluctuations as was Nokia.

<< Insert Tables 4(a) to 4(c) about here>>

5.8 *Conventional investment performance proxy – Internal rate of return (IRR)*

As a robustness check, we also perform internal rate of return (IRR) calculations without imposing any horizon assumptions other than the start and end dates of the projects to evaluate household, domestic institutional and foreign nominees trading ability. IRR takes an NPV "investment view" of expected financial results. This means, essentially, that the magnitudes and timing of cash flow returns are compared to cash flow costs. IRR analysis begins with a cash flow stream, the series of net cash flow outflow figures required for the investment with a positive realization of the portfolio at the end. We computed the HPI portfolio initial values of each agent-type, as described above, and marked to market on day 0 as its own initial investment outlay. We then take the daily value of stock purchases as additional investment outlay with sales representing a cash benefit over each one-day period from 2nd January 1995 to 31st December 2011. On the final day, the value of the portfolio is marked to market as the cash realization.

Our continuously compounded IRR formula is standard, (e.g., as in SAS's IRR solve routine):

$$\sum_{j=1}^{j=k} NPV_j = \sum\nolimits_{j=1}^{j=k}\left[-IHV_{j,t=0} + \sum\nolimits_{j,t=1}^{j,t=n-1}\left(Daily\ NCF_{j,t}\right)e^{-rt} + FHV_{j,n}e^{-rn}\right] = 0\ , \qquad (5)$$

where NPV is the net present value of the portfolio of the k stocks with $k = 33\, or\, 32$ when there are multiple stocks, $IHV_{j,t=0}$ is the opening initial holding value of the *j*th stock in the portfolio representing the initial investment outlay, t is the designated day commencing at day 0 and finishing at $t = n-1$, $Daily\ NCF_{j,t}$ is the daily *Net Cash Flow* consisting of the EURO value of sells for the *j*th stock in the portfolio when a sell occurs and is negative for purchases representing investment outlays, $FHV_{j,n}$ is the final realized holding value of the *j*th stock in the portfolio on the last day, $day\, t = n$, and e^{-rt} is discount factor with r the continuously compounded daily rate of return that is converted to its annual equivalent based on 250 trading days per year. Solving for the arithmetic return yields similar results.

The "Buy Only" IRR is represented by:

$$\sum_{j=1}^{j=k} NPV_j = \sum\nolimits_{j=1}^{k}\left[-IHV_{j,t=0} - \sum\nolimits_{j,t=1}^{j,t=n-1}\left(Daily\ Purchases_{j,t}\right)e^{-rt} + FHV_{j,n}e^{-rn}\right] = 0\ , \qquad (6)$$

where the only difference is that sales are ignored until the end-date with $Daily\ Purchases_t$ representing the negative cash outlay each day a stock purchase occurs.

Table 5(a) displays the IRR results for Nokia alone over the four periods described above and for the entire seventeen year period. The households HPI investment portfolio yields a unique 42.84% annualized continuous compounded internal rate of return, compared with a – 42.84% internal rate of return made by foreign nominee institutional investors over the entire seventeen years period. The counterfactual household "BuyOnly IRR" is massively lower at -25.15% pa., indicating that it is necessary to include the exact timing of asset sales, as well as purchases, as the regular IRR method does. The BuyOnly IRR is but a crude extension of the conventional "buy and hold" C-T methodology, with our findings indicating that it severely distorts performance measurement. The remaining rows show that there is a huge variation in the IRR over the four shorter periods. For the most recent interval from March 2009 to December 2011 all IRR's are either negative or are not defined due to falling prices.

Table 5(b) extends the IRR analysis to the full sample of a portfolio of the 33 (32) designated stocks, with the entire portfolio treated in the same way as the IRR for a single stock. In the interests of space, only the entire sample period results are shown. The table indicates that the IRR earned by households in trading with foreign nominees in the 33 stocks sampled earned a lower IRR of 19.1% pa., which is about half the magnitude for Nokia alone. The final row in Table 4(a) above shows that this return corresponds to a trading profit rate on trades of 0.0288%. Thus relatively small trading profit rates translate into quite high IRRs, given the magnitude of trading.

<< Insert Tables 5(a) and 5(b) about here >>

6. HOUSEHOLDER INVESTMENT STRATEGY

6.1 *A model of informed trading*

The exceedingly high returns earned by households trading with either domestic or foreign institutional investors over the 17-year period, or for that matter, domestic institutions with foreign, suggests that they trade on the basis of information. In this section we pose the question: does sufficient information exist in the daily price history to explain the collective trading success of both households and domestic institutions in the pairings for which they are successful?[16]

Individual households in their paired relationships with either domestic or foreign institutions and, similarly, individual domestic institutions paired with foreign, receive a private and noisy signal of the stock's fundamental, i.e., 'True', value at time *t*, denoted p_t^T, with this estimate not observable by either the household's counterparties, domestic or foreign, nor the local institution's counterparty, foreign institutions. This household or local institutional advantage could be due to local knowledge possessed by both households and local institutions and the household's particular advantage which is the absence of agency issues and thus better motivation. If this valuation is identical to the current observed stock price, p_t, then the relatively informed party does not trade, $s_t = 0$, as in our framework informational advantage rather than, say, risk sharing, is the major trading motivation. This observed price is set in global markets and is taken as exogenously given by individual Finnish households and domestic institutional traders.[17] Alternatively, if $p_t^T > p_t$ then $s_t > 0$ and a purchase is made with the counterparty making an identical sale. Then again, if $p_t^T < p_t$ a sale is made, $s_t < 0$, with the counterparty making an identical purchase.

[16] We thank Gerald Garvey for suggesting this extension.

[17] Recall that the trade volume of foreign nominees is over one hundred times larger than that of the domestic investor groups.

How does the relatively informed domestic trader receive this noisy signal the expected true price? A highly plausible and, for that matter, simple assumption is that individual informed traders learn iteratively by observing a private signal of the geometric informational decay rate or probability, $0 < \lambda \leq 1$, on the informed trader's current valuation signal, p_{t-1}^{T}, i.e., λp_{t-1}^{T}, while assigning the residual or remaining information, $1-\lambda$, to the current observed price, i.e., $\left(1-\lambda\right) p_t$. We go on to show that given our 17 years of daily matched pairs of trades between the various counterparties and the entire price histories which themselves are public, it is possible for us as econometricians to recover the private signals received by the most informed of each matched trading pair type. It would not have been possible for the biggest counterparty losers, namely foreign delegated money managers, to extract such signal information as the paired daily stock investment sign and magnitude data is not publicly available, even had they the incentive to do so.

To implement this method, suppose the imperfect signal of the 'true' valuation depends on current and past prices according to an intercept term α_0, a multiplicatively constant discount term $1 \leq \alpha > 0$, and decays each period at the constant geometric rate $0 < \lambda \leq 1$, as given by Koyck's (1954) distributed lag signal equation:

$$p_t^T = \alpha_0 + \alpha\left(1-\lambda\right)\left(p_t + \lambda p_{t-1} + \lambda^2 p_{t-2} + \cdots\right) + \tilde{\varepsilon}_t \ , \tag{7}$$

where $\tilde{\varepsilon}_t$ is normally and independently distributed with mean 0 and variance σ_{ε}^2 .

Expressing the lagged value of the same signal by:

$$p_{t-1}^T = \alpha_0 + \alpha\left(1-\lambda\right)\left(p_{t-1} + \lambda p_{t-2} + \lambda^2 p_{t-3} + \cdots\right) + \varepsilon_{t-1}, \tag{8}$$

evaluating $p_t^T - \lambda p_{t-1}^T$, and rearranging, yields the private valuation:

$$p_t^T = (1-\lambda)\alpha_0 + \alpha(1-\lambda)\, p_t + \lambda p_{t-1}^T + \tilde{\varepsilon}_t - \lambda\tilde{\varepsilon}_{t-1}. \tag{9}$$

If the α value is approximately 1 and the intercept α_0 approximately zero, as turns out to be the case, then this Koyck updating expression for the private fundamental value achieves our objective of placing a geometric weight of $(1-\lambda)$ on contemporaneous stock price and λ on the lagged fundamental value.

There are two limiting updating rules. First, if $\lambda \to 0$, the signal moves according to the observed price and the random error term such that the trader gains no informational advantage and cannot be expected to systematically earn trading profits. Second, if $\lambda \to 1$, updating is random with the best estimate of tomorrow's private valuation being today's private valuation, as in an efficient market with rational expectations.

The informed investor takes advantage of his private signal of expected fundamental value, p_t^T, to choose his risky stock investment of s_t at date t to maximize his expected CARA exponential utility function of his wealth:

$$\begin{aligned} s_t &= \arg\max_{s_t} E\left[-\exp\left(-\frac{w_t}{r}\right)\right], \\ &= \arg\max_{s_t}\left[x_{t-1} - s_t p_t + p_t^T\left(y_{t-1}+s_t\right) - \frac{1}{2}\frac{\sigma^2}{r}\left(y_{t-1}+s_t\right)^2\right], \\ &= \frac{r}{\sigma^2}\left(p_t^T - p_t\right) - y_{t-1} \equiv \beta\left(p_t^T - p_t\right) - y_{t-1}, \end{aligned} \tag{10}$$

where *exp* denotes the exponential value, $E[w_t] = x_{t-1} - p_t s_t + p_t^T\left(y_{t-1}+s_t\right)$ is the informed investor's expected wealth, x_{t-1} represents his existing cash reserve, y_{t-1} represents his existing investment in the risky asset, r his risk tolerance, i.e., inverse of his CARA constant absolute risk aversion coefficient, and σ^2 the variance of the normally distributed risky asset return. For convenience, the cash yield has been set to zero. Since our CARA/Normal setup resembles that of Kyle's (1989) linear model, it is not surprising that our derived asset investment demand function with constant slope $\beta > 0$ is also linear.

Lagging the investment function given by equation (10) by one period and solving for the unknown value of the lagged private valuation yields:

$$p_{t-1}^T = \frac{s_{t-1}}{\beta} + p_{t-1} + \frac{y_{t-2}}{\beta}. \tag{11}$$

Substituting equation (11) back into the private signal updating equation (9) yields an expression for the contemporaneous private signal:

$$p_t^T = (1-\lambda)\alpha_0 + \alpha(1-\lambda)\, p_t + \lambda\left(\frac{s_{t-1}}{\beta} + p_{t-1} + \frac{y_{t-2}}{\beta}\right) + \tilde{\varepsilon}_t - \lambda\tilde{\varepsilon}_{t-1}\ . \tag{12}$$

Writing the informed investor's expected profit per share as $\pi_t \equiv p_t^T - p_t$, and solving for the investment demand expressed in terms of observables, yields:

$$s_t \equiv \beta\pi_t = \beta\left\{(1-\lambda)\alpha_0 - \left[1-\alpha(1-\lambda)\right] p_t + \lambda p_{t-1}\right\} + \lambda s_{t-1} - y_{t-1} + \lambda y_{t-2} + \varepsilon_t - \lambda\varepsilon_{t-1}, \tag{13}$$

which is an expression for the optimal trade size and direction for the informed investor as a function of observable values consisting of the contemporaneous and lagged stock prices and the exogenously given trade size and direction in the previous period represented by s_{t-1}.

The magnitude of this informed trade motivated by the private signal is not perfectly observable by other market participants, as in Kyle (1985). Thus the trade magnitude s_t in period t evolves according to the simple equation that depends on the price change in the current period and choice of investment made in the previous period. It represents an estimable regression equation if the magnitudes of these informed trades with counterparties are observable to the econometrician.

Conditional on the previous period's investment choice, this investment regression equation predicts that the informed group will relatively disinvest in the event of a positive return, i.e., $s_t - \lambda s_{t-1} < 0$, if $\left[1-\alpha\left(1-\lambda\right)\right] p_t - \lambda p_{t-1} > 0$, as the estimated respective price coefficients for p_t and p_{t-1}, $\left[1-\alpha\left(1-\lambda\right)\right]$ and λ, are both positive. That is, the informed group must be contrarian, as is also the case with partially revealing rational expectations (e.g., Brennan and Cao (1996)).

Moreover, in the limiting case in which the private valuation p_t^T follows a random walk, the informational decay rate $\lambda = 1$ and the change in the investment outlay is given by:

$$\Delta s_t \equiv s_t - s_{t-1} = -\beta\left(p_t - p_{t-1}\right) \equiv -\beta \Delta p_t, \tag{14}$$

as the only new information and trade motivation is reflected in the price update. Once again, the investment policy is contrarian in nature with negative autocorrelation of the change in investment and the change in prices. More importantly, it is identical to Brennan and Cao's (1996, p.174) partially revealing rational expectations equilibrium. It thus enables us to interpret the coefficient β as the product of the investor's risk tolerance r (inverse CARA coefficient) as investors are assumed to have constant absolute risk aversion (CARA) preferences and, the difference in the value of the private informational signal between in the informed and uninformed participant. Hence, in the limiting case, the interpretation of ours and the Brennan and Cao (1996) model are the same. Since we find evidence that the λ coefficient is significantly less than 1, this nested rational expectations model is empirically rejected by the data.

6.2 *Testing the model of informed trading*

We now turn to the empirical estimation[18] of investment equation (13) using Ordinary Least Squares (OLS), while estimating the Cochrane Orcutt Durbin Watson values to check for autocorrelation. Table 6 column (1) summaries the 4,292 daily household trades in Nokia with foreign institutional investors over the period, January 1995 to December 2011. Of these buys and sells, 47.09 percent are in the opposite direction to the contemporaneous price movement, 15.89 percent are in the same direction and on 37 percent of days there was no trade. Similarly, column (2) summarizes daily household trades in 33 major Finnish stocks including Nokia, with foreign institutional investors and column (3) the same except excluding Nokia. Similarly, columns (4) to (6) summarize household trades with domestic institutional investors. Unsurprisingly, the only informed trading group not to have a majority of contrarian trades when viewed narrowly with a one-day horizon is domestic institutional investors when they trade with foreign nominees.

<< Insert Table 6 about here >>

Table 7(a), displays three sets of regression results and implied parameter values found by estimating equation (13) using the daily household trade volume in Nokia over the period, January 1995 to December, 2011, with foreign nominees as the dependent variable in column (1), households with domestic institutions in column (3), and domestic institutions with foreign nominees in column (5). All parameter values are statistically significant at the 1% level and the Durban Watson values indicate no evidence of serial correlation. In column (1) the implied intercept, α_0, is both small, statistically significant, and positive at 0.0912 and the overall discount parameter, α, is very close to 1 at 0.9950. The daily price decay rate, λ, for households trading with foreign nominees is not only highly statistically significant and high in comparison with its no-information value of 0 at 0.2364 or 23.64 percent per day but also

[18] Note that for convenience we ignore the lagged stock holding terms, y_{t-1} and y_{t-2} that also appear in the investment equation.

low compared with the rational expectations efficient markets hypothesis predicted value of 1, as noted above. The investment sensitivity parameter β, is also highly statistically significant and large in magnitude at 613,804. For the matched trading pairs summarized in columns (3) and (5) the estimated Lambda information decay rate is lower at 7.57 and 16.64 percent respectively, indicating a greater departure from the partially revealing rational expectations equilibrium. Moreover, the explanatory power of these two models is lower.

In all likelihood, these estimation problems stem from the very short daily investment period, giving rise to many non-trading and thus directionless trading days. Columns (2), (4) and (6), present the a weekly rather than daily trading interval, resulting in far better model fits and naturally, a sizably larger estimated values for the information decay rate, Lambda, especially in the column (6) trades between domestic and foreign institutions. The information decay rate on a weekly basis rises to approximately 41 percent and R-Squared is also much higher at 21 percent.

The weekly-horizon regression results for all 33 major Finnish stocks are presented in columns (1), columns (3) and column (5) of Table 7(b) and excluding Nokia, in columns (2), (4) and (6), but the results are not quite as good as for Nokia alone. For example, the estimated Lambda value for domestic institutions trading with foreign nominees is only about half the magnitude of Nokia alone and the explanatory power is far lower. This is probably because we do not see the vastly dominant role of foreign nominees in these smaller stocks together with the same sizeable swings in valuation as with Nokia. In other words, the informational home bias is not as great.

<< Insert Table 7 about here >>

For the parameter values estimated in Table 7 we simulate the projected private signal of expected fundamental value, p_t^T, for each of our trading pairs, households and foreign nominees, households and domestic institutions, and domestic institutions and foreign nominees, in order to compute the percentage differences between the projected 'true' and actual prices. The findings provided in Table 8, column (1) to column (3) show that the projected 'true' price of Nokia is substantially lower than the actual price by about six percent for the trading pair, domestic institutions and foreign nominees and about 4 percent higher for households and foreign nominees. However, columns (4) to columns (9) of Table 8 indicate that the differences are mostly slight for the set of investigated Finnish stocks with the highest discrepancy of about 3 percent for the trading pair, households and domestic institutions.

<< Insert Table 8 about here >>

Based on an efficient markets rational expectations benchmark, the informed trader's decay rate of information in the stock price would be 100 percent, not the estimated 20 to 40 percent per week that we find. Thus the profitable trader groups we analyze act as if they receive a private signal based on extracted information from past stock prices in order to formulate their investment strategy which we demonstrate to be 'contrarian' in nature with the purchase of 'losers' and the sale of 'winners'. This is especially so for households.

7. CONCLUSIONS

In this paper we develop and apply to the entire population of households, domestic institutions, and foreign nominee institutional investors in Nokia and 32 other major Finnish stocks a new methodology we dub the horizon-period-invariant portfolio method. This is in contrast to the conventional C-T portfolio methodology that had its origins in important contributions made by Jaffe (1974) and Mandelker (1974) approximately forty years ago. We also adopt an extensive seventeen-year window of matched daily trades by each investor group based on the daily portfolios of all Finnish investors in Finnish stocks, all households and all domestic institutional investors.

The conventional C-T portfolio approach owes its justification to the presence of cross-sectional dependence in the trades of individual participants and hence the aggregation of individual trades to the level of a single investor-type. However, this method then unnecessarily assumes that all investors mechanically turn over their entire portfolio at a specified interval corresponding to an assumed horizon. We show that this methodology leads to bias and considerable errors and even an inability to correctly indicate the direction of the trading profit change. By contrast, our methodology is free of such error and bias, enabling it to recognize the endogenous nature of investment timing decisions made by the million or so individual households in our dataset.

We find that the direct trade portfolio of households with foreign institutional investors in Nokia results in a gain to households of EUR 4,923 Million over the seventeen years of our dataset. This represents a striking internal rate of continuously compounded return of 42.84 percent pa. If the Calendar-Time "Buy and Hold" equivalent of the IRR, that we dub the "BuyOnly IRR", is used instead the return falls to minus 25% pa., indicating severe methodological error. While domestic institutions lost out to households in direct trading, these institutional investors gained an even larger reward of EUR 14,113 Million, or an IRR of 61 percent pa., in their trades with foreign nominees, 1995-2011.

The trading advantage of households over both domestic and foreign institutional investors is unlikely to be due purely to a locational home advantage as households share their advantage with local institutions. Hence the household trading gain of a fairly modest EUR 354 Million in Nokia at the expense of local institutional investors (IRR 13.18 p.a.) appears dependent on the absence of agency issues with the concomitant better risk-reward incentives possessed by households and ability to better exploit any personal or 'inside' information. The extremely better performance of both households and domestic institutions over foreign institutions with a combined gain of EUR 20,809 Million suggests also a 'home-bias' informational advantage, but little is known about the nature and source of any such advantage.

In order to elucidate these informational and incentive issues we construct a simple Koyck distributed lag model describing the nature of the daily private signal received by the informed group in each trading pair, either households or domestic institutional investors depending on the trading counterparty. This private signal sets the daily and weekly differential between the fundamental value derived from the private signal and the observed price. Assuming that informed investors maximize their expected CARA utility of wealth, we estimate weekly informational decay rates of 28, 24 and 41 percent, respectively, for household trades in Nokia with foreign nominees and domestic institutions, and domestic institutions with foreign nominees. The noisy partially revealing rational expectations model of Brennan and Cao (1996) is nested by our specification. However, our estimated informational decay rates are way lower than the 'rational expectations efficient market' conjecture of 100 percent. Hence we can safely empirically reject the rational expectations model based on our method and data.

Our findings indicate that informed traders who trade on fundamentals, unlike foreign nominees who appear largely to be trend followers, receive a private signal that can be extracted from past informed trades and price movements that inform their current investment decisions. Net purchases occur when the contemporaneous price falls and vice versa, indicating that informed traders are contrarian. While the noisy rational expectations literature helps explain why foreign traders lacking local knowledge, private information, and suffering agency issues appear to be trend followers and relatively informed locals appear to be contrarian, this literature does not explain why institutional investors would rationally choose to trade with far more informed counterparties in the absence of severe agency issues.

As Hayek (1945) pointed out, the only way that individuals possessing valuable private information can effectively exploit such information is for them to act on it themselves. Delegation to others is impossible, putting the agents of relatively less informed households – namely institutional investors – at a disadvantage.

Of utmost significance is the apparent severe effect of moral hazard on institutional performance, particularly foreign institutional investors. Institutional investors lose other peoples' money whereas households lose their own. Consequently, there appears to be evidence of private informational signals motivating households to trade, with households investing and trading on their own behalf based on unique Hayekian information to achieve superior outcomes when prices divert from fundamental values due to institutional price pressure and trend following. Friedman (1953) famously predicted the demise of destabilizing speculative activity due to inevitable losses. However, his prediction failed to account for agency issues endemic with professional money managers and their loss of other people's money.

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Table 1: Household Investor Summary Statistics, 1995-2011, Inclusive

	Number HHs		Total HH Value		Portfolio Value		Stocks	Age	
Year	Active (000's)	Inactive (000's)	Level EUR B	Change %	Mean EUR	Median	Mean No.	Mean Years	Women %
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1995	59.6	300.0	15.53	NA	43,183	5,167	1.9	44.5	42.9
1996	140.1	217.0	14.69	-5.5	41,142	4,928	1.8	49.1	33.2
1997	127.6	232.8	18.56	23.4	51,485	5,348	1.9	48.7	33.4
1998	176.5	193.1	63.14	122.4	170,829	6,916	1.9	47.2	35.9
1999	330.3	36.8	50.09	-23.2	136,470	5,988	2.0	46.8	41.6
2000	323.5	129.0	27.29	-60.7	60,299	4,144	2.2	46.6	36.4
2001	245.3	248.2	24.94	-9.0	50,531	3,440	2.3	48.3	31.4
2002	194.1	286.9	22.09	-12.1	45,934	3,369	2.3	48.0	31.9
2003	158.2	325.7	21.90	-0.9	45,256	3,440	2.3	49.1	32.5
2004	256.0	281.1	22.55	2.9	41,996	3,265	2.4	50.7	34.9
2005	251.4	300.1	24.67	9.0	44,729	3,440	2.5	49.9	33.3
2006	205.5	351.0	27.43	10.6	49,278	3,600	2.7	49.7	31.1
2007	194.4	359.8	28.79	4.8	51,948	3,679	2.6	50.1	31.0
2008	175.4	402.4	26.63	-7.8	46,088	3,707	2.9	49.1	29.6
2009	227.2	376.7	30.12	12.3	49,868	4,166	3.2	50.1	32.2
2010	216.1	407.7	33.39	10.3	53,531	4,514	3.4	48.7	29.3
2011	268.7	387.4	32.05	-4.1	48,843	4,255	3.4	49.1	31.5
Mean	**208.8**	**284.5**	**28.46**		**60,670**	**4,315**	**2.5**	**48.6**	**33.7**

The number of household (HH) accounts holding stocks is split into "Active" in column (1) and "Inactive" in column (2). "Active" means that the household conducted one or more share trades in that year. The total value of all household accounts, active and inactive, at the end of each year is displayed in EURO Billions in the HH Value column (3), with the percentage change shown in column (4). The mean value of each account in EUROs, regardless of its activity status, is displayed in column (5) and the median value in column (6). The mean number of stocks in each account is shown in column (7). While for space reasons, the median number is not shown, it nonetheless remains constant at 1 until 2010 when it increases to 2. The mean age of household investors is shown in column (8) and the percentage of female accounts is shown in column (9).

Table 2: Summary Statistics of daily HPI Portfolio Trades and Trading Value in EURO (Millions) by Households, Foreign Nominees and Domestic Financial Institutions from 1995 to 2011, respectively.

Descriptive Statistics	Household trades with Foreign Nominees		Household trades with Domestic Financial Institutions		Domestic Financial Institutions trades with Foreign Nominees	
	HPI Trades	Household Traded Value (EUR M)	HPI Trades	Domestic Institutions Traded Value (EUR M)	HPI Trades	Foreign Nominees Traded Value (EUR M)
Mean	30,006***	1.7931***	8,833***	1.2933***	42,436***	192.9717***
Median	2,953.7	0.2982	0	0.2024	1,200	17.2548
Maximum	11,948,399	300.4981	2,203,411	337.6233	13,533,875	49,440.74
Standard Deviation	119,434.34	5.4821	37,299.77	4.0729	139,947.41	874.5347
t-value	79.44	103.43	74.88	100.41	95.88	69.77
Number observations	99,979	99,979	99,979	99,979	99,979	99,979

*** represents statistically significant at 0.001 probability level.

Table 3(a): Cumulative P&L after Transaction Costs for Direct Trades between Households and Foreign Nominees in Nokia

Periods	Households Cum. P&L (EUR M)	Foreign Nominees Cum. P&L (EUR M)
03/01/1995 - 27/12/1996	3.24	-3.68
01/01/1997 - 03/07/2003	2,663.38***	-2,664.84***
04/07/2003 - 06/03/2009	580.23*	-581.76*
07/03/2009 - 30/12/2011	-613.20	611.54
03/01/1995 - 30/12/2011	4,922.53*	-4,927.63***

Table 3(b): Cumulative P&L after Transaction Costs for Direct Trades between Households and Domestic financial institutions in Nokia

Periods	Households Cum. P&L (EUR M)	Domestic Institutions Cum. P&L (EUR M)
03/01/1995 - 27/12/1996	-2.33	2.15
01/01/1997 - 03/07/2003	108.30***	-108.63***
04/07/2003 - 06/03/2009	132.99*	-133.33*
07/03/2009 - 30/12/2011	-60.64	60.26
03/01/1995 - 30/12/2011	353.65*	-354.89***

Table 3(c): Cumulative P&L after Transaction Costs for Direct Trades between Domestic financial institutions and Foreign Nominees in Nokia

Periods	Domestic Institutions Cum. P&L (EUR M)	Foreign Nominees Cum. P&L (EUR M)
03/01/1995 - 27/12/1996	-13.90	12.50
01/01/1997 - 03/07/2003	7,275.35***	-7,277.62***
04/07/2003 - 06/03/2009	162.17*	-163.43*
07/03/2009 - 30/12/2011	-123.23	122.37
03/01/1995 - 30/12/2011	14,112.94***	-14,113.91***

The cumulative P&L is at the end of day of each period and the cumulative P&L of each period is independent which means that every starting point of the cumulative P&L is zero. The significance of these cumulative profits and losses is tested by running a Monte Carlo simulation 10,000 times, where the daily direction taken by each of the investor categories in each stock is random. We thus employ an informationless benchmark. The result of this simulation provides the confidence interval we use to test the significance of the reported profits. Transaction cost per trade for households is EUR0.005 and EUR0.001 for foreign nominees, respectively.
*** represents statistically significant at 0.001 probability level.
* represents statistically significant at 0.1 probability level.

Table 4(a): Cumulative P&L after Transaction Costs for Direct Trades between Households and Foreign Nominees in Large Finnish stocks (33 stocks, inclusive of and exclusive of Nokia, respectively)

Periods	Households Cum. P&L inclusive of Nokia (EUR M)	Foreign Nominees Cum. P&L inclusive of Nokia (EUR M)	Households Cum. P&L exclusive of Nokia (EUR M)	Foreign Nominees Cum. P&L exclusive of Nokia (EUR M)
03/01/1995 - 27/12/1996	-5.98	5.38	-9.22	9.06
01/01/1997 - 03/07/2003	2,960.85***	-2,964.29***	297.47***	-299.45***
04/07/2003 - 06/03/2009	664.71	-672.41	84.48	-90.65
07/03/2009 - 30/12/2011	-621.25	615.00	-8.05	3.46
03/01/1995 - 30/12/2011	5,614.61***	-5,632.61***	692.08***	-704.98***
Ratio of HPI trading profits to total trading value from 1995 to 2011	0.0288%	-0.0289%	0.0036%	-0.0036%

Table 4(b): Cumulative P&L after Transaction Costs for Direct Trades between Households and Domestic Financial Institutions in Large Finnish stocks (33 stocks, inclusive of and exclusive of Nokia, respectively)

Periods	Households Cum. P&L inclusive of Nokia (EUR M)	Domestic Institutions Cum. P&L inclusive of Nokia (EUR M)	Households Cum. P&L exclusive of Nokia (EUR M)	Domestic Institutions Cum. P&L exclusive of Nokia (EUR M)
03/01/1995 - 27/12/1996	-5.71	5.46	-3.32	3.32
01/01/1997 - 03/07/2003	218.93***	-219.93***	110.63***	-111.30***
04/07/2003 - 06/03/2009	112.57	-114.64	-20.42	18.69
07/03/2009 - 30/12/2011	-8.61	6.63	-53.36	-53.62
03/01/1995 - 30/12/2011	558.14***	-563.44***	204.49***	-208.55***
Ratio HPI trading profits to total trading value	0.1809%	-0.1826%	0.0663%	-0.0676%

Table 4(c): Cumulative P&L after Transaction Costs for Direct Trades between Domestic Financial Institutions and Foreign Nominees in Large Finnish stocks (33 stocks, inclusive of and exclusive of Nokia, respectively)

Periods	Domestic Institutions Cum. P&L inclusive of Nokia (EUR M)	Foreign Nominees Cum. P&L inclusive of Nokia (EUR M)	Domestic Institutions Cum. P&L exclusive of Nokia (EUR M)	Foreign Nominees Cum. P&L exclusive of Nokia (EUR M)
03/01/1995 - 27/12/1996	-37.66	35.54	-23.75	23.04
01/01/1997 - 03/07/2003	7,444.04***	-7,451.68***	168.69***	-174.06***
04/07/2003 - 06/03/2009	656.99	-667.01	494.82	-503.58
07/03/2009 - 30/12/2011	-168.53	162.85	-45.31	40.48
03/01/1995 - 30/12/2011	15,194.10***	-15,202.58***	1,082.12***	-1,088.68***
Ratio of HPI trading profits to total trading value from 1995 to 2011	0.0782%	-0.0783%	0.0056%	-0.0056%

The cumulative P&L is at the end of day of each period and the cumulative P&L of each period is independent which means that every starting point of the cumulative P&L is zero. The significance of these cumulative profits and losses is tested by running a Monte Carlo simulation 10,000 times, where the daily direction taken by each of the investor categories in each stock is random. We thus employ an informationless benchmark. The result of this simulation provides the confidence interval we use to test the significance of the reported profits. Transaction cost per trade for households is EUR0.005 and EUR0.001 for foreign nominees, respectively. Total trading value is computed as the sum of daily total trading value in two groups from 1995 to 2011.
*** represents statistically significant at 0.001 probability level.

Table 5(a): Summary of Continuously Compounded Internal Rate of Return (IRR) and BuysOnly IRR for Various Periods using daily HPI Trading for Nokia for Trades within the Three Groups

	Households with Foreign Nominees	Households with Domestic Financial Institutions	Domestic Financial Institutions with Foreign
Period: 03/01/1995-27/12/1996			
IRR	34.49%	1.34%	28.16%
BuyOnlyIRR	35.38%	30.79%	27.72%
Period: 01/01/1997-03/07/2003			
IRR	77.57%	55.18%	79.29%
BuyOnlyIRR	-6.12%	-6.03%	-3.17%
Period: 04/07/2003-06/03/2009			
IRR	2.41%	7.37%	1.98%
BuyOnlyIRR	-33.50%	-32.30%	-44.05%
Period: 07/03/2009-30/12/2011			
IRR	NA	NA	-38.09%
BuyOnlyIRR	-50.15%	-52.80%	-45.72%
Entire Period: 03/01/1995-30/12/2011			
IRR	42.84%	13.18%	51.79%
BuyOnlyIRR	-25.15%	-20.42%	-18.19%

The term 'NA' indicates that SAS function cannot provide a valid root due to the nature of the different values of cash flows and the IRR is annualized based on 250 trading days per year. BuyOnlyIRR indicates that sell trades are ignored until the portfolio is realized on the last day.

Table 5(b): Summary of Continuously Compounded Internal Rate of Return (IRR) of daily HPI Trading for 33 stocks (inclusive of Nokia) and 32 stocks (exclusive of Nokia) for Trades within the Three Groups from 1995 to 2011, respectively.

	Households with Foreign Nominees		Households with Domestic Financial Institutions		Domestic Financial Institutions with Foreign Nominees	
	Inclusive of Nokia	Exclusive of Nokia	Inclusive of Nokia	Exclusive of Nokia	Inclusive of Nokia	Exclusive of Nokia
Number of Stocks	33	32	33	32	33	32
IRR	19.10%	6.87%	7.63%	7.15%	27.40%	6.94%
Buys Only IRR	-4.04%	0.56%	-2.97%	0.58%	-1.93%	0.18%

IRR presents the continuously compounded internal rate of return for 33 (32) stocks with each group treated as a single investor in the entire portfolio of stocks each day. BuyOnlyIRR is computed using the same single investor methodology as for the conventional IRR except that sell trades are ignored until the portfolio is realized on the last day.

Table 6: HPI Daily Trading Strategy Summary in each Trading Group, respectively, January 1995-December 2011

Trading Strategy	Trading Action	Household with Foreign Nominees			Household with Domestic Institutions			Domestic Institutions with Foreign Nominees		
		Nokia	33 stocks inclusive of Nokia	32 stocks exclusive of Nokia	Nokia	33 stocks inclusive of Nokia	32 stocks exclusive of Nokia	Nokia	33 stocks inclusive of Nokia	32 stocks exclusive of Nokia
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		% (out of 4,292)	% (out of 99,947)	% (out of 95,656)	% (out of 4,292)	% (out of 99,947)	% (out of 95,656)	% (out of 4,292)	% (out of 99,947)	% (out of 95,656)
Contrarian Strategy	Purchase following a negative return	26.61%	19.97%	19.67%	13.14%	11.42%	11.34%	10.14%	14.42%	14.07%
	Selling following a positive return	20.48%	18.80%	18.73%	13.58%	10.70%	10.57%	13.23%	13.74%	13.58%
	Sum	47.09%	38.77%	38.41%	26.72%	22.11%	21.91%	23.37%	28.16%	27.65%
Positive Feedback Strategy	Purchase following a positive return	7.06%	10.05%	10.18%	5.59%	6.17%	6.20%	22.13%	11.36%	11.42%
	Selling following a negative return	8.83%	10.28%	10.34%	5.99%	6.25%	6.26%	17.26%	10.90%	10.79%
	Sum	15.89%	20.33%	20.52%	11.58%	12.42%	12.46%	39.40%	22.26%	22.21%
Hold position - No action	**Sum**	37.02%	40.90%	41.07%	61.70%	65.47%	65.63%	37.23%	49.58%	50.14%

This table summarizes the daily Household trading strategy with Domestic Financial Institutions, daily Households trading strategy with Domestic Financial Institutions, and daily Domestic Financial Institutions with Foreign Nominees from 1995 to 2011, in Nokia, with 33 stocks and 32 stocks, respectively. Trading actions are shown relative to the number of stock-days in the sample.

Table 7(a): Model Explaining the Daily and Weekly Household Nokia Stock Purchases by Households from Foreign Nominees, Households from Domestic Institutional Investors, and Domestic Institutional from Foreign Investors, respectively, January 1995-December, 2011.

Variable: Stock Purchases - Nokia only

	Households with Foreign Nominees		Households with Domestic Institutions		Domestic Institutions with Foreign Nominees	
	Daily	Weekly	Daily	Weekly	Daily	Weekly
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	42,728***	187,913***	2,365	9,123	-194	-17,366
(*t*-value)	(4.18)	(2.95)	(0.76)	(0.55)	(0.02)	(0.27)
Closing price (p_t)	-147,396***	-247,783***	-20,364***	-32,097***	-66,365***	-116,655***
(*t*-value)	(16.51)	(9.11)	(7.47)	(4.47)	(6.76)	(4.25)
(*DW*)	(2.0602)	(2.1227)	(2.0168)	(2.0904)	(2.0656)	(2.0972)
Lag closing price(p_{t-1})	145,042***	237,657***	20,250***	31,707***	63,231***	106,867***
(*t*-value)	(14.04)	(8.74)	(7.43)	(4.42)	(6.44)	(3.9)
(*DW*)	(1.8454)	(1.6782)	(1.8601)	(1.6885)	(1.6821)	(1.8487)
Lag net household purchase (s_{t-1})	0.2364***	0.2842***	0.0757***	0.2444***	0.1664***	0.4063***
(*t*-value)	(16.25)	(9.18)	(5.00)	(7.58)	(11.1)	(13.43)
(*DW*)	(1.8473)	(1.786)	(1.8649)	(1.9663)	(1.7885)	(1.8925)
Number observations	4,292	885	4,292	885	4,292	885
R Square	0.1203	0.1749	0.0187	0.0829	0.0461	0.2057
Implied values						
Lambda (λ) measure of market efficiency	0.2364	0.2842	0.0757	0.2444	0.1664	0.4063
Intercept (α_0)	0.0912	0.3139	0.0000	0.0000	0.0000	0.0000
Alpha coefficient (α)	0.9950	0.9831	0.9995	0.9960	0.9901	0.9373
Beta investment sensitivity (β)	613,804	836,232	267,503	129,734	379,994	263,025

The absolute *t*-values and Durban Watson values are shown in brackets. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 7(b) Model Explaining the Weekly Household 33 and 32 Stock (Excluding Nokia) Purchases from Foreign Investors and Domestic Financial Institutional investors, Domestic Financial Institutional Nokia Stock Purchases from Foreign Investors, respectively, January 1995-December, 2011.

Variable: Stock Purchases

	Households with Foreign Nominees		Households with Domestic Institutions		Domestic Institutions with Foreign Nominees	
	33 stocks	32 stocks	33 stocks	32 stocks	33 stocks	32 stocks
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	46,558***	42,083***	7,719***	7,715***	30,987***	32,299***
(*t*-value)	(4.01)	(3.79)	(3.4)	(3.34)	(3.41)	(3.39)
Closing price (p_t)	-108,198***	-103,696***	-19,254***	-18,980***	-49,275***	-47,097***
(*t*-value)	(5.64)	(5.96)	(4.08)	(4.02)	(6.04)	(5.73)
Lag closing price (p_{t-1})	103,677***	99,352***	18,303***	18,303***	44,904***	42,912***
(*t*-value)	(9.89)	(6.02)	(4.22)	(4.22)	(5.74)	(5.44)
Lag net household purchase (s_{t-1})	0.2791***	0.2789***	0.1898***	0.1886***	0.2014***	0.195***
(*t*-value)	(5.68)	(9.56)	(14.04)	(13.93)	(9.18)	(9.02)
Number observations	20,799	19,915	20,799	19,915	20,799	19,915
Average R Square	0.2036	0.2045	0.0959	0.0962	0.0741	0.0574

Implied values						
Lambda (λ) Market Efficiency	0.2791	0.2789	0.1898	0.1886	0.2014	0.1950
Intercept (α_0)	0.1739	0.1638	0.0988	0.0980	0.1740	0.1823
Alpha coefficient (α)	0.9831	0.9831	0.9878	0.9914	0.9755	0.9764
Beta investment sensitivity (β)	371,469	356,227	96,433	97,046	222,959	220,063

This table presents results from weekly regressions on 33 (32) stocks inclusive (exclusive) of Nokia. Standard errors employ the Newey-West (1987) correction for autocorrelation in the time series of the averaged regression coefficients. Average coefficients and Newey-West (1987) standard errors with lags equal to 4, i.e., approximate one month horizon are presented. The absolute *t*-values are shown in brackets.

*** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

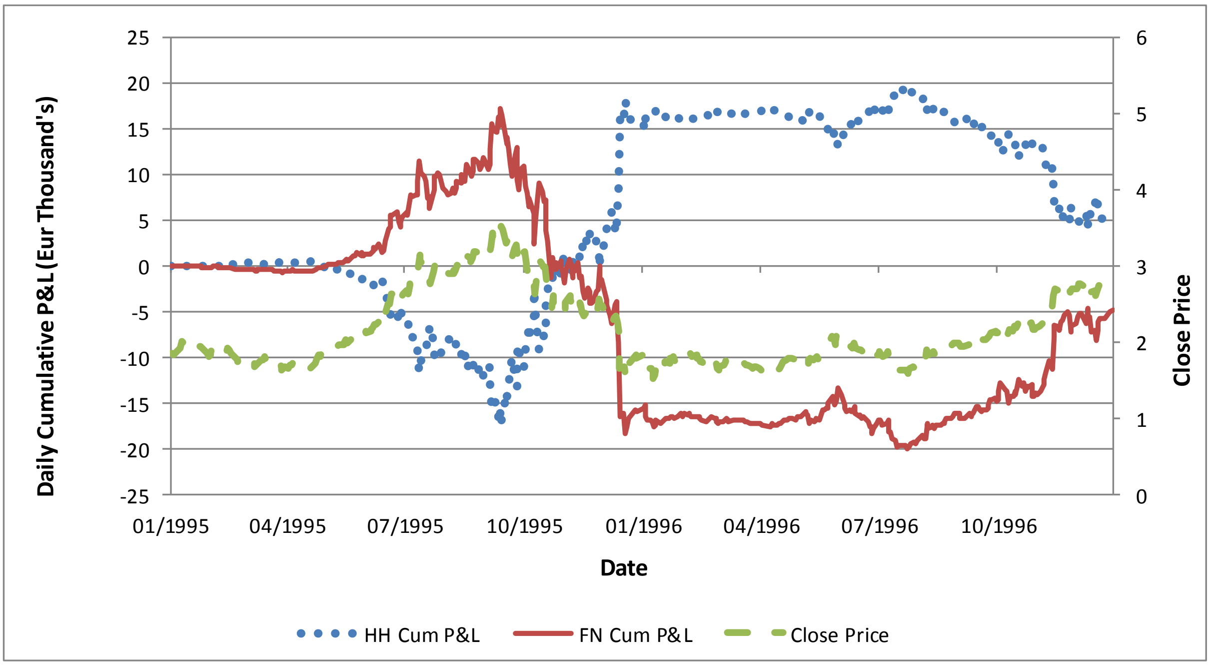
Table 8: Summary of Trading Model Simulation Utilizing the Percentage of the Difference between Weekly Informed Investor Expected Fundamental Value and Actual Price deflated by Actual Price for Nokia, All 33 stocks and 32 stocks, respectively.

Descriptive Statistics - Weekly

	Nokia			33 stocks			32 stocks		
	Household with Foreign Nominees	Household with Domestic Institutions	Domestic Institutions with Foreign Nominees	Household with Foreign Nominees	Household with Domestic Institutions	Domestic Institutions with Foreign Nominees	Household with Foreign Nominees	Household with Domestic Institutions	Domestic Institutions with Foreign Nominees
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Mean	4.38%	-0.39%	-6.26%	-0.45%	3.12%	0.32%	-0.66%	3.20%	0.68%
Standard Error	0.22%	0.06%	0.10%	0.07%	0.19%	0.04%	0.07%	0.19%	0.04%
Median	2.26%	-0.48%	-6.43%	0.78%	0.35%	0.03%	0.74%	0.34%	0.11%
Standard Deviation	6.57%	1.84%	3.08%	9.87%	29.20%	5.49%	9.95%	29.74%	5.28%
Skewness	1.684	-1.965	-1.580	-3.102	15.198	5.761	-3.161	14.920	6.830
Confidence Level (95.0%)	0.00433	0.00121	0.00203	0.00134	0.00367	0.00075	0.00138	0.00381	0.00073

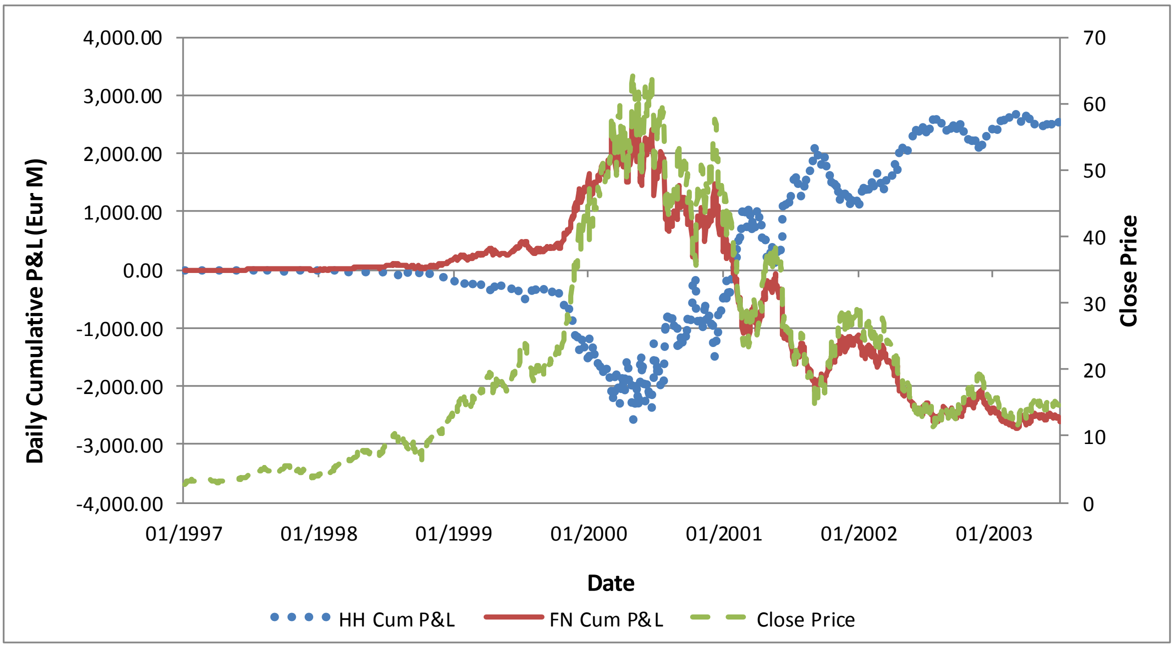
Period 1: January 3, 1995 to December 30, 1996 – Grinblatt and Keloharju (2000) Evaluation Period

Figure 1: Cumulative daily Profit and Loss for Household and Foreign Nominees on Nokia and Nokia's Closing Price



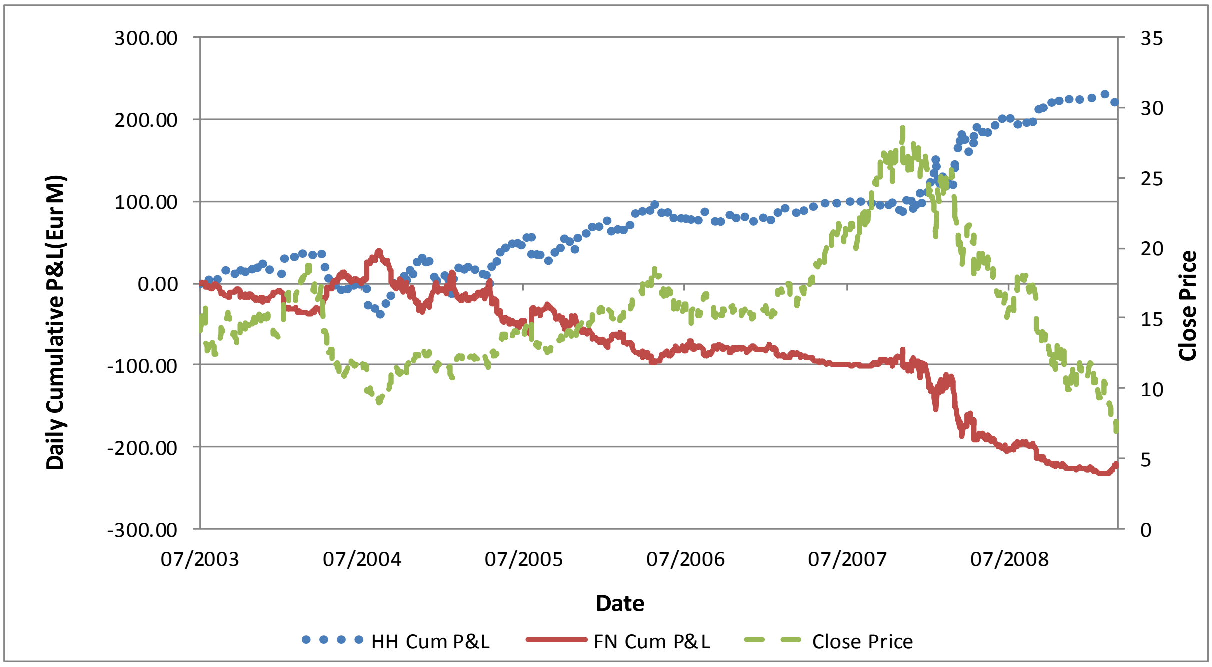
Period 2: January 3, 1997 to July 3, 2003 – the Hi-Tech Bubble Period

Figure 2: Cumulative daily Profit and Loss for Household and Foreign Nominees on Nokia and Nokia's Closing Price



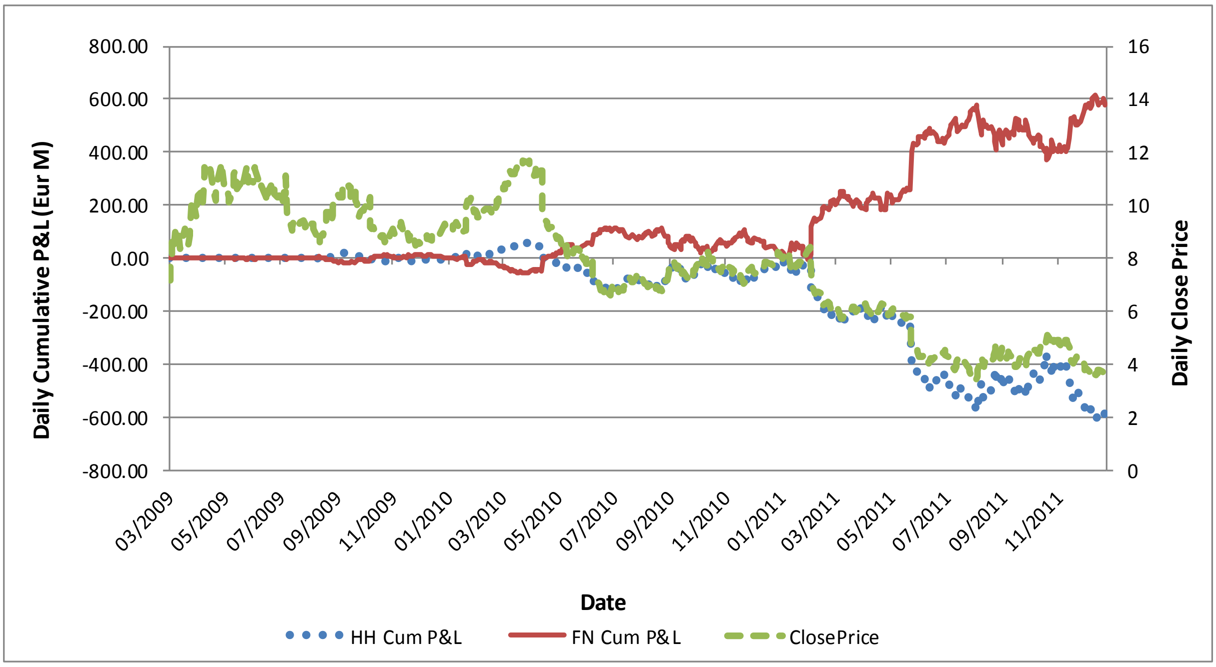
Period 3: July 4, 2003, to March 6, 2009

Figure 3: Cumulative daily Profit and Loss for Household and Foreign Nominees on Nokia and Nokia's Closing Price



Period 4: March 9, 2009, to December 30, 2011

Figure 4: Cumulative daily Profit and Loss for Household and Foreign Nominees on Nokia and Nokia's Closing Price



Period 5: January 3, 1995 to December 30, 2011 – Entire Period

Figure 5: Daily cumulative net purchases for Households and Foreign Nominees

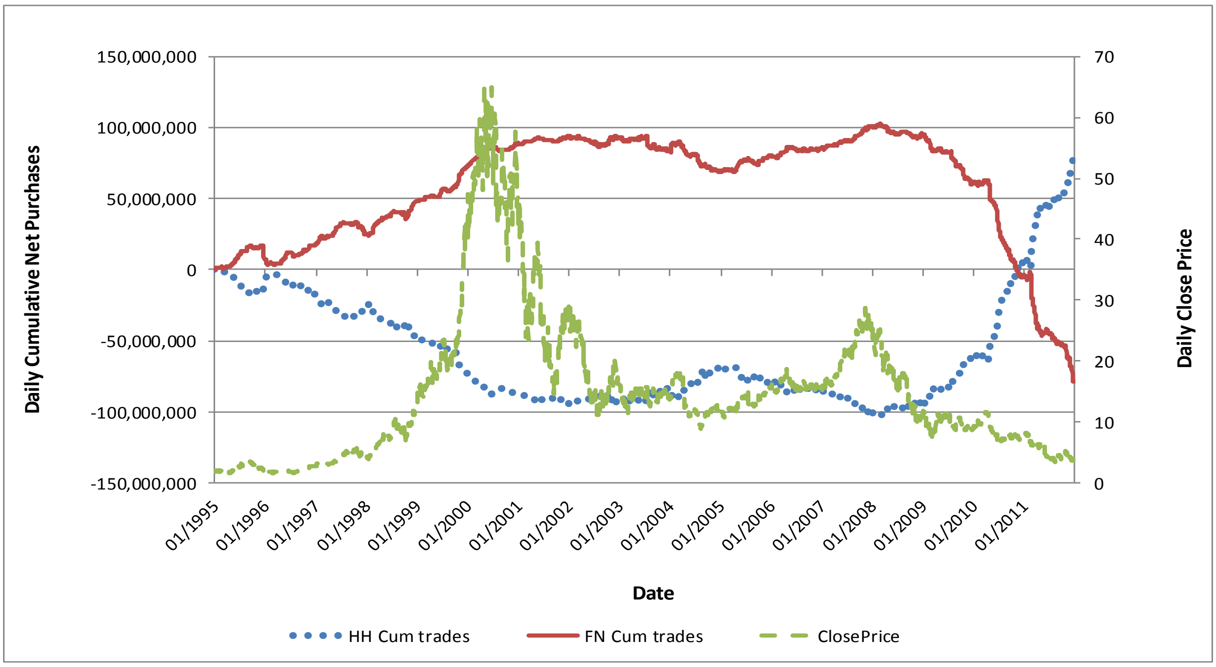
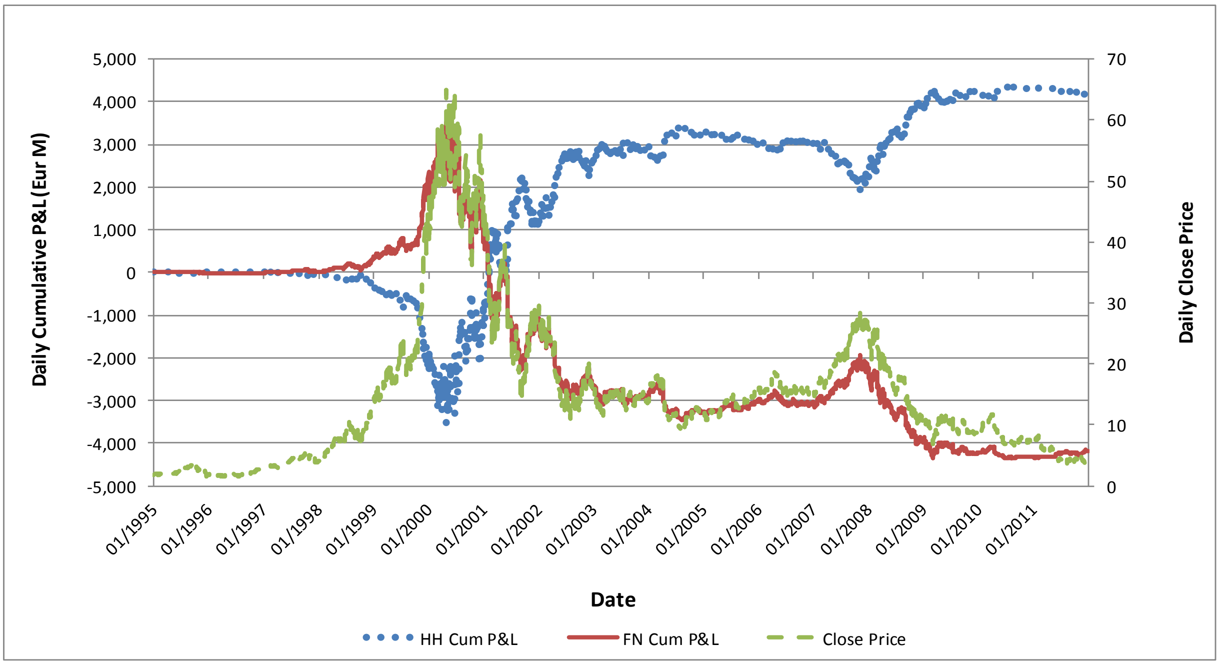


Figure 6: Cumulative daily Profit and Loss for Household and Foreign Nominees on Nokia and Nokia's Closing Price



Errors introduced by the use of the Calendar Time (C-T) Methodology

Figure 7: The Daily Difference in Cumulative Profit and Loss for the direct trades between Households and Foreign Nominees, as measured by Horizon Free method and Calendar-Time (C-T) method for horizons of 1 month, 6 months, and 12 months, 1995-2011

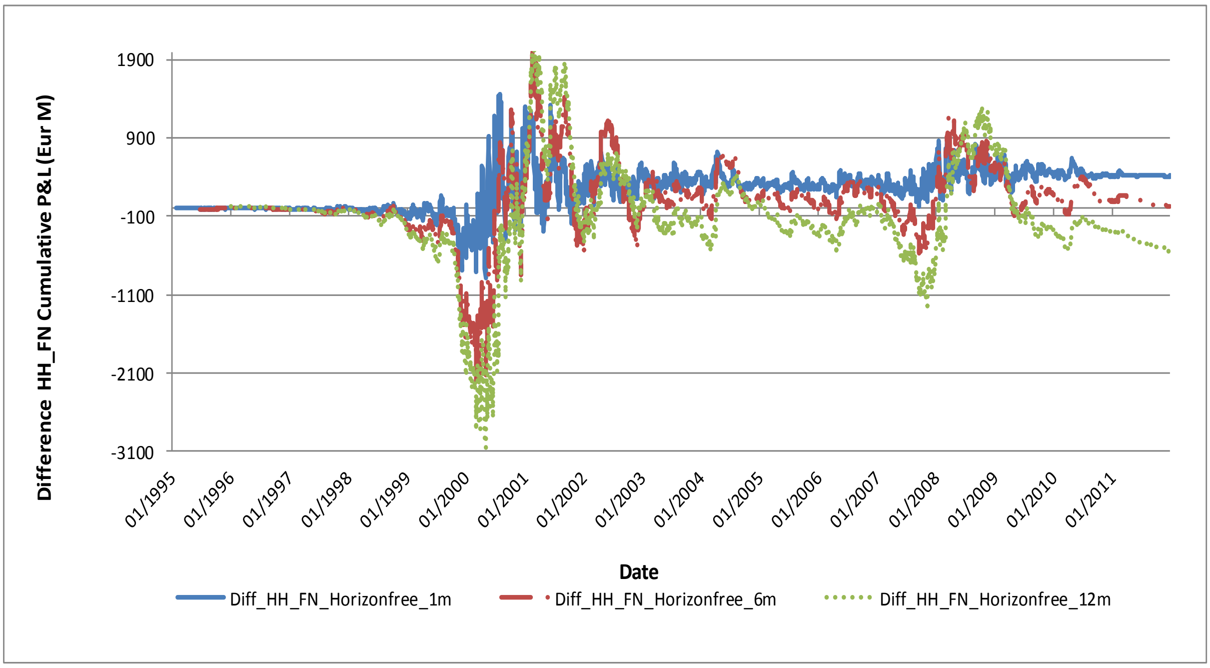
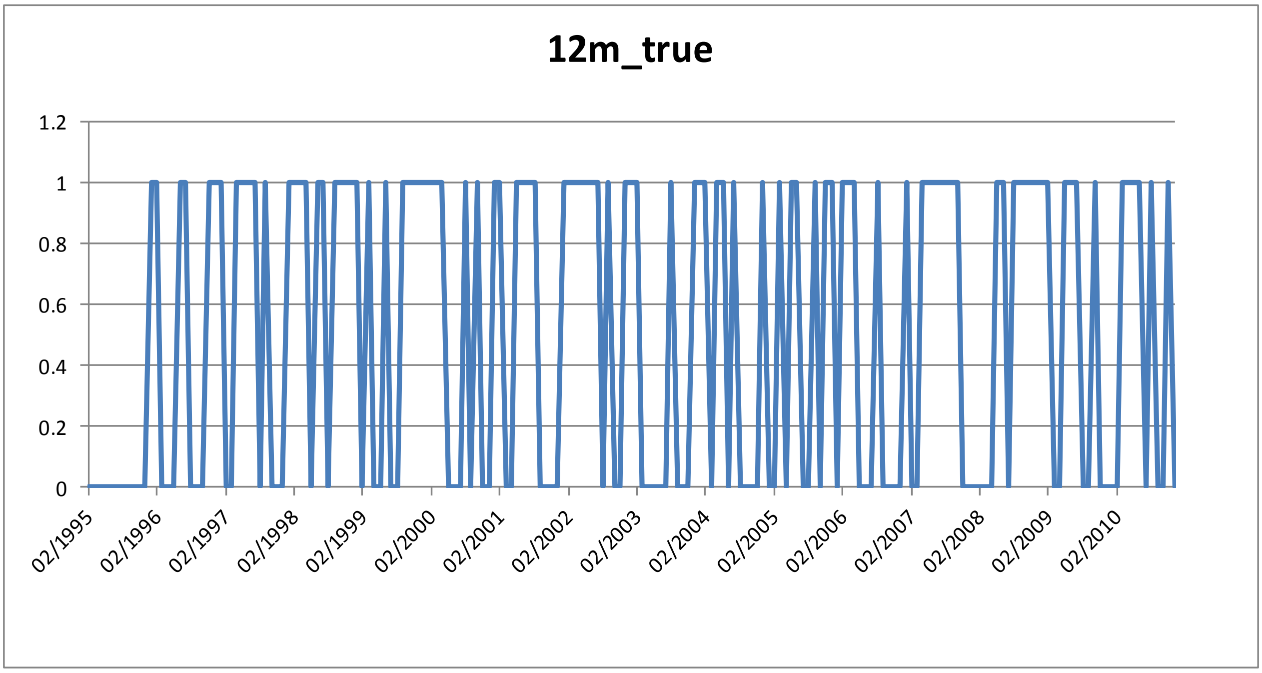


Figure 8: The numbers of times that the one-year Calendar-Time (C-T) portfolio provides a correct direction for actual Profit and Loss changes, 1995-2011 (100 out of 196 direction changes, or 51%)

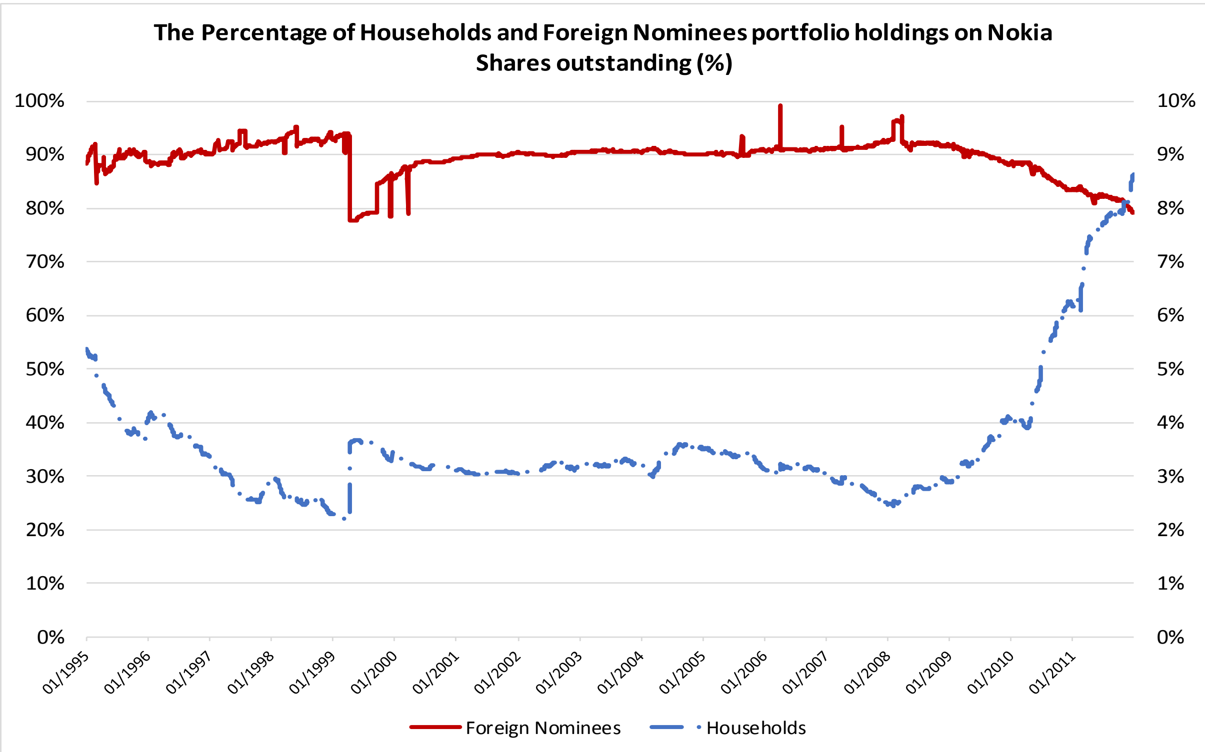


APPENDIX A.1 ADDITIONAL ROBUSTNESS ANALYSIS

A.1.1. Portfolio holdings vs. Shares outstanding

Could our finding that, in the long-term households outperform foreign delegated money managers, be due to errors in the data? One necessary consistency check is to ensure that neither households or foreign nominees hold negative balances. Since short-selling requires borrowed script and is inherently expensive it would be surprising if any one investor class had negative holdings. We undertake a comparison between daily shares outstanding computed from Compustat Global and portfolio holdings in each agent-class, respectively. An inspection of the comparison in Figure A.1.1 shows that the sum of each class of portfolio holdings relative to shares outstanding is less than 100 percent throughout the entire period.

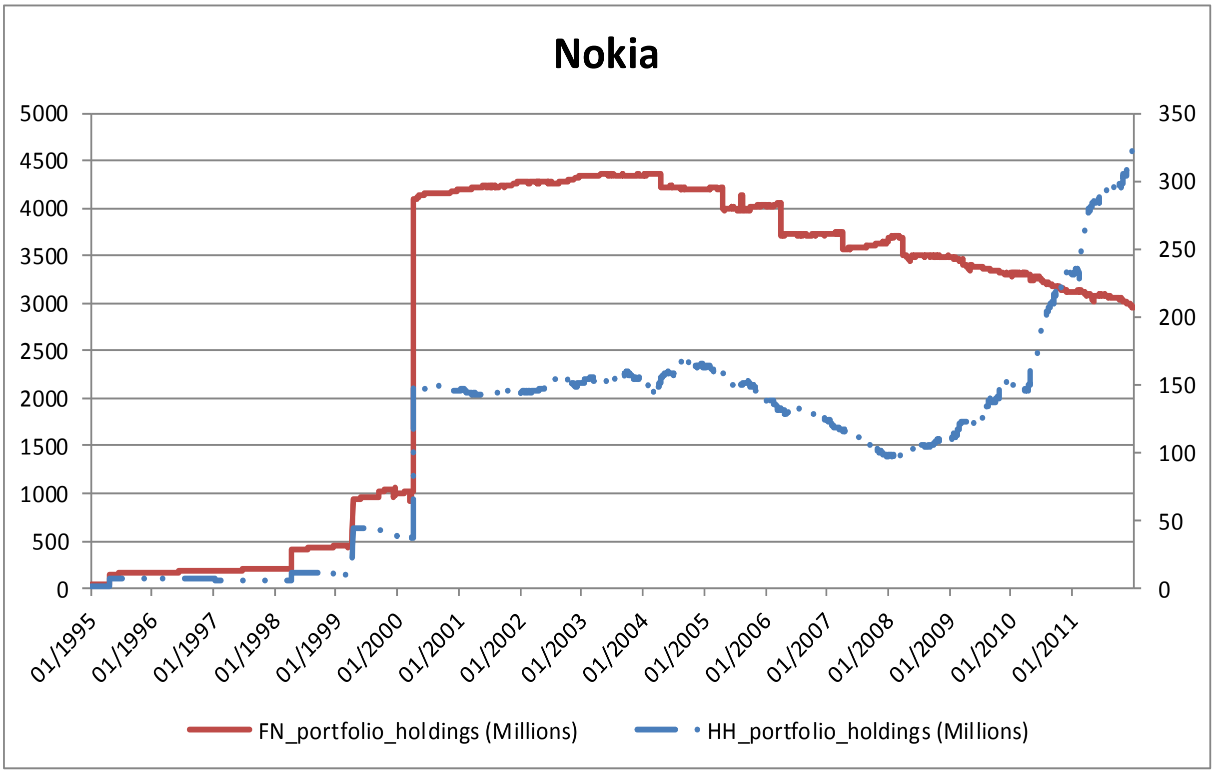
Figure A.1.1: The ratios of portfolio holdings in Nokia's shares outstanding for Households and Foreign nominees over the entire period



A.1.2 Non-negative portfolio holdings of each agent

Furthermore, for each trading party's portfolio holdings over the entire seventeen years, we need to verify that neither of these party's portfolio holdings become negative on any trading day. We adjust for share splits and issues transfers. We also track other issues of shares based on changes in the number of shares outstanding (dividend re-investment, executive option exercises and bonus issues). Figure A.1.2 clearly displays both households and foreign nominees' portfolio positions stay positive throughout entire period. Our verification ensures that the raw data source is sufficiently rigorous to investigate trading performance in each agent by employing our HPI method and to ensure that our findings are not a consequence of faulty or inconsistent data.

Figure A.1.2: Portfolio holdings of Households and Foreign Nominees for Nokia



A.3 Table A1: Summary of 33 Selected Sample Stocks

Capital IQ code	ISIN	Company Name	Mean Volume	Mean Value	Mean Shares Outst	Mean Market Cap	Mean FO M Share
HLSE:NOK1V	FI0009000681	NOKIA CORP	30,056,016	352,527,651	3,851,781,129	44,535,020,668	0.958530886
HLSE:FUM1V	FI0009007132	FORTUM OYJ	2,466,920	49,930,620	887,556,530	17,804,113,922	0.909422925
HLSE:UPM1V	FI0009005987	UPM-KYMMENE CORP	3,268,632	40,551,702	522,068,598	6,352,455,198	0.939649802
HLSE:SAMAS	FI0009003305	SAMPO PLC	2,089,425	38,009,067	564,804,908	10,514,412,236	0.937550908
HLSE:STERV	FI0009005961	STORA ENSO OYJ	4,758,081	36,644,065	612,949,118	4,698,950,016	0.940980784
HLSE:MEO1V	FI0009007835	METSO OYJ	1,104,503	31,176,959	145,500,991	4,255,837,732	0.924883279
HLSE:OUT1V	FI0009002422	OUTOKUMPU OY	2,074,503	23,927,025	333,741,715	2,705,784,105	0.909488252
HLSE:NES1V	FI0009013296	NESTE OIL OYJ	1,289,223	22,132,332	256,403,686	4,020,037,875	0.923615115
HLSE:NRE1V	FI0009005318	NOKIAN TYRES OYJ	909,119	19,050,977	125,919,141	2,802,348,374	0.79931646
HLSE:WRT1V	FI0009003727	WARTSILA OYJ ABP	544,324	17,482,803	116,406,594	3,653,204,142	0.865264964
HLSE:KNEBV	FI0009013403	KONE CORP	518,043	17,286,929	187,275,360	6,595,849,331	0.930845614
HLSE:SSABBH	FI0009003552	RAUTARUUKKI OYJ	780,927	15,545,602	140,055,775	2,700,174,160	0.829097514
HLSE:ELI1V	FI0009007884	ELISA CORP	832,895	13,789,200	166,331,462	2,682,423,612	0.914593401
HLSE:OTE1V	FI0009014575	OUTOTEC OYJ	460,319	13,348,013	43,849,818	1,359,240,457	0.923542119
HLSE:TIE1V	FI0009000277	TIETO CORP	617,052	10,594,628	73,002,822	1,135,993,832	0.897785329
HLSE:KCR1V	FI0009005870	KONECRANES PLC	477,856	10,409,925	60,274,976	1,332,696,923	0.908528497
HLSE:KESAV	FI0009000202	KESKO OYJ	331,852	9,710,509	66,344,202	1,892,409,245	0.830456684
HLSE:CGCBV	FI0009013429	CARGOTEC OYJ	246,709	6,512,188	54,697,280	1,465,286,800	0.907065822
HLSE:ORNBV	FI0009014377	ORION CORP	346,545	5,308,255	90,615,622	1,383,790,688	0.918285328
HLSE:KRA1V	FI0009004824	KEMIRA OY	418,128	4,809,597	138,714,628	1,528,469,852	0.840017735
HLSE:METSB	FI0009000665	METSA BOARD CORP	1,661,534	4,390,216	291,826,062	749,217,384	0.890402332
HLSE:AMEAS	FI0009000285	AMER SPORTS CORP	338,888	4,259,139	95,391,607	1,023,411,289	0.876132047
HLSE:UNR1V	FI0009002158	UPONOR OYJ	218,560	3,415,267	73,246,967	1,048,811,116	0.75106204
HLSE:KRA1V	FI0009012843	KEMIRA GROWHOW O	352,253	3,325,147	57,208,857	482,778,497	0.81431186
HLSE:HUH1V	FI0009000459	HUHTAMAKI OYJ	326,315	3,145,042	105,605,055	1,038,009,789	0.847634622
HLSElSDA1V	FI0009006829	SPONDA OYJ	496,128	2,187,072	195,116,918	831,890,060	0.869873674
HLSE:TIK1V	FI4000008719	TIKKURILA OYJ	85,457	1,297,934	44,108,252	661,870,591	0.808884926
HLSE:ALN1V	FI0009013114	ALMA MEDIA OYJ	138,465	1,170,786	74,886,031	556,262,943	0.776717513
HLSE:OKDBV	FI0009014351	ORIOLA-KD CORP	286,433	844,418	97,694,607	276,661,933	0.827989825
HLSE:LAT1V	FI0009010854	LASSILA & TIKANO	49,462	812,734	38,731,012	590,141,597	0.747536499
HLSE:POY1V	FI0009006696	POYRY PLC	72,339	778,738	57,757,923	609,785,622	0.74254226
HLSE:VAC1V	FI0009009567	VACON OYJ	17,575	511,454	15,295,000	466,718,675	0.781057625
HLSE:CTY1S	FI0009503023	CITYCON OYJ	976,723	107,440	192,810,271	21,209,130	0.972506487