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THREE ESSAYS ON THE TRADING BEHAVIOR OF MARKET PARTICIPANTS

By

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ABSTRACT

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Grinblatt and Keloharju (2001) find that investors prefer to trade and hold the stock of firms that have the same national cultural origin as the investor. The second chapter extends Grinblatt and Keloharju (2001) by studying brokerage houses' choice of trade counterparties in the upstairs market. Brokerage houses are found not to be more likely to trade with counterparties having the same national culture. Market-making financial institutions are culturally unbiased in their trading behavior, which contradicts Grinblatt and Keloharju's (2001). There is no evidence to support an investor-level preference for trading via like-culture brokerage houses. Brokerage houses are not more likely to trade with like-culture counterparties when there is a greater chance of informed trading. Finally, evidence supports the variable cost of upstairs searching for counterparties being small.

The third chapter studies the existence and determinants of trading relationships between investors and individual brokers and brokerage houses. It is found that when an individual broker moves to a new brokerage house, customers shift a statistically significant proportion of their trade volumes to the new brokerage house. Customers of the old brokerage house are more likely to switch when they have closer trading relationships with the new brokerage house, consistent with the hypothesis that investors incur costs when switching brokers. A new brokerage house attracts trading for stocks it

trades less actively, consistent with individual brokers being hired to increase a brokerage house's market share. Results are mixed for more savvy investors' likelihood of switching. Female investors are more likely to switch than males, consistent with female investors being more relationship-oriented.

The fourth chapter redevelops Grossman's (1992) model, and discusses the economic implications of intermediate results. Unexpressed demand of investors in the upstairs market is split into private and public components. It is found that as the public signal of unexpressed demand becomes less (more) noisy, the execution quality of the upstairs market improves (worsens) relative to the downstairs market. Thus, exclusive or close trading relationships between customers and market makers where signals for unexpressed demand remain private, can hurt upstairs market liquidity.

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CHAPTER 1: INTRODUCTION

People are drawn to the familiar. People like to interact with familiar people. People prefer ideas, objects, and behaviors already known to them, as opposed to ideas, objects and behaviors unknown to them. In conventional economic theory, agents act only to maximize their economic utility. It is unclear whether agents' preference for the familiar is a result of either personal biases or real world constraints (such as language barriers) which limit the agent's choices and reduce economic utility, or whether it is the result of utility maximization, where a preference for the familiar provides more complete information and allows agents to make more optimal decisions.[1] Merton (1987) shows that investors' unfamiliarity with a stock causes the stock to be underpriced in equilibrium. Merton's finding is similar that of Stapleton and Subrahmanyam (1977), and Alexander, Eun, and Janakiraman (1987), who showed that internationally segmented markets for a firm's stock lead to an equilibrium underpricing of the stock which also increase the firm's equity cost of capital.

The 'investor recognition' bias of Merton (1987), refers to an investor's familiarity with only a limited number of securities. According to Merton (1987) this explains why investors invest in securities that are (more) familiar to them, a phenomenon which is extensively researched in the literature and referred to as 'home bias'. In more recent years, numerous empirical studies have used different dimensions of agents' familiarity with assets to explain 'home bias'. Grinblatt and Keloharju (2001) use language culture, language and geographical distance, to explain differences in investors' propensity to buy and hold stock within a country (Finland). Hau (2001) uses language and distance to

[1] Hirschleifer (2001) provides an extensive review of the psychological bias of investors and asset pricing.

explain the difference in trading profits of German and foreign traders on the electronic trading system of the German Security Exchange. Huberman (2001) finds that the portfolios of the employees of a Regional Bell Operating Company are tilted towards that particular company. Thus, the general thrust of the literature is that investors' familiarity with a security increases their likelihood of buying and holding that security, and also increases their economic gain from doing so. Hau (2001) finds geographic and cultural distance inversely related to trading profits and argues that these measures of familiarity may proxy for information advantage. However, Grinblatt and Keloharju (2001) do not find a correlation between profits and familiarity, and between profits and investor sophistication, and argue that the familiarity bias exhibited by investors indicates a psychological bias.

Although familiarity biases seem both pervasive and economically significant enough to affect the pricing of assets, the literature has thus far ignored the possibility of a familiarity bias among economic agents in the financial market itself, even though this may also affect asset prices. Allen (2001) states that agency and information problems between financial institutions and investors can help explain asset-pricing anomalies such as price-bubbles. Therefore, to the extent that familiarity among investors and financial institutions and among market makers themselves can reduce such agency and information problems, familiarity may also help explain such asset-pricing anomalies. Furthermore, the study of familiarity may also help in understanding why markets are segmented. For example, if market makers in a financial market prefer to transact with familiar counterparties, then this may segment financial markets, leading to an artificial type of order-preferencing (without side-payments) that reduces trade execution quality and increases transaction costs. On the other hand, in a segmented market, agency and information asymmetry problems may be alleviated, and transaction costs reduced, by trading with more familiar counterparties, so that a possible familiarity bias would not be the cause but the symptom of a segmented market. Hansch, Naik and Viswanathan (1999) examine the practices of preferencing and internalization on the London Stock Exchange, and they interpret the absence of a relationship between order-flow preferencing/internalization and the cross-section of bid-ask spreads across stocks as not being consistent with collusion among dealers but as being consistent with costly trading relationships. Hence, a familiarity bias, if it existed among market makers, may be a symptom of segmented markets rather than a cause.

The concept of familiarity has also played an important role in the banking and relationship lending literature. The main thrust of this literature is that lending relationships, in which lenders become familiar with their borrowers over repeated business transactions, can alleviate asymmetric information problems and can facilitate a more efficient allocation of the lenders' financial resources. This relationship parallels the relationship between investors and market makers in the market microstructure literature, which also has been researched extensively. For example, the market maker can learn whether or not an investor is trading on private information, which would inflict losses on the market maker and on investors trading for liquidity reasons. Seppi (1990) argues that such familiarity helps an upstairs market maker learn about his customers, and helps him distinguish between informed and uninformed order-flow, which can help reduce transaction costs for uninformed investors. Benveniste, Marcus, and Wilhelm (1992) suggest that professional relationships between brokers and specialists and in the upstairs market between market makers and investors can reduce asymmetric information problems, a benefit they argue is not easily achieved in anonymous (automated) trading systems. Grossman (1992) argues that the business relationship of upstairs market makers with their customers allows them to learn their customers' unexpressed demand, so that market makers can more accurately predict order flow, and hence reduce the cost of providing immediacy. The implication of this strand of the literature is that when market participants are familiar with each other information problems are less likely, which reduces transaction costs and increases market liquidity.

Chapters 2 and 3 of this dissertation study whether the existence of familiarity affects the trading behavior of market makers and investors. Chapter 4 is also related to the concept of familiarity as the chapter studies how the greater familiarity upstairs market makers have with their customers, and with their customers' trading behaviors, can impact upstairs market liquidity.

Chapter 2 examines the concentration of brokerage house trading among different counterparties in the upstairs market of the Helsinki Stock Exchange. Due to the ability of upstairs brokers to decide on the trading venue and trading counterparty, and the absence of explicit order-preferencing arrangements, the study permits the testing of whether or not cultural familiarity between market makers increases the likelihood of a trade. If cultural familiarity does matter, then this would support the costly search and relationship hypothesis, implying that market makers may choose culturally familiar counterparties to reduce the costs involved in searching for trade counterparties and in maintaining a relationship with counterparties. It would also be consistent with the existence of agency problems between market makers, which are reduced by trading with culturally more familiar counterparties. Chapter 3 studies the changes in customers' trading relationships with brokerage houses when individual brokers switch brokerage houses. It uses different measures of customers' familiarity with the old and new brokerage houses, and the switching broker to explain the changes in these trading relationships. Chapter 4 develops a model that captures the impact close business relationships between upstairs market makers and their customers can have on upstairs market liquidity. Finally, Chapter 5 presents the concluding remarks.

CHAPTER 2: DOES THE NATIONAL CULTURAL ORIGIN OF BROKERS AFFECT THEIR CHOICE OF TRADING PARTNERS?

ABSTRACT

Grinblatt and Keloharju (2001) find that investors prefer to trade and hold the stock of firms that have the same national cultural origin as the investor. This chapter extends Grinblatt and Keloharju (2001) by studying brokerage houses' choice of trade counterparties in the upstairs market. It is found that brokerage houses are not more likely to trade with counterparties having the same national culture than they are to trade with counterparties having a different national culture. Contrary to Grinblatt and Keloharju's (2001) finding that institutional investors show a cultural bias in their stockholdings and trades, it is found that market-making financial institutions, i.e. brokerage houses, are culturally unbiased in their trading behavior. Furthermore, there is no evidence to support an investor-level preference for trading via like-culture brokerage houses. Brokerage houses are not more likely to trade with like-culture counterparties when there is a greater chance of informed trading. Finally, evidence supports the variable cost of upstairs searching for counterparties being small.

2.1 Introduction

In an ideal world, cultural differences between people should not matter. However, in the real world cultural differences among people have always mattered, and the identification with a particular culture has always defined societies and nations. But what is culture? Most contemporary definitions of culture define it as the shared knowledge, value or belief systems, and behaviors of a particular group of people. There are racial, religious, tribal and national cultures. There are cultures of managers and employees within organizations. There are the cultures of national fraternities, sororities, and student cultures in schools, colleges, and the culture of criminal gangs.

In economics, culture is ignored in the classical rational expectations framework. Recently, however, there has been a trend to understand if and how culture can affect the behaviors of market agents. Grinblatt and Keloharju (2001) show that investors prefer to trade and hold the stock of firms more familiar to them, where familiarity is measured as physical, cultural or linguistic closeness of investors to the firms in question. The authors show using a unique data set from Finland, a country whose citizens have either a Finnish national cultural origin (native Finnish-speakers) or a Swedish national cultural origin (native Swedish-speakers), that investors prefer to trade and hold the stock of firms identified as having the same national cultural origin as the investor.[2] Specifically, the authors find that investors prefer to trade and hold the stock of companies whose CEOs have the same native language as the investor. The authors also find that this cultural bias is stronger for households than for institutional investors, and interpret the stronger effect

[2] Although both the native Finnish-speaking and the native Swedish-speaking groups in Finland have different national cultural origins, members of both groups nevertheless identify themselves as Finns.

of culture among households as implying that households are less sophisticated investors. Bikhchandani, Hirshleifer and Welch (1992) show how an informational cascade model can replicate certain observed effects of culture, such as "the localized conformity of behavior" which leads to the authors' observation that "Americans act American, Germans act German, and Indians act Indian" [page 992]. Lazear (1999) argues that having a common culture and language facilitates trades between individuals, and therefore that learning another culture or language brings additional economic benefit to individuals.

Despite the recent research interest in the effects of culture on the behavior of investors and individuals, no research has been done on whether or not culture can affect the behavior of agents in the financial market itself. For example, cultural biases can exist among the broker-dealers of an upstairs market, a decentralized trading environment where these broker-dealers are responsible for facilitating the block trades of their customers. As each broker-dealer in the upstairs market searches for trade counterparties to a customer order among other broker dealers, he may concentrate his trading among counterparties having the same cultural classification. Consequently, such cultural biases may segment the upstairs market along cultural lines, thereby reducing the liquidity available in the upstairs market as a whole, and increasing transactions costs for investors. On the other hand cultural biases among the broker-dealers of an upstairs market may be just the consequence of a fragmented market in which there are fewer agency and information problems (e.g. due to front-running) among broker-dealers sharing a similar culture. In an upstairs market setting, a broker-dealer's execution of its own customer's trades is referred to as internalization, whereas preferencing refers to the practice of choosing the same dealer or counterparty regardless of price and time-priority. Hansch, Naik and Viswanathan (1999) find that preferencing and internalization in an upstairs market reduce transaction costs for investors, which is consistent with trading relationships and searches in the upstairs market being costly. Therefore, these upstairs market costs may also be reduced when broker-dealers trade with similar culture counterparties.

This paper extends the work of Grinblatt and Keloharju (2001) by examining whether brokerage houses active on the upstairs market of the Helsinki Stock Exchange prefer to trade with counterparty brokerage houses that have a similar national cultural origin to their own. If similarity of the national cultural origin among upstairs brokerage houses can reduce the costs of maintaining trading relationships and search costs, then brokerage houses may conduct a greater proportion of their trading with counterparties sharing the same national cultural origin, ceteris paribus. Alternately, a cultural bias in the trading behavior of brokers could mean that brokers are ignoring different culture counterparties, which may adversely affect the purported liquidity benefits of the upstairs market as argued by extant research. There are two competing joint hypotheses which can explain the possible finding of a cultural bias in the trading of upstairs brokers. One hypothesis is that a cultural bias in the trading of upstairs brokers is good because brokers having incomplete information use similar culture counterparties to reduce search and relationship costs, which improves liquidity provision in an upstairs market. A competing hypothesis is that a cultural bias in the trading of upstairs brokers is bad because it segments the upstairs market along cultural lines reducing the upstairs market's liquidity benefits. After controlling for a host of idiosyncratic brokerage house and stock characteristics, the paper finds no evidence of a cultural preference in brokerage houses' trading choices. Therefore as the paper finds that the trading choices of brokers in the upstairs market are not divided along cultural lines, neither of the two competing hypotheses is supported. Arguably, a more direct study of the effect of culture on the liquidity provision in an upstairs market is not likely to provide significant additional insight. There is also no evidence of an investor-level preference for trading via like-culture brokerage houses, such that while investor-level cultural biases affect which stock investors choose to trade, as Grinblatt and Keloharju (2001) find, such biases do not affect how or with whom (broker) investors trade the stock.

Seppi (1990) argues that upstairs brokers can screen informed trades and thereby reduce transaction costs. If information about the informativeness of the trades of customers is shared among brokerage houses having the same culture (i.e. information clienteles), such that there is a smaller adverse selection cost associated with trading with like-culture counterparties, then brokerage houses should show an increasing preference to trade with like-culture counterparties when a trade is more likely to contain information, everything else remaining constant. The paper finds no evidence that a greater potential for informed trading leads brokers to trade with like-culture counterparties. This may imply, as Seppi (1990) suggests, that upstairs brokers successfully screen out informed trades, such that brokers are indifferent to the culture of counterparties. It may also imply that there is informed trading in the upstairs market and that a broker is equally familiar with the trades of like-culture counterparties as with the trades of unlike-culture counterparties. However, as a result of not screening informed trades which may lead to losses by a counterparty broker, a broker is likely to suffer adverse reputation effects. Hence, the former alternative seems more plausible.

The paper makes the following contributions to the literature. First, by studying whether or not national culture affects the trading choices of brokers, the paper extends the work of Grinblatt and Keloharju (2001) into the realm of financial institutions. Second, the paper contributes to the literature on upstairs markets by finding that the cultural differences among brokers do not fragment upstairs markets. Third, by documenting a lack of cultural bias in the trading behavior of brokers, the paper supports the idea that brokers are members of a closely-knit professional community.

Section 2.2 reviews the literature on culture, upstairs markets and internalization. Section 2.3 describes the features of the Helsinki Stock Exchange and introduces the data set. Section 2.4 presents the hypotheses to be tested. Section 2.5 presents statistics that examine the trading behavior of brokerage houses as a function of the national culture of brokerage houses and traded firms. Section 2.6 introduces a multivariate model that studies the effect of brokerage house national culture and the national culture of CEOs of traded firms on the trading intensity between brokerage houses. Section 2.7 presents the results of the multivariate analysis. Section 2.8 discusses and interprets the results. Finally, Section 2.9 concludes.

2.2 Discussion of the Literature

The study examines whether national culture may influence the trading behavior of brokerage houses in an upstairs market. Therefore, this section presents literature on upstairs markets, including the practices order-flow preferencing and internalization, and discusses the role culture may play in an upstairs market.

The extant literature studies how certain features of upstairs markets that are different from downstairs markets, such as lack of customer anonymity and market fragmentation, can create information clienteles and counterparty search and trading relationship costs. The contribution of upstairs markets to liquidity provision is also explored. The literature argues that upstairs markets are special and that their role is not duplicated by downstairs markets. This paper's examination of the existence of a cultural determinant in the trading behavior of upstairs market makers shows whether cultural biases are another special feature of such markets. Seppi (1990) develops a multi-period model of block trading and finds that traders who can credibly signal that their trades are uninformed prefer to trade in the upstairs market. Grossman (1992) argues that the upstairs market is a repository of information about the unexpressed demand of investors and that this feature enhances the liquidity provided by the upstairs market relative to a downstairs market. Using a data set of block transactions in Dow Jones stocks on the NYSE, Madhavan and Cheng (1997) show that the downstairs market contributes significantly to liquidity in these stocks, and that the upstairs market provides better execution than the downstairs market, although this difference is not economically significant. However, the authors do find support for Seppi's (1990) hypothesis that uninformed traders prefer to trade in the upstairs market. Keim and Madhavan (1996) find that information leakage occurs in the upstairs market prior to a trade, and that a concave relationship exists between trade size and the temporary price impact of liquidity. Booth, Lin, Martikainen and Tse (2002) find that upstairs trades have less information content and lower price impact than downstairs trades, consistent with Seppi (1990) and Grossman (1992). The authors also find that the upstairs market uses the downstairs market to set prices, suggesting that price discovery occurs in the downstairs market. Together these two findings are taken as evidence that the liquidity advantage of an upstairs market depends on informed order trades being done in the downstairs market where they contribute to the price discovery process. Smith, Turnbull and White (1999), show that brokers in the upstairs market successfully filter out information-based trades, reducing the adverse selection costs relative to the downstairs market, which supports Seppi (1990). It is also found that trading in the upstairs market is more likely during times when liquidity is low in the downstairs market.

Studies of the upstairs market have also examined the practices of order preferencing and internalization. Burdett and O'Hara (1987) develop a theoretical model of the syndication process of block trading, and argue that in a search for syndication counterparts, the dealer conducting the search must take into account the incentive that potential counterpart dealers contacted during the search have to front-run the impending block trade, thereby adversely affecting the price of the stock in the downstairs market, and reducing the benefits of syndication to the dealer if the dealer has quoted a commitment price to the trader. This indicates optimal stopping rules for the search, such that at some point the dealer stops the search and trades the remaining (unmatched) order flow against his own account. As a trade-initiating dealer knows the identities of each of the potential trade counterparts in an upstairs market, he can exclude from the syndication dealers who are likely to front-run the impending upstairs trade. If cultural similarity is an important factor in brokers' decision to choose trading counterparties, such that having the same culture as the counterparty broker allows the trade initiator better to assess the likelihood that the counterparty will front-run, then brokers should choose to trade with like-culture counterparties.[3]

Hansch, Naik and Viswanathan (1999) demonstrate that in an upstairs market the broker practices of preferencing and internalization do not lead to higher spreads being paid by investors and this contradicts the collusion hypothesis, but agrees with the hypothesis that searching and trading relationships in the upstairs market are costly. Therefore, the study refutes claims that preferencing and internalization indicate tacit collusion among dealers. If there are cultural biases in the trading preferences of brokerage houses, then the finding of Hansch, Naik and Viswanathan (1999) could imply that cultural biases among brokers also reduce the costs associated with searching and trading relationships in the upstairs market. This would also be consistent with Cornell and Welch (1996)'s assertion that cultural similarity helps reduce the asymmetric information problems between principal and agent. Battalio and Holden (1997) develop a model of payment for order flow and internalization, and show that when brokers know more about certain characteristics of their customers than third-parties, they can profit from payment-for-order-flow practices by selectively internalizing order flow. This idea also has implications about internalization in an upstairs market. As Seppi (1990) argues, if a broker knows his own customers better than others, the broker can screen the orders of an informed customer so that these orders go to the downstairs market while uninformed customers' orders are executed in the upstairs market. On the other hand, potential counterparties not observing the characteristics of the broker's customers will

[3] This idea is consistent with Cornell and Welch's (1996) assumption that an employer's cultural similarity with a job applicant allows the employer to learn the quality of the applicant.

not know whether the broker's customer really is uninformed. Therefore it will be difficult for the broker to find counterparties in the upstairs market, and the broker would have to internalize the uninformed order. However, if the cultural similarity of brokers can reduce such asymmetric information problems among brokers, then brokers would be expected to prefer trading with counterparties having the same culture, ceteris paribus. Hence, the asymmetric information problem presented in Battalio and Holden (2001) would increase the cost of trading with other brokers in the upstairs market, and make internalization and trading with similar culture brokers more attractive. Therefore, if upstairs market trading relationships are costly, then to the extent that trading with a like-culture counterparty broker can reduce such costs, whether these are search costs as in Burdett and O'Hara (1987), or asymmetric information costs as implied by Battalio and Holden (1997), brokers should prefer trading with like- culture counterparties.

The work of economists and economic sociologists in the area of culture and language is especially concerned with immigration/emigration and cultural or linguistic assimilation. These papers build theoretical models based on the assumption that culture and language differences among economic agents affect agents' behaviors. However, despite this argument, few studies actually test the relevance and importance of culture and language to the behavior of market participants and to the functioning of markets in general. Akerlof (1976) studies how the individuals' decision of whether to behave consistently with social norms and consequently to gain certain economic and social benefits, or to behave contrary to social norms and therefore be devoid of these benefits, can distort Arrow-Debreu's general equilibrium model of perfect competition. Bikhchandani, Hirshleifer, and Welch (1992) define an informational cascade as occurring “when it is optimal for an individual, having observed the actions of those ahead of him, to follow the behavior of the preceding individual without regard to his own information”. The authors use informational cascades to generate localized conformity of individual behavior, and interpret this as an explanation of how “fads, fashion, custom, and cultural change” occur. Church and King (1993) examine a game-theoretic model where a person’s utility depends positively on the number of other people the person can communicate with, so that the popularity of a language induces a network externality. Katz and Matsui (1995) show that the standardization of language brings about benefits for trade. John and Yi (1995) study how the unequal distribution of language endowments motivate individuals’ decision to learn a new language and the decision to emigrate. Cornell and Welch (1996) assume that cultural similarity with a job applicant allows the employer to learn the applicant’s quality, and show that employers tend to employ job applicants with a similar cultural background, referred to as ‘screening discrimination’, even when employers are unbiased and the characteristics of job applicants are the same across cultural groups. This discrimination is greater when quality is important but difficult to observe, and screening is cheap. Lazear (1999) builds a model in which an individual can only trade with others having a similar culture and language, and can learn a new culture or language to increase the number of potential trading partners. Therefore, the view that cultural differences represent barriers or additional costs to trade among market agents, combined with the finding of Hansch, Naik and Viswanathan (1999) that upstairs trading relationships are costly, may imply that cultural differences create additional transaction costs in the upstairs market, and that culturally similar upstairs brokers prefer to interact with each other in order to reduce transactions costs.

2.3 The Data Set

The Helsinki Stock Exchange is composed of two markets, an upstairs market and a downstairs market, which are connected by an automated trading and information system called the HETI. Trades are made during one of three periods each day, namely, the pre-trading, free-trading and the after-market periods. The downstairs market of the HETI is essentially an open electronic limit order book that is updated in real-time. Trading members of the stock exchange enter market and limit orders into the HETI where the orders are matched anonymously and executed into trades according to price and time priority. In the upstairs market, trades are negotiated and then recorded in the HETI system by the buyer in a timely manner after they occur. However, due to the requirement that upstairs trades occur at prices no worse than the concurrent downstairs book quotes, the reporting of upstairs trades may sometimes be delayed until the after-market period, when the range of acceptable transaction prices is wider.[4]

During the pre-trading period, which starts at 8:30 a.m., traders announce bid and offer prices and the HETI system matches orders and executes these as transactions. Any unexecuted portions of orders are then transferred to the free-trading period, which is a continuous trading session beginning at 10:00 a.m. and ending at 5:00 p.m.. During free-trading, customers submit orders to their brokers, who typically make the decision about whether to send the order directly to the HETI limit order book (downstairs market), or to negotiate the trade with a counterparty (upstairs market), and then to report the trade to the HETI. Conversations with HSE brokers suggest that while investors

[4] Trade prices reported during the after-market periods are required to occur inside the price range bracketed by the greater of the highest transactions price of the trading day and the closing ask of the free-trading session, and the smaller of the lowest transactions price of the trading day and the closing bid of the free-trading session.

hypothetically can express a preference for trade venue, such as upstairs or downstairs, the decision to choose either the upstairs or downstairs market is typically made by the broker. However, even if the decision to execute an order in the upstairs market is made by a customer, the choice of upstairs trade counterparty is made by the broker, and therefore implies that the study in this paper of the upstairs brokers' trading behavior is free of a possible customer-level preference. Although large orders in less liquid stocks are most often negotiated upstairs, for the most liquid stocks, notably Nokia, the broker uses the downstairs market even for very large orders. Brokers receive these large orders typically from big foreign institutions and break-up and trade the orders 'over-the-day' in the downstairs market to obtain the best Volume Weighted Average Price (VWAP). The after-market consists of two trading sessions, one from 5:05 p.m. to 6:00 p.m., and the other from 8:00 a.m. to 8:25 a.m. of the following day. The after-market is distinguished from the free-trading period by the fact that the HETI electronic limit order book system is closed, and that all trades must therefore be negotiated and then reported to HETI. However, anecdotal evidence suggests that most of the trades reported during the after-market are in fact trades that have occurred earlier in the day.

As the paper investigates trading decisions made by brokerage houses, and downstairs market trades in the pre-trading and free-trading periods involve automated trade matching by the HETI system, the study uses upstairs market trades of the free-trading and after-market periods to investigate the trading behavior of brokerage houses. Brokerage houses often work over-the-day orders from large foreign customers. An over-the-day order for a particular customer is executed as multiple trades in the downstairs market, and the order is again reported during the after-market period as a single pseudo-trade, usually at the request of the customer in order to simplify settlement. A pseudo-trade report in the after-market is identified by the fact that the same brokerage house is reported as both the buyer and seller, even though the actual downstairs trades that make up the pseudo-trade are typically with numerous other brokerage houses. Therefore, in order to exclude these pseudo-trades, the study disregards trades reported in the after-market where the buyer and seller are the same. Upstairs trades with the same buyer and seller reported during the free-market period are also disregarded, for consistency. The paper uses data from 1997 and earlier, as the HSE stopped providing broker codes after 1997. Therefore, the data set consists of all upstairs market trades of firms occurring between different brokerage houses, and where the stock of the firm is continuously listed on the Helsinki Stock Exchange from January 1, 1996 to December 31, 1997.

Although stocks of a firm listed on the HSE can belong to one of several categories called share classes, which give different voting rights to shareholders, most firms have only a single share class. As in Grinblatt and Keloharju (2000), this paper treats each share class as a separate stock.[5] After removing share classes not continuously listed on the HSE during the sample period, and an additional eight stocks whose firms could not be classified by culture, 76 share classes remained in the sample, corresponding to 61 unique firms. Table 2.1 shows the list of share classes in the sample, grouped by the cultural classification of the firm's CEO. The classification method for the firm's cultural heritage is similar to the method used by Grinblatt and Keloharju (2001). The national

[5] Grinblatt and Keloharju (2000) point out that the different share classes of a particular company reflect different voting rights, i.e. the more liquid share classes have fewer votes, and by Ilmanen and Keloharju (1997) this gives rise to different clienteles of share ownership.

culture of the firm is classified according to the national culture associated with the name of the firm's CEO.[6] There are 58 share classes where the firm's culture is Finnish, compared to 16 share classes of Swedish, and two firms having non-Finnish and non-Swedish cultures. A unique feature of the HSE data set is that for each trade the brokerage houses of the buyer and seller are identified. As of year-end 1997, there were 23 brokerage house members of the HSE.[7]

Table 2.2 lists according to cultural heritage, the brokerage houses that were active in the after-market during the sample period. The cultural heritage of the brokerage house is defined as Finnish if either the cultural heritage of the name of the brokerage house is Finnish, or the company that owns the brokerage house is headquartered in Finland. If the brokerage house's name is Swedish and the house is headquartered in Sweden, then the house is classified as having a Swedish culture. If a brokerage house cannot be categorized according to these rules, then it is given the cultural classification 'Other'. The three Finnish brokerage houses that fall into the national culture category 'Other' are headquartered in Switzerland, Denmark and the UK, respectively.[8] According to this classification 15 brokerage houses have a Finnish culture, five have a Swedish culture, and three have neither a Swedish nor a Finnish culture.

[6] If both the first and last names of the CEO are Finnish, then the firm's culture is identified as Finnish. If both the first and last names of the CEO are Swedish, then Finnish biographical sources and the language of the CEOs university education are used to identify the native language of the CEO and hence the CEO's national culture.

[7] At the beginning of January 1996, there were 21 brokerage houses. During the sample two brokerage houses stopped trading while four new brokerage houses started trading, so that 19 of the brokerage houses that were trading at the start of the sample were also trading at the end of the sample.

[8] The analysis in this paper is repeated with the brokerage house's national culture defined as the national culture of the brokerage house's managing director. The qualitative results of the paper were robust to this reclassification.

Table 2.2 shows 25,812 after-market trades in the sample, where 15,914 trades are conducted by the 15 Finnish culture brokerage houses, and 9,233 trades are conducted by the five Swedish culture brokerage houses. Although Swedish culture houses trade more actively in the after-market on average than the average Finnish culture house, the difference is not statistically significant. Furthermore, more active brokerage houses conduct a smaller percentage of their trades with other houses than less active brokerage houses. Therefore it is likely that the difference between the medians of the average percentage of externalized buys and sells (Table 2.2, fourth column), for Finnish culture houses and Swedish culture houses of 22.2, and 17.4, respectively, is due to the difference in trade activity between the brokerage houses.

2.4 Hypotheses to be Tested

Traditional models of market microstructure treat market makers as agents whose primary function is to match the supply and demand curves of traders, while being adequately compensated for their services. Grinblatt and Keloharju (2001) find that investors' national culture affect their preferences for trading and shareownership, and interpret this as a lack of sophistication, consistent with investors' lack of familiarity. If there is also a lack of familiarity in the upstairs market among brokerage houses, then this may imply that brokerage houses prefer to trade with counterparties having the same culture. This leads to the following hypothesis:

Hypothesis I = A brokerage house prefers to trade with other brokerage houses having the same national culture, ceteris paribus.

Grinblatt and Keloharju (2001) find that investors prefer to trade stocks of firms having the same culture as the investor. If a brokerage house also prefers to trade in stocks of firms sharing the same culture as itself, then it should have a closer trading relationship with other brokerage houses that have the same culture as the stocks of firms it wishes to trade. However, a brokerage house's specialization in trading the stock of a firm with the same culture as itself may not necessarily indicate a bias on the part of the brokerage house. The bias may originate from the investor level because an investor who trades stocks of firms with the same culture may also prefer to do business with brokerage houses with the same culture. As Grinblatt and Keloharju (2001) showed that investors prefer to trade stocks of firms similar in culture to the investor, a cultural bias in investors' choice of brokerage house when both buying and selling a stock may lead to like-culture brokerage houses having a closer trading relationship in trading the stock of a like-culture firm, than in trading the stock of an unlike-culture firm. For example, a Swedish culture brokerage house trading with other Swedish culture brokerage house would prefer to trade stocks of Swedish culture firms to trading stocks of firms with non-Swedish cultures. Hence:

Hypothesis II = An upstairs brokerage house has a closer trading relationship with a like-culture brokerage house when trading the stock of a like-culture firm than when trading the stock of an unlike-culture firm.

Battalio and Holden (1997) argue that brokers observing characteristics of their own customers can distinguish between uninformed and informed order flow. The upstairs market requires a broker receiving an order from a customer to shop around among different counterparty brokers. As counterparty brokers do not directly observe characteristics of the order submitting customer, it is likely for there to be an asymmetric information problem, such that a counterparty broker does not know whether the order being shopped is informed. Burdett and O'Hara (1987) simulate an asymmetric information problem with their model, and argue that searching for trade counterparts gives other brokers the opportunity to front-run the impending trade, which limits the number of counterparties the broker contacts during the search. Therefore to the extent that having the same national culture can reduce such information asymmetries, the order receiving broker would be expected to concentrate the upstairs market search among brokers having the same national culture.

Therefore, asymmetric information problems may contribute to the influence of culture on brokers' trading preferences:

Hypothesis III = A brokerage house trades more often with brokerage houses having the same culture when there is a greater likelihood of asymmetric information with counterparty brokers about the transaction, ceteris paribus.

Hansch, Naik and Viswanathan (1999) found that trading relationships in the upstairs market were costly. Therefore, upstairs brokers should limit their search and trading of a particular stock to a few counterparties that are most active in trading that stock and hence most likely to be counterparties to trades of that stock. This leads to the hypothesis:

Hypothesis IV = In the trading of any given stock, an upstairs brokerage house prefers to buy from brokerage houses that are more active than itself in selling that stock, ceteris paribus.

2.5 Trading Behavior as a Function of the National Culture of Brokerage Houses and Traded Firms

2.5.1 Ratios Showing the Effect of the National Culture of a Firm's CEO on Trading Intensity of the Firm's Stock

Grinblatt and Keloharju (2001) find that investors prefer to hold, and trade the stock of firms with CEOs that share the same national culture as the investor. This section uses some ratios to examine whether brokerage houses trade in stocks of firms with CEOs that share the same national culture as the brokerage house. As the data set does not uniquely identify the order submitter, i.e. either agency trades from a customer, or proprietary trades of the brokerage house, one cannot distinguish between cultural biases caused by investors' preference of trading stock of like-culture firms with like-culture brokerage houses, and the brokerage house's preference for trading like-culture firms from its portfolio. However, anecdotal evidence from interviews with brokers suggests that brokerage houses carried very small inventories and there was also little proprietary trading in the sample period. Furthermore much of inventory and proprietary trading was limited to a few highly liquid stocks. Therefore, any investor level cultural bias for trading stock of like-culture firms with like-culture brokerage houses would be picked up as a brokerage house level cultural bias for trading stock of like-culture firms.

Table 2.3 shows the intensity of the trading of brokerage houses in stocks of firms whose CEOs belong to one of three different national culture groups, Finnish, Swedish and Other (neither Finnish nor Swedish). Panel A shows the intensity of trading of Finnish culture brokerage houses in stocks of firms with CEOs having Finnish, Swedish and Other national culture. Panel B shows the same information for brokerage houses having a Swedish national culture, and Panel C shows the information for brokerage houses having the national culture classification of Other, i.e. neither Swedish nor Finnish.

The trading intensity ratio of a brokerage house i in the stock of firms with CEOs having a Finnish national culture is defined as:

$$\frac{\left(\begin{array}{c}\text{Brokerage house } i\text{'s proportion of trading in stocks of firms}\\ \text{with Finnish national culture CEOs}\end{array}\right)}{\text{Brokerage house } i\text{'s proportion of trading in all stocks}} \tag{2.1}$$

The numerator in the above ratio is the number of trades in stocks of all firms with CEOs having a Finnish culture where brokerage house i was the buyer (seller), divided by the number of trades in stocks of all firms with CEOs having a Finnish culture executed by all brokerage houses. The denominator is the number of trades in all stocks where brokerage house i was the buyer (seller), divided by the number of trades in all stocks executed by all brokerage houses. Taking the brokerage house Evli as an example, the number trades in stocks of firms with CEOs having Finnish national culture where Evli was the buyer, is 1,577, and the number of buy trades all brokerage houses conduct in Finnish stocks of firms with CEOs having Finnish national culture is 23,823. Therefore, the numerator, or Evli's trading proportion in stocks of firms with CEOs having a Finnish national culture where Evli was the buyer is 0.066. The number of trades in all stocks where Evli was the buyer is 1,637, and the total number of trades conducted by all brokerage houses in all stocks is 25,817. Therefore, the denominator, or Evli's trading proportion in all stocks where Evli was the buyer, is 0.063. The trading intensity ratio for Evli in stocks of firms with CEOs having a Finnish national culture is therefore, 0.066/0.063, or 1.044.

The trading intensity ratios of Swedish, and Other (neither Finnish nor Swedish) national culture brokerage houses are calculated in a similar manner. If the trading intensity ratio for a brokerage house i is greater (less) than one, then the brokerage house i trades more (less) intensely in stocks of firms with CEOs having a Finnish culture than it does in all stocks. In other words, the ratio measures the brokerage house i's after-market specialization in stocks of firms with CEOs having a Finnish culture. Table 2.3, Panel A shows that the median trading intensity ratio of brokerage houses in each of the three firm CEO culture categories, Finnish, Swedish and Other, are all similar and close to 1, for both buys and sells columns. Also, the fractions of the number of brokerage houses that have trading intensities larger than 1, are similar and close to 0.5, which indicates that for stocks of firms with CEOs having a Finnish culture, the trading intensity ratios are evenly distributed within each brokerage house national culture category, and that the distributions of this ratio among brokerage house national culture categories are also similar.

Panel B shows that the median trading intensity ratio of Finnish culture brokerage houses in stocks of firms with Swedish culture CEOs, is about one, but the median trading intensity ratios for Swedish and Other culture brokerage houses in stocks of firms with Swedish culture CEOs are significantly less than 1. Also, the fraction of trading intensity ratios greater than one under the buyer column for Finnish culture brokerage houses is 0.6, whereas for Swedish culture brokerage houses, this figure is 0.17, which is statistically significantly less than 0.6. Although the fraction under the buyer column for Other culture brokerage houses is 0.33, the standard error is too big to reject the null that it is equal to the figure for Finnish culture brokerage houses of 0.6. Therefore, Finnish culture brokerage houses are more active than Swedish culture brokerage houses in trading stocks of firms with Swedish culture CEOs.

Table 2.3, Panel C shows that the median trading intensity ratios of all brokerage house culture categories are less than one in stocks of firms with CEOs having the culture Other. Also, the fractions of trading intensity ratios in each brokerage house culture category are less than 0.5. The median brokerage house in each cultural category trades less intensely in stocks of firms with CEOs having 'Other' national culture than in all stocks. Hence trading in stocks of firms with CEOs having the national culture classification 'Other', is concentrated in a very few brokerage houses in each brokerage house culture category.

2.5.2 Ratios Showing the Effect of the National Culture of Brokerage Houses on their Choice of Trading Partners

Table 2.4 shows for stocks of firms with CEOs having Finnish, Swedish and Other national culture, the intensity of trading between brokerage houses on both sides of a trade, i.e. trade-initiating and trade-counterparty brokerage houses, belonging to Finnish, Swedish and Other culture categories. Panel A shows for all firms with CEOs having Finnish national culture, the median and the fraction greater than one for trade-initiating brokerage house cultures of the median trade intensity ratio with cultures of trade-counterparty brokerage houses. Panels B and C show this information for firms with CEOs having Swedish and Other national culture, respectively. The trading intensity ratio between a trade-initiating brokerage house i and a trade-counterparty brokerage house j, where $i \neq j$, in stocks of all firms having x culture CEOs, is defined as:

$$\frac{\left(\begin{array}{c}\text{Trade-initiating brokerage house } i\text{'s trading weight with counterparty} \\ j \text{ in stocks of firms having } x \text{ culture CEOs}\end{array}\right)}{\left(\begin{array}{c}\text{Trade-initiating brokerage house } i\text{'s trading weight with all other} \\ \text{counterparties in stocks of firms having } x \text{ culture CEOs}\end{array}\right)} \tag{2.2}$$

The numerator is the number of trades brokerage house i conducts with brokerage house j in stock of firms with CEOs having culture x, divided by the number of trades all brokerage houses except j conduct with brokerage house j in stock of firms with CEOs having culture x. The denominator is the number of trades brokerage house i conducts with all brokerage houses except i in stock of firms with CEOs having culture x, divided by the number of trades all brokerage houses conduct with all other brokerage houses ($i \neq j$) in stock of firms with CEOs having culture x.

Panel A shows that for stocks of firms with CEOs having Finnish national culture that the median among trade-initiating Finnish brokerage houses of the median trade intensity ratios with Finnish, Swedish, and Other culture trade-counterparty brokerage houses are 0.85, 0.70 and 0.28 respectively. The figures for the fraction of trade intensity ratios greater than one for the Finnish trade-initiating brokerage house culture category, are 0.27, 0.13 and 0.33, for Finnish, Swedish and Other trade-counterparty brokerage house culture categories, respectively. The fact that all median ratios are less than one and the fractions are less than 0.5, means that for the Finnish trade-initiating brokerage house culture category, the trading with each trade-counterparty culture category is concentrated between a small number of brokerage house trading pairs. The largest median trade intensity ratio for Finnish trade-initiating brokerage house culture category of 0.85 occurs when the trade-counterparty culture category is Finnish. The median trade intensity ratio when the trade-counterparty culture category is Swedish is 0.7, which is somewhat less than the ratio for the Finnish trade-counterparty culture category of 0.85 but larger than the ratio for Other trade-counterparty culture category of 0.28, although these differences are not statistically significant. The median trade-intensity ratios with each of the trade-counterparty culture categories, Finnish, Swedish and Other, when the trade-initiating culture category is Swedish, are 0.97, 1.07, and 0.67, respectively. The fraction of ratios greater than one for each trade-counterparty culture, Finnish, Swedish, and Other, when the trade-initiating culture category is Swedish, are 0.40, 0.60, and 0.20, respectively. The largest trade intensity ratio of 1.07 occurs with the Swedish trade-counterparty culture category, implying that Swedish brokerage houses trade most intensively with other Swedish brokerage houses. As the median ratio for each trade-counterpart culture category is greater in the Swedish trade-initiating culture category than the corresponding ratio in the Finnish trade-initiating culture category, the trades of Swedish culture brokerage houses are more evenly distributed within each trade-counterpart category than are the trades of Finnish culture brokerage houses. This may be due to Swedish brokerage houses being larger than Finnish brokerage houses on average and being more likely to trade with a greater number of brokerage houses. For the trade-initiating culture category 'Other', the medians of trade intensity ratios with trade-counterparty culture categories are all zero except with the Swedish trade-counterparty culture category.

Panel B examines the trading intensity ratios among brokerage house culture categories for stocks of firms with CEOs having Swedish national culture. The median ratios are zero for all trade-initiating and trade-counterparty cultural category combinations, indicating that these stocks are not traded between most of the trade-initiating and trade-counterparty brokerage house pairs. The fraction of ratios greater than one also are all zero except when the trade-initiating brokerage house culture is Finnish and the trade-counterparty culture is either Finnish, where the fraction is 0.08, or Swedish, where the fraction is 0.23, and when the trade-initiating and trade-counterparty cultures are both Swedish, where the fraction is 0.40. A noteworthy difference between the results in Panel A and Panel B is that for Panel B the fraction of ratios greater than one for the Finnish trade-initiating culture category is greater when the trade-counterparty culture category is Swedish than when it is Finnish, whereas for Panel A, the fraction is greater when the counterparty culture category is Finnish. This indicates that Finnish culture brokerage houses trade more intensively with other Finnish culture brokerage houses than they do with Swedish culture brokerage houses when the stocks belong to firms with CEOs having Finnish national culture, but Finnish culture brokerage houses trade less intensively with other Finnish culture brokerage houses than they do with Swedish culture brokerage houses when the stocks belong to firms with CEOs having Swedish national culture. However, the differences among the fractions are not statistically significant.

Panel C examines the trading intensity ratios between trade-initiating and trade-counterparty brokerage house culture categories for stocks of firms with CEOs having national culture of Other. The results are very similar qualitatively to Panel B. The medians of all trade-initiating and trade-counterparty culture combinations are zero except for trades occurring between brokerage houses that both belong to a Swedish culture category, where the median is 0.37. Also, the fractions greater than one are all zero except when the trade-initiating culture is Finnish, and the trade-counterparty culture is either Swedish or Other, where the fractions for both are 0.08, or when the trade-initiating and trade-counterparty cultures are both Swedish, where the fraction is 0.25.

Overall, the results of Table 2.4 are consistent with the hypothesis that brokerage houses prefer to trade with brokerage houses that share the same culture, although many of the statistics are not statistically significant.

2.6 A Multivariate Model to Study the Effect of National Culture on the Strength of Trading Relationships between Brokerage Houses

The previous section presented some statistics examining the effect of national culture on the trading intensities of brokerage houses. This section presents a multivariate regression model in which to test the hypotheses presented earlier. The model's dependent variable $D_{i,j,x}$, is a measure of the strength of the trading relationship in stock x between buying (selling) brokerage house i and selling (buying) partner j and is defined as the difference between i's trading weight with j's in stock x, $W_{i,j,x}$, where $i \neq j$, and i's trading weight with all brokerage houses in stock x, $W_{i,x}$. The dependent variable is therefore the difference of these trading weights which are expressed in equation (2.2) as a ratio. Using the difference of the two trading weights instead of their ratio means that unlike the ratio variable, which is truncated at zero, the dependent variable can take on negative values as well, so that weaker than expected trading relationships, i.e. negative values of the dependent variable, are accurately represented. This was not a consideration when using equation (2.2), the ratio, as a 'relative' measure of the trading relationship, i.e. the median of the ratio of weights, is more intuitive a descriptive statistic, than the difference of the weights. Therefore,

$$D_{i,j,x} = W_{i,j,x} - W_{i,x} \tag{2.3}$$

The trading weight of i with j in stock x, $W_{i,j,x}$ is defined as the number of trades in stock x where brokerage house i is the buyer (seller) and brokerage house j is the seller (buyer), divided by the number of trades in stock x where brokerage house j is the seller (buyer) and any other brokerage house is the buyer (seller), and the trading weight of i with all brokerage houses, $W_{i,x}$, is defined as the number of trades in stock x where i is the buyer (seller), divided by the number of trades in stock x occurring between different brokerage houses. For example, during the sample period, Alfred Berg bought Nokia stock on 18 occasions (trades) from Arctos, and on 60 occasions Arctos sold Nokia to all brokerage houses, so that the trading weight of Alfred Berg with Arctos for Nokia stock is 18/60, or 0.3. Alfred Berg bought Nokia stock on 47 occasions from all brokerage houses and all brokerage houses bought Nokia stock on 479 occasions from all other brokerage houses, so that the trading weight of Alfred Berg with all brokerage houses for Nokia stock is 47/479, or 0.1. Therefore the difference between these figures is 0.3-0.1, or 0.2. As this figure is positive, the buying relationship of Alfred Berg with Arctos for Nokia stock is stronger than Alfred Berg's buying relationship with all brokerage houses.

The multivariate ordinary least squares regression method is used to estimate the determinants of trading behavior among brokers. Each data point in the data set is composed of the buying brokerage house, the selling brokerage house and the stock traded by the brokerage houses. There are 14,027 observations. The following independent variables are used to test the hypotheses introduced earlier, as indicated in Table 2.5: dummy variables *Swedish Buyer*, *Other Buyer*, *Swedish Seller*, *Other Seller*, indicating the national cultures of the buying and selling brokerage houses, where the Finnish buyers represent the base case for buyer dummies and Finnish sellers represent the base case for seller dummies; dummy variables *Finnish Buyer×Swedish Seller*, *Finnish Buyer×Other Seller*, *Swedish Buyer×Finnish Seller*, *Swedish Buyer×Swedish Seller*, *Swedish Buyer×Other Seller*, *Other Buyer×Finnish Seller*, *Other Buyer×Swedish Seller*, *Other Buyer×Other Seller*, indicating the buyer and seller brokerage house combinations, where *Finnish Buyer×Finnish Seller* is the base case; dummy variables *Traded Firm's CEO has Swedish culture*, *Traded Firm's CEO has Other Culture*, indicating the national culture of the CEO of the firm whose stock is traded, the base case being stocks of firms with CEOs having a Finnish culture; dummy variables for each stock but one; standard deviation of the average daily return for the stock over the whole sample period *Average Daily Return Volatility*, proxying for information asymmetry among brokers; the natural log of the number of all trades in a stock where the buying brokerage house was the seller divided by the number of trades in that stock where the selling brokerage house was the seller, *Log(No of Seller Sells/No of Buyer Sells)*, proxying for search costs in the upstairs market. The regression also uses over 600 dummies to control for spurious significance in the right hand side variables, i.e.

dummies are used for all stocks but one, and for all buying and selling brokerage house combinations but one. Stock dummies control for whether a stock is widely held and hence widely traded among brokers, or narrowly held and hence traded by a few brokers. Buying and selling brokerage house combination dummies control for idiosyncratic trading relationships between brokerage houses that cannot otherwise be proxied and that may lead to spurious statistical significance in the brokerage house culture combination dummies.

As the broker's choice of counterparty for an externalized small trade should be less constrained by the liquidity that can be provided by the counterparty, measures of trading relationships using small trades should be more indicative of brokers' personal trading preferences than similar measures using medium or large trades. Therefore, any cultural bias among broker trading behavior should be stronger for smaller trades. Therefore the regression is run separately for dependent variables constructed using trades from different trade size categories. The trade size categories are constructed with the same trade size cutoffs used in Barclay and Warner (1993). Barclay and Warner (1993) use these trade size cutoffs when analyzing the information content of different trade size categories for stocks traded on the NYSE. Thus the small trade size category is defined as all externalized trades with volume less than 500 shares, the medium size category is defined as all externalized trades where the volume is between 500 and 10,000 shares, and the large trade size category as all externalized trades where the volume is greater than 10,000 shares. The distribution of the number of trades in each of the size categories is not much different from Barclay and Warner (1993), implying that the trade size cutoffs used for the NYSE are also appropriate for the HSE.[9] According to Barclay and Warner (1993), the small trade size category is the least likely to contain informed trading. However, as this paper studies the upstairs market which according to Seppi (1990) filters out informed trades, the size categories used in this paper do not separate trades based on the likelihood of information content, as in Barclay and Smith (1993) but on the demand they place on the liquidity of the upstairs market. Hence, the cutoffs of Barclay and Warner (1993) are used here merely for consistency and do not affect qualitatively the results obtained in this paper.

2.7 Results

Table 2.6 shows the results of the various multivariate regression models. In the first column the dependent variable is constructed using all externalized trades. In the second, third and fourth columns, the dependent variable, trading intensity between the buying and selling brokers for a given stock, is constructed using trades from the small, medium and large trade size categories. The p-values are presented in parentheses, next to each point estimate. The adjusted R^2 are 0.013 for MODEL I which uses all available externalized upstairs trades, 0.0045 for the model that uses small trades, -0.0008 for the model that uses medium trades, and 0.074 for the model that uses large trades.

In MODEL I, for the explanatory variables used to test Hypothesis I, i.e. that brokerage houses prefer to trade with others having the same culture, namely *Finnish Buyer × Swedish Seller*, *Finnish Buyer × Other Seller*, *(Swedish Buyer × Swedish Seller − Swedish Buyer × Finnish Seller)*, *(Swedish Buyer × Swedish Seller − Swedish Buyer*

[9] For example, in Barclay and Warner (1993), the median of the percentage of trades in each trade category were 59.6%, 38.6%, 0.8% for the small, medium and large trade size categories, respectively. The corresponding percentages in the HSE sample used in this paper are 49.8%, 45.1% and 3.1%, respectively.

× *Other Seller)*, *(Other Buyer* × *Other Seller* − *Other Buyer* × *Finnish Seller)* and *(Other Buyer* × *Other Seller* − *Other Buyer* × *Swedish Seller)*, the point estimates are 0.062, −0.003, 0.065 (=0.096−0.031), 0.091 (=0.096−(−0.005)), −0.095 (=−0.075−0.020) and −0.01 (=−0.075−0.085), and the p-values are all greater than 0.1. Furthermore, only two of the six point estimates have the expected sign. For the models using the different trade size categories, the p-values of all corresponding point estimates are also greater than 0.1. Thus the findings do not support Hypothesis I. The explanatory variables used in MODEL I to test Hypothesis II, i.e. that when brokerage houses trade with others having the same culture, they are more likely to trade stock of like-culture firms than that of unlike-culture firms, namely *((Swedish Buyer* × *Swedish Seller)* × *Traded Firm's CEO has Swedish Culture −Swedish Buyer* × *Swedish Seller)*, and *((Swedish Buyer* × *Swedish Seller)* × *Traded Firm's CEO has Swedish Culture−(Swedish Buyer* × *Swedish Seller)* × *Traded Firm's CEO has Other Culture)*, the point estimates are −0.1 (=−0.004−0.096) and −0.023 (=−0.004−0.019), and the p-values are greater than 0.1. Neither of the two point estimates have the expected value. The corresponding point estimates from the other models also have p-values greater than 0.1. Thus, the findings do not support Hypothesis II. The explanatory variables used in MODEL I to test Hypothesis III, that there is more cultural bias in trading when there is more chance of asymmetric information, namely *Average Daily Return Volatility*, × *Finnish Buyer* × *Swedish Seller*, × *Finnish Buyer* × *Other Seller*, × *Swedish Buyer* × *Finnish Seller*, × *Swedish Buyer* × *Swedish Seller*, × *Swedish Buyer* × *Other Seller*, × *Other Buyer* × *Finnish Seller*, and × *Other Buyer* × *Swedish Seller*, are 3.446, −0.115, −0.375, −0.675, 0.754, 0.735, 0.247, 0.109, and 0.240, and the p-values are all greater than 0.1. However, the first six of the nine point estimates have the expected value. The corresponding point estimates in other models have p-values greater than 0.1. Finally, the explanatory variable used in MODEL I to test Hypothesis IV, that stock brokerage houses prefer to buy from others that are more active sellers than itself for a given stock, *Log(No of Seller Sells / No of Buyer Sells)*, the point estimate is 0.001, and has the expected sign but the estimate's p-value is greater than 0.1. The p-values of the corresponding estimates in other models are also greater than 0.1. Hence the results do not support Hypothesis IV.

Therefore, the results of the multivariate analysis do not support any of the hypotheses being tested. The overall thrust of the results are consistent with broker trading behavior in the upstairs market being determined by idiosyncratic brokerage house specific, and stock specific factors. After controlling for these idiosyncratic factors, the study finds that brokerage house culture, and the culture of the traded firm has no effect on brokerage houses' trading behaviors. Thus the cultural effect Grinblatt and Keloharju (2001) document in the trading preference of investors does not exist in the trading preference of brokerage houses.

2.8 Discussion and Interpretation of Results

The lack of a culture effect in the trading behavior of brokers may be interpreted as being consistent with the assumption that brokers are professional market participants. The study supports the idea that cultural differences among brokers do not present an extra trading cost for brokers that would lead brokers to prefer trading with like-culture counterparties. The lack of a cultural preference may also be due to the close physical proximity of brokers to one another, as in the Helsinki Stock Exchange. In fact all brokerage houses in Finland are within walking distance of each other in the downtown area of Helsinki. This physical proximity may mean that brokers are already familiar with each other and that culture has no additional explanatory power in determining broker trading behavior. Moreover, despite the fact that brokers are in competition with each other for customers, brokers are also dependent on one other when making markets, i.e. in the upstairs market brokers need to shop around among other brokers in order to find the best price for their own customers. This business-related interdependence as well as brokers' personal familiarity with each other in a community of professionals may also explain the lack of a cultural bias observed in brokers' trading preferences.

The lack of a preference for trading the stock of a like-culture firm between two like-culture brokers implies two things, namely that investors are indifferent about the culture of the brokerage house they place their orders with, and that brokerage houses do not have a preference for trading like-culture firms with like-culture counterparties. Of course, if there had been a cultural bias, then it would be incumbent upon the study to differentiate between possible sources of this bias. Although it would be interesting to study whether or not there was such a bias at an investor level, instead of inferring this bias or lack thereof from the trading behavior of brokerage houses, it can be argued that such a study would yield no significant additional insight.

There is also evidence that potential information asymmetry between brokers for a particular stock does not affect brokers' likelihood of trading with like-culture counterparties. This is consistent with brokers not using the cultural identity of a counterparty to reduce potential adverse selection costs due to asymmetric information about the future price of a stock. The paper does not distinguish between causes of a change in the price of a stock. Such a price change can be due to a lack of liquidity or the release of new information. As the presence of asymmetric information imparts no cultural bias in a broker's choice of trade counterparty, it can be argued that neither of the possible causes of a price change have an effect. Hence, the lack of a broker's bias for like-culture counterparties when trading stock with a highly uncertain future price, can either mean that there are no information asymmetries that create adverse selection costs for the broker that could be lessened by trading with like-culture counterparties, or that cultural differences between the broker and counterparty brokers do not indicate the presence of inter-broker information asymmetry regarding the future price of the stock.

Brokers do not prefer to buy from others that are more active sellers in a particular stock than the broker itself. After controlling for effects of idiosyncratic trading activity between the buyer and seller, i.e. trading relationships, brokers do not concentrate their upstairs trading among a small number of highly active sellers. This is consistent with the average marginal cost of searching for an additional upstairs counterparty being small, and consistent with upstairs trading costs not having a significant variable component.

2.9 Conclusion

The paper examines cultural and other determinants of brokerage houses' choice of trading counterparties. The main result is that brokerage houses are indifferent to trading with like-culture counterparties. This is contrary to Grinblatt and Keloharju's (2001) finding that investors prefer to trade the stock of like-culture firms. Furthermore, there does not seem to be an investor level bias for placing orders with like culture brokerage houses, or a brokerage house level bias that makes brokers concentrate the trading of the stock of like-culture firms with like-culture counterparties. This finding is also contrary to investors' cultural bias as documented by Grinblatt and Keloharju (2001). There is no cultural bias in brokers' trading preferences caused by possible asymmetric information about the informativeness of order flow. And lastly, upstairs brokers do not concentrate their trading among a few large counterparties, which is consistent with the marginal cost of searching for additional counterparties being small.

This paper studied the effect of national culture on the trading relationships in the upstairs market on the Helsinki Stock Exchange, and found that such differences did not affect the trading relationships of upstairs market makers. Therefore this result can be interpreted to imply that cultural heterogeneity among broker-dealers of a country's upstairs market does not affect the trading relationships in that market.[10] More generally, this result implies that cultural 'home bias' for assets documented by papers such as Grinblatt and Keloharju (2001), and Hau (2001), seems not to occur in the trading relationships between market makers. Hence, while 'home bias' in general, and cultural 'home bias' in particular exist and seem to be relevant for the asset trading and holding behaviors of investors, they do not seem to exist and hence seem not to be relevant for the trading behaviors of the market making middlemen of the upstairs market. Another way to interpret the irrelevance of culture is in terms of the fragmentation of the upstairs market, so that while the upstairs market is fragmented in that market makers need to search for the best price, this fragmentation does not appear to have a national cultural dimension. Therefore differences in the national culture of upstairs market makers seem neither to increase the fragmentation of the upstairs market by increasing the search and trading relationship costs of the upstairs market, nor do they appear to reduce the

[10] Other examples of culturally heterogeneous stock markets include Toronto and Brussels.

fragmentation of the upstairs market such that upstairs market makers try to reduce agency costs (e.g. related to front-running) by trading with similar culture counterparties.

While this paper examined the trading behavior of brokerage houses based on the national culture of these brokerage houses, the determination of the national culture was done using the cultural origin of the name of the brokerage houses, and the country of the headquarters or parent company of the brokerage house, instead of the native language of the CEO or director of the brokerage house which would have been more consistent with the classification used in Grinblatt and Keloharju (2001). However, any misclassification is unlikely to be systematic and unlikely to affect materially the result that culture is irrelevant. Furthermore, idiosyncratic misclassifications are not likely to obtain the result that culture is irrelevant.

CHAPTER 3: HOW LOYAL ARE A BROKER'S CUSTOMERS?

ABSTRACT

This paper studies the existence and determinants of trading relationships between investors and individual brokers by analyzing events in which individual brokers moved from one brokerage house to another. The paper also studies the extent to which ex-ante measures of the strength of a trading relationship between the investor and his brokerage house, or individual broker, affect the investor's trading relationships with the old and new brokerage houses of the individual broker. The study also uses various investor characteristics, such as investor type and investor national culture as well as characteristics of the traded firm and the brokerage houses. It is found that customers do shift a statistically significant proportion of their trades to the new brokerage house when the individual broker switches. Existing relationships with the new brokerage house make it more likely that the customer will switch, supporting the hypothesis that investors incur costs when switching brokers. The new brokerage house attracts trading in stocks in which it is less active, consistent with the idea that the individual brokers are lured away by brokerage houses for their ability to increase their market share. There are mixed results on whether more savvy investors are more or less likely to switch to the new brokerage house. Female investors are more likely than male investors to switch to the new brokerage house, consistent with the hypothesis that female investors are more relationship-oriented. Finally, there is some evidence, although statistically insignificant, supporting the hypothesis that investors prefer to trade with like culture brokerage houses.

3.1 Introduction

How important are personal relationships? More precisely, how does the existence of personal relationships between market agents affect the agents' decisions to conduct business with each other? In order to study the importance of 'relationships', one must first define what is meant by the word 'relationship'. Webster's defines the word 'relationship' as "a state of being related". The American Heritage Dictionary defines a 'relationship' as ".. a condition or fact of being related", as "a connection or association", and more specifically as ".. a particular type of connection existing between people related to or having dealings with each other." While historically the study of relationships between people has been central to disciplines such as psychology, sociology, and even to business disciplines such as organizational behavior and human resources, and to marketing, the relationship between market agents as the term applies to the fields of economics and finance has not been investigated in its own right, but rather it has been used to motivate certain assumptions in theoretical settings and the term 'relationship' has been used to describe specific arrangements, for example the close business relationship a bank has with the individuals and institutions it lends to, is referred to as a 'lending relationship' or as 'relationship banking'. In this setting the assumption of the existence of a relationship motivates the widely accepted belief that banks learn about the type of their customers by lending to them, monitoring their actions and updating their prior beliefs based on what they observe.

The effect social or human capital may have on the theory of the firm has also been acknowledged by Rajan and Zingales (2000) as well as Zingales (2000). Zingales (2000) points out that the traditional theory of the firm needs to be revised to recognize the fact that many of today's firms, including but by no means limited to those in the high-tech industry, are more aptly defined in terms of the human capital they possess than in terms of their physical assets, which unlike the latter are difficult to control by traditional methods of corporate governance. The author gives the advertising firm Saatchi and Saatchi as an example of what can happen when such traditional governance methods are used. Namely, in 1994 the US fund manager equity holders of this company voted against the proposal of an arguably undeserved but generous option package for the management, which resulted in the departure of the chairman and top executives of the firm, who subsequently regrouped under a new name, and captured some of the most important clients of their former company. In this example, it can easily be argued that the close business relationships the Saatchi and Saatchi managers had with the firm's clients as well as the expertise of the managers contributed to the latter groups' ability to take a sizeable part of the firm value away from the firm's owners.

In the fields of business, sociology and political science the concept of 'social capital' has attracted a great deal of attention lately. Burt (2000) defines social capital as ".. the contextual complement to human capital", and continues "... Certain people or certain groups are connected to certain others, trusting certain others, obligated to support certain others, dependent on exchange with certain others. Holding a certain position in the structure of these exchanges can be an asset in its own right." DeMarzo, Vayanos and Zwiebel (2001) have formalized in a bounded-rationality framework, the concept of social influence and social networks and their influence on the opinion formation of agents. The authors show that under the assumption that agents cannot tell whether they have been exposed to a particular opinion before, due to their bounded rationality, their posterior beliefs are biased toward these 'double-counted' opinions. This is defined by authors as 'persuasion bias' that arises in their model from the social network hierarchies in which the opinions of agents higher up in the network are multiplied further down the hierarchy. The definition of persuasion used in DeMarzo, Vayanos and Zwiebel (2001), that repeated exposure to an opinion biases the beliefs of the listener toward the opinion, is also consistent with the concepts of trust and trusting business relationships among economic agents.

This paper uses a unique data set to study the strength of the business relationship between a brokerage house, and its customers. Specifically, it studies the determinants of a change in a customer's trading relationship with a brokerage house when an individual broker of the brokerage house changes jobs, i.e. moves to another brokerage house. The paper investigates whether various characteristics of the customer, the old brokerage house, the new brokerage house, the job-switching individual broker, the stock, trade direction, and market venue (upstairs or downstairs) affect the customer's proportion of trading with the brokerage house.

Studies on the switching costs of economic agents, as reviewed by Klemperer (1995), imply that a business relationship with one's broker generates costs for an investor if the investor decides to use another broker. Thus, a utility maximizing investor should prefer to trade with a broker already familiar to him or with whom the investor already has a business relationship. In the scope of the interaction between an investor and his broker, switching costs can arise for the investor from the need to communicate his trading preferences to the broker. Grossman (1992) argues that it is prohibitively costly for an investor to reveal his demand for a stock to the market by continuously trading, and that an investor instead can communicate (costlessly) his demand schedules for the stock to an upstairs market broker, who acts as a repository of information about the investor's unexpressed demand. However, due to an unavailability of investor and broker level data, the nature and strength of the business relationship between investors and their brokers has not yet been studied empirically. Furthermore it is unclear if the business relationship exists at an individual broker level or at a brokerage house level. In theoretical models of the upstairs market, where brokers are assumed to have a relationship with their customers, no distinction is made between individual brokers and brokerage houses.

This study finds that a customer's pre-existing relationship with the new brokerage house increases (decreases) the customer's trading with the new brokerage house (old brokerage house) after the individual broker moves to the new brokerage house. This finding is consistent with the existence of switching costs for a customer, such that a customer's existing relationship with the new brokerage house reduces the costs of switching for the customer, and makes it more likely that he will switch his business away from the old brokerage house to the new brokerage house, when the individual broker moves. Interestingly, the proportion of a customer's trading done through the individual broker prior to the broker's move to the new brokerage house, does not appear to affect the trading proportions of the customer after the individual broker moves. This implies that the proportion of a customer's trading done by the individual broker is perhaps not an adequate measure of the business relationship with the individual broker. In fact, individual brokers that have the closest relationships with customers tend the be sales brokers who often delegate the execution of their customers' trades to other brokers. The finding that an investor's switch to the new brokerage house may have less to do with maintaining the relationship with the switching broker than with increasing an existing relationship with the new brokerage house, is consistent with the finding of Anand (2002) that specialist firms can provide a uniform quality of execution out of the extremely diverse quoting behavior of individual specialists.

This study analyzes the changes in the proportion of a customer's trading business received by both the old and new brokerage houses, i.e. both the house which loses the individual broker dealer and the house that gains the individual broker. If there is a strong business relationship between a customer of the brokerage house and the switching individual broker, then the customer's proportion of trading conducted by the (old) brokerage house should decrease after the individual broker leaves, whereas the customer's proportion of trading conducted by the new brokerage house should increase after the individual broker begins working for the new brokerage house. If relationships with the individual broker are weak or non-existent, then a customer's proportion of trading should not change for either the old or the new brokerage house. The study uses a unique data sample during which 11 individual brokers stopped trading at one brokerage house and began to trade at another, i.e. switched from one brokerage house to another. The study identifies the customers of switching brokers and their old brokerage houses, and estimates multivariate models to explain changes in the proportion of a customer's trading after the switch. The study uses various cross-sectional characteristics of investors, characteristics of the old and new brokerage houses and the individual broker involved in the switch, as well as characteristics of the market and the traded stock, to explain changes in customers' proportions of trading with the old and new brokerage houses.

The rest of the paper is organized as follows. Section 3.2 reviews the literature. Section 3.3 introduces the research questions and the hypotheses to be tested. Section 3.4 describes trading on the HSE, the HETI and FCSD Data Sets, and the classification of individual broker switching events. Section 3.5 presents descriptive statistics. Section 3.6 analyzes the effect of individual broker switching on the customers' percentage of trading with the individual brokers old and new brokerage houses. Section 3.7 introduces a multivariate model framework to study the effect of pre-existing business relationships, and investor characteristics on customer trading proportions when individual brokers switch brokerage houses, and defines the proxy variables being used. Section 3.8 introduces the results. Section 3.9 interprets the results and discusses the implications for the theory. Finally, Section 3.10 concludes.

3.2 Literature Review

The literature review is organized into three main subject areas, economic relationships, the role of an upstairs market, and order flow internalization and preferencing. Overlaps of subject matter among these different areas are also highlighted.

3.2.1 Economic Relationships

This section reviews the literature on the treatment of relationships between economic agents, and the types of information and other problems these relationships are presumed to alleviate or cause.

Intermediary Relationships (Banking)

Studies involving banking relationships in the banking and financial intermediation literature have recently become more and more common. Relationship banking can be defined as the provision of lending, and other services to customers by financial intermediaries, where the intermediary obtains proprietary borrower-specific information during repeated transactions with the borrower. Such borrower-specific information is typically assumed to include the profitability of a borrower's projects, and the effort of the borrowing firm's entrepreneur, etc. The ability of banks and other financial intermediaries to collect information that is not publicly available, i.e. proprietary, is often cited as one of the major differences between financial intermediaries such as banks and the public debt markets. Boot (2000) mentions that relationship banking is a response to problems of asymmetric information in financial intermediation.

Diamond's (1984) seminal paper on financial intermediation involves an intermediary that raises funds from depositors and uses these funds to make loans to entrepreneurs. The model relies on the assumption of costly information and the ability of banks to monitor the loans given to entrepreneurs and to learn project cash flows otherwise known only to entrepreneurs. This gathering of proprietary information is therefore accomplished through costly monitoring, which underlies relationship banking. The paper shows that a world with financial intermediation reduces the expected costs of monitoring relative to a world without such intermediation. Without financial intermediaries, each lender must either monitor the entrepreneurs and their projects, or be faced with a free-rider problem where they don't make loans in equilibrium. Thus, financial intermediaries eliminate the duplication of effort in monitoring, and facilitate the funding of profitable projects.

Diamond (1991) develops a repeated game model of reputation and monitoring and shows that bank lending can solve moral hazard problems of project choice. The main result of the paper is that bank monitoring can reduce borrower moral hazard by allowing borrowers (entrepreneurs) to develop reputations of creditworthiness, which can reduce the cost of borrowing. Thus, firms that develop higher credit ratings prefer to borrow from banks as opposed to the publicly placed debt market. In Allen (1990) and Ramakrishnan and Thakor (1984), banks collect proprietary information from borrowers when screening low quality borrowers. However, lending relationships in banking, while they can alleviate asymmetric information problems, can also create other types of problems. Rajan (1992) uses the assumption that a bank lending relationship allows the bank to learn about the cash flows from a firm's project, which reduces the asymmetric information problem the bank faces relative to other lenders. However, this means that the bank can extract rents from the borrower to allow the continuation of a positive NPV project, which creates a moral hazard problem, in that the borrower exerts less than the maximum effort. Therefore, lending relationships can reduce asymmetric information problems for the bank but in doing so can cause moral hazard problems.

The importance of intermediary relationships is not confined to the banking industry, however. Private equity markets, such as venture capital markets also rely heavily on relationships between the venture capitalist and entrepreneur. A venture capitalist learns about the entrepreneur and his project on an ongoing basis and continually updates the payoffs expected from the project, and if necessary abandons the project. Gompers (1995) finds empirical evidence suggesting that the staging of capital allows the venture capitalist to learn about the entrepreneur and his project. Hence, the role of staging in venture capital is similar to the role of lending in the banking literature, in that potential information asymmetries about the entrepreneur's or borrower's project are resolved by the repeated interactions of the capital staging or lending relationship. Fenn, Liang and Prowse (1997) provide a comprehensive survey of the venture capital market.

Dealer and Broker Relationships (Market Microstructure)

The market microstructure literature has used assumptions about relationships between brokers and dealers and their customers in various theoretical models.

Benveniste, Marcus and Wilhelm (1992) study the importance of professional relationships between floor brokers who act on behalf of traders, and the specialists who conduct the trades. They show that these relationships, by allowing specialists to identify the floor brokers with whom they trade, can alleviate the asymmetric information problem between these market participants, thereby reducing the costs to trade for uninformed traders and under certain conditions that of the informed as well. The authors' basic intuition involves the fact that floor brokers such as exist on the NYSE trading floor can have relationships with specialists, much the same way that dealers in an upstairs market knowing the identities of their customers can screen informed trades. This would indicate that professional relationships among the dealers of an upstairs market could also serve an information screening purpose. However, since the upstairs market already screens informed traders, due to the fact that informed traders are known to the upstairs dealers and therefore prefer to trade anonymously in the downstairs market, it is not clear whether an asymmetric information problem such as the one in Benveniste et al. (1992) would exist among upstairs market dealers. Benveniste et al. (1992) also state that reputation effects among the brokerage houses and the dealers of a brokerage firm would limit the dealers' incentives to conceal private information when trading with each other.

This would imply that a professional relationship if it did exist among dealers of an upstairs market would not be justifiable on the basis of certifying trades as uninformed.

Hansch, Naik and Viswanathan (1998) use the data available on the inventories of the dealers operating on the London Stock Exchange, to test the inventory control hypothesis of Ho and Stoll (1983), and to study the effect of dealer inventory levels on interdealer trading behavior. The authors find strong support for Ho and Stoll (1983), and find that inventory imbalances motivate interdealer trading, which emphasizes the importance of interdealer trading in the management of large dealer inventories, such as exist for the dealers active on the LSE.

3.2.2 The Upstairs Market and Relationships

The term 'upstairs market' refers to the decentralized trading environment created among broker-dealers where block trades are negotiated on behalf of counterparties known to the brokers. A few theoretical and some empirical papers study the various features of upstairs markets. Seppi (1990) develops a multi-period model of block trading and finds that traders who can credibly signal that their trades are not information based prefer to trade in the upstairs market. Grossman (1992) argues that the upstairs market is a repository of information about the unexpressed demand of investors and that this feature enhances the liquidity provided by the upstairs market. Using a dataset of block transactions in Dow Jones stocks on the NYSE, Madhavan and Cheng (1997) show that the downstairs market contributes significantly to liquidity in these stocks, but that the upstairs market provides better execution than the downstairs market, although the difference is not economically significant. However, the authors do find support for Seppi's (1990) hypothesis that uninformed traders prefer to trade in the upstairs market.

Keim and Madhavan (1996) find that information leakage occurs in the upstairs market prior to a trade, and that a concave relationship exists between trade size and the temporary price impact of liquidity. Booth, Lin, Martikainen and Tse (2001) find that upstairs trades have less information content and lower price impact than downstairs trades, which is consistent with Seppi (1990) and Grossman (1992). The authors also find that price discovery occurs in the downstairs market, and that the downstairs market is used to set trade prices in the upstairs market. Smith, Turnbull and White (1999), show that brokers in the upstairs market successfully filter out information-based trades, reducing the adverse selection costs relative to the downstairs market, which supports Seppi (1990). It is also found that trading in the upstairs market is more likely during times when liquidity is low in the downstairs market.

Therefore the extant literature supports the hypotheses that trading relationships between the upstairs market makers and traders give market makers the ability to improve liquidity by screening informed trades and that such relationships also allow market makers to learn about the unexpressed demand schedules of investors who use the upstairs market.

3.2.3 Order Flow Preferencing and Internalization

Hansch, Naik and Viswanathan (1999) demonstrate that the broker practices of preferencing and internalization do not lead to higher spreads being paid by investors and this contradicts the collusion hypothesis, but agrees with the hypothesis that searching and trading relationships in the upstairs market are costly. Therefore, the study refutes claims that preferencing and internalization indicate tacit collusion among dealers.

3.3 Research Questions (Hypotheses)

How strong is the business relationship between an investor and his broker? Business relationships may develop between investors and their brokers, both at the brokerage house and individual broker level, as a result of the cost of communicating an investor's trading preferences to a new broker. Grossman (1992) argues that upstairs brokers through their continuing relationship learn the trading preferences of their customers, defined by the author as the customers' unexpressed demand. This reduces the costs of trading in the upstairs market for the broker who can pass the savings on to the customer. Another reason for an investor to develop business relationships with a broker is to reduce agency costs associated with the investor's inability costlessly to monitor the broker and to verify that the broker is finding the best price. Therefore if a pre-existing business relationship with a broker reduces such costs, an investor is more likely to continue to maintain these relationships. Hence if an investor has a close business relationship with an individual broker at a brokerage house, the investor can be expected to continue the relationship even after the broker quits and moves to another house. Similarly, a close business relationship with the switching broker's old brokerage house can make it less attractive for an investor to continue the relationship with his individual broker after the broker switches to the new brokerage house. Also, a pre-existing relationship with the switching broker's new brokerage house may make it more likely that the investor will follow his broker to the new brokerage house.

The proportion of an investor's trading during the estimation period (i.e. 30 calendar days of trades 60 days before the broker leaves) by trade value via the old brokerage house, excluding the trades of the switching broker, via the new brokerage house, and via the switching broker, proxy for the ex-ante relationships between the investor and other brokers at the old brokerage house, the investor and the new brokerage house, and the investor and the switching broker, respectively.

Therefore the first hypothesis is: *Hypothesis 1 = Trading relationships affect investors' likelihood of switching.*

Hypothesis 1 is split into three sub-hypotheses, defined as follows.

After the broker leaves the old brokerage house, an investor having a higher ex-ante proportion of trading with the old brokerage house (excluding switching broker) should show a smaller decrease in his proportion of trading with the old brokerage house, and a greater increase in his proportion of trading with the new brokerage house. For example, this is consistent with an investor who does 30 percent and five percent of ex-ante trades (by volume) via the old and new brokerage houses, respectively, shifting a substantial 20 percent of his ex-post proportion of trades from the old to the new brokerage house, and another investor who does 80 percent and five percent of ex-ante trades via the old and new brokerage houses, respectively, shifting only three percent of his ex-post proportion of trades from the old to the new brokerage house. Therefore:

Sub-hypothesis 1a = Investors having stronger ex-ante trading relationships with other brokers in the old brokerage house are less likely to switch with broker (higher switching cost).

The greater is the investor's ex-ante trading relationship with either the new brokerage house, or the switching broker, the lower should be the cost of shifting order flow to this new brokerage house. Hence, an investor having a higher ex-ante proportion of trading with either the new brokerage house or the switching broker, however, should show a larger decrease in his proportion of trading via the old brokerage house after the broker leaves. This is consistent with an investor who does 20 percent of his ex-ante trades (by volume) via the new brokerage house, increasing his ex-post proportion of trades through the old brokerage house a lot to 30 percent, and another investor who does ten percent of his ex-ante trades via the new brokerage house, increasing his ex-post proportion of trades through the new brokerage house only slightly to 11 percent.

The ex-ante measures of an investor's relationships should also affect the proportion of trading done by the new brokerage house after the broker starts working at the new brokerage house. Therefore, after the broker starts working at the new brokerage house, an investor having a higher ex-ante proportion of trading with the old brokerage house (excluding the switching broker) should show a smaller increase in his proportion of trading with the new brokerage house. This is consistent with an investor who does 30 percent of his ex-ante trades via the old brokerage house and ten percent of his ex-ante trades (by volume) via the new brokerage house, increasing his ex-post proportion of trades through the new brokerage house a lot to 20 percent, and another investor who does 80 percent of his ex-ante trades via the old brokerage house and also ten percent of his ex-ante trades via the new brokerage house, increasing his ex-post proportion of trades through the new brokerage house only slightly to 11 percent. There are therefore two additional hypotheses:

Sub-hypothesis 1b = Investors having (stronger) ex-ante trading relationships with switching broker are more likely to switch with the broker (lower switching cost),

and, also:

Sub-hypothesis 1c = Investors having stronger ex-ante trading relationships with brokers in the new brokerage house are more likely to switch with the broker (lower switching cost).

If the upstairs market is more likely than the downstairs market to foster a trading relationship, as the literature argues, then investors trading mainly in the upstairs market should be more likely to continue the relationship than investors trading mainly in the downstairs market. At the HSE, however, all customer orders to trade in the sample period under study are received by brokers, who then decide on the venue for the trade (upstairs or downstairs). This means that brokers always know the identities of investors who place orders through the broker. However, brokers typically spend less time trading in the downstairs market than finding a counterparty in the upstairs market, and still should be able to develop closer relationships with investors whose orders are worked more frequently in the upstairs market. Therefore:

Hypothesis 2 = Upstairs market investors develop closer business relationships with the broker, and are more likely to switch with the broker.

The ability of a broker to provide liquidity affects his ability to attract order flow. Hence, a brokerage house or individual broker that is dominant in the trading of a stock in the market, and is dominant in providing liquidity in that stock, should be more likely to attract order flow from investors. This is also consistent with the idea that markets (and brokers) are networks having positive externalities, such that the benefit for an investor of trading in a market (or via a broker) goes up with the number of investors using the market (or the broker). Furthermore, a broker that is dominant in the trading for a stock is also more visible to investors, and is likely to have a high degree of investor recognition and therefore likely to attract a lot more order flow. This is similar to the investor recognition theory of Merton (1987), that investors invest only in stocks they have heard about. Therefore, the main hypothesis is:

Hypothesis 3 = Brokers' market dominance affects investors' likelihood of switching.

Hypothesis 3 is split into three sub-hypotheses as follows:

Hypothesis 3a = Investors are less likely to switch with the broker if the old brokerage house (excluding the switching broker), is more dominant in the stock,

Hypothesis 3b = Investors are more likely to switch with the broker if the broker is more dominant in the stock,

and, also:

Hypothesis 3c = Investors are more likely to switch with the broker if the new brokerage house is more dominant in the stock.

The data set identifies six different classes of investors, namely, households, and financial, non-financial, governmental, non-profit, and foreign institutions. In Grinblatt and Keloharju (2001), financial and non-financial institutions are assumed to be savvy, or sophisticated, while governmental, and non-profit institutions and households are assumed to be unsavvy, or unsophisticated investors. Institutional investors are generally assumed to be more sophisticated than individual (household) investors. In theoretical models of market microstructure institutional traders are assumed to be informed traders, whereas individual traders are the liquidity or uninformed traders. If institutional traders have more complicated trading preferences than individual traders, they are more likely to develop close relationships with their brokers, and given the greater cost of conveying these preferences to a new broker, they should prefer to continue such relationships.

Institutional investors such as mutual funds that rebalance their portfolios due to liquidity needs and not due to private information may also be considered unsophisticated, at least for liquidity motivated trades. However, it is possible that institutional investors while not being informed for every trade, may still be more sophisticated on average than individual investors. In fact, Grinblatt and Keloharju (2000) find strong evidence that Finnish households are less sophisticated investors than are Finnish institutions, where the performance of an investor's stock portfolio after controlling for the investment strategy (i.e. momentum or contrarian) is used as a measure of investor sophistication.

Hence, a savvy investor is likely to have more complicated trading preferences than an unsavvy one, and hence likely to develop closer business relationships with brokers in order to reduce the cost of being present in the market, which is consistent with Grossman's (1991) assertion that (upstairs) market makers learn the unexpressed demand of customers. A savvy investor may also be less dependent on relationships with particular individual brokers, and likely to have relationships with many individual brokers at a brokerage house. Hence more (less) savvy investors may be less (more) biased toward the (switching) broker and therefore less (more) likely to switch with a particular individual broker to a new brokerage house.

Hence two non-mutually exclusive and competing hypotheses can be formed regarding how savviness affects investors' switching behavior:

Hypothesis 4: Less savvy investors are (more) biased toward the broker, and are more likely to switch with the broker, and, *Hypothesis 5: Less savvy investors have simpler trading preferences, and are less likely to switch with the broker.*

These non-mutually exclusive and competing hypotheses are further subdivided into non-mutually exclusive and competing sub-hypotheses, each of which tests the main hypotheses in each of the different investor classes.

Grinblatt and Keloharju (2001) argue that household investors are less savvy than institutional investors, in that they are biased toward the familiar. Therefore, households should be more attached to their brokers and hence more likely to switch with their brokers than institutions. Hence:

Hypothesis 4a = Households are less savvy than institutions and more biased towards the broker, and are more likely to switch with the broker.

However, as households are likely to have less complicated trading preferences than institutions, they are less dependent on their brokers and therefore are less likely to switch with their brokers. The competing hypothesis is:

Hypothesis 5a = Households have less complicated trading preferences than institutional investors, and are less likely to switch with the broker.

Grinblatt and Keloharju (2001) regard financial and non-financial institutions as savvy and households as unsavvy. Thus, savvy institutions should be less biased toward their brokers and hence less likely to switch with their brokers than household investors. Hence:

Hypothesis 4b = Financial and non-financial institutions are more savvy (than households), and less biased toward the switching broker, and are less likely to switch with the broker.

Also, as financial and non-financial institutions are savvy, they are likely to have more complicated trading preferences than households, and are more dependent on the switching brokers and are more likely to switch with the brokers. The competing hypothesis is:

Hypothesis 5b = Financial and non-financial institutions are more savvy (than households) and have more complicated trading preferences, and are more likely to switch with the broker.

The paper also tests the differences between savvy and unsavvy institutions regarding their tendencies to switch with brokers. Thus, savvy institutions should be less biased toward their brokers and hence less likely to switch with their brokers than unsavvy institutions. Hence:

Hypothesis 4c = Governmental and non-profit institutions are less savvy than financial and non-financial institutions and more biased toward trading with the broker, and are more likely to switch with the broker.

As governmental and non-profit institutions are unsavvy, they are likely to have less complicated trading preferences than households, and are less dependent on their brokers and are less likely to switch with their brokers. Hence, the competing hypothesis is:

Hypothesis 5c = Governmental and non-profit institutions are less savvy than financial and non-financial institutions and have less complicated trading preferences, and are less likely to switch with the broker.

Investors' biases toward brokers may also be gender based. Therefore, male investors may have stronger relationships with individual brokers who are typically male, than female investors do. Thus:

Hypothesis 6 = Male investors have stronger relationships with (male) brokers than female investors (i.e. gender bias) do, and are more likely to switch with the broker.

It is often argued that females in general tend to be more emotional than males, and that females are more relationship oriented than males. If so, then male investors should be less likely to switch when the broker switches than female investors do. Hence, the hypothesis that is non-mutually exclusive and competing with Hypothesis 6 is:

Hypothesis 7 = Male investors are less relationship-oriented and have weaker relationships with brokers than female investors do, and are less likely to switch with the broker.

Cultural familiarity with a brokerage house may also affect an investor's decision to do business with a brokerage house. Brokerage houses in the sample are identified by name and headquarters location as being of Finnish or Swedish cultural origin. If investors prefer same culture brokerage houses, an investor having the same culture as an old brokerage house is less likely to switch to a different culture new brokerage house than an investor that has the same culture as the new brokerage house. The last hypothesis to be tested therefore is:

Hypothesis 8 = A Finnish customer of a Finnish culture old brokerage house, is less likely to switch with the broker to a Swedish culture new brokerage house, than a Swedish culture customer of the old brokerage house.

3.4 Description of Trading on the HSE, the HETI and FCSD Data Sets, and the Classification of Individual Broker Switching Events

The data consists of all trades of firms continuously and publicly listed on the Helsinki Stock Exchange during the period Jan 1, 1996 to December 31, 1997. In 1990, the HSE adopted the Helsinki Stock Exchange Automated Trading and Information Systems, otherwise known as the HETI. In the years subsequent to its adoption of the HETI, the HSE grew both in the number and volume of its listings. The downstairs and upstairs markets at the HSE are linked to the HETI system, in that all trades are recorded on the HETI system and the information is made available instantly to the public. The downstairs market of the HSE, which is a part of HETI, is essentially an open electronic limit order book that is continuously updated with the limit orders of customers who retain their anonymity in the HETI system, and where orders are matched according to price and time priority. The upstairs market consists of authorized broker dealers of brokerage houses who upon receiving a customer order to trade look for trade counterparties, finding them either among their own customers or among the customers of other broker dealers either in the same or in a different brokerage house.[11] Trading on the HSE occurs during one of three trading periods each day, namely, the pre-trading, free-trading and the after-market trading periods. During the first twenty minutes of the pre-trading period, beginning at 8:30 a.m. each day, traders announce bid and offer prices, after which the HETI system matches orders and executes transactions from 9:50 a.m. to 10:00 a.m. Any unexecuted portions of orders are then transferred to the free-trading period. During "free-trading", a continuous trading session beginning at 10:00 a.m., customers can submit their orders via the brokers. If the customer does not express a preference for the trading venue, i.e. upstairs or downstairs, then the broker chooses the venue at his discretion. The upstairs trade occurs in the office of one of the authorized brokerage firms and is reported in a timely manner to the HETI system. The

[11] There were 25 brokerage houses actively trading on the HSE as of the end of 1997.

free-trading round lasts until 5 p.m. each day, after which there are two after-market trading sessions, one from 5:05 p.m. to 6:00 p.m., and the other from 8:00 a.m. to 8:25 a.m. of the following day. The after-market is distinguished from the free-trading period by the fact that the HETI system is closed, and that all trades must therefore occur in the upstairs market. Trades during the after-market periods are required to occur inside the price range bracketed by the greater of the highest transactions price of the trading day and the closing ask of the free-trading session, and the smaller of the lowest transactions price of the trading day and the closing bid of the free-trading session. Appendix A shows the list of share classes, 85 in total corresponding to 67 firms in the sample. As in Grinblatt and Keloharju (2000), the share classes are treated as separate stocks. Grinblatt and Keloharju (2000) point out that the different share classes of a particular company reflect different voting rights, i.e. the more liquid share class have fewer votes, and by Ilmanen and Keloharju (1997) this gives rise to different clienteles of share ownership.

The FCSD, or Finnish Central Securities Depository keeps an electronic database of investor share ownership and trading, called the Book Entry System, which contains records of each investor's initial shareholdings of HEX listed (public) companies, as of January 1, 1995, and all changes of share ownership that occur between January 1 1995, and May 31, 2000. The FCSD's Book Entry System contains investor ID numbers which identify uniquely Finnish individual and institutional investors as these investors are required to register their holdings under their own names. As the registration for foreigners is less strict, and can be done in a street name, a single ID number typically represents many foreign individuals. The Book Entry System also contains share class, which identifies both the share type and the company whose shares are being traded, the number of shares, and type of ownership of which only private (Finnish) and nominee registered (foreign) ownership types are meaningful. The data set used in the study is composed of two data sets, the HETI transactions data set for the years 1996 to 1997, inclusive, which contains codes for brokerage houses and individual brokers, and trading venue (upstairs and downstairs markets), and the FCSD's Book Entry System. The matching algorithm is rather complicated, where for each trading day, and in each stock, one or more buyers of a stock are paired with one or more sellers, such that the buyers' total trade quantity and the average transaction price equal the sellers' total trade quantity and average transaction price, which must also equal the trade volume and price of a transaction reported in the HETI transactions data set. As not all entries in the FCSD data set could be unambiguously (uniquely) matched with counterparts in the HETI data set, about half of the HETI transactions were discarded, leaving over 420,000 transactions for the years 1996 and 1997. An analysis of the matching results, as shown in Table 3.2, indicates that trades of more active stocks were less likely to be matched successfully. For example, on average, 74.4% of the trades of the nine least active stocks and 34.6% of the trades of the four most active stocks were matched successfully. Furthermore trades of stocks on more active days were also less likely to be matched successfully. This is because an increasing number of trades per day in the HETI data set increases the number of possible combinations of FCSD records that match each HETI trade, and thus reduces the likelihood of a unique match.

In the sample data set, the broker code of each of 20 individual brokers became disassociated with one brokerage house code and later became associated with another brokerage house code. In the case of brokerage house ABB, all seven of the house's individual broker codes abruptly became disassociated with the house's code, one of which became associated with the house code ALF five months later, while the remaining six became associated with the house code ARO a few days later, which prior to the association of the first individual broker, did not exist in the data. This systematic reassociation of individual broker codes is consistent with a name change of the old brokerage house subsequent to a merger or a takeover, and these events are thus excluded from this study. Additionally, all three of the remaining individual broker codes of the house SEL became disassociated with the house code SEL and became associated with the codes for houses CAR, and ARC, both of which existed in the data set prior to the switching of the three individual broker codes. After the three switching events, the house code SEL ceased to exist in the data set. This would be consistent with brokerage house SEL terminating its operations and the individual brokers finding employment at the brokerage houses CAR and ARC. Of the remaining 11 individual brokers, two left brokerage house SEL six months before and one left SEL a year before the house terminated its operations. As six months is more than sufficient for the purpose of the study, these switching events are not discarded from the data set. The old brokerage houses of the remaining seven switching brokers on the other hand continued their operations until the end of the sample period. Therefore, the study considers these 11 cases of reassociation of individual broker codes with new house codes, i.e. individual broker switching events.

3.5 Descriptive Statistics

Panel A in Tables 3.4 and 3.5 (Tables 3.6 and 3.7) show the percentages by value of customers' downstairs and upstairs trades, respectively, done by the old brokerage house (new brokerage house) for each switching event and for each relative period, t, where $t = -i$, is the ith month before the broker's last trade at his old brokerage house, and $t = j$ is the jth month after the broker's first trade at his new brokerage house. Panel B in Tables 3.4 to 3.7 show the means of the percentages by value of the trades and the change in the means of the percentages after a broker leaves the old brokerage house (t=0) and after the broker begins to work at the new brokerage house (t>0), relative to the periods when the broker is still working at his old brokerage house (t<0). The data sample used for Tables 3.4 to 3.7 is restricted to the three most active stocks in the data set, as customers do not trade less active stocks each month. The customers in Tables 3.4 to 3.7 are defined as investors who have traded at least once in the trading venue (upstairs or downstairs) and via the brokerage house (old or new) in question during the earliest trading month for the brokerage house, i.e. January 1996. Therefore Tables 3.4 to 3.7 examine the mean trading percentages and changes in mean trading percentages for the same group of customers throughout the entire sample. In Table 3.4 Panel B all of the changes in the percentage mean are negative. In the *All Events* section of Table 3.4 Panel A, the negative change in the mean percentage from *t=-1,-2 to t=1,2*, of 14.9% and from *t<0 to t>0*, of 5.7% are both significant at the 0.05 level, implying that on average customers reduce their proportion of downstairs trades done through the old brokerage house, when the individual broker switches. Similarly, in Table 3.5 Panel B, all changes in the mean percentage are negative, and in the *Events with at least 4 months of observations* section, the negative change in the mean percentage from *t=-4 to -1 to t=1 to 4*, of 12.9% is significant at the 0.05 level, implying that on average customers also reduce their proportion of upstairs trades done through the old brokerage house.

Furthermore in the *All Events* section of Table 3.6 Panel B, the positive change in the mean percentage from *t<0 to t>0*, of 3.1% is significant at the 0.05 level, implying that on average customers increase their proportion of downstairs trading done through the new brokerage house, when the broker switches. The corresponding statistic in Table 3.6 Panel B is 1.5% and significant at the 0.1 level, implying that for upstairs trades, the average increase is half as much as that for the downstairs trades. This appears to contradict the theory that investors trading in the upstairs market form closer relationships with brokers. However, it is also possible that investors using the upstairs market have weaker relationships on average with switching brokers, than investors using the downstairs market. This may be due to switching brokers being less active in the upstairs market, and hence forming weaker relationships with customers using the upstairs market, but this appears not to be the case. Table 3.3 shows a comparison of statistics measuring the presence of individual switching brokers in the upstairs market to the respective statistics for the median individual broker of the switching broker's old brokerage house, prior to the broker's switch. As can be seen, eight out of eleven of the switching brokers, are more active than the median in terms of the average daily volume traded in the upstairs market (fourth column), but only six out of the eleven are more active than the median in terms of the average daily number of trades (third column). As they are among the more active upstairs brokers, switching brokers are likely to be sales brokers and have close relationships with customers. However, in terms of the presence in the upstairs market relative to the entire market as measured by the average percentage of daily number of trades, and average percentage of daily volume, only four, and two of the eleven switching brokers are more active than the median, respectively. This means that while switching brokers are more active than the median in absolute terms, in percentage terms they tend to be less active than the median. This means that switching brokers are also more active in the downstairs market in absolute terms than the median broker, and as the average shift in the proportion of a customer's business done via the upstairs market is only half that via the downstairs market, this may mean that brokers in general and switching brokers in particular develop closer relationships with customers using the downstairs market. Although this appears to contradict the theory of Seppi (1990) and Grossman (1992) that relationships develop in the upstairs market but not the downstairs market, it is reasonable in the context of the customer-broker relationship on the HSE. This is because brokers active on the HSE know the identities of all customers, as most customers telephone in their orders and typically leave the decision of market venue up to the broker. Therefore, in both the upstairs and downstairs markets of the HSE, brokers know the identities of customers and can develop relationships with them.

3.6 An Analysis of the Effect of Individual Broker Switching on Customers' Percentage of Trading with the Individual Brokers Old and New Brokerage Houses

This section analyzes the effect on the trading activity of a brokerage house's customers when an individual broker of the brokerage house leaves to work at another brokerage house. If the relationship between customers and their brokers is at the brokerage house level, then the leaving of an individual broker should not affect the business that the brokerage house receives from its customers. If on the other hand, some customers prefer to do business with a brokerage firm at least partly because of their relationship with an individual broker, then one should expect these customers to have a weakened preference for doing business with the brokerage house of their preferred individual broker if the broker quits this brokerage house. Moreover, if the broker subsequently begins to work for another brokerage house, his customers should then show a stronger preference for trading with the new brokerage house of the broker. This implies that from a switching costs perspective, a customer of a switching individual broker faces a higher utility cost when switching to a new brokerage house than when switching to a different individual broker at the same brokerage house. Anecdotal evidence from brokers at the HSE suggests that an individual broker is likely to be hired away from his brokerage house by a competing brokerage house hoping to attract the business of the broker's customers. Although it is known that such predatory hiring practices occurred among HSE brokerage houses during the sample period used in the study, only 11 switching brokers were identified in the two year sample used in this study. However, as the study examines the determinants of the customers' trading behavior after the switch, and the switching brokers had a total of 362 customers prior to the switch, the size of the sample size is sufficiently large. Furthermore, the finding of 11 brokers who switch in non-overlapping periods means that each broker switch is likely to be independent of cross-sectional effects from other broker switches. For example, if two brokers leave two different brokerage houses and move to the same new brokerage house, then it would not be possible to attribute an increase in an investor's proportion of trading with the new brokerage house uniquely to a single switching broker.

3.6.1 Do Customers of the Individual Broker's Old Brokerage House Reduce Their Trading with the Old Brokerage House when the Broker leaves?

If customers of a brokerage house have a strong business relationship with a particular individual broker then their orders may follow the broker to a new brokerage house rather than stay with a different individual broker at the broker's old house. The study uses different proxies for business relationships to explain the change in an existing customer's trade concentration with a brokerage house. After an individual broker has switched to a new brokerage house, one would expect to observe a drop in the proportion of a customer's trading by value done via the broker's old brokerage house. This expectation depends on the assumption that the percentage by value, or equivalently, the percentage volume of a customer's trades in a particular stock made by a brokerage house is constant in the short term, for example a month before and after the individual broker leaves the old brokerage house. Although for a given stock, a constant proportion by value more or less implies a constant proportion by volume, the use of proportion by value makes it easier to aggregate trades of all stocks when creating a value-weighted measure of the concentration of a customer's trades (across all stocks) with a particular broker or brokerage house. This distinction is important, because having a large proportion of one's trade volume for a low-priced stock with a broker arguably is not as indicative of an important trading relationship as having a similarly high proportion of trade volume for a high-priced stock with that broker. Therefore, the analysis weights trading relationships involving high-priced stock more heavily than those involving low-priced stock.

The change in the percentage value of customer c's trades in stock x executed through the old brokerage house o of an individual broker after the individual broker leaves, Δ*(% Value After Broker Leaves Old Job)*$_{c,x,o}$ is therefore expected to be negative on average, and is defined as:

$$\frac{\textit{Value After Broker Leaves Old Job}_{c,x,o}}{\textit{Total Value After Broker Leaves Old Job}_{c,x}} - \frac{\textit{Value Before Broker Leaves Old Job}_{c,x,o}}{\textit{Total Value Before Broker Leaves Old Job}_{c,x}} \tag{3.1}$$

where *Value After Broker Leaves Old Job*$_{c,x,o}$ and *Total Value After Broker Leaves Old Job*$_{c,x}$ are the values of customer c's trades in stock x, executed by the old brokerage house o, and by all brokerage houses after the individual broker leaves the old brokerage house, respectively. Similarly, *Value Before Broker Leaves Old Job*$_{c,x,o}$ and *Total Value Before Broker Leaves Old Job*$_{c,x}$ are the values of customer c's trades in stock X executed by the old brokerage house o, and by all brokerage houses before the individual broker leaves the old brokerage house, respectively.

Most of the individual brokers in the sample of 11 switching brokers execute their first trade at their new positions at least one month after the last trade at their old positions. While this does not mean that brokers stop working during these periods, it may mean they are less active than when executing trades and are not as involved in generating business for either their new or their old brokerage houses. Perhaps brokers spend this time familiarizing themselves with their positions at their new brokerage house. Given that a switching broker is not as active during these periods, it is possible that his customers use either another broker at the old brokerage house of the broker, or a broker at another brokerage house with which they have an existing business relationship, or both. To the extent that other brokers at the old brokerage house can take over the role of the switching broker, at least until the switching broker starts working again at the new brokerage house, the leaving of a broker should not instantly shift all of the broker's order flow away from the old brokerage house. However, the full effect of the leaving of a broker may not be felt until the broker begins his new job at the new brokerage house. As periods of a broker's trading inactivity between jobs may lead to temporary changes in the order placement behavior of the broker's customers, these periods are studied separately from periods when the broker is actively trading.

Therefore, the trading preferences of the customers of the switching broker and the switching broker's old brokerage house, after the broker starts to trade at the new brokerage house, are also examined. The change in the percentage value of customer c's trades in stock x executed through the old brokerage house o of an individual broker after the broker starts working at the new brokerage house, $\Delta\%$ *Value After Broker Begins New* $Job_{c,x,o}$ is expected to be negative on average, and is defined as:

$$\frac{\textit{Value After Broker Begins New Job}_{c,x,o}}{\textit{Total Value After Broker Begins New Job}_{c,x}} - \frac{\textit{Value Before Broker Leaves Old Job}_{c,x,o}}{\textit{Total Value Before Broker Leaves Old Job}_{c,x}} \tag{3.2}$$

where *Value After Broker Begins New* $Job_{c,x,o}$ and *Total Value After Broker Begins New* $Job_{c,x}$ are the values of customer c's trades in stock x, executed by the old brokerage house o, and by all brokerage houses after the individual broker's first trade at the new brokerage house, respectively. Similarly, *Value Before Broker Leaves Old* $Job_{c,x,o}$ and *Total Value Before Broker Leaves Old* $Job_{c,x}$ are the values of customer c's trades in stock x executed by the old brokerage house o, and by all brokerage houses, before the individual broker leaves the old brokerage house, respectively.

3.6.2 Do Customers of the Individual Broker's Old Brokerage House Intensify Their Trading with the Broker's New Brokerage House when The Broker Moves to the New Brokerage House?

The previous section described the construction of a proxy for measuring the loss in customer business when an individual broker stops working at a brokerage house. If customer business follows the individual broker to the new brokerage house, then an increase in customer business with the new brokerage house should be observed. In other words, there should be an increase in the proportion of their business customers of the individual broker's old brokerage house conduct with the new brokerage house after the individual broker relocates. As it is not known if the broker begins to generate business immediately at his new position after leaving his old position, the study examines the changes in the customers' proportion of business with the new brokerage house both after the broker's last trade at his old position and after the broker's first trade at his new position. For example, it is possible that the broker starts his new job immediately after leaving his old position, but may not yet be trading actively. In fact in most of the broker switching events in the sample there was approximately a thirty day delay between the broker's last trade at his old position and his first trade at his new position. Hence, if the broker receives orders from his loyal customer base during this time, he may delegate trade execution to other brokers in the new brokerage house. This practice is supported by strong anecdotal evidence which suggests that switching brokers tend to be sales brokers, who generate business for the house from a personal network of clients and tend to delegate order execution in-house to brokers specializing in trade execution. Trade executing brokers then either enter the order in the HETI limit order book for automatic execution or find counterparties for negotiated (upstairs) trading. As in the previous section, a measure of the change in an investor's trade concentration, this time with the broker's new house, is constructed. If customers of the switching broker's old house prefer to continue their trading relationship with the broker at the new house, then one would expect an increase in the proportion of the trading by value of these investors made via the new house to increase after the broker switches. The change in the percentage value of old brokerage house customer c's trades in stock x executed through the new brokerage house n of an individual broker after the individual broker leaves, Δ*(% Value After Broker Leaves Old Job)*$_{c,x,n}$ is therefore expected to be positive on average, and is defined as:

$$\frac{\textit{Value After Broker Leaves Old Job}_{c,x,n}}{\textit{Total Value After Broker Leaves Old Job}_{c,x}} - \frac{\textit{Value Before Broker Leaves Old Job}_{c,x,n}}{\textit{Total Value Before Broker Leaves Old Job}_{c,x}} \tag{3.3}$$

where *Value After Broker Leaves Old Job*$_{c,x,n}$ and *Total Value After Broker Leaves Old Job*$_{c,x}$ are the values of customer c's trades in stock x, executed by the new brokerage house n, and by all brokerage houses after the individual broker leaves the old brokerage house, respectively. Similarly, *Value Before Broker Leaves Old Job*$_{c,x,o}$ and *Total Value Before Broker Leaves Old Job*$_{c,x}$ are the values of customer c's trades in stock X executed by the new brokerage house n, and by all brokerage houses before the individual broker leaves the old brokerage house, respectively.

As a broker begins to trade at his new brokerage house at least one-month after the last trade at his old brokerage house, it is likely that loyal customers of the broker hold off on placing their orders with the broker before he starts trading actively at his new position. Thus, as in the previous section, the change in customers' proportion of trading variable is again constructed after the broker begins to trade actively at the new house. The change in the proportion by value of customer c's trades in stock x executed through the new brokerage house n of an individual broker after the broker starts working at the new brokerage house, $\Delta\%$ *Value After Broker Begins New Job*$_{c,x,n}$ is expected to be positive on average, and is defined as:

$$\frac{\textit{Value After Broker Begins New Job}_{c,x,n}}{\textit{Total Value After Broker Begins New Job}_{c,x}} - \frac{\textit{Value Before Broker Leaves Old Job}_{c,x,n}}{\textit{Total Value Before Broker Leaves Old Job}_{c,x}} \tag{3.4}$$

where *Value After Broker Begins New Job*$_{c,x,n}$ and *Total Value After Broker Begins New Job*$_{c,x}$ are the values of customer c's trades in stock x, executed by the new brokerage house n, and by all brokerage houses after the individual broker's first trade at the new brokerage house, respectively. Similarly, *Value Before Broker Leaves Old Job*$_{c,x,n}$ and *Total Value Before Broker Leaves Old Job*$_{c,x}$ are the values of customer c's trades in stock x executed by the new brokerage house n, and by all brokerage houses, before the individual broker leaves the old brokerage house, respectively.

3.7 A Multivariate Model to Study the Effect of pre-existing business relationships, and Investor Characteristics on Customer Trading Proportions when Individual Brokers Switch Brokerage Houses

This section presents a series of multivariate regression models to test the hypotheses presented earlier. Specifically, investor and stock characteristics are used to explain the changes in a customer's proportion of trading done by a brokerage house when an individual broker either leaves or begins working at the brokerage house. Each of the change in proportion variables defined in (3.1), (3.2), (3.3) and (3.4) represented by Δ*(% Value)* is used in turn as the dependent variable in three model specifications. Trade value proportion and market share related independent variables are constructed using trades in the estimation period, which is defined as a 30 calendar day period beginning 60 calendar days prior to the last trade of each switching broker at his old brokerage house. Each observation in the data set represents the trades for a particular investor, in a particular stock, on both the buy and sell sides, and executed through either the upstairs or downstairs market.

Independent variables used to test the hypotheses presented earlier are shown in Table 3.1, along with the expected signs of the coefficients. The variables *Prop. of Investor Trading Via Old B. House*, *Prop. of Investor Trading Via Switching Broker*, and *Prop. of Investor Trading Via New B. House*, are proportions of the value of investor trading in stock done by the switching broker, old brokerage house (excluding switching broker) and new brokerage house, respectively; *Customer of Switching Broker* is a dummy equal to one if the investor traded via the switching broker in the estimation period, and zero otherwise; *Upstairs Market* is a dummy equal to one if the observation is constructed using trades in the upstairs market; *Log(Total Value Traded in Stock)*, is the log of total value traded in a stock; *Old B. House's Market Share in Stock*, *Switching Broker's Market Share in Stock*, and *New B. House's Market Share in Stock*, are the market shares by value in the stock for the old brokerage house (excluding the switching broker), the switching broker, and new brokerage house; *Household* is a dummy equal to one if the investor is a household and zero otherwise; *Financial Institution*, *Non-financial Institution*, *Governmental Institution*, and *Non-profit Institution*, are dummies equal to one if the investor is a financial, non-financial, governmental or non-profit institution, respectively, and zero otherwise; *Investor is Male*, and *Investor is Female* are dummies equal to one if the investor is male, or female, respectively, and zero otherwise; *Investor and Old House = Finnish, New House = Swedish*, is a dummy equal to one if the culture of the investor and the old brokerage house is Finnish and the culture of the new brokerage house is Swedish, and zero otherwise, and where the base is that the old brokerage house is Finnish, and the investor and new brokerage house are Swedish. Other variables used, but not shown in Table 3.1, are, a dummy indicating whether the observation is constructed using the buy sides of transactions, dummies for all but one of the switching events, and dummies for each stock but one.

As the decrease in a customer's proportion of trading via the old brokerage house and its increase in the new brokerage house of the investor occur contemporaneously, each of the two variables for the change in the proportion of investor trading are likely to be determined endogenously to the other. Hence estimation of each variable separately using single stage multivariate regressions, as was done earlier, are likely to yield coefficients that are inconsistent, as each variable will be correlated with the stochastic error term of the other's model, i.e. y_1 will be correlated with the error term ϵ in the regression equation: $y_2 = \alpha + \beta_1 x + \beta_2 y_1 + \epsilon$. To alleviate this potential problem, both equations are estimated simultaneously using two-stage least squares (2SLS) estimation. Tables 3.12 and 3.13 show the results of the 2SLS estimation for the relative periods *t=-1 to t=0* and *t=-1 to t=1*, respectively. In Tables 3.12 and 3.13, the change in the customers' proportion of trading via the old brokerage house is defined as dependent variable (1), the left hand side variable of the first simultaneous equation. The change in the customers' proportion of trading via the new brokerage house is defined as dependent variable (2), and is used as a right hand side variable in the first simultaneous equation.

Other right hand side variables of the first simultaneous equation include all exogenous variables used in the earlier single stage models. The dependent variable (2) is the left hand side variable of the second simultaneous equation, whereas the dependent variable (1) is a right hand side variable of this equation.

3.8 Results

Tables 3.8, 3.9, 3.10, and 3.11, show the results of estimation of models having change in proportion variables defined in (3.1), (3.2), (3.3) and (3.4), respectively, whereas Tables 3.12 and 3.13 show the results for two simultaneous equations models, one having (3.1) and (3.2), and the other having (3.3) and (3.4), as the dependent variables, respectively. Each of the following subsections interprets the results presented in these tables in the light of one of the hypotheses presented in Table 3.1.

3.8.1 Hypothesis 1: Trading Relationships Affect Investors' Likelihood of Switching

In Table 3.8, the coefficient of the variable *Prop. of Investor Trading Via Old B. House* in all three models is positive and significant, and in Table 3.12 the coefficient of the third model is positive and significant. This is consistent with sub-hypothesis 1a, that investors having stronger relationships with the old brokerage house, will be less likely to switch to the new brokerage house when the broker leaves. The corresponding coefficients of this variable for the models in Table 3.9 and Table 3.13 are statistically insignificant, although in two of the three models in both tables, the coefficient has the expected sign, consistent with the hypothesis. However, the coefficients of this variable in Table 3.10 and in Table 3.11 are insignificant for all models. Thus, a stronger relationship with the brokers of the old brokerage house increases the proportion of an investor's trading via the old brokerage house in the first month after the broker leaves, (Table 3.8), but not after he starts trading at the new brokerage house (Table 3.9). Furthermore, the insignificance of the coefficients in Tables 3.10 and 3.11 implies that an investor's past relationship with the old brokerage house does not affect the likelihood of his switching to the new brokerage house. Therefore, the results indicate weak support at best for sub-hypothesis 1a.

The coefficients of *Customer of Switching Broker* are insignificant in all models and in all tables. However, in Tables 3.9, 3.10 and 3.11, the corresponding coefficients in all models have the expected sign. The coefficients of *Prop. of Investor Trading Via Switching Broker* are significant in Table 3.8 but do not have the expected sign. In Tables 3.9, 3.10, and 3.13, the corresponding coefficients in all models have the expected sign but are insignificant. Therefore, the thrust of the evidence does not support sub-hypothesis 1b, that investors having a (stronger) ex-ante relationship with switching brokers are more likely to switch with the broker.

The coefficients of *Prop. of Investor Trading Via New B. House* are significant in Table 3.8 but none have the expected sign. In Table 3.9 the coefficients in all three models have the expected sign and in two of the three cases they are statistically significant. In Table 3.10 the coefficients do not have the expected sign and are insignificant. However, in Table 3.11 all three coefficients have the expected sign and are significant. The results most supportive of the sub-hypothesis 1c comes from Tables 3.9 and 3.11 which use the change in an investors proportion of trading via the old and new brokerage houses after the broker starts trading at the new brokerage house. Hence an ex-ante relationship with the new brokerage appears to affect trading of investors after the broker starts working at the new brokerage house. In the simultaneous equation regressions shown in Table 3.13, all coefficients have the expected sign but are not significant. Therefore, there is moderate support for sub-hypothesis 1c.

Therefore, the weak support for sub-hypothesis 1a and moderate support for sub-hypothesis 1c, imply that there is little support for Hypothesis 1, that trading relationships affect the investors' likelihood of switching.

3.8.2 Hypothesis 2: Upstairs Market Investors Develop Closer Business Relationships with the Broker and are More Likely To Switch With The Broker

The coefficients of *Upstairs Market* in all model specifications except for those in Table 3.13 have the expected signs. However, despite the fact that the signs of the coefficients imply overwhelming support for Hypothesis 2, none of these coefficients are statistically significant. Hence, there is no statistical evidence supporting Hypothesis 2, that upstairs market investors develop closer business relationships.

3.8.3 Hypothesis 3: Brokers' Market Dominance Affects Investors' Likelihood of Switching

In Tables 3.8, and 3.10, 3.11, and 3.12, the coefficients of *Old House's Market Share in Stock* in all model specifications have the expected sign but are all insignificant. In Tables 3.9 and 3.13, the coefficients do not have the expected signs and are also insignificant. Therefore, there is no statistically significant evidence supporting sub-hypothesis 3a, that investors are less likely to switch if the old brokerage house is more dominant in a stock.

In Tables 3.8, 3.11, and3.12, the coefficients of *Switching Broker's Market Share in Stock* in all model specifications have the expected signs but are all insignificant. In

Tables 3.9, 3.10, and 3.13, the coefficients do not have the expected signs and are also insignificant. Sub-hypothesis 3b is therefore not supported.

In Tables 3.8, 3.10, and in Model 3, Table 3.13, the coefficients of *New House's Market Share in Stock* have the expected signs but are statistically insignificant. In Tables 3.9, and 3.11, the coefficients are significant but do not have the expected sign. Therefore, in Table 3.9, all three coefficients of the variable are significantly positive, implying that customers of the old brokerage house reduce their trading with the old brokerage house when the new brokerage house is less active in the stock. In Table 3.11, all three coefficients are significantly negative, implying that customers of the old brokerage house increase (decrease) their trading with the new brokerage house when the new brokerage house is less (more) active in the stock. These two results imply that investors are more (less) likely to switch in stocks where the new brokerage house is less (more) active.

Overall, although there is strong support that a new brokerage house's market dominance affects investors' likelihood of switching, this effect is opposite in direction to what was hypothesized. Hence, there is little support for Hypothesis 3.

3.8.4 Hypotheses 4 / 5: Less Savvy Investors are Biased and More Likely to Switch / Less Savvy Investors Have Simpler Trading Preferences and Less Likely to Switch

Although not statistically significant, the coefficients of *Household* in Tables 3.8, 3.9, 3.10 and 3.11 have signs consistent with sub-hypothesis 5a, that households have less complicated trading preferences and are therefore less likely to switch with the broker. The coefficients in Tables 3.12 and 3.13 support the sub-hypothesis that households are biased and therefore more likely to switch, although the coefficients are not statistically significant. Therefore, the result is on the balance consistent with sub-hypothesis 5a rather than sub-hypothesis 4a, but not significantly so.

In Table 3.8, the coefficients of both *Financial Institution* and *Non-financial Institution* are insignificant but their signs being positive is consistent with sub-hypothesis 4b. In Table 3.10, the coefficients of both variables are insignificant but their signs are both negative and also consistent with sub-hypothesis 4b. In Table 3.9, the sign of *Financial Institution* is insignificant and negative, which is consistent with sub-hypothesis 5b, and the sign of *Non-financial Institution* is insignificant and positive, which is consistent with sub-hypothesis 4b. Finally, in Table 3.11, the signs of both coefficients are insignificant and positive, which is consistent with sub-hypothesis 5b. Overall, the signs of the coefficients are not consistent with either of the sub-hypotheses 4b and 5b. Furthermore, none of the coefficients of either variable is significant.

The coefficients of *Governmental Institution – Financial Institution*, and *Governmental Institution – Non-financial Institution*, are insignificant and consistent with sub-hypothesis 5c in Table 3.8, and significant and consistent with sub-hypothesis 5c in Table 3.11. The coefficients of these variables are insignificant and consistent with sub-hypothesis 4c in Tables 3.9, and 3.11. Thus, in the case of governmental institutions there is some evidence to support sub-hypothesis 5c, the hypothesis that governmental institutions have less complicated trading preferences than financial and non-financial institutions and are therefore less likely to switch. On the other hand the coefficients of *Non-profit Institution – Financial Institution* and *Non-profit Institution – Non-financial Institution* are insignificant and consistent with sub-hypothesis 4c in Table 3.8, and significant and consistent with sub-hypothesis 4c in Table 3.10. The coefficients are insignificant and consistent with sub-hypothesis 5c in Tables 3.9 and 3.11. Thus, in the case of non-profit institutions there is some evidence to support sub-hypothesis 4c, the hypothesis that non-profit institutions are less savvy than financial and non-financial institutions and more biased toward the broker and therefore more likely to switch.

Although there is some evidence to support sub-hypothesis 4c and 5c, there is insufficient evidence to reject Hypothesis 4 in favor of Hypothesis 5, or vice versa.

3.8.5 Hypotheses 6 / 7: Male Investors Have Stronger Relationships with (Male) Brokers and More Likely to Switch / Female Investors are More Relationship-Oriented and More Likely to Switch

In all model estimations, the coefficients of *Investor is Male – Investor is Female*, have signs consistent with Hypothesis 7, and in the case of Tables 3.8, 3.11 and 3.13, the coefficients are also statistically significant, implying that female investors are more likely than their male counterparts to leave the old brokerage house and move to the new brokerage house after the broker switches. Hence there is strong evidence to support the hypothesis, Hypothesis 7, that female investors are more relationship-oriented than male investors, and are more likely to switch with the broker.

3.8.6 Hypothesis 8: Investors Prefer Brokerage Houses with Same Culture, and are Less Likely to Switch if New Brokerage House has Different Culture

In Tables 3.8, 3.9, and 3.12 and two model specifications in 3.13, the coefficients of *Investor and Old House = Finnish, New House = Swedish* have a positive sign which is consistent with Hypothesis 8, although they are insignificant. The coefficients have a positive sign in Table 3.9 which is inconsistent with the hypothesis, but have a negative sign in Table 3.11 which is consistent with the hypothesis. On the balance, the signs of the coefficients appear to support the hypothesis that Finnish culture investors are less likely to switch to a Swedish culture new brokerage house from a Finnish culture old brokerage house than a Swedish culture investor. However, this support is not statistically significant.

In Table 3.12, for all three specifications, the coefficients of dependent variable (2) in the second simultaneous equation are negative, and for the third model it is also significant. This is consistent with the idea of changes in trading proportions of the old and the new brokerage houses being negatively correlated. For example, a decrease in the proportion of investor's trading in stock done by the old brokerage house of 50% is accompanied by a contemporaneous increase in the proportion of trading in stock done by the new brokerage house of $0.5 \times 27.2\%$ or 13.6%. This negative relation is even more apparent in Table 3.13, where the coefficients of both *Dependent Variable (1)* and *Dependent Variable (2)*, are negative, and statistically significant in two of the three model specifications for the first variable, and significant in all three model specifications for the latter variable.

3.9 Discussion and Interpretation of Results

The hypothesis that trading relationships with brokers affect investors' likelihood of switching, namely Hypothesis 1, was not supported. However, there is some evidence that having a stronger pre-existing relationship with the new brokerage house increases the proportion of an investor's trading with the new brokerage house after the broker switches. Hence, trade relationships with the new brokerage house appear to lower the cost of switching for an investor, such that it becomes 'cheaper' for the investor to follow the individual broker to the new brokerage house, and shift a greater proportion of trading to the new brokerage house.

The hypothesis that the upstairs market is more conducive to the development of business relationships between investors and the switching broker, namely Hypothesis 2, was not supported. This may be due to the fact that brokers can develop equally close relationships with investors using either the upstairs or the downstairs markets because brokers get to know all investors personally regardless of where their orders eventually end up, i.e. either in the upstairs or the downstairs market. Therefore, in the case of the HSE, there may be less of a distinction between the strength of relationships that develop in the upstairs and the downstairs markets. However, in markets where downstairs trades are entered directly by investors, such as via an electronic order placement system, it would be more reasonable to expect there to be a difference between upstairs and downstairs markets.

It is found that new brokerage houses that are less dominant in a stock attract a greater proportion of investor trading when the broker switches. This contradicts the hypothesis, namely sub-hypothesis 3c, that new brokerage houses more dominant in a stock and therefore better able to provide liquidity, attract a greater proportion of investor trading when the broker switches. One reason for this result could be that when the new brokerage house is less active in the stock, investors who wish to trade this stock can have a closer and more valuable relationship with the new brokerage house. Another explanation is that the new brokerage houses try to attract order flow from the old brokerage house of the switching broker for stocks in which the new brokerage house is not dominant, in order to increase their market share for these stocks. Additionally, the study did not find evidence to support the hypotheses, sub-hypotheses 3a and 3b, so that old brokerage houses more dominant in a stock do not retain a greater proportion of investor trading when the broker leaves, and switching brokers more dominant in a stock do not attract a greater proportion of investor trading away from the old brokerage house when they leave.

There is some evidence albeit statistically insignificant, that households have less complicated trading preferences than institutions and are therefore less likely to switch, i.e. sub-hypothesis 5a. There is no statistically significant evidence for either sub-hypothesis 4b, the hypothesis that financial and non-financial institutions are either less biased than households and less likely to switch, or sub-hypothesis 5b, the hypothesis that financial and non-financial institutions have more complicated trading preferences and are more likely to switch. With regard to the switching behavior of savvy versus unsavvy institutional investors, the results are mixed. While there is evidence that governmental institutions, assumed to be unsavvy, are less likely to switch than savvy investors, including both financial and non-financial institutions, there is also some evidence that non-profit institutions, also assumed to be unsavvy are also more likely to switch to the new brokerage house. This means that there is some support for both of the competing hypotheses. Hence the evidence supports both the hypothesis that less savvy investors have simpler trading preferences and are more likely to switch with the broker as well as the hypothesis that less savvy investors are biased toward the broker and more likely to switch.

There is very strong evidence that male investors are less likely to switch with the broker than female investors. This is consistent with the hypothesis that female investors are more relationship-oriented and are more likely to switch in order to continue their relationship with the broker.

Finally, there was weak evidence to support the hypothesis that Finnish culture investors were less likely than Swedish culture investors to switch to new brokerage houses having a Swedish culture.

3.10 Conclusions

This paper studied the determinants of customer switching from one brokerage house to another, when an individual broker of the first house switches to the second house. There is significant evidence to support that customers of a brokerage house do indeed switch their trading to a new brokerage house when an individual broker switches. A main finding of the paper is that customers' pre-existing relationships with the new brokerage house make it more likely that they will switch to the new brokerage house after the individual broker switches. This is consistent with the hypothesis that there are costs of switching between brokerage houses, and that already existing trading relationships can reduce such switching costs. Another interesting finding, albeit inconsistent with one of the hypotheses, is that new brokerage houses that are less active in a particular stock are more likely to attract the customers from old brokerage houses of the switching broker. This is consistent with the idea that brokerage houses attempt to increase their market share in a stock by attracting brokers away from other houses. Interestingly, however, customers are not lured away from the old brokerage house by switching brokers having a greater presence in the market for trading the stock. There were mixed results for the hypotheses related to whether savvy or unsavvy investors were more likely to switch. While governmental institutions were more likely to switch than financial and non-financial institutions, non-profit institutions were less likely to switch. Thus, it is not clear whether unsavvy investors are less likely to switch because they have less complicated trading preferences, or whether unsavvy investors are more likely to switch because they are biased toward the switching broker. There is strong evidence supporting the hypothesis that female investors are more likely to switch with the broker than male investors, consistent with the hypothesis that female investors are more relationship oriented. Finally there is some evidence albeit statistically insignificant, that investors prefer to trade with similar culture brokerage houses.

CHAPTER 4: UNEXPRESSED DEMAND AND THE TRADING BEHAVIOR OF UPSTAIRS MARKET MAKERS

ABSTRACT

Due to the possibility of front-running, an upstairs market maker is unlikely to share with others information on his customers' likelihood of trading, called unexpressed demand by Grossman (1992). This is because a market maker more knowledgeable about the likelihood of future trading can more accurately predict price movements, and can front-run other market makers more successfully. As costs of switching lead investors to concentrate their business with a limited number of upstairs market makers, this implies that market makers do not learn the unexpressed demand of all upstairs market investors. In this chapter, Grossman's (1992) model is redeveloped, and the economic implications of intermediate results are discussed. An extension of Grossman's (1992) model is made where the unexpressed demand in the upstairs market is split into private and public components. It is found that as the public signal of the unexpressed demand in the upstairs market becomes less (more) noisy, the execution quality of the upstairs market improves (worsens) relative to the downstairs market. Thus, exclusive or close trading relationships between customers and market makers where signals for unexpressed demand remain private, can be detrimental to upstairs market liquidity.

4.1 Introduction

Upstairs markets have certain unique properties, which authors such as Seppi (1990) and Grossman (1992) have argued improve liquidity provision in such markets. One of these unique properties is that upstairs market makers know the identities of their customers in each trade and can become familiar to some extent with these customers' trading preferences and their willingness to trade in certain states of the world. For example, a customer may ask the upstairs broker to buy or sell a certain quantity of stock when the price is within a pre-specified range, or to buy or sell a certain quantity of stock continuously in pre-specified intervals. It is also possible that the customer wishes to buy or sell a large enough number of shares of a relatively illiquid stock that the order needs to be executed in multiple transactions over many days, weeks, or even months. In such cases, it is quite obvious that upstairs market makers can become privy to information that will affect the future price of a security. Grossman (1992) refers to this as 'a repository of information about the unexpressed demand of customers'. However, Grossman's (1992) model makes the assumption that the upstairs market is composed of a number of identical market makers who observe the expressed and unexpressed demands of the whole upstairs market. This assumption implies that the expressed and unexpressed elements of the total order flow in the upstairs market are observed by each market maker.[12]

However, since the upstairs market is fragmented, and there are possibly many upstairs market prices for a security at any given time, it is unlikely that each market

[12] Expressed order flow refers to the aggregate of all orders currently arriving in the upstairs market. Unexpressed order flow refers to an aggregate of the unexpressed demand schedules of the customers who are expected to trade in the upstairs market at same later date, and whose willingness to trade is taken exogenously.

maker knows the expressed and unexpressed demands of all upstairs market customers. But as each upstairs market maker knows the identities of its customers, it can be argued that it is not the whole upstairs market but each upstairs market maker that is a repository of information about the unexpressed demands of upstairs market customers. Furthermore, in the upstairs market, market makers can be brokers as well as dealers. This means that upstairs market makers can serve a dual role as both broker to their customers by finding counterparties for their customers' orders, and as a dealer who takes the opposite side of a trade, i.e. internalizes the order. The analysis of market makers in Grossman (1992) and also in this paper, take into account this dual role of market makers in the upstairs market.

The development of trading and professional relationships with other market makers, as well as with the customers of other market makers can allow an upstairs market maker to become more informed about the trading habits of other market makers' customers. However, due to the possibility of front-running, the development of trading or professional relationships among upstairs market makers would not necessarily increase the market makers' knowledgeability about the trading preferences of each others' customers. A market maker's knowledgeability is more likely to increase through professional relationships with customers who also use other market makers. For example, if an individual broker switches to another brokerage house, he may take with him the knowledge of the unexpressed demand of his old brokerage house's customers. As studied in the previous chapter, a customer of the individual broker's old brokerage house may also switch some of his trading to the new brokerage house. Thus depending on the predictability of the customer's trading habits, the old brokerage house is likely to retain some or all of the knowledge about that customer's unexpressed demand. Also, the new brokerage house is likely to increase its knowledge of this customer's trading habits, and therefore the customer's unexpressed demand. Investors in need of liquidity, i.e. for an illiquid stock, may also shop around in the upstairs market among different brokerage houses, and over time reveal their trading preferences to brokerage houses they may not transact with. Thus upstairs market makers are likely to have some information about the unexpressed demand of other market makers' customers. Thus, the insight that trading relationships help market makers become more informed about the unexpressed demand of other market makers' customers, is also incorporated into the Grossman (1992) model in this paper.

First, the paper redevelops Grossman's (1992) original model, presents a setup of the model, derives the model including intermediate steps left out of Grossman (1992). Economic implications of some intermediate findings are also discussed. Next, the general Grossman (1992) model is revised under the assumption that upstairs market makers only observe the unexpressed demand of their own customers, but not that of other market makers. Upper and lower bounds on the informativeness of order flow are identified in this general model and are compared to the findings of Grossman. A simplified but tractable model incorporates the more plausible assumption that allows for varying levels of informedness about the unexpressed demand of other market makers' customers. The paper then develops a more general model of the upstairs market where market makers know their own customers' unexpressed demand with certainty, but the unexpressed demand of other market makers' customers with a probability. The paper finds a parsimonious expression for the upstairs equilibrium price of the security, and the volatility of the change in upstairs market price, which corresponds to execution quality in the upstairs market. The execution quality in the upstairs market under Grossman's (1992) assumptions is compared to its counterpart under the general model derived here.

4.2 Grossman's (1992) Model

This section derives Grossman's (1992) model of the upstairs and downstairs markets, explaining clearly the intermediate steps in the derivation. The sequence of events in Grossman's (1992) model is also presented.

The model assumes, without loss of generality, that there are two time periods. At time 1, the following events take place:

1) Each investor decides whether to use the upstairs or the downstairs market.

2) Each investor experiences an exogenous liquidity shock, and either places an order to trade in the appropriate market (expressed demand) or informs all upstairs market makers of his willingness to trade at some future period (unexpressed demand), where the proportion of the demand in the upstairs versus the downstairs market is taken exogenously.

3) All M_U upstairs market makers observe all of the expressed and unexpressed demands of upstairs market customers, but not the expressed demand of downstairs market customers.

4) All M_D downstairs market makers observe all of the expressed demands of downstairs customers but neither the expressed nor the unexpressed demands of the upstairs market customers.

5) Upstairs market makers clear the upstairs market by choosing their demand to maximize the utility of their future (time 2) wealth. An average upstairs clearing price at time 1, P_{1U}, is established. There are as many upstairs market prices as upstairs market makers, but each deviates from the average price by an amount ε_i.

6) Downstairs market makers clear the downstairs market by choosing their demand to maximize the utility of their future (time 2) wealth. A single downstairs clearing price at time 1, P_{1D}, is established.

Finally, at time 2, the following event occurs:

7) The upstairs and downstairs market prices of the asset converge to a single price, P_2, reflecting all public information about the asset, minus the cost of providing liquidity in both the upstairs and downstairs markets at time 1.

The model also assumes that the asset being traded is a forward or a futures contract and is in zero net supply. It is immaterial to the analysis whether or not the asset is assumed to be in zero net supply, except that it simplifies the exposition.[13] The price at time 2, $\tilde{P}_2$, can therefore be viewed as the settlement price of a forward or a futures contract:

$$\tilde{P}_2 = \tilde{g}_2 - b\tilde{x}_2 \tag{4.1}$$

where $\tilde{g}_2$ is the random payoff of the contract's underlying asset, the coefficient b represents the sensitivity of the contract's settlement price to $\tilde{x}_2$, which is the total order flow at dates 1 and 2, expressed and unexpressed, in both the upstairs and downstairs

[13] If assets were not assumed to be in zero net supply, then the supply side of the market clearing equation would contain an exogenous constant, and this would not affect the analysis qualitatively.

markets. Therefore $-b\tilde{x}_2$ is the liquidity cost incurred by the holder of the contract due to the trading of liquidity motivated traders. The price $\tilde{P}_2$ is viewed as a 'long-run' equilibrium price.

The model defines $\tilde{x_2}$ as a combination of the total expressed customer order flow in both the upstairs and downstairs markets at time 1, $\tilde{x_1}$, and the total unexpressed customer order flow in the upstairs market, $\tilde{y_2}$. Total time 1 order flow is in turn expressed as a combination of the total upstairs and downstairs market expressed demands, $\tilde{y_U}$, and $\tilde{y_D}$, respectively. Hence:

$$\tilde{x}_1 = \tilde{y}_D\sqrt{q} + \tilde{y}_U\sqrt{1-q} \tag{4.2}$$

and,

$$\tilde{x}_2 = \tilde{x}_1\sqrt{f} + \tilde{y}_2\sqrt{1-f} \tag{4.3}$$

where $\sqrt{q}$ is the proportion of the total time 1 (expressed) order flow that is sent to the downstairs market, and $\sqrt{f}$ is the proportion of the total demand that is expressed at time 1. The $\sqrt{q}$ and $\sqrt{1-q}$ are used to reallocate the variance of expressed order flow between the upstairs and downstairs markets so that the variance of expressed order flow remains constant. The $\sqrt{f}$ and $\sqrt{1-f}$ are used to reallocate the variance of total order flow between expressed and unexpressed components, so that the variance of total order flow is constant. Although the proportions $\sqrt{f}$ and $\sqrt{1-f}$ add to more than one except when $f = 1$ or $f = 0$, this is necessary to satisfy the model's assumption that the total variance of order flow stays constant. The scaling up of the order flow proportion to possibly greater than one, does not impact the analysis, however, since the analysis is concerned with the quality of the market, which is found to be a function not of the order flow, but its volatility.

It is also assumed that $\tilde{y}_U$, $\tilde{y}_D$, and $\tilde{y}_2$, are independent and identically distributed normal random variables with zero mean and variance σ_Y^2.

The model assumes that market makers in a particular market can only trade in that market. Therefore, downstairs (upstairs) market makers, observing the order flow only from downstairs (upstairs) market customers, trade only in the downstairs (upstairs) market. Hence, two separate market equilibria arise as a result of the disconnect between trading in the upstairs and downstairs markets. These two market equilibria are now derived.

4.2.1 Downstairs Market Equilibrium

After observing the order flow from the downstairs market traders, downstairs market makers determine the amount they wish to trade, Z_D, in order to maximize the utility of their future (time 2) wealth, $\tilde{W}_2$. Therefore, conditional on their observation of the order flow of all downstairs market customers, y_D, the downstairs market makers choose Z_D to maximize:

$$E\left[U\left(\tilde{W}_2\right)|y_D\right] \equiv -\exp\left[-a\tilde{W}_2\right] \tag{4.4}$$

where $\tilde{W}_2 = W_1 + \left(\tilde{P}_2 - P_{1D}\right) Z_D$, and W_1 is the initial wealth of each market maker, and P_{1D} is the date 1 price of the asset in the downstairs market. Since the risk aversion coefficient a in equation (4.4) is independent of market maker, the model assumes all market makers are equally risk averse.

The optimal demand of downstairs market makers, Z_D is found to be equal to:

$$Z_D = \frac{E\left[\tilde{P}_2 \left| y_D\right.\right] - P_{1D}}{a\left\{Var\left[\tilde{P}_2 \left| y_D\right.\right] + \sigma_U^2\right\}} \tag{4.5}$$

There are M_D identical downstairs market makers, each of which independently choose the same optimal demand, Z_D. To clear the market, the total market maker demand must equal the order flow of all customers in the downstairs market at time 1. Therefore, the market clearing condition is:

$$M_D Z_D = y_D \sqrt{q} \tag{4.6}$$

After rearranging the market clearing equation (4.6), the downstairs equilibrium price at time 1 is:

$$P_{1D} = E\left[\tilde{P}_2 \left| y_D\right.\right] - \frac{\left(a\sqrt{q}\right)}{M_D} Var\left[\tilde{P}_2 \left| y_D\right.\right] y_D. \tag{4.7}$$

Equation (4.7) shows that the time 1 price is negatively related to the customer supply in the downstairs market. Hence, customer sell orders push down the time 1 price, whereas customer buy orders push the price up. Furthermore, as in Grossman and Miller (1988), the impact of the liquidity demanded by customers at time 1 on the price at time 1, is inversely proportional to the number of market makers in the downstairs market. Hence, in a highly competitive market with lots of market makers, the impact of the liquidity demand is reduced. The number of market makers trading in the downstairs market, however, depends on how easily agents can become market makers, i.e. on whether or not the benefits of market making exceed the costs.

Endogenously Determined Market Makers

As in Grossman and Miller (1988), it is assumed that each potential market maker must incur a cost of c_D at time 0, in order to become a market maker and observe the expressed order flow in the downstairs market at time 1. Each potential market maker must at least break even when he decides to pay c_D to enter the market and profit from market making, as opposed to staying out of the market. Thus, the individual rationality condition for becoming a market maker must be exactly satisfied at date 0. This means that in equilibrium, the unconditional expectation of the utility of becoming a downstairs market maker must equal the unconditional expectation of the utility of non-participation in the downstairs market. In other words:

$$E_0\left[U\left(W_0 - c_D + \left(\tilde{P}_2 - \tilde{P}_{1D}\right)Z_D\right)\right] = E_0\left[U\left(W_0\right)\right] \tag{4.8}$$

where W_0 is the initial endowment of each market maker, i.e. at date 0, Z_D is the optimal demand of each downstairs market maker as shown in equation (4.5).

Now, by using the Law of Iterated Expectations, the left hand side of equation (4.8) can be expressed as an expectation of a conditional expectation, so that:

$$E_0\left[E_1\left[U\left(W_0 - c_D + \left(\tilde{P}_2 - \tilde{P}_{1D}\right)Z_D\right)|y_D\right]\right] = E_0\left[U\left(W_0\right)\right] \tag{4.9}$$

Therefore, after substituting for Z_D from equation (4.6), using the negative utility function, i.e. equation (4.8), the conditional expectation expression on the left hand side of equation (4.9) becomes:

$$E_1\left[U\left(W_0 - c_D + \left(\tilde{P}_2 - \tilde{P}_{1D}\right) Z_D\right) |y_d\right] =$$
$$-exp(-aW_0)\ exp(ac_D)\ E_1\left[exp\left(-a\left(\tilde{P}_2 - \tilde{P}_{1D}\right)\tilde{y}_D\frac{\sqrt{q}}{M_D}\right)|y_D\right] \tag{4.10}$$

Given a constant a, a normally distributed variable X, has the following property:

$$\mathrm{E}\left[exp(aX)\right] \equiv \exp\left(a\overline{X} + \frac{a^2}{2}\sigma_X^2\right), \tag{4.11}$$

where $\overline{X}$ and σ_X^2 are the mean and variance of X, respectively. Using the property in (4.11), equation (4.10) becomes:

$$E_1\left[U(.)\,|.\right] = -exp(-aW_0)\ exp(ac_D)\exp\Big(-a\left(E_1\left[\tilde{P}_2\,|y_d\right] - P_{1D}\right)\tilde{y}_D\frac{\sqrt{q}}{M_D} + \frac{a^2}{2}\left(Var_1\left[\tilde{P}_2\,|y_D\right]\right)\tilde{y}_D^2\frac{(q)}{M_D{}^2}\Big) \tag{4.12}$$

Now, substituting for $E_1\left[\tilde{P}_2\,|y_D\right] - P_{1D}$ from equation (4.7), and simplifying the resulting expression, one obtains:

$$E_1\left[U(.)\,|.\right] = -exp(-aW_0)\ exp(ac_D)\exp\left(-\frac{a^2}{2}(q)\left(Var_1\left[\tilde{P}_2\,|y_D\right]\right)\left(\frac{\tilde{y}_D}{M_D}\right)^2\right) \tag{4.13}$$

Now, after substituting for the conditional expectation on left hand side of equation (4.9) from equation (4.13), substituting for the right hand side of equation (4.9) from equation (4.8), cancelling the $exp(-aW_0)$ terms from both sides, and moving the $exp(ac_D)$ term from the left to the right hand side, the following is obtained:

$$E_0\left[\exp\left(-\frac{a^2}{2}(q)\left(Var_1\left[\tilde{P}_2\,|y_D\right]\right)\left(\frac{\tilde{y}_D}{M_D}\right)^2\right)\right] = exp(-ac_D) \tag{4.14}$$

Now, let:

$$t_D = \frac{a^2{\sigma_Y}^2(q)\left(Var_1\left[\tilde{P}_2\,|y_D\right]\right)}{{M_D}^2} \tag{4.15}$$

and

$$z^2 = \frac{\tilde{y}_D^2}{{\sigma_Y}^2} \tag{4.16}$$

where $\tilde{y}_D$ is normally distributed with mean μ_Y and variance ${\sigma_Y}^2$, and z^2 has a non-central χ^2 distribution. Now, let $\tilde{X} = \dfrac{\tilde{y}_D - \mu_Y}{\sigma_Y}$, so that $\tilde{X}$ has the standard normal distribution.

Then, the moment generating function of z^2, $M_x(T)$ is given by:

$$\mathrm{E}exp(z^2T) = \mathrm{E}\left(exp\left(\tilde{X} + \frac{\mu_Y}{\sigma_Y}\right)^2 T\right) \tag{4.17}$$

which equals:

$$exp\left(\frac{{\mu_Y}^2 T}{{\sigma_Y}^2(1-2T)}\right)(1-2T)^{-\frac{1}{2}} \tag{4.18}$$

Now, for equation (4.18), let $T = -\frac{t_D}{2}$, and substitute for t_D from (4.15), to obtain:

$$\mathrm{E}[exp(z^2T)] = exp\left(\frac{-\mu_Y{}^2}{\sigma_Y{}^2(1+t_D)}\frac{t_D}{2}\right)(1+t_D)^{-\frac{1}{2}} \tag{4.19}$$

It is assumed that at date 0, the expected magnitude of the liquidity event occurring at date 1 is equal to zero, so that $\mu_Y = 0$.

Therefore, by letting $\mu_Y = 0$, equation (4.19) reduces to $(1+t_D)^{-\frac{1}{2}}$ which is equal to the right hand side of equation (4.14), i.e.:

$$(1+t_D)^{-\frac{1}{2}} = exp(-ac_D) \tag{4.20}$$

Now, using equation (4.20) to substitute for t_D into (4.15), the equilibrium number of market makers can be obtained for the downstairs market:

$$M_D = \frac{a\sigma_Y\sqrt{q}\sqrt{Var_1\left(\tilde{P}_2\,|y_D\right)+\sigma_Y{}^2}}{\sqrt{exp(2ac_D)-1}} \tag{4.21}$$

Thus, it can be seen from equation (4.21) that the number of market makers entering the downstairs market increases with the uncertainty of the time 2 price given that the market maker observes the order flow of downstairs customers, y_D. Increasing the cost of downstairs market making, c_D on the other hand, reduces the number of market makers that enter the market in equilibrium, as smaller market making profits support fewer market makers.

A Measure of Execution Quality in the Downstairs Market

Although, the time 1 price and the number of equilibrium market makers have been found, nevertheless the liquidity demanded by customers has been assumed to be exogenous. However, it is more natural to assume that an investor receives a random liquidity shock before it observes the time 1 or time 2 prices in the downstairs market. It is further assumed that the investor decides to trade in the downstairs market, even before it learns its liquidity shock, x. Supposing that an investor sells x contracts in the downstairs market at a price P_{1D} and holds the position until time 2 when the price becomes P_2, the expected utility of the investor's wealth can be expressed as:

$$EU_c\left[\tilde{x}\left(\tilde{P}_{1D} - \tilde{P}_2\right)\right] \tag{4.22}$$

where $\tilde{x}$ is normally distributed and independent of $(\tilde{P}_{1D} - \tilde{P}_2)$, $\tilde{g}_2$, $\tilde{y}_D$, $\tilde{y}_U$ and $\tilde{y}_2$, and has mean zero and variance σ_X^2.

The utility function of the customer is negative exponential, same as the market maker. However, the customer is allowed to have a different risk aversion than the market maker. The following is the form of the customer's utility, where h is the customer's risk aversion coefficient:

$$U_c(W) = -exp(-hW) \tag{4.23}$$

Using the law of iterated expectations, the equation (4.22) can also be written as:

$$EU_c\left[\tilde{x}\left(\tilde{P_{1D}} - \tilde{P}_2\right)\right] = E\left(E\left(U\left[\tilde{x}\left(\tilde{P}_{1D} - \tilde{P}_2\right)\right]|x\right)\right) \tag{4.24}$$

Now, the distribution of the price change from time 1 to time 2, i.e. $\tilde{P}_{1D} - \tilde{P}_2$ is found as follows. First, $E\left[\tilde{P}_2 \left| y_D \right.\right]$ is moved to the left hand side of equation (4.7) and expectations are taken of both sides. Since by iterated expectations $E\left[E\left[\tilde{P}_2 \left| y_D \right.\right]\right] = E\left[\tilde{P}_2\right]$, it obtains that:

$$E\left[P_{1D} - \tilde{P}_2\right] = -\frac{\left(a\sqrt{q}\right)}{M_D} E\left[Var\left[\tilde{P}_2 \left| y_D \right.\right]\right] E y_D \tag{4.25}$$

Now, since $E\tilde{y}_D = 0$, the expected value (or mean) of $\tilde{P}_{1D} - \tilde{P}_2$ is also zero. It is also obvious that $\tilde{P}_{1D} - \tilde{P}_2$ is normally distributed. Its variance is thus:

$$\sigma^2_{\Delta Pd} \equiv Var\left(P_{1D} - P_2\right) = -\frac{a^2 q}{M_D^2}\left(Var\left[\tilde{P}_2 \left| y_D \right.\right]\right)^2 \sigma^2_Y + Var\left[\tilde{P}_2 \left| y_D \right.\right]. \tag{4.26}$$

The conditional expectation on the right hand side of equation (4.24) becomes:

$$E\left(U\left[\tilde{x}\left(\tilde{P}_{1D} - \tilde{P}_2\right)\right] |x\right) = -exp\left[h^2 \frac{x^2}{2} \sigma^2_{\Delta Pd}\right] \tag{4.27}$$

After substituting the right hand side of equation (4.27) for the conditional expectation expression in equation (4.24), and evaluating the expectations operator for a χ^2 distribution, the following is obtained:

$$E\left(U\left[\tilde{x}\left(\tilde{P}_{1D} - \tilde{P}_2\right)\right]\right) = -\left[1 - h^2 \sigma^2_{\Delta Pd} \sigma^2_X\right]^{1/2}. \tag{4.28}$$

Provided that the condition $\sigma^2_X < \left(h^2 \sigma^2_{\Delta Pd}\right)^{-1}$ is met, i.e. the variance of the customer's demand is small enough, then equation (4.28) will be valid. Hence it can be seen that the customer's expected utility is inversely proportional to the variance of the price change from time 1 to time 2, i.e. σ_X^2. Thus, a customer will be better off when the variance of the price change, σ_X^2, is lower. Therefore, σ_X^2 can be viewed as a cost arising from the liquidity demanded in the downstairs market at time 1. After substituting for M_D^2 in equation (4.26) from equation (4.15), the following is obtained for the variance of the price change in the downstairs market:

$$\sigma_{\Delta Pd}^2 = Var\left[\tilde{P}_2 \,|y_D\right] \text{ exp}(2ac_D) \tag{4.29}$$

This means that the customer is better off when the expressed demand in the downstairs market at time 1 is more informative about the time 2 price, and when the downstairs market makers find it less costly (c_D) to enter the market. Also, increasing the market maker cost of entry for the downstairs market, c_D, increases $\sigma_{\Delta Pd}^2$, the 'downstairs trading cost', exponentially. Thus even a small reduction in the cost of entry can dramatically improve market liquidity.

4.2.2 Upstairs Market Equilibrium

After observing the order flow from the upstairs market traders, upstairs market makers determine the amount they wish to trade, Z_U, in order to maximize the utility of their future (time 2) wealth, $\tilde{W}_2$. Therefore, conditional on their observation of the expressed and unexpressed demand of all upstairs market customers, y_U, and y_2, respectively, the upstairs market makers choose Z_U to maximize:

$$E\left[U\left(\tilde{W}_2\right) |y_U, y_2\right] \equiv -\exp\left[-a\tilde{W}_2\right] \tag{4.30}$$

where $\tilde{W}_2 = W_1 + \left(\tilde{P}_2 - P_{1U}\right) Z_U$, and W_1 is the initial wealth of each market maker, and P_{1U} is the average date 1 price of the asset in the upstairs market. Since the risk aversion coefficient a in equation (4.30) is independent of market maker, the model assumes all market makers are equally risk averse.

As mentioned by Grossman (1992), the price traded at by each market maker i, can be defined as being equal to the average upstairs price P_{1U} plus a perturbation ε_i which averages to zero across all M_U upstairs market makers, and which causes additional volatility of σ_U^2 in the date 1 upstairs price. Thus,

$$P_{1U,i} = P_{1U} + \varepsilon_i \tag{4.31}$$

Since simultaneous upstairs trades can take place at different prices, one can view each upstairs trade as taking place at the average upstairs market price plus a random error term. Hence, in the Grossman (1992) model, upstairs market makers are identically informed about the upstairs order flow, and random errors therefore cancel out in the expression for the average price in the upstairs market at time 1, i.e. P_{1U}. In other words, the average of $P_{1U,i}$ across i upstairs market makers is simply P_{1U}, the average price in the upstairs market at date 1.

However, the random errors create additional volatility in the average upstairs market price, which is denoted by σ_U^2.

Therefore, optimal demand of upstairs market makers, Z_U is found in the same way as the downstairs market maker demand in the previous section, and is equal to:

$$Z_U = \frac{E\left[\tilde{P}_2 \left| y_U, y_2\right.\right] - P_{1U}}{a\left\{Var\left[\tilde{P}_2 \left| y_U, y_2\right.\right] + \sigma_U^2\right\}} \tag{4.32}$$

There are M_U identical upstairs market makers, each of which independently choose the same optimal demand, Z_U. To clear the market, the total market maker demand must equal the expressed order flow of all customers in the upstairs market at time 1. Therefore, the market clearing condition is:

$$M_U Z_U = y_U\sqrt{1-q} \tag{4.33}$$

After rearranging the market clearing equation (4.33), the average upstairs equilibrium price at time 1 is:

$$P_{1U} = E\left[\tilde{P}_2 \left| y_U, y_2\right.\right] - \frac{\left(a\sqrt{1-q}\right)}{M_U} Var\left[\tilde{P}_2 \left| y_U, y_2\right.\right] y_U. \tag{4.34}$$

The equilibrium number of upstairs market makers, M_U can be derived in the same way as in the previous section, equations (4.8) to (4.21), where c_U represents each upstairs market maker's cost of entry. Hence:

$$M_U = \frac{a\sigma_Y\sqrt{1-q}\sqrt{Var_1\left(\tilde{P}_2 \left| y_U, y_2\right.\right) + \sigma_Y{}^2}}{\sqrt{exp(2ac_U) - 1}} \tag{4.35}$$

Thus, it can be seen from equation (4.35) that the number of market makers entering the upstairs market increases with the uncertainty of the time 2 price given that the market maker observes the expressed and unexpressed order flows of all upstairs customers, y_U, and y_2. Increasing the cost of upstairs market making, c_U on the other hand, reduces the number of market makers that enter the market in equilibrium, as smaller market making profits support fewer market makers.

The expression for execution quality in the upstairs market is also derived analogous to the equations (4.22) to (4.29) in the previous section. Therefore, the variance of the price change in the upstairs market which represents the 'upstairs market trading cost' for an upstairs market customer, is given by:

$$\sigma^2_{\Delta Pu} = \left(Var\left[\tilde{P}_2 \,|y_U, y_2\right] + \sigma^2_U\right)\exp(2ac_U) \tag{4.36}$$

This means that the customer is better off when the expressed demand in the upstairs market at time 1 is more informative about the time 2 price, and when the upstairs market makers find it less costly (c_U) to enter the market. Also, increasing the market maker cost of entry for the upstairs market, c_U, increases $\sigma^2_{\Delta Pu}$, the 'upstairs market trading cost', exponentially. Thus even a small reduction in the cost of entry can dramatically improve market liquidity.

4.2.3 Relative Quality of Upstairs Market versus Downstairs Market

From equations for the trading cost in the upstairs and downstairs markets, (4.36) and (4.29), respectively, it is obvious that a lower market entry cost for the downstairs (upstairs) market, $c_D(c_U)$ will benefit the customers of the downstairs (upstairs) market.

Thus, in order to place the two markets on an equal footing the same cost of market entry is used for both upstairs and downstairs market makers, i.e. $c_U = c_D = c$. Hence, the difference of equations (4.36) and (4.29) will indicate whether the upstairs or the downstairs market has better quality. Thus:

$$\Delta(D-U) \equiv exp(-2ac)\left(\sigma^2_{\Delta Pu} - \sigma^2_{\Delta Pd}\right) \tag{4.37}$$

which equals:

$$= Var\left[\tilde{P}_2 \, | y_U, y_2\right] + \sigma^2_U - Var\left[\tilde{P}_2 \, | y_D\right] \tag{4.38}$$

By substituting for P_2 into $Var\left[\tilde{P}_2 \, | y_U, y_2\right]$ and $Var\left[\tilde{P}_2 \, | y_D\right]$ from equation (4.1), and simplifying gives:

$$= \Delta(D-U)(q) = b^2\sigma^2_Y \left[2fq - 1\right] + \sigma^2_U. \tag{4.39}$$

4.3 Grossman's Model when Market Makers Know the Unexpressed Demand Only of their Own Customers

This section develops Grossman's model under the assumption that individual market makers are repositories of information about the expressed and unexpressed demand of their own customers, but not that of other market makers. Although the model makes the assumption that a market maker knows both expressed and unexpressed demands of his own customers but not that of other market makers' customers, it is likely that at least some of the expressed demands (orders) may be made available to all upstairs market participants. Therefore, large orders may be displayed to all upstairs market makers, instead of only being known by the market maker who receives the order. The main difference with this assumption, and the one in Grossman (1992) is that market makers are not assumed to be identical, which does not lead to a tractable expression for the price of the security at market clearing, as in Grossman (1992). In order to simplify the analysis, upper and lower bounds for the informativeness of order flow are developed, and compared with the results of Grossman (1992). The setup is similar to Grossman (1992). There are M_U market makers in the upstairs market. However, each of the market makers is assumed to know only the expressed and unexpressed demand of her own customers. At time 1, there is an exogenous liquidity event that changes the customers' optimal portfolio holdings of an asset from their current portfolio holdings of the asset. This change motivates the customers to trade. For expositional consistency, the paper also makes the same assumption as in Grossman (1992) that the assets being traded are in zero net supply (e.g. futures or forwards contracts). Therefore, these contracts are traded at date 1 and settled at date 2.

In this paper, it is further assumed that each upstairs market maker i receives at time 1 an exogenous expressed order flow of $\tilde{y}_{U,i}$, such that:

$$\tilde{y}_U = \sum_{i=1}^{Mu} \tilde{y}_{U,i}\sqrt{\alpha_i} \tag{4.40}$$

and

$$\sum_{i=1}^{Mu} \alpha_i = 1 \tag{4.41}$$

where $\sqrt{\alpha_i}$ is the proportion of the total expressed order flow at time 1 that upstairs market maker i receives.

This paper makes a further assumption that the total unexpressed demand in the upstairs market, $\tilde{y}_2$, is composed of exogenous unexpressed demands of each upstairs market maker.

Therefore, $\tilde{y}_{2,i}$ is the exogenous unexpressed demand of the customers of market maker i, such that:

$$\tilde{y}_2 = \sum_{i=1}^{Mu} \tilde{y}_{2,i}\sqrt{\beta_i} \tag{4.42}$$

and

$$\sum_{i=1}^{Mu} \beta_i = 1 \tag{4.43}$$

where $\sqrt{\beta_i}$ is the proportion of the unexpressed demand that upstairs market maker i receives. Further, it is assumed that $\tilde{y}_{2,i}$, $\tilde{y}_{U,i}$, and $\tilde{y}_D$ are independently and identically normally distributed with zero mean and variance σ_Y^2.

4.3.1 Upstairs Market Equilibrium

At date 1, each upstairs market maker, i, chooses his demand $Z_{U,i}$ to maximize his expected utility of final wealth. As in Grossman (1992), it is assumed that the market maker agents have negative exponential utility, and market makers are unable to trade simultaneously in both upstairs and downstairs markets, so that they are forced to carry the position they acquire at time 1 through to time 2, when they can unwind their position by selling the asset at a price of $\tilde{P}_2$.[14] Also, as in Grossman (1992), it is assumed that the upstairs market makers do not immediately observe the arrival of orders in the downstairs market. This paper makes the additional assumption that the upstairs market makers only learn the expressed and unexpressed demands of their own customers, and not of other market makers. Therefore, each upstairs market maker maximizes his expected utility of wealth conditional on the expressed and unexpressed demands of his own customers. Thus,

$$E\left[U\left(\tilde{W}_{2,i}\right)|y_{U,i}, y_{2,i}\right] \equiv -\exp\left[-a\tilde{W}_{2,i}\right] \tag{4.44}$$

where $\tilde{W}_{2,i} = W_{1,i} + \left(\tilde{P}_2 - P_{1U,i}\right) Z_{U,i}$, and $W_{1,i}$ is the initial wealth of market maker i, and $P_{1U,i}$ is the date 1 price of the asset traded by upstairs market maker i. Since the risk aversion coefficient a in equation (4.44) is independent of the subscript i, this means that the model assumes all dealers are equally risk averse (risk tolerant).

Then, using the normality assumption, for any market maker i, the optimal demand $Z_{U,i}$ is given by:

$$Z_{U,i} = \frac{E\left[\tilde{P}_2 |y_{U,i}, y_{2,i}\right] - P_{1,i}}{a\left\{Var\left[\tilde{P}_2 |y_{U,i}, y_{2,i}\right] + \sigma_U^2\right\}} \tag{4.45}$$

The market clearing condition therefore implies that:

$$\sum_{i=1}^{Mu} Z_{U,i} = y_U\sqrt{1-q} \tag{4.46}$$

[14] The negative exponential utility implies that dealers have constant absolute risk aversion. This means that agents' absolute risk aversion is unaffected by wealth. An extra dollar of wealth gives rise to a similar increase in the utility of an agent's wealth regardless of the agent's wealth level. This is arguably counter-intuitive. However, despite this drawback, the negative exponential utility leads to tractable solutions in utility maximization problems, which explains the popularity of its use in the asset pricing and market microstructure literature.

After substituting for $Z_{U,i}$ above from equation (4.45) and for $P_{1U,i}$ from equation (4.31), and some algebraic manipulation, the following expression is obtained for the average upstairs market price, P_{1U}:

$$\begin{aligned} P_{1U} &= \left[\sum_{i=1}^{Mu}\left(\frac{1}{Var\left[\tilde{P}_2\,|y_{U,i},y_{2,i}\right]+\sigma_U^2}\right)\right]^{-1} \\ &\quad \left[\sum_{i=1}^{Mu}\left(\frac{E\left[\tilde{P}_2\,|y_{U,i},y_{2,i}\right]-\varepsilon_i}{Var\left[\tilde{P}_2\,|y_{U,i},y_{2,i}\right]+\sigma_U^2}\right)-\left(a\sqrt{1-q}\right)y_U\right] \end{aligned} \quad (4.47)$$

Now, in order to continue the analysis, one needs to simplify this expression. First, choose $y_{U,j} \in (y_{U,1}, y_{U,2}, \cdots y_{U,Mu})$ and $y_{2,k} \in (y_{2,1}, y_{2,2}, \cdots y_{2,Mu})$ such that:

$$\underline{\sigma_{P2}^2} = Var\left[\tilde{P}_2\,|y_{U,j},y_{2,k}\right] \leq Var\left[\tilde{P}_2\,|y_{U,i},y_{2,i}\right] \text{ for all } i = 1, \ldots M_U. \quad (4.48)$$

This means that $\underline{\sigma_{P2}^2}$ is the minimum variance of the date 2 price of the asset given that the expressed order flow is as informative as that of the market maker with the most informative expressed order flow, and the unexpressed order flow is as informative as that of the market maker with the most informative unexpressed order flow. Note that j and k can be different, meaning that $\underline{\sigma_{P2}^2}$ could be smaller than any market maker's observed variance of the date 2 price. Therefore, one can see that no single market maker observes a variance of date 2 price that is less than $\underline{\sigma_{P2}^2}$. Thus, if one assumes that all market makers observe order flows that lead to the minimum variance of the date 2 price, the expression for the date 1 average price, equation (4.47), becomes:

$$\underline{P_{1U}} = \left[\sum_{i=1}^{Mu}\left(\frac{1}{\underline{\sigma_{P2}^2}+\sigma_U^2}\right)\right]^{-1}\left[\sum_{i=1}^{Mu}\left(\frac{E\left[\tilde{P}_2\,|y_{U,j},y_{2,k}\right]-\varepsilon_i}{\underline{\sigma_{P2}^2}+\sigma_U^2}\right)-\left(a\sqrt{1-q}\right)y_U\right] \quad (4.49)$$

which reduces to:

$$\underline{P_{1U}} = E\left[\tilde{P}_2 \,|y_{U,j}, y_{2,k}\right] - \frac{\left(a\sqrt{1-q}\right)}{M_U}\left\{\underline{\sigma_{P2}^2} + \sigma_U^2\right\} y_U.^{15} \tag{4.50}$$

Therefore, given market makers observe the order flows that give rise to minimum volatility in price changes, the optimal demand of each dealer i becomes:

$$\underline{Z_U} = \frac{E\left[\tilde{P}_2 \,|y_{U,j}, y_{2,k}\right] - P_{1U}}{a\left\{\underline{\sigma_{P2}^2} + \sigma_U^2\right\}}.^{16} \tag{4.51}$$

Similarly, choose $y_{U,v} \in (y_{U,1}, y_{U,2}, \cdots y_{U,M_U})$ and $y_{2,w} \in (y_{2,1}, y_{2,2}, \cdots y_{2,M_U})$ such that:

$$\overline{\sigma_{P2}^2} = Var\left[\tilde{P}_2 \,|y_{U,v}, y_{2,w}\right] \geq Var\left[\tilde{P}_2 \,|y_{U,i}, y_{2,i}\right] \text{ for all } i = 1, \ldots M_U. \tag{4.52}$$

This means that $\overline{\sigma_{P2}^2}$ is the maximum variance of the date 2 price of the asset given that the expressed order flow is as informative as that of the market maker with the least informative expressed order flow, and the unexpressed order flow is as informative as that of the market maker with the least informative unexpressed order flow. Note that as above, v and w can be different, meaning that $\overline{\sigma_{P2}^2}$ could be larger than any market maker's observed variance of the date 2 price. Therefore, one can see that no single market maker observes a variance of date 2 price that is greater than $\overline{\sigma_{P2}^2}$.

[15] Note that when summed over all market makers, the ε_i's of equation (4.49) cancel out.

[16] Note that in the market clearing condition of equation (11), using $\underline{Z_U}$ instead of the actual optimal demand $Z_{U,i}$ will lead to a cancellation of the ε_i's from the expression for $P_{1U,i}$, as defined in equation (4.31). Therefore equation (16) shows P_{1U} instead of $P_{1U,i}$.

Thus, if one assumes that all market makers observe order flows that lead to the maximum variance of the date 2 price, the expression for the date 1 average price, equation (4.45), becomes:

$$\overline{P_{1U}} = \left[\sum_{i=1}^{Mu}\left(\frac{1}{\overline{\sigma_{P2}^2} + \sigma_U^2}\right)\right]^{-1}\left[\sum_{i=1}^{Mu}\left(\frac{E\left[\tilde{P}_2 \left| y_{U,v}, y_{2,w}\right.\right] - \varepsilon_i}{\overline{\sigma_{P2}^2} + \sigma_U^2}\right) - \left(a\sqrt{1-q}\right) y_U\right] \tag{4.53}$$

which reduces to:

$$\overline{P_{1U}} = E\left[\tilde{P}_2 \left| y_{U,v}, y_{2,w}\right.\right] - \frac{\left(a\sqrt{1-q}\right)}{M_U}\left\{\overline{\sigma_{P2}^2} + \sigma_U^2\right\} y_U \tag{4.54}$$

Therefore, given that market makers observe the order flows that give rise to maximum volatility in price changes, the optimal demand of each dealer i becomes:

$$\overline{Z_U} = \frac{E\left[\tilde{P}_2 \left| y_{U,v}, y_{2,w}\right.\right] - P_{1U}}{a\left\{\overline{\sigma_{P2}^2} + \sigma_U^2\right\}} \tag{4.55}$$

4.3.2 Endogenously Determined Market Makers

In this section, as in Grossman (1992), the equilibrium value of the number of upstairs market makers, M_U is determined, consistent with the upper and lower bounds of the informativeness of the expressed and unexpressed order flows of each market maker, as obtained in the previous section.

First, it is assumed that both the expressed and unexpressed order flows of each upstairs market maker are as informative as that of the market maker having the most informative order flows. This is the upper bound for the informativeness of order flows in the upstairs market, and therefore the upper bound for the quality of execution in the upstairs market. Therefore each market maker observes $y_{U,j}$ and $y_{2,k}$, subject to condition (4.48). It is further assumed that $\tilde{y}_{U,j}$ and $\tilde{y}_{2,k}$ are normally distributed and uncorrelated with $\tilde{P}_2$, meaning that the liquidity event is exogenous to the realization of $\tilde{P}_2$. Each agent spends an amount c_U in order to become a market maker. An agent only observes the order flows $y_{U,j}$ and $y_{2,k}$ at the time of the liquidity event at date 1, if he has already spent c_U and become a market maker at date 0.

Therefore, in equilibrium, the number of market makers will be such that any potential agent is indifferent between paying c_U and becoming a market maker and not paying c_U and not participating in the market. Thus, the individual rationality condition for becoming a market maker must be exactly satisfied at date 0. This means that in equilibrium, the unconditional expectation of the utility of becoming a market maker must equal the unconditional expectation of the utility of non-participation in the market. In other words:

$$E_0\left[U\left(W_0 - c_U + \left(\tilde{P}_2 - \underline{\tilde{P}_{1U}}\right)\underline{Z_U}\right)\right] = E_0\left[U\left(W_0\right)\right] \qquad (4.56)$$

where W_0 is the initial endowment of each dealer, i.e. at date 0, $\underline{Z_U}$ is the optimal demand of each dealer i given the dealer observes the most informative order flows, as defined in equation (4.51).

Now, by using the Law of Iterated Expectations, the left hand side of equation (4.56) can be expressed as an expectation of a conditional expectation, so that:

$$E_0\left[E_1\left[U\left(W_0 - c_U + \left(\tilde{P}_2 - \underline{\tilde{P}_{1,u}}\right)\underline{Z_U}\right)|y_{U,j}, y_{2,k}\right]\right] = E_0\left[U\left(W_0\right)\right] \tag{4.57}$$

Since each of the $\underline{M_U}$ market makers, i, has the same optimal demand, $\underline{Z_U}$, the market clearing condition, (i.e. equation (4.46)) becomes:

$$\underline{M_U}\,\underline{Z_{U,i}} = \tilde{y}_U\sqrt{1-q}. \tag{4.58}$$

Therefore, after substituting for $\underline{Z_U}$ from equation (4.58), using the negative utility function, i.e. equation (4.44), the conditional expectation expression on the left hand side of equation (4.57) becomes:

$$\begin{aligned} &E_1\left[U\left(W_0 - c_U + \left(\tilde{P}_2 - \underline{\tilde{P}_{1U}}\right)\underline{Z_U}\right)|y_{U,j}, y_{2,k}\right] = \\ &-exp(-aW_0)\,exp(ac_U)E_1\left[exp\left(-a\left(\tilde{P}_2 - \underline{\tilde{P}_{1U}}\right)\tilde{y}_U\frac{\sqrt{1-q}}{\underline{M_U}}\right)|y_{U,j}, y_{2,k}\right] \end{aligned} \tag{4.59}$$

Given a constant a, a normally distributed variable X, has the following property:

$$\mathrm{E}\left[exp(aX)\right] \equiv exp\left(a\overline{X} + \frac{a^2}{2}\sigma_X^2\right), \tag{4.60}$$

where $\overline{X}$ and σ_X^2 are the mean and variance of X, respectively.

Using the property in (4.60), equation (4.59) becomes:

$$
\begin{aligned}
E_1\left[U\left(.\right)\left|.\right.\right] &= -exp(-aW_0)\, exp(ac_U) \\
& \text{exp}\left(-a\left(E_1\left[\tilde{P}_2\left|y_{U,j}, y_{2,k}\right.\right] - \underline{P_{1U}}\right)\tilde{y}_U\frac{\sqrt{1-q}}{\underline{M_U}}\right. \\
& \left.+\frac{a^2}{2}\left(Var_1\left[\tilde{P}_2\left|y_{U,j}, y_{2,k}\right.\right] + {\sigma_U}^2\right)\tilde{y}_U^2\frac{(1-q)}{\underline{M_U}^2}\right)
\end{aligned}
\tag{4.61}
$$

Now, substituting for $E_1\left[\tilde{P}_2\left|y_{U,j}, y_{2,k}\right.\right] - \underline{P_{1,u}}$ from equation (4.50), and simplifying the resulting expression, one obtains:

$$
\begin{aligned}
E_1\left[U\left(.\right)\left|.\right.\right] &= -exp(-aW_0)\, exp(ac_U) \\
& \text{exp}\left(-\frac{a^2}{2}(1-q)\left(Var_1\left[\tilde{P}_2\left|y_{U,j}, y_{2,k}\right.\right] + {\sigma_U}^2\right)\left(\frac{\tilde{y}_U}{\underline{M_U}}\right)^2\right)
\end{aligned}
\tag{4.62}
$$

Now, after substituting for the conditional expectation on left hand side of equation (4.57) from equation (4.62), substituting for the right hand side of equation (4.57) from equation (4.44), cancelling the $exp(-aW_0)$ terms from both sides, and moving the $exp(ac_U)$ term from the left to the right hand side, the following is obtained:

$$
E_0\left[\text{exp}\left(-\frac{a^2}{2}(1-q)\left(Var_1\left[\tilde{P}_2\left|y_{U,j}, y_{2,k}\right.\right] + {\sigma_U}^2\right)\left(\frac{\tilde{y}_U}{\underline{M_U}}\right)^2\right)\right] = exp(-ac_U)
\tag{4.63}
$$

Now, let:

$$t_U = \frac{a^2{\sigma_Y}^2(1-q)\left(Var_1\left[\tilde{P}_2\,|y_{U,j}, y_{2,k}\right] + {\sigma_U}^2\right)}{{M_U}^2} \tag{4.64}$$

and

$$z^2 = \frac{\tilde{y}_U^2}{{\sigma_Y}^2} \tag{4.65}$$

where $\tilde{y}_U$ is normally distributed with mean μ_Y and variance ${\sigma_Y}^2$, and z^2 has a non-central χ^2 distribution. Now, let $\tilde{X} = \frac{\tilde{y}_U - \mu_Y}{\sigma_Y}$, so that $\tilde{X}$ has the standard normal distribution.

Then, the moment generating function of z^2, $M_x(T)$ is given by:

$$\mathrm{E}exp(z^2T) = \mathrm{E}\left(exp\left(\tilde{X} + \frac{\mu_Y}{\sigma_Y}\right)^2 T\right) \tag{4.66}$$

which equals:

$$exp\left(\frac{{\mu_Y}^2 T}{{\sigma_Y}^2(1-2T)}\right)(1-2T)^{-\frac{1}{2}} \tag{4.67}$$

Now, for equation (4.67), let $T = -\frac{t_U}{2}$, and substitute for t_U from (4.64), to obtain:

$$\mathrm{E}exp(z^2T) = exp\left(\frac{-{\mu_Y}^2}{{\sigma_Y}^2(1+t_U)}\frac{t_U}{2}\right)(1+t_U)^{-\frac{1}{2}} \tag{4.68}$$

As in Grossman (1992), it is assumed that at date 0, the expected magnitude of the liquidity event occurring at date 1 is equal to zero, so that $\mu_Y = 0$.

Therefore, by letting $\mu_Y = 0$, equation (4.68) reduces to $(1+t_U)^{-\frac{1}{2}}$ which is equal to the right hand side of equation (4.63), i.e.:

$$(1+t_U)^{-\frac{1}{2}} = exp(-ac_U) \tag{4.69}$$

Now, using equation (4.69) to substitute for t_U into (4.64), the equilibrium number of market makers can be obtained for the upper bound of the informativeness of the expressed and unexpressed order flow:

$$\underline{M_U} = \frac{a\sigma_Y\sqrt{1-q}\sqrt{Var_1\left(\tilde{P}_2\left|y_{U,j}, y_{2,k}\right.\right) + \sigma_U{}^2}}{\sqrt{exp(2ac_U)-1}} \tag{4.70}$$

By a similar method, the equilibrium number of marker makers can be obtained for the lower bound of order flow informativeness, so that:

$$\overline{M_U} = \frac{a\sigma_Y\sqrt{1-q}\sqrt{Var_1\left(\tilde{P}_2\left|y_{U,v}, y_{2,w}\right.\right) + \sigma_U{}^2}}{\sqrt{exp(2ac_U)-1}} \tag{4.71}$$

It is evident from equations (4.48) and (4.52) that

$Var_1\left(\tilde{P}_2\left|y_{U,j}, y_{2,k}\right.\right) < Var_1\left(\tilde{P}_2\left|y_{U,v}, y_{2,w}\right.\right)$. Therefore, equations (4.70) and (4.71) imply that $\underline{M_U} < \overline{M_U}$.

4.4 Extension of Grossman's Model of the Upstairs Market

This section outlines an extension of Grossman's (1992) model (for the upstairs market) by relaxing the assumption that upstairs market makers know the unexpressed demand of all upstairs customers.

In this model, it is assumed that unexpressed demands of upstairs market customers are made up of two components. The first component, called private unexpressed demand, is unexpressed demand that is known by just one upstairs market maker, and represents the portion of customers' trading preferences known only by that market maker. The second component, called public unexpressed demand, is unexpressed demand that is known by all upstairs market makers. For customers that have trading relationships with many upstairs market makers, a market maker can learn public unexpressed demand directly through trading or business relationships with customers, or through professional relationships with other market makers. Therefore, at any given time in the upstairs market, some portion of the unexpressed demand is privately known and the remaining unexpressed demand is known publicly. As customers make trading relationships with new market makers, the public proportion of unexpressed demand is likely to increase over time, and the private proportion is likely to decrease proportionately. For example, in the case of a brokerage house that hires an individual broker from another brokerage house, the hiring brokerage house can learn the trading preferences of other brokerage house's customers, which increases the proportion of unexpressed demand that is known publicly. However, new customers entering and leaving the market, as well as customers changing their trading preferences, mean that it probably is not possible to make all unexpressed demand public.

Hence, the model assumes that an upstairs market maker observes the private unexpressed demand of its own customers as well as the public unexpressed demand of either its own or other market makers' customers. The total unexpressed demand $y_{2,i}$, observed by a single upstairs market maker i is therefore:

$$\tilde{y}_{2,i} = \sqrt{p}\tilde{y}_{2,Publ} + \sqrt{(1-p)}\tilde{y}_{2,Priv,i} \tag{4.72}$$

where $\tilde{y}_{2,Publ}$ is the public unexpressed demand, and $\tilde{y}_{2,Priv,i}$ is the private unexpressed demand of market maker i's customers. Furthermore, it is assumed that $\tilde{y}_{2,Publ}$ and $\tilde{y}_{2,Priv,i}$, $i = 1 \cdots M_U$, are mutually independently and identically normally distributed variables with mean zero and variances $\sigma^2_{Y,Publ}$ and $\sigma^2_{Y,Priv}$, respectively. The total unexpressed demand in the upstairs market, $y_2(p)$ is therefore just the sum of the public and the individual private unexpressed demand components of all upstairs market makers:

$$\tilde{y}_2(p) = \sqrt{p}\tilde{y}_{2,Publ} + \sqrt{(1-p)}\sum_{i=1}^{Mu} \tilde{y}_{2,Priv,i} \tag{4.73}$$

where the proportions $\sqrt{p}$ and $\sqrt{1-p}$ are used to ensure that the variance of total unexpressed demand is constant. Therefore p and $(1-p)$ can be viewed as the proportion of the variance of total unexpressed order flow made up of public and private unexpressed demands, respectively. It is also clear that when $p = 1$, the expression for the unexpressed demand in the whole upstairs market reduces to that used in Grossman's (1992) model, as unexpressed demands of all upstairs customers in Grossman's (1992) model are by assumption publicly known to the entire upstairs market, and therefore known by all market makers. When $p = 0$, all unexpressed demand is private.

The events assumed to take place in this model are similar to the events described for the Grossman (1992) model, in section (4.2), with the exception that each of the M_U upstairs market makers observes all of the expressed upstairs demand, public unexpressed demand of upstairs market customers, and private unexpressed demand of his own customers, but not the expressed demand of downstairs market customers. This model also uses the same definitions used in Grossman's (1992) derivation of the upstairs market equilibrium for P_2, $P_{1U,i}$, and y_U.

Therefore, the objective function of each upstairs market maker i becomes:

$$E\left[U\left(\tilde{W}_{2,i}\right)|y_U, y_{2,i}\right] \equiv -\exp\left[-a\tilde{W}_{2,i}(p)\right] \tag{4.74}$$

where $\tilde{W}_{2,i}(p) = W_{1,i} + \left(\tilde{P}_2 - P_{1U,i}\right) Z_{U,i}(p)$, and $W_{1,i}$ is the initial wealth of market maker i, and $P_{1U,i}$ is the date 1 price of the asset traded by upstairs market maker i. This expression of the expected utility is similar to the one in Grossman's (1992) model for the upstairs market, (4.30), except that the market maker demand $Z_{U,i}$ and hence the market maker wealth at time 2, $\tilde{W}_{2,i}$, is a function of the proportion p, which is an exogenous variable. The optimal demand for market maker i is therefore:

$$Z_{U,i} = \frac{E\left[\tilde{P}_2 |y_U, y_{2,i}\right] - P_{1U,i}}{a\left\{Var\left[\tilde{P}_2 |y_U, y_{2,i}\right] + \sigma_U^2\right\}} \tag{4.75}$$

There are M_U identical upstairs market makers, each of which independently choose the same optimal demand, Z_U. To clear the market, the total market maker demand must equal the expressed order flow of all customers in the upstairs market at time 1. Therefore, the market clearing condition is:

$$M_U Z_U = y_U \sqrt{1-q} \tag{4.76}$$

After rearranging the market clearing equation (4.76), the upstairs equilibrium price at time 1 is:

$$P_{1U} = E\left[\tilde{P}_2 \left| y_U, y_{2,i} \right.\right] - \frac{\left(a\sqrt{1-q}\right)}{M_U} Var\left[\tilde{P}_2 \left| y_U, y_{2,i} \right.\right] y_U. \tag{4.77}$$

The equilibrium number of upstairs market makers, M_U can be derived in the same way as in the previous section, equations (4.8) to (4.21), where c_U represents each upstairs market maker's cost of entry.

Hence:

$$M_U = \frac{a\sigma_Y \sqrt{1-q}\sqrt{Var_1\left(\tilde{P}_2 \left| y_U, y_{2,i} \right.\right) + \sigma_Y{}^2}}{\sqrt{exp(2ac_U) - 1}} \tag{4.78}$$

Thus, it can be seen from equation (4.78) that the number of market makers entering the upstairs market increases with the uncertainty of the time 2 price given that the market maker observes the expressed and unexpressed order flows of upstairs customers, y_U, and $y_{2,i}$. Increasing the cost of upstairs market making, c_U on the other hand, reduces the number of market makers that enter the market in equilibrium, as smaller market making profits support fewer market makers.

The expression for execution quality in the upstairs market is also derived analogous to the equations (4.22) to (4.29) in the section on the downstairs market equilibrium.

Therefore, the variance of the price change in the upstairs market which represents the 'upstairs market trading cost' for an upstairs market customer, is given by:

$$\sigma^2_{\Delta Pu} = \left(Var\left[\tilde{P}_2 \left| y_U, y_{2,i}\right.\right] + \sigma^2_U\right) \exp(2ac_U) \tag{4.79}$$

This means that the customer is better off when the expressed demand in the upstairs market at time 1 is more informative about the time 2 price, and when the upstairs market makers find it less costly (c_U) to enter the market.

4.5 Comparison of Upstairs Market Equilibrium under Extended Model to the Downstairs Market Equilibrium of Grossman (1992)

The downstairs market has better quality execution compared to the upstairs market if the following expression is positive, where it is assumed that the upstairs and downstairs markets have the same cost of entry, i.e. $c_U = c_D = c$:

$$\Delta(D-U) \equiv exp(-2ac)\left(\sigma^2_{\Delta Pu} - \sigma^2_{\Delta Pd}\right) \tag{4.80}$$

which equals:

$$= Var\left[\tilde{P}_2 \left| y_U, y_{2,i}\right.\right] + \sigma^2_U - Var\left[\tilde{P}_2 \left| y_D\right.\right] \tag{4.81}$$

By substituting for P_2 and $y_{2,i}$ into $Var\left[\tilde{P}_2 \left| y_U, y_{2,i}\right.\right]$ and $Var\left[\tilde{P}_2 \left| y_D\right.\right]$ from equations (4.1) and (4.72) one obtains:

$$= \Delta(D-U)(q) = b^2\left[\sigma^2_y\left[2fq - f\right] - (1-f)\left[(1-p)\sigma^2_{Y,Priv} - p\sigma^2_{Y,Publ}\right]\right] + \sigma^2_U. \tag{4.82}$$

It is clear from equation (4.82) that when the term $\left[(1-p)\sigma^2_{Y,Priv} - p\sigma^2_{Y,Publ}\right]$ is equal to one, equation (4.82) reduces to the relative market quality equation of Grossman (1992), as derived in (4.39). Hence, if this term is less than one, then the quality advantage of the downstairs (upstairs) market increases (decreases) relative to Grossman's (1992) model. Therefore, in order to ensure that the upstairs market's quality relative to the downstairs market, is no worse than in the Grossman (1992) model, the following must hold:

$$= p < \frac{\sigma^2_{Y,Priv} - 1}{\sigma^2_{Y,Priv} + \sigma^2_{Y,Publ}}. \tag{4.83}$$

This makes sense because if the volatility of private unexpressed demand, $\sigma^2_{Y,Priv}$ is high, and keeping volatility of the total unexpressed demand constant, this causes the volatility of public unexpressed demand, $\sigma^2_{Y,Publ}$, to fall, and hence the public signal becomes less noisy, and this improves the overall efficiency and hence the liquidity of the upstairs market. Therefore reducing the public component of the unexpressed demand volatility and increasing the private component, is good for the upstairs market. Hence keeping p very low implies that the public signal of unexpressed demand becomes very informative, which improves the liquidity in the upstairs market.

Therefore, if the unexpressed demand of customers in the upstairs market is not sufficiently public, such that equation (4.83) does not hold, then the upstairs market's execution quality will be reduced. For example, if customers' switching costs are too high, such that customers concentrate their trade with a small number of market makers (broker dealers), and the upstairs market as a whole is not sufficiently informed about customers' unexpressed demands, i.e. if there is little public unexpressed demand, the upstairs market's liquidity benefits will be adversely affected.

Finally, exclusive or close trading relationships between customers and their brokers, in which unexpressed demands of such customers are not communicated to other market makers but kept private, may reduce the liquidity benefits of the upstairs market.

4.6 Conclusion

The paper redevelops Grossman's (1992) model for clearer exposition and economic intuition. A more realistic model of unexpressed demand in the upstairs market is developed, where the unexpressed demand of Grossman (1992) is broken into private and public components, such that in the first case each market maker observes a unique private signal, and in the second all market makers observe a common public signal. It is found that when public signals of unexpressed demand are less noisy, this has a beneficial effect on the liquidity provision of an upstairs market, whereas when public signals are noisier, this reduces the benefits of the upstairs market relative to the downstairs market. This finding underlies possible detrimental effects noisy public signals of customers' unexpressed demand can have on the upstairs market. Therefore, close trading relationships among customers and market makers, where unexpressed demand of the customer is held privately by a small number of market makers, can hurt upstairs market liquidity, whereas an open sharing of information about the unexpressed demand of a market maker's customers with other market makers, can improve upstairs market liquidity.

CHAPTER 5: CONCLUSION

The first two chapters studied empirically the existence and the determinants of trading relationships among brokerage houses, and between brokerage houses, individual brokers and their customers. The general thrust of the findings is that whereas brokerage houses do not display a preference or a bias for trading with another brokerage house, such as a cultural bias, customers of individual brokers and brokerage houses appear to display such preferences or biases. Proxies for familiarity among brokerage houses do not explain the trading relationships between brokerage houses, but measures of familiarity among brokers and their customers do explain the trading choices of customers. This suggests that brokerage houses are already familiar enough with each other that measures of familiarity do not explain their trading relationships. Furthermore brokerage houses may not show any biases in their trading because they are unbiased. However, perhaps due to switching costs, or due to psychological biases, investors can develop close relationships with their brokers.

However, familiarity with their customers and the customers of other brokerage houses, can help brokers better provide liquidity in a market. The third essay finds that when market makers learn about the trading habits of their customers, such as how likely they are to trade at some time in the future, and if this information about their customers remains private to each market maker, then this can adversely affect upstairs market trade execution quality. Trading and business relationships with customers increase market makers' awareness about their trading habits which can help improve (upstairs) market liquidity, especially if such information can be shared with other market makers. This implies that the trading preferences and biases shown by customers of brokerage houses may also hinder the quality of an upstairs market.

Table 2.1: 76 share classes in the sample belonging to 61 firms

Share Class	Ticker	Industry
CEO Culture = Finnish		
Aamulehti	AAM2S	Media
Atria Oyj	ATR1V	Food
Citycon Oyj	CTY1S	Investment
Espoon Sähkö	ESS1V	Energy
Finnair Oyj	FIA1S	Transport
Finvest Oyj A	FINAS	Investment
Finvest Oyj B	FINBS	Investment
Finnlines Oyj	FLG1S	Transport
Hackman Oyj A	HACAS	Multi-Bus.
Oyj Hartwall A	HARAS	Food
Huhtamäki Oyj	HUHIV	Food
Huhtamäki Oyj	HUHKV	Food
Instrumentarium	INSAS	Other
Instrumentarium	INSBV	Other
Interavanti Oyj	INT1S	Investment
J Tallberg-Kiint. B	JTKBS	Investment
Kesko	KES1S	Trade
Kone Oyj B	KONBS	Metal & Eng.
Kemira Oyj	KRA1V	Chemicals
Lassila & Tikanoja	LAS1S	Multi-Bus.
Lemminkäinen	LEM1S	Construction
Leo Longlife A	LEOAS	Other
Lännen Tehtaat	LTE1S	Food
Länsivoima Oyj	LVO1V	Energy
Metsä-Serla A	MESAS	Food
Metsä-Serla B	MESBS	Food
Merita	MTAAV	Banks & Fin.
Merita	MTABV	Banks & Fin.
Neste	NES1V	Energy
Nokia A	NOKAV	Telecom & Elec.
Nokia K	NOKKV	Telecom & Elec.
Nokian Renkaat	NOR1V	Other
OKO Bank A	OKOAS	Banks & Fin.
Orion-yhtymä A	ORIAS	Chemicals
Orion-yhtymä B	ORIBS	Chemicals
Outokumpu Oyj	OUTAS	Metal & Eng.
Pohjola A	POHAS	Insurance
Pohjola B	POHBS	Insurance
Polar Kiinteistöt	POLKS	Investment
Raisio Yhtym	RAIVV	Food
Rauma	RAM1V	Metal & Eng.
Rautakirja A	RTK1S	Trade
Rautakirja B	RTKBS	Trade
Rautaruukki K	RTRKS	Metal & Eng.
Raute Oyj A	RUTAV	Metal & Eng.
CEO Culture = Finnish		
Santosalo-JOT	SAJ1V	Metal & Eng.
Yrityspankki A	SCAAS	Banks & Fin.
Starckjohann Steel	STABS	Metal & Eng.
Stockmann Oyj A	STOAS	Trade
Stockmann Oyj B	STOBV	Trade
Tamfelt Kanta	TAFKS	Other
Tamfelt Etu	TAFPS	Other
Tulikivi Oyj A	TULAV	Construction
Vaisala Oyj A	VAIAS	Telecom
Valmet	VALAS	Metal & Eng.
Sanoma	WSOAS	Media
Sanoma	WSOBS	Media
YIT-Yhtymä Oyj	YTY1V	Construction
CEO Culture = Swedish		
Arctos Capital	ACA1V	Banks & Fin.
Aspoyhtyma	ASY1V	Multi-Bus.
Birka Line Abp	BIRKS	Transport
Birka Line Abp	BIRPS	Transport
Fiskars Oyj Abp A	FISAS	Metal & Eng.
Fiskars Oyj Abp K	FISKS	Metal & Eng.
Metra Oyj Abp A	METAS	Metal & Eng.
Metra Oyj Abp A	METBS	Metal & Eng.
Norvestia Oyj	NVABV	Investment
Partek Oyj Abp	PAR1S	Metal & Eng.
Sampo A	SAMAS	Banks & Fin.
Silja Line	SLJAV	Transport
Silja Line	SLJKV	Transport
Stromsdal Oyj B	STMBS	Forestry
Tamro Oyj	TRO1V	Trade
Viking Line Abp	VIK1V	Transport
CEO Culture = Other		
Amer-yhtymä A	AMEAS	Other
Suunto	SUU1V	Metal & Eng.

Table 2.2: 23 Brokerage Houses in the Sample Grouped by Culture

Culture of Brok. House	Brok. House Name	Brok. House Code	Avg. No. of Buys & Sells*	Avg. % of Externalized Buys & Sells**
Finnish	Ane Gyllenberg	AG	1,769.5	19.9
	Aktia Savings Bank Ltd	AKT	2,735.5	4.3
	Arctos Capital Oy	ARC	951	28.0
	Aros	ARO	1,316	16.9
	Evli Securities Ltd	EVL	1,593	16.8
	FIM Securities Ltd	FIM	456	22.2
	FSB Securities	FSB	125.5	39.4
	Hiisi	HII	70.5	22.8
	Interbank	IBA	376	25.8
	Merita Securities Ltd.	MER	3,505	18.8
	Opstock Securities Ltd.	OPS	848.5	29.9
	Postipankki	PSP	421	42.4
	Protos Davy Securities	PTS	844	16.6
	Sofi Securities, Inc.	SOF	363	21.7
	United Bankers Securities	UB	539.5	23.8
			Subtotal: 15,914	*Median:* 22.2
Swedish	Alfred Berg Finland Oyj Ab	ALF	3,230	15.6
	D. Carnegie, Finland Branch	CAR	1,959	16.9
	Svenska Handelsbanken	HAN	1,769	17.4
	Skandinaviska Enskilda Bank	SEB	1,704.5	20.5
	Erik Selin Securities	SEL	570.5	31.2
			Subtotal: 9,233	*Median:* 17.4
Other	ABB Financial Services	ABB	346.5	21.7
	Danske Bank Securities	DDB	298.5	9.5
	Williams de Broë	WDB	20.5	50.5
			Subtotal: 665.5	*Median:* 21.7
			Total: 25,812.5	**Median: 20.5**

*This is the average of the number of buys and the number of sells conducted in the after-market period by the brokerage house.

**This is the average of the percentage of buys and the percentage of sells conducted by the brokerage house during the after-market period where another brokerage house is the counterparty.

Table 2.3: Ratios showing the effect of the Cultural Heritage of a Firm's CEO on Trading Intensity of the Firm's Stock

Panel A shows for firms with CEOs having Finnish cultural heritage, the medians of the trading intensity ratios of Finnish, Swedish and Other culture brokerage houses. Panels B and C show the same data for firms with CEOs having Swedish and Other cultural heritage, respectively. The trading intensity of a brokerage house in stocks of firms having Finnish, Swedish and Other culture CEOs is defined as the brokerage house's trading weight in stocks of firms having Finnish, Swedish and Other Culture CEOs, respectively, divided by the brokerage house's trading weight in all stocks. The trades used in calculating the ratios took place in the after-market of the Helsinki Stock Exchange, between January 1996 and December 1997. Standard errors are shown in parentheses, and denoted by 'na' where missing.

	Trading Weights where Brokerage House is			
	Buyer		Seller	
Panel A: Stocks of Firms with Finnish Culture CEOs. Summary Statistics for the Ratio: Brokerage House i's Trading Weight in Stocks of Firms with Finnish Cultural Heritage CEOs Divided by Brokerage House i's Trading Weight in All Stocks.				
Median for brokerage houses having:				
Finnish cultural heritage $n = 15$	1.01		1.01	
Swedish cultural heritage $n = 5$	1.01		1.01	
Other cultural heritage $n = 3$	1.05		1.06	
Fraction >1 for brokerage houses having:				
Finnish cultural heritage $n = 15$	0.53	(0.13)	0.53	(0.13)
Swedish cultural heritage $n = 5$	0.67	(0.19)	0.60	(0.22)
Other cultural heritage $n = 3$	0.67	(0.27)	1.00	(na)
Panel B: Stocks of Firms with Swedish Culture CEOs. Summary Statistics for the Ratio: Brokerage House i's Trading Weight in Stocks of Firms with Swedish Cultural Heritage CEOs Divided by Brokerage House i's Trading Weight in All Stocks.				
Median for brokerage houses having:				
Finnish cultural heritage $n = 15$	1.10		0.97	
Swedish cultural heritage $n = 5$	0.58		0.45	
Other cultural heritage $n = 3$	0.45		0.31	
Fraction >1 for brokerage houses having:				
Finnish cultural heritage $n = 15$	0.60	(0.13)	0.46	(0.13)
Swedish cultural heritage $n = 5$	0.17	(0.15)	0	(na)
Other cultural heritage $n = 3$	0.33	(0.27)	0	(na)
Panel C: Stocks of Firms with Other Culture CEOs. Summary Statistics for the Ratio: Brokerage House i's Trading Weight in Stocks of Firms with Other Cultural Heritage CEOs Divided by Brokerage House i's Trading Weight in All Stocks.				
Median for brokerage houses having:				
Finnish cultural heritage $n = 15$	0.67		0.80	
Swedish cultural heritage $n = 5$	0.41		0.51	
Other cultural heritage $n = 3$	0.17		0.17	
Fraction >1 for brokerage houses having:				
Finnish cultural heritage $n = 15$	0.33	(0.12)	0.40	(0.13)
Swedish cultural heritage $n = 5$	0.33	(0.19)	0.40	(0.22)
Other cultural heritage $n = 3$	0	(na)	0	(na)

Table 2.4: Ratios showing the effect of the Cultural Heritage of Brokerage Houses on their Choice of Trading Partners

Panel A shows for all firms with CEOs having Finnish cultural heritage, the median and the fraction greater than one for trade-initiating brokerage house cultures of the median trade intensity ratio with cultures of trade-counterparty brokerage houses. Panels B and C show the same data for stocks of all firms with CEOs having Swedish and Other cultural heritage, respectively. The trading intensity ratio between a trade-initiating brokerage house i and a trade-counterparty brokerage house j in stocks of all firms having CEOs of culture x, is defined as trade-initiating brokerage house i's trading weight with trade-counterparty brokerage house j in stocks of all firms having CEOs of culture x, divided by trade-initiating brokerage house i's trading weight with all other counterparty brokerage houses ($i \neq j$) in stocks of all firms having CEOs of culture x. The trading weights are calculated using buy trades only. Results with sell trades are qualitatively similar and are not shown. Standard errors are shown in parentheses, and denoted by 'na' where missing.

	Trade-counterparty brokerage house culture is:		
	Finnish	Swedish	Other
Panel A: Stocks of Firms with CEOs having Finnish Cultural Heritage Summary Statistics for the Ratio: Trade-Initiating Brokerage House i's Trading Weight with Counterparty Brokerage House j in Stocks of Firms with CEOs having Finnish Cultural Heritage, Divided by Trade-Initiating Brokerage House i's Trading Weight with All Counterparty Brokerage Houses ($i \neq j$) in Stocks of Firms with CEOs having Finnish Cultural Heritage			
Median, where trade-initiating brokerage house culture is:			
Finnish $n = 15$	0.85	0.70	0.28
Swedish $n = 5$	0.97	1.07	0.67
Other $n = 3$	0	0.41	0
Fraction >1, where trade-initiating brokerage house culture is:			
Finnish $n = 15$	0.27 (0.11)	0.13 (0.09)	0.33 (0.12)
Swedish $n = 5$	0.40 (0.22)	0.60 (0.22)	0.20 (0.18)
Other $n = 3$	0 (na)	0 (na)	0 (na)
Panel B: Stocks of Firms with CEOs having Swedish Cultural Heritage Summary Statistics for the Ratio: Trade-Initiating Brokerage House i's Trading Weight with Counterparty Brokerage House j in Stocks of Firms with CEOs having Swedish Cultural Heritage, Divided by Trade-Initiating Brokerage House i's Trading Weight with All Counterparty Brokerage Houses ($i \neq j$) in Stocks of Firms with CEOs having Swedish Cultural Heritage			
Median, where trade-initiating brokerage house culture is:			
Finnish $n = 13$	0	0	0
Swedish $n = 5$	0	0	0
Other $n = 3$	0	0	0
Fraction >1, where trade-initiating brokerage house culture is:			
Finnish $n = 13$	0.08 (0.07)	0.23 (0.11)	0 (na)
Swedish $n = 5$	0 (na)	0.40 (0.22)	0 (na)
Other $n = 3$	0 (na)	0 (na)	0 (na)

Table 2.4: (cont'd)

	Trade-counterparty brokerage house culture is:		
	Finnish	Swedish	Other
Panel C: Stocks of Firms with CEOs having Other Cultural Heritage			
Summary Statistics for the Ratio: Trade-Initiating Brokerage House i's Trading Weight with Counterparty Brokerage House j in Stocks of Firms with CEOs having Other Cultural Heritage, Divided by Trade-Initiating Brokerage House i's Trading Weight with All Counterparty Brokerage Houses ($i \neq j$) in Stocks of Firms with CEOs having Other Cultural Heritage			
Median, where trade-initiating brokerage house culture is:			
Finnish $n = 12$	0	0	0
Swedish $n = 5$	0	0.37	0
Other $n = 1$	0	0	0
Fraction >1, where trade-initiating brokerage house culture is:			
Finnish $n = 12$	0 (na)	0.08 (0.08)	0.08 (0.08)
Swedish $n = 5$	0 (na)	0.25 (0.22)	0 (na)
Other $n = 1$	0 (na)	0 (na)	0 (na)

Table 2.5: Hypotheses Being Tested and the Corresponding Independent Variables

Hypothesis Number	Hypothesis Description	Independent Variables	Expected Sign
I	Brokerage houses prefer to trade with other having a similar culture	*Finnish Buyer × Swedish Seller*	–
		Finnish Buyer × Other Seller	–
		(Swedish Buyer × Swedish Seller) – (Swedish Buyer × Finnish Seller)	+
		(Swedish Buyer × Swedish Seller) – (Swedish Buyer × Other Seller)	+
		(Other Buyer × Other Seller) – (Other Buyer × Finnish Seller)	+
		(Other Buyer × Other Seller) – (Other Buyer × Swedish Seller)	+
II	When brokerage houses trade with others having a similar culture, they are more likely to trade the stock of like-culture firms than that of unlike-culture firms	*(Swedish Buyer × Swedish Seller) × Traded Firm's CEO has Swedish Culture –Swedish Buyer × Swedish Seller*	+
		(Swedish Buyer × Swedish Seller) × Traded Firm's CEO has Swedish Culture –(Swedish Buyer × Swedish Seller) × Traded Firm's CEO has Other Culture	+
III	There is more cultural bias in trading when there is more chance of information asymmetry	*Average Daily Return Volatility*	+
		× Finnish Buyer × Swedish Seller	–
		× Finnish Buyer × Other Seller	–
		× Swedish Buyer × Finnish Seller	–
		× Swedish Buyer × Swedish Seller	+
		× Swedish Buyer × Other Seller	–
		× Other Buyer × Finnish Seller	–
		× Other Buyer × Swedish Seller	–
IV	Brokerage Houses prefer to buy from others that are more active sellers than itself	*No of Seller Sells / No of Buyer Sells*	+

Table 2.6: A Multivariate Model to Study the Effect of National Culture on the Strength of Trading Relationships between Brokerage Houses

Independent Variables	MODEL I		MODEL II		MODEL III		MODEL IV	
	All Trades		*Small Trades*		*Medium Trades*		*Large Trades*	
Finnish Buyer × Swedish Seller	0.062	(0.401)	0.103	(0.587)	−0.012	(0.807)	−0.083	(0.483)
Finnish Buyer × Other Seller	−0.003	(0.982)	−0.093	(0.607)	−0.020	(0.732)	−0.114	(0.489)
Swedish Buyer × Finnish Seller	0.031	(0.841)	−0.084	(0.663)	−0.007	(0.859)	0.340	(0.167)
Swedish Buyer × Swedish Seller	0.096	(0.593)	−0.147	(0.804)	−0.043	(0.490)	0.284	(0.266)
× Traded Firm's CEO has Swedish Culture	−0.004	(0.835)	−0.006	(0.877)	−0.032	(0.168)	0.030	(0.473)
× Traded Firm's CEO has Other Culture	0.019	(0.604)	0.050	(0.403)	−0.002	(0.964)	0.052	(0.586)
Swedish Buyer × Other Seller	−0.005	(0.978)	−0.189	(0.326)	−0.026	(0.704)	0.305	(0.314)
Other Buyer × Finnish Seller	0.020	(0.839)	0.216	(0.726)	0.032	(0.416)	0.037	(0.810)
Other Buyer × Swedish Seller	0.085	(0.471)	0.024	(0.944)	−0.022	(0.746)	−0.101	(0.617)
Other Buyer × Other Seller	−0.075	(0.748)	0.126	(0.854)	−0.053	(0.649)	−0.773	(0.494)
Traded Firm's CEO has Swedish Culture	0.022	(0.786)	−0.019	(0.902)	−0.125	(0.587)	0.006	(0.961)
Traded Firm's CEO has Other Culture	−0.013	(0.649)	−0.021	(0.742)	−0.011	(0.778)	0.029	(0.830)

Table 2.6: (cont'd)

Independent Variables	MODEL I		MODEL II		MODEL III		MODEL IV	
	All Trades		*Small Trades*		*Medium Trades*		*Large Trades*	
Average Daily Return Volatility	3.446	(0.538)	0.508	(0.963)	−8.965	(0.652)	−1.469	(0.922)
×*Finnish Buyer*×*Swedish Seller*	−0.115	(0.841)	−0.233	(0.846)	−0.198	(0.733)	0.808	(0.613)
×*Finnish Buyer*×*Other Seller*	−0.375	(0.704)	−2.680	(0.454)	−0.353	(0.785)	−0.179	(0.969)
×*Swedish Buyer*×*Finnish Seller*	−0.675	(0.222)	2.549	(0.259)	0.490	(0.689)	0.971	(0.633)
×*Swedish Buyer*×*Swedish Seller*	0.754	(0.426)	−0.763	(0.521)	−0.582	(0.441)	0.410	(0.797)
×*Swedish Buyer*×*Other Seller*	0.735	(0.623)	0.476	(0.936)	1.090	(0.539)	−2.176	(0.703)
×*Other Buyer*×*Finnish Seller*	0.247	(0.811)	3.390	(0.848)	0.435	(0.916)	13.778	(0.800)
×*Other Buyer*×*Swedish Seller*	0.109	(0.946)	−0.642	(0.837)	−0.119	(0.927)	−1.914	(0.770)
×*Other Buyer*×*Other Seller*	0.240	(0.944)	2.555	(0.634)	−0.406	(0.835)	1.876	(0.823)
Log(No of All Trades in Stock)	0.001	(0.971)	−0.003	(0.950)	−0.011	(0.732)	0.009	(0.889)
Log(No of Seller Sells/No of Buyer Sells)	0.001	(0.457)	−0.003	(0.374)	−0.002	(0.151)	−0.003	(0.432)
Traded Firm is headquartered outside Helsinki	−0.009	(0.675)	0.008	(0.838)	0.027	(0.602)	0.002	(0.975)
Intercept	−0.054	(0.906)	−0.436	(0.774)	0.341	(0.594)	0.179	(0.669)
Number of Observations	14,027		6,663		9,895		3,343	
Adjusted R^2	0.013		0.0045		−0.0008		0.074	

All data are from the Helsinki Stock Exchange's trade reports, from January 1996 to December 1997, inclusive. For calculation of the dependent variable, the trade intensity between the buyer and the seller for a given stock: MODEL I uses all externalized upstairs trades; MODEL II uses small (trades less than 500 shares) externalized upstairs trades; MODEL III uses medium (trades between 500 and 10,000 shares) externalized upstairs trades; and MODEL IV uses large (trades greater than 10,000 shares) externalized upstairs trades. The dependent variable is a measure of trading intensity between two brokerage houses, and is the difference between the trading weights of the buying brokerage house with the selling brokerage house in a given stock and the trading weight of the buying brokerage house among all selling brokerage houses for the same stock. Trading weight is the proportion of the number of trades of the selling broker(s) that is conducted with the buying broker. The p-values of the *t*-statistics are presented in parentheses.

Table 3.1: Hypotheses Being Tested and the Corresponding Independent Variables

The table shows the expected signs of the variables used to test the hypotheses indicated. The last two columns represent the expected signs of the independent variables in multivariate regressions where the dependent variables, Δ*(% Value) Old B. House*, and Δ*(% Value) New B. House*, are the change in the percentage by volume of a customer's trades executed through the old and new brokerage houses of the switching broker, respectively. For the combination of sub-hypotheses, 4a/5a, 4b/5b, 4c/5c, and hypotheses 6/7, the same independent variables, are used to test two competing hypotheses, where each hypothesis in the pair has an expected sign opposite to the other. Hence, the observed sign of the independent variable represents the net combined effect and indicates which of the two competing hypotheses has a larger impact. Also, the main hypothesis of each group of sub-hypotheses is highlighted in bold font.

(Sub-)Hyp. Number	(Sub-)Hypothesis Description	Independent Variable(s)	Expected Sign: Δ(% Value) Old B. House	Expected Sign: Δ(% Value) New B. House
1	**Trading relationships affect investors' likelihood of switching**			
1a	Investors having stronger ex-ante trading relationships with other brokers in the old brokerage house are less likely to switch with broker (higher switching cost)	*Prop. of Investor Trading Via Old B. House*	+	–
1b	Investors having (stronger) ex-ante trading relationships with switching broker are more likely to switch with the broker (lower switching cost)	*Customer of Switching Broker*	–	+
		Prop. of Investor Trading Via Switching Broker	–	+
1c	Investors having stronger ex-ante trading relationships with brokers in the new brokerage house are more likely to switch with the broker (lower switching cost)	*Prop. of Investor Trading Via New B. House*	–	+
2	Upstairs market investors develop closer business relationships with the broker and are more likely to switch with the broker	*Upstairs Market*	–	+
3	**Brokers' market dominance affects investors' likelihood of switching**			
3a	Investors are less likely to switch with the broker if the old brokerage house (excl. broker), is more dominant in the stock	*Old B. House's Market Share in Stock*	+	–
3b	Investors are more likely to switch with the broker if the broker is more dominant in the stock	*Switching Broker's Market Share in Stock*	–	+

Table 3.1: (cont'd)

(Sub-)Hyp. Number	(Sub-)Hypothesis Description	Independent Variable(s)	Expected Sign: Δ(% Value) Old B. House	Expected Sign: Δ(% Value) New B. House
3c	Investors are more likely to switch with the broker if the new brokerage house is more dominant in the stock	*New B. House's Market Share in Stock*	–	+
4 / 5	**Less savvy investors are biased, and more likely to switch / Less savvy investors have simpler trading preferences, and less likely to switch with the broker**			
4a / 5a	Households are less savvy than institutions and more biased toward broker, and are more likely to switch with the broker / Households have less complicated trading preferences, and are less likely to switch with the broker	*Household*	– / +	+ / –
4b / 5b	Financial and non-financial institutions are more savvy than households and less biased toward broker, and are less likely to switch with the broker / Financial and non-financial institutions are more savvy than households and have more complicated trading preferences, and are more likely to switch with the broker	*Financial Institution*	+ / –	– / +
		Non-financial Institution	+ / –	– / +
4c / 5c	Governmental and non-profit institutions are less savvy than financial and non-financial institutions and more biased toward broker, and are more likely to switch with the broker / Governmental and non-profit institutions are less savvy than financial and non-financial institutions and have less complicated trading preferences and are less likely to switch with the broker	*(Governmental Institution – (Non-)Financial Institution)*	– / +	+ / –
		(Non-profit Institution – (Non-)Financial Institution)	– / +	+ / –
6 / 7	Male investors have stronger relationships with (male) brokers, than female investors (gender bias) and more likely to switch / Female investors are more relationship-oriented than male investors and are more likely to switch	*(Investor is Male – Investor is Female)*	– / +	+ / –
8	Investors prefer same culture b. house, and are less likely to switch if new b. house has a different culture than the investor	*(Investor and Old House = Finnish, New House = Swedish)*	+	–

Table 3.2: Percentage of the Number of All HETI Trades Matched Successfully with Investor Records in the FCSD Data Set

The table shows the mean and median within each stock activity decile of the percentage of HETI trades by number matched with investor records in the FCSD data set. The most active decile is ten, and the least active decile is one.

Activity Decile No.	Median %	Mean %	No. of Stocks
1	82.9	74.4	9
2	78.7	76.5	8
3	72.5	64.2	9
4	71.1	66.8	9
5	68.1	65.5	9
6	65.6	65.0	8
7	55.1	56.1	9
8	59.2	55.1	9
9	51.4	50.8	9
10	32.1	34.6	4
All Stocks	*66.9*	*62.3*	*83*

Table 3.3: Comparison of Switching Brokers' Presence in the Upstairs Market Before the Switch to that of all Individual Brokers of the same Brokerage House

The table shows descriptive statistics of the switching broker in the upstairs market during the free-trading period. For example, *# Days Traded* is the number of days traded by the switching broker in the upstairs market before the switch, *Avg Daily # Trades* is the average daily number of trades conducted by the switching broker in the upstairs market before the switch, and *Avg % of Daily # Trades* is the average of the daily percentage of the number switching broker's trades conducted in the upstairs market. The median of the corresponding values of all individual brokers in the same brokerage house, and in the same period, are given in parentheses below each statistic. The value of each statistic greater than or equal to the corresponding median value for all individual brokers of the brokerage house, is highlighted in bold font.

Switching Event	# Days Traded	Avg Daily # Trades	Avg Daily Volume	Avg % of Daily # Trades	Avg % of Daily Volume	No of Brokers in B. House
1	**65**	**48.0**	**184,372**	17.4	41.1	
	(63)	*(30.4)*	*(138,310)*	*(24.1)*	*(46.2)*	4
2	78	**47.8**	**40,352**	12.9	11.3	
	(78)	*(16.3)*	*(31,604)*	*(16.0)*	*(30.3)*	5
3	225	**34.6**	**48,943**	13.6	14.7	
	(240)	*(29.6)*	*(47,114)*	*(13.9)*	*(20.6)*	6
4	72	25.6	37,838	10.6	11.6	
	(241)	*(30.1)*	*(47,103)*	*(13.9)*	*(20.6)*	6
5	**327**	18.2	**95,971**	13.7	**32.4**	
	(78)	*(25.6)*	*(40,352)*	*(13.7)*	*(16.3)*	9
6	148	**23.1**	**64,445**	14.0	32.5	
	(161)	*(12.2)*	*(61,146)*	*(22.4)*	*(47.5)*	4
7	**306**	12.1	**69,121**	**25.0**	**49.1**	
	(227)	*(15.7)*	*(66,783)*	*(21.9)*	*(46.1)*	4
8	10	2.9	3,360	0.0	0.0	
	(60)	*(19.7)*	*(87,300)*	*(14.0)*	*(28.6)*	4
9	165	**18.4**	**66,120**	15.1	30.4	
	(165)	*(16.5)*	*(63,181)*	*(15.1)*	*(30.4)*	5
10	**232**	17.2	64,731	**20.7**	**44.1**	
	(165)	*(17.2)*	*(64,731)*	*(14.6)*	*(30.4)*	5
11	**292**	**32.9**	**110,121**	15.2	**34.0**	
	(164)	*(14.5)*	*(50,268)*	*(15.2)*	*(30.4)*	7

Table 3.4: Percentage of Customers' Downstairs Trades via Old Brokerage House

The table shows the average percentage of customer trading by value done in the downstairs market by the switching broker's old brokerage house, for each switching event and period relative to broker's last trade at the old house (t). **Note:** t=−1 represents the switching broker's last month of trading at the old house, and t=1 represents the switching broker's first month of trading at the new brokerage house. In this table, customers are defined as investors who have traded at least once in the downstairs market via the old brokerage house during the earliest month in the sample, i.e. January 1996. Data sample is restricted to the three most active stocks.

Panel A

	Switching Event											
t	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	***Mean***
−17					70.0		55.0					*62.5*
−16					58.2		67.2				49.8	*58.4*
−15					44.0		60.0				51.7	*51.9*
−14					75.0		66.7				39.9	*60.5*
−13			66.6	58.3	39.8		66.7				73.8	*61.0*
−12			54.2	46.4	57.1		54.8				40.6	*50.6*
−11			56.2	56.2	53.4		50.0			49.3	25.0	*48.3*
−10			83.5	83.5	59.3		33.3			57.1	64.4	*63.5*
−9			66.3	66.3	51.1	42.9	32.8		45.9	40.0	63.5	*51.1*
−8			71.5	80.0	32.6	48.6	17.4		47.5	77.4	35.7	*51.3*
−7			61.1	57.1	41.2	50.0	16.6		42.9	33.3	74.8	*47.1*
−6			73.2	76.9	50.7	50.0	22.6		68.8	46.0	50.5	*54.8*
−5			58.7	69.9	53.6	66.7	33.3		40.0	76.4	48.4	*55.9*
−4			48.5	62.0	55.3	36.0	50.0		25.0	95.2	60.0	*54.0*
−3		55.7	45.2	50.4	64.0	62.2	25.0		64.4	100.0	25.0	*54.7*
−2	91.3	59.8	52.6	58.3	78.1	66.7	40.0	48.0	80.1	99.4	44.0	*65.3*
−1	100.0	40.7	57.1	57.1	66.7	29.8	33.3	47.1	50.0	100.0	65.6	*58.9*
0	57.6	66.7	66.4	71.4	73.5	24.6	33.3	54.6	66.5	63.5	26.8	*55.0*
1	74.6	42.2	48.6	48.9	100.0	29.0	20.0	35.6	50.0	60.0	0.0	*46.3*
2	49.8	69.1	50.0	100.0	56.2	33.3	40.0	32.6	47.6	50.0	0.0	*48.1*
3	71.3	55.9	45.6	90.7	57.3	54.0	25.0	28.6	60.0	74.5	0.0	*51.2*
4	59.4	57.4	85.9	98.1	80.4	29.2	50.0	0.0	50.0	64.1	0.0	*52.2*
5	73.8	51.1	100.0	75.0		33.3		0.0	74.5	0.0		*51.0*
6	64.4	32.8	72.5	65.3		33.3		0.0	63.9	0.0		*41.5*
7	66.7	37.0	72.9	78.2		33.3		0.0	33.3	0.0		*40.2*
8	65.3	47.2	81.5	77.5		25.0		0.0	0.0	0.0		*37.1*
9	67.2	59.0				25.0			0.0			*37.8*
10	74.9	55.3				25.0			0.0			*38.8*
11	97.9	64.0										*80.9*
12	66.7	78.1										*72.4*
13	41.0	66.7										*53.8*
14	74.8	63.9										*69.4*
15	75.0	100.0										*87.5*
16	75.0	66.7										*70.8*
17	73.9	55.3										*64.6*
18	75.0	85.9										*80.4*
Mean												
t<0	95.6	52.1	61.1	63.3	55.9	50.3	42.6	47.5	51.6	70.4	50.8	*58.3*
t>0	69.3	60.4	69.6	79.2	73.5	32.1	33.8	12.1	37.9	31.1	0.0	*45.4*

Table 3.4: (cont'd)

Panel B

	Mean (%)	N	Std.dev	Mean[t>0] − Mean[t<0] (%) *(p-values in parentheses)*	Mean[t=0] − Mean[t<0] (%) *(p-values in parentheses)*
				All Events	
t<0	55.7	112	1.7	−5.7	−0.7
t=0	55.0	11	5.5	(0.061)	(0.902)
t>0	50.0	118	2.5		
t= −2, −1	62.1	22	4.6	−14.9	−7.1
t=0	55.0	11	5.5	(0.04)	(0.329)
t=1, 2	47.2	22	5.4		
	Events having at least four months of observations before t = 0 (i.e. eight events)				
t= −4 to −1	57.7	32	3.8	−7.8	−4.5
t=0	53.2	8	7.4	(0.221)	(0.603)
t=1 to 4	50.0	32	5.0		
t=-2, −1	61.2	16	5.2	−12.2	−7.9
t=0	53.2	8	7.4	(0.172)	(0.398)
t=1, 2	49.0	16	6.9		

Table 3.5: Percentage of Customers' Upstairs Trades via Old Brokerage House

The table shows the average percentage of customer trading by value done in the upstairs market by the switching broker's old brokerage house, for each switching event and period relative to broker's last trade at the old house (t). **Note:** t=−1 represents the switching broker's last month of trading at the old house, and t=1 represents the switching broker's first month of trading at the new brokerage house. In this table, customers are defined as investors who have traded at least once in the upstairs market via the old brokerage house during the earliest month in the sample, i.e. January 1996. Data sample is restricted to the three most active stocks.

Panel A

	Switching Event											
t	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	***Mean***
−17					36.6		71.0					*53.8*
−16					55.5		39.4				76.0	*57.0*
−15					100.0		40.6				50.0	*63.5*
−14					100.0		40.0				69.7	*69.9*
−13			79.9	85.0	100.0		46.7				40.3	*70.4*
−12			93.3	93.3	100.0		30.4				25.0	*68.4*
−11			50.0	94.9	61.2		25.0			72.4	49.8	*58.9*
−10			79.1	68.9	68.0		74.3			66.7	25.0	*63.7*
−9			100.0	100.0	63.0	57.5	50.0		83.6	49.4	25.0	*66.1*
−8			97.3	100.0	86.0	40.0	33.3		66.7	36.2	25.0	*60.6*
−7			67.2	67.4	67.8	52.1	20.0		67.0	49.8	66.7	*57.3*
−6			77.8	81.5	69.1	33.3	25.0		40.0	25.0	25.0	*47.1*
−5			88.6	88.6	46.3	38.9	49.2		25.0	33.3	49.4	*52.4*
−4			72.0	71.5	58.0	0.0	50.0		40.4	33.3	50.0	*46.9*
−3		19.5	75.0	75.0	95.0	35.5	100.0		33.3	50.0	50.0	*59.3*
−2	87.3	83.2	80.5	57.4	42.1	36.3	66.7	78.4	33.3	50.0	60.0	*61.4*
−1	75.0	100.0	80.3	77.5	100.0	49.0	50.0	100.0	20.0	25.0	82.3	*69.0*
0	67.7	95.7	88.1	100.0	50.6	40.2	33.3	44.8	26.5	33.0	27.2	*55.2*
1	100.0	63.3	96.6	96.5	50.0	32.8	35.8	51.4	25.0	33.3	0.0	*53.2*
2	83.2	100.0	50.0	79.7	78.5	25.0	20.0	34.5	33.0	33.3	0.0	*48.8*
3	100.0	66.6	88.2	68.2	50.0	33.3	27.9	0.0	33.3	51.7	0.0	*47.2*
4	100.0	37.5	64.1	67.2	78.4	40.0	33.3	0.0	33.3	27.6	0.0	*43.8*
5	100.0	63.0	100.0	75.0		50.0		0.0	61.3	0.0		*56.2*
6	100.0	90.6	100.0	85.1		20.0		0.0	34.5	0.0		*53.8*
7	99.9	75.9	66.7	82.5		22.1		0.0	0.0	0.0		*43.4*
8	78.4	52.8	89.6	100.0		20.0		0.0	0.0	0.0		*42.6*
9	99.8	44.7				38.7			0.0	0.0		*36.6*
10	99.7	77.8				33.3			0.0	0.0		*42.2*
11	100.0	95.0							0.0			*65.0*
12	100.0	42.1							0.0			*47.4*
13	100.0	100.0										*100.0*
14	82.2	55.1										*68.7*
15	100.0	50.0										*75.0*
16	100.0	75.4										*87.7*
17	93.8	0.0										*46.9*
18	100.0	75.9										*87.9*
Mean												
t<0	81.2	67.6	80.1	81.6	73.4	38.1	47.7	89.2	45.5	44.6	48.1	*63.4*
t>0	96.5	64.8	81.9	81.8	64.2	31.5	29.3	10.7	18.4	14.6	0.0	*44.9*

Table 3.5: (cont'd)

Panel B

	Mean (%)	N	Std.dev	Mean[t>0] – Mean[t<0] (%) *(p-values in parentheses)*	Mean[t=0] – Mean[t<0] (%) *(p-values in parentheses)*
				All Events	
t<0	60.0	112	2.3	−8.5	−4.8
t=0	55.2	11	8.4	(0.031)	(0.596)
t>0	51.5	118	3.2		
t= −2, −1	65.2	22	5.2	−14.2	−10.0
t=0	55.2	11	8.4	(0.103)	(0.327)
t=1, 2	51.0	22	6.7		
	Events having at least four months of observations before t=0 (i.e. eight events)				
t= −4 to −1	56.2	32	4.2	−12.9	−6.4
t=0	49.9	8	10.1	(0.049)	(0.574)
t = 1 to 4	43.3	32	4.9		
t= −2, −1	56.9	16	5.7	−14.9	−7.0
t=0	49.9	8	10.1	(0.128)	(0.556)
t=1, 2	42.0	16	7.6		

Table 3.6: Percentage of Customers' Downstairs Trades via New Brokerage House

The table shows the average percentage of customer trading by value done in the downstairs market by the switching broker's new brokerage house, for each switching event and period relative to broker's last trade at the old house (t). **Note:** t=−1 represents the switching broker's last month of trading at the old house, and t=1 represents the switching broker's first month of trading at the new brokerage house. In this table, customers are defined as investors who have traded at least once in the downstairs market via the old brokerage house during the earliest month in the sample, i.e. January 1996. Data sample is restricted to the three most active stocks.

Panel A

	Switching Event											
t	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	***Mean***
-17					0.0		13.5					*6.7*
-16					4.7		0.0				1.8	*2.2*
-15					0.0		0.0				0.3	*0.1*
-14					0.0		0.0				0.0	*0.0*
-13			0.0	0.0	10.2		0.0				0.0	*2.0*
-12			0.0	0.0	0.0		0.0				0.0	*0.0*
-11			0.0	0.0	0.0		0.0			1.7	0.0	*0.3*
-10			0.0	4.0	0.0		0.0			0.0	0.0	*0.7*
-9			0.0	0.0	0.0	0.0	0.0		8.2	0.0	0.0	*1.0*
-8			0.0	0.0	0.0	0.0	0.0		14.0	0.0	0.0	*1.8*
-7			8.3	0.0	0.0	0.0	0.0		16.7	0.0	0.0	*3.1*
-6			0.0	0.0	0.0	0.0	0.0		11.1	0.0	0.0	*1.4*
-5			0.0	14.3	2.7	0.0	0.0		20.2	0.0	0.0	*4.6*
-4			0.0	0.0	0.0	0.0	0.0		25.0	0.0	0.0	*3.1*
-3		0.0	0.0	2.9	0.0	0.0	0.0		20.0	0.0	25.0	*5.3*
-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.9	16.7	0.0	25.0	*5.1*
-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.4	50.0	0.0	0.0	*6.4*
0	6.1	0.0	0.0	0.0	0.0	0.0	0.0	17.9	33.3	0.0	4.6	*5.6*
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.7	50.0	0.0	12.3	*8.2*
2	0.0	0.0	0.0	0.0	0.0	0.0	20.0	33.3	24.9	50.0	0.0	*11.7*
3	0.0	4.7	0.0	0.0	16.7	0.0	0.0	23.4	0.0	0.0	33.3	*7.1*
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.2	0.0	0.0	0.0	*3.0*
5	0.0	0.0	0.0	0.0		0.0		40.0	0.0	0.0		*5.0*
6	0.0	0.0	0.0	0.0		0.0		69.0	1.2	0.0		*8.8*
7	0.0	0.0	0.0	0.0		0.0		65.5	14.8	25.6		*13.2*
8	0.0	0.0	0.0	4.3		0.0		50.0	1.8	0.0		*7.0*
9	0.0	0.0				0.0			0.0			*0.0*
10	0.0	0.0				0.0			0.0			*0.0*
11	0.0	0.0										*0.0*
12	0.0	0.0										*0.0*
13	4.8	0.0										*2.4*
14	0.2	0.0										*0.1*
15	0.0	0.0										*0.0*
16	0.0	0.0										*0.0*
17	0.0	0.0										*0.0*
18	0.0	0.0										*0.0*
Mean												
t<0	0.0	0.0	0.6	1.6	1.0	0.0	0.8	17.7	20.2	0.2	3.3	*4.1*
t>0	0.3	0.3	0.0	0.5	4.2	0.0	5.0	42.8	9.3	9.4	0.0	*6.5*

Table 3.6: (cont'd)

Panel B

	Mean (%)	N	Std.dev	Mean[t>0] – Mean[t<0] (%) *(p-values in parentheses)*	Mean[t=0] – Mean[t<0] (%) *(p-values in parentheses)*
				All Events	
t<0	3.0	112	0.7	3.1	2.7
t=0	5.6	11	3.2	(0.034)	(0.436)
t>0	6.1	118	1.3		
t= −2,−1	5.8	22	2.7	4.1	−0.1
t=0	5.6	11	3.2	(0.359)	(0.973)
t=1, 2	9.9	22	3.6		
	Events having at least four months of observations before t=0 (i.e. eight events)				
t= −4 to −1	5.1	32	2.1	1.3	−0.4
t=0	4.7	8	4.1	(0.682)	(0.932)
t = 1 to 4	6.5	32	2.5		
t= −2,−1	5.7	16	3.5	3.3	−1.0
t=0	4.7	8	4.1	(0.557)	(0.856)
t=1, 2	9.1	16	4.4		

Table 3.7: Percentage of Customers' Upstairs Trades via New Brokerage House

The table shows the average percentage of customer trading by value done in the upstairs market by the switching broker's new brokerage house, for each switching event and period relative to broker's last trade at the old house (t). **Note:** t=−1 represents the switching broker's last month of trading at the old house, and t=1 represents the switching broker's first month of trading at the new brokerage house. In this table, customers are defined as investors who have traded at least once in the upstairs market via the old brokerage house during the earliest month in the sample, i.e. January 1996. Data sample is restricted to the three most active stocks.

Panel A

	Switching Event											
t	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	***Mean***
−17					0.0		8.0					*4.0*
−16					0.0		0.0				0.0	*0.0*
−15					0.0		2.2				0.0	*0.7*
−14					0.0		15.0				0.0	*5.0*
−13			0.0	0.0	0.0		27.1				0.0	*5.4*
−12			0.0	0.0	0.0		13.7				0.0	*2.7*
−11			0.0	0.0	10.9		0.0			0.0	0.0	*1.8*
−10			0.0	0.0	0.0		0.0			0.0	0.0	*0.0*
−9			0.0	0.0	26.5	0.0	0.0		0.0	0.0	0.0	*3.3*
−8			0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	*0.0*
−7			2.6	13.1	0.0	0.0	16.3		0.0	0.0	0.0	*4.0*
−6			0.0	0.0	0.0	0.0	11.7		20.0	0.0	0.0	*4.0*
−5			0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	*0.0*
−4			0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	*0.0*
−3		0.0	4.7	0.0	0.0	0.0	0.0		0.0	0.0	0.0	*0.5*
−2	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0	2.1	*0.7*
−1	0.0	0.0	4.7	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0	*2.3*
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	25.2	0.0	10.3	*3.3*
1	0.0	0.0	0.0	0.0	0.0	0.0	14.2	0.0	0.4	0.0	0.0	*1.3*
2	16.8	0.0	0.0	0.0	0.0	0.0	7.0	0.0	17.2	0.0	47.2	*8.0*
3	0.0	2.6	0.0	0.0	0.0	0.0	20.3	50.0	0.0	3.1	0.0	*6.9*
4	0.0	33.3	8.2	0.0	0.0	4.7	0.0	0.0	0.0	0.0	0.0	*4.2*
5	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0		*0.0*
6	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0		*0.0*
7	0.0	0.0	0.0	2.7		0.0		16.0	0.0	14.6		*4.2*
8	0.0	0.0	0.0	0.0		3.2		12.5	0.0	37.1		*6.6*
9	0.0	0.0				0.0			0.0	0.0		*0.0*
10	0.0	6.4				0.0			20.9	0.0		*5.5*
11	0.0	0.0							0.0			*0.0*
12	0.0	0.0							0.0			*0.0*
13	0.0	0.0										*0.0*
14	0.0	2.5										*1.2*
15	0.0	0.0										*0.0*
16	0.0	0.0										*0.0*
17	0.0	0.0										*0.0*
18	0.0	5.4										*2.7*
Mean												
t<0	0.0	0.0	0.9	1.5	2.2	0.0	5.5	0.0	4.4	0.0	0.1	*1.3*
t>0	0.9	2.8	1.0	0.3	0.0	0.8	10.4	9.8	3.2	5.5	0.0	*3.2*

Table 3.7: (cont'd)

Panel B

	Mean (%)	N	Std.dev	Mean[t>0] – Mean[t<0] (%) *(p-values in parentheses)*	Mean[t=0] – Mean[t<0] (%) *(p-values in parentheses)*
				All Events	
t<0	1.8	112	0.5	1.5	1.5
t=0	3.3	11	2.4	(0.102)	(0.548)
t>0	3.3	122	0.8		
t= −2,−1	1.5	22	0.9	3.2	1.8
t=0	3.3	11	2.4	(0.221)	(0.482)
t=1, 2	4.7	22	2.4		
	Events having at least four months of observations before t=0 (i.e. eight events)				
t= −4 to −1	1.2	32	0.7	2.7	3.3
t=0	4.4	8	3.2	(0.151)	(0.354)
t = 1 to 4	3.8	32	1.7		
t= −2,−1	2.0	16	1.3	3.9	2.4
t=0	4.4	8	3.2	(0.262)	(0.508)
t=1, 2	5.9	16	3.1		

Table 3.8: Multivariate Model for the Change in Customers' Proportion of Trading By Value via Old Brokerage House (Month=−1 to Month=0)

Dependent Variable: Change in Old Brokerage House's Customers' Proportion of Trading By Value of their Buy (Sell) Side Trades in a Stock in the Upstairs/Downstairs Market conducted by the old brokerage house. The change in proportion of trading is measured from switching broker's last month of trading at old house (month=−1) to the period immediately thereafter when broker does not trade (month=0). P-values are given in parentheses next to coefficients.

(Sub-)Hyp. No.	Independent Variable(s)	Model 1	Model 2	Model 3
1a	Prop. of Investor Trading Via Old B. House	0.37 *(.0014)*	0.397 *(.0006)*	0.39 *(.0008)*
1b	Customer of Switching Broker	0.023	0.03	0.023
	Prop. of Investor Trading Via Switching Broker	0.37 *(.0027)*	0.384 *(.0017)*	0.391 *(.0016)*
1c	Prop. of Investor Trading Via New B. House	0.655 *(.0048)*	0.688 *(.0028)*	0.683 *(.0032)*
2	Upstairs Market	−0.018	−0.017	−0.02
3a	Old House's Market Share in Stock	0.113	0.091	0.121
3b	Switching Broker's Market Share in Stock	−0.272	−0.315	−0.277
3c	New House's Market Share in Stock	−0.707	−0.621	−0.791
4a / 5a	Household	−0.011		
4b / 5b	Financial Institution			0.012
	Non-Financial Institution			0.014
4c / 5c	Governmental Institution − Financial Institution			0.006
	Governmental Institution − Non-financial Institution			0.004
	Non-Profit Institution − Financial Institution			−0.305
	Non-Profit Institution − Non-financial Institution			−0.307
6 / 7	Investor is Male − Investor is Female		0.085 *(.0068)*	
8	Investor and Old House = Finnish, New House = Swedish	0.091	0.105	0.065
	Adjusted R^2	0.049	0.07	0.057
	No. of Observations	362	362	362

Table 3.9: Multivariate Model for the Change in Customers' Proportion of Trading By Value via Old Brokerage House (Month=−1 to Month=1)

Dependent Variable: Change in Old Brokerage House's Customers' Proportion of Trading By Value of their Buy (Sell) Side Trades in a Stock in the Upstairs/Downstairs Market conducted by the old brokerage house. The change in proportion of trading is measured from the switching broker's last month of trading at old house (month=−1) to the broker's first month of trading at the new house (month=1). P-values are given in parentheses next to coefficients.

(Sub-)Hyp. No.	Independent Variable(s)	Model 1	Model 2	Model 3
1a	Prop. of Investor Trading Via Old B. House	0.006	0.006	−0.004
1b	Customer of Switching Broker	−0.015	−0.01	−0.015
	Prop. of Investor Trading Via Switching Broker	−0.018	−0.019	−0.026
1c	Prop. of Investor Trading Via New B. House	−0.178 *(.0269)*	−0.154	−0.202 *(.0146)*
2	Upstairs Market	−0.003	−0.002	−0.004
3a	Old House's Market Share in Stock	−0.085	−0.086	−0.079
3b	Switching Broker's Market Share in Stock	0.072	0.032	0.071
3c	New House's Market Share in Stock	0.824 *(.0115)*	0.761 *(.0199)*	0.903 *(.0065)*
4a / 5a	Household	0.008		
4b / 5b	Financial Institution			−0.007
	Non-Financial Institution			0.005
4c / 5c	Governmental Institution − Financial Institution			−0.049
	Governmental Institution − Non-financial Institution			−0.061
	Non-Profit Institution − Financial Institution			0.016
	Non-Profit Institution − Non-financial Institution			0.004
6 / 7	Investor is Male − Investor is Female		0.0353	
8	Investor and Old House = Finnish, New House = Swedish	0.041	0.053	0.037
	Adjusted R^2	0.006	0.013	0.002
	No. of Observations	278	278	278

Table 3.10: Multivariate Model for the Change in Customers' Proportion of Trading By Value via New Brokerage House (Month=−1 to Month=0)

Dependent Variable: Change in Old Brokerage House's Customers' Proportion of Trading By Value of their Buy (Sell) Side Trades in a Stock in the Upstairs/Downstairs Market conducted by the new brokerage house. The change in proportion of trading is measured from the switching broker's last month of trading at old house (month=−1) to the period immediately thereafter when broker does not trade (month=0). P-values are given in parentheses next to coefficients.

(Sub-)Hyp. No.	Independent Variable(s)	Model 1	Model 2	Model 3
1a	Prop. of Investor Trading Via Old B. House	0.083	0.081	0.071
1b	Customer of Switching Broker	0.002	0.003	0.005
	Prop. of Investor Trading Via Switching Broker	0.067	0.06	0.053
1c	Prop. of Investor Trading Via New B. House	−0.128	−0.153	−0.146
2	Upstairs Market	0.008	0.012	0.012
3a	Old House's Market Share in Stock	−0.054	−0.052	−0.067
3b	Switching Broker's Market Share in Stock	−0.001	0.011	−0.022
3c	New House's Market Share in Stock	0.522	0.524	0.644
4a / 5a	Household	0.005		
4b / 5b	Financial Institution			−0.009
	Non-Financial Institution			−0.014
4c / 5c	Governmental Institution − Financial Institution			0.082
	Governmental Institution − Non-financial Institution			0.087
	Non-Profit Institution − Financial Institution			0.388 *(.0063)*
	Non-Profit Institution − Non-financial Institution			0.393 *(.0063)*
6 / 7	Investor is Male − Investor is Female		−0.008	
8	Investor and Old House = Finnish, New House = Swedish	0.03	0.023	0.084
	Adjusted R-Square	−0.029	−0.017	0.023
	No. of Observations	362	362	362

Table 3.11: Multivariate Model for the Change in Customers' Proportion of Trading By Value via New Brokerage House (Month=−1 to Month=1)

Dependent Variable: Change in Old Brokerage House's Customers' Proportion of Trading By Value of their Buy (Sell) Side Trades in a Stock in the Upstairs/Downstairs Market conducted by the new brokerage house. The change in proportion of trading is measured from the switching broker's last month of trading at old house (month=−1) to the broker's first month of trading at the new house (month=1). P-values are given in parentheses next to coefficients.

(Sub-)Hyp. No.	Independent Variable(s)	Model 1	Model 2	Model 3
1a	Prop. of Investor Trading Via Old B. House	0.026	0.012	−0.01
1b	Customer of Switching Broker	0.029	0.029	0.03
	Prop. of Investor Trading Via Switching Broker	0.006	−0.006	−0.028
1c	Prop. of Investor Trading Via New B. House	0.234 *(.001)*	0.245 *(.0006)*	0.157 *(.0223)*
2	Upstairs Market	0.021	0.018	0.017
3a	Old House's Market Share in Stock	−0.044	−0.045	−0.026
3b	Switching Broker's Market Share in Stock	0.011	0.0003	0.003
3c	New House's Market Share in Stock	−1.704 *(<.0001)*	−1.74 *(<.0001)*	−1.477 *(<.0001)*
4a / 5a	Household	−0.022		
4b / 5b	Financial Institution			0.029
	Non-Financial Institution			0.055
4c / 5c	Governmental Institution − Financial Institution			−0.158 *(.0033)*
	Governmental Institution − Non-financial Institution			−0.184 *(.0033)*
	Non-Profit Institution − Financial Institution			−0.051
	Non-Profit Institution − Non-financial Institution			−0.077
6 / 7	Investor is Male − Investor is Female		−0.006 *(.0387)*	
8	Investor and Old House = Finnish, New House = Swedish	−0.028	−0.019	−0.043
	Adjusted R-Square	0.131	0.144	0.213
	No. of Observations	278	278	278

Table 3.12: Multivariate Simultaneous Equations Model for the Change in Customers' Proportion of Trading By Value via Old and New Brokerage Houses (Month=−1 to Month=0)

Dependent Variable (1): Change in old brokerage house's customers' proportion of trading by value of their Buy (Sell) side trades in a stock in the upstairs/downstairs market conducted by the *old* brokerage house; ***Dependent Variable (2)*** Change in old brokerage house's customers' proportion of trading by value of their Buy (Sell) side trades in a stock in the upstairs/downstairs market conducted by the new brokerage house. The change in proportion of trading is measured from the switching broker's last month of trading at old house (month=−1) to the period immediately thereafter when broker does not trade (month=0). P-values are given in parentheses next to coefficients. Switching event dummies are not shown.

(Sub-)Hyp. No.	Independent Variable(s)	Model 1	Model 2	Model 3
	Simultaneous Equation 1: Dependent Variable (1)			
	(2) Change in Prop. of Investor's Trading Via New House	4.461	4.912	0.327
1a	Prop. of Investor Trading Via Old B. House	0.0001	0.0001	0.366 *(0.0094)*
1b	Customer of Switching Broker	0.013	0.015	0.021
	Prop. of Investor Trading Via Switching Broker	0.072	0.089	0.374 *(0.0089)*
1c	Prop. of Investor Trading Via New B. House	1.224	1.439	0.73 *(0.0057)*
2	Upstairs Market	−0.053	−0.074	−0.024
3a	Old House's Market Share in Stock	0.353	0.348	0.143
3b	Switching Broker's Market Share in Stock	−0.267	−0.37	−0.27
3c	New House's Market Share in Stock	−3.034	−3.197	−1.001
4a / 5a	Household	−0.031		
6 / 7	Investor is Male − Investor is Female		0.145	
8	Investor and Old House = Finnish, New House = Swedish	0.501	0.715	0.137
	Adjusted R-Square	−13.82	−16.178	−0.232
	Simultaneous Equation 2: Dependent Variable (2)			
	(1) Change in Prop. of Investor's Trading Via Old B. House	−0.136	−0.168	−0.272 *(0.0041)*
	Adjusted R-Square	0.134	0.156	0.199
	No. of Observations	363	363	363

Table 3.13: Multivariate Simultaneous Equations Model for the Change in Customers' Proportion of Trading By Value via Old and New Brokerage Houses (Month=−1 to Month=1)

Dependent Variable (1): Change in old brokerage house's customers' proportion of trading by value of their Buy (Sell) side trades in a stock in the upstairs/downstairs market conducted by the old brokerage house; ***Dependent Variable (2)***: Change in old brokerage house's customers' proportion of trading by value of their Buy (Sell) side trades in a stock in the upstairs/downstairs market conducted by the new brokerage house. The change in proportion of trading is measured from the switching broker's last month of trading at old house (month=−1) to the broker's first month of trading at the new house (month=1). P-values are given in parentheses next to coefficients. Switching event dummies are not shown.

(Sub-)Hyp. No.	Independent Variable(s)	Model 1	Model 2	Model 3
	Simultaneous Equation 1: Dependent Variable (1)			
	(2) Change in Prop. of Investor's Trading Via New House	−0.484 *(0.013)*	−0.437 *(0.02)*	−1.214
1a	Prop. of Investor Trading Via Old B. House	0.019	0.012	−0.015
1b	Customer of Switching Broker	−0.0007	0.003	0.022
	Prop. of Investor Trading Via Switching Broker	−0.015	−0.022	−0.06
1c	Prop. of Investor Trading Via New B. House	−0.065	−0.047	−0.011
2	Upstairs Market	0.007	0.006	0.016
3a	Old House's Market Share in Stock	−0.106	−0.105	−0.111
3b	Switching Broker's Market Share in Stock	0.077	0.032	0.075
3c	New House's Market Share in Stock	0.0001	0.0001	−0.89
4a / 5a	Household	−0.003		
6 / 7	Investor is Male − Investor is Female		0.033 *(.0286)*	
8	Investor and Old House = Finnish, New House = Swedish	0.002	0.004	−0.014
	Adjusted R-Square	−0.169	−0.125	−0.913
	Simultaneous Equation 2: Dependent Variable (2)			
	(1) Change in Prop. of Investor's Trading Via Old B. House	−0.892 *(0.0003)*	−0.744 *(0.0006)*	−0.572 *(0.0046)*
	Adjusted R-Square	−0.667	−0.431	−0.219
	No. of Observations	279	279	279

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