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I am submitting herewith a dissertation written by Kenneth Wayne Small, Jr. entitled "Three Essays in Market Microstructure." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Business Administration.

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Three Essays in Market Microstructure

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Kenneth Wayne Small, Jr.
August 2004

Acknowledgments

I wish to thank all those who encouraged me to complete my academic training. Special thanks go to my committee chair, Dr. Wansley, and to the dissertation committee members, Dr. Collins, Dr. Daves and Dr. McKee. I also want to thank the following people who helped me along the way: Erika Small, Sara Whitner, John Deskins, Brian Hill, Tami Richards, Jeff Smith, and Mark Tuttle.

Abstract

This dissertation consists of three essays. The first essay examines the liquidity impact of NASDAQ security cross-listings on the American Stock Exchange (Amex). Using a comprehensive sample of cross-listing equities, transactions data obtained from the NYSE Trade and Quote (TAQ) database, and market data obtained from the Center for Research in Securities Pricing (CRSP) database, I find positive abnormal returns on days when positive news is released regarding security cross-listings. This indicates that cross-listing creates value for cross-listing firms. I also document significant decreases in trading costs of the cross-listed securities around the cross-listing date. In general, market participants perceive exchange competition to create value, and in the case of Amex cross-listing the NASDAQ 100, trading costs decrease significantly around the cross-listing date.

The second essay examines adverse selection costs in basket securities. I compare the adverse selection costs of exchange traded funds against a matched sample of equities. I document lower quoted and effective spreads and higher quoted depth in exchange traded funds relative to a matched sample of equities. I also examine how industry and security concentration in basket securities influences trading and adverse selection costs. I find increased quoted and effective spreads and lower depth in industry concentrated and international basket securities. The results of this essay have a direct impact on the trading decisions of individual and institutional investors, and on fund management firms that sponsor the creation of exchange traded fund products.

The third essay examines the impact of the introduction of nine Sector Standard and Poor Depository Receipts on the underlying securities. I employ a Seemingly Unrelated Regression model to measure the changes in liquidity of the underlying equities around the introduction of the Sector Standard and Poor Depository Receipts. I examine the changes in adverse selection costs in the underlying securities around the introduction of the concentrated basket securities. The third essay is the first examination of the liquidity impact of Sector specific exchange traded fund on the underlying equities

Table of Contents

Part 1	Dissertation Introduction.....	1
Part 2	Unlisted Trading Privileges and Market Quality.....	5
	I. Introduction.....	6
	II. The American Stock Exchange and Unlisted Trading Privileges.....	9
	III. Order Splitting and Market Fragmentation.....	12
	IV. Hypotheses Development.....	15
	V. Methodology.....	18
	VI. Liquidity	25
	VII. Adverse Selection	26
	VIII. Impact of UTP Trading.....	28
	IX. Conclusion.....	29
	References.....	31
	Appendix 1.....	35
Part 3	Adverse Selection and Exchange Traded Funds.....	43
	I. Introduction.....	44
	II. Exchange Traded Funds.....	45
	III. Literature Review.....	49
	IV. Hypothesis Development.....	51
	V. Method.....	53
	VI. Liquidity Analysis	59
	VII. Conclusion.....	68
	References.....	70
	Appendix 2.....	73
	Appendix 2.a Robustness	82
Part 4	The Liquidity Impact of Concentrated Basket Security Introduction....	86
	I. Introduction.....	87

Table of Contents (Continued)

II. Literature Review.....	89
III. Hypotheses.....	90
IV. Method.....	92
V. Conclusion.....	99
References.....	101
Appendix 3.....	104
Part 5 Limiting Factors and Future Research.....	109
I. Limiting Factors.....	110
II. Future Research.....	111
Vita.....	113

List of Tables

Table 2.a Cross-Listing Dates.....	36
Table 2.b Event Study	37
Table 2.c Matching Scores.....	38
Table 2.d Univariate Spread, Depth, and Adverse Selection Cost Measures	39
Table 2.e Spreads and Depth Measures	40
Table 2.f Spreads and Depth Measures Controls.....	41
Table 2.g Adverse Selection Model	42
Table 3.a ETF Matching Scores.....	74
Table 3.b Exchange Traded Fund Univariate Characteristics.....	75
Table 3.c Exchange Traded Fund and Equity Spread Analysis.....	76
Table 3.d Exchange Traded Fund and Equity Spread Extended Analysis.....	77
Table 3.e Exchange Traded Fund and Equity Adverse Selection Analysis.....	78
Table 3.f Exchange Traded Fund and Equity Adverse Selection Extended Analysis.....	79
Table 3.g Intra-ETF Liquidity Analysis.....	80
Table 3.h Intra-ETF Adverse Selection Analysis.....	81
Table 3.i Exchange Traded Fund and Equity Spread Analysis (Random Sample).....	83
Table 3.j ETF and Equity Spread Extended Analysis (Random Sample).....	84
Table 3.k ETF and Equity Adverse Selection Extended Analysis (Random Sample).....	85
Table 4.a SPDR Matching Scores.....	105

List of Tables (continued)

Table 4.b S and P 500 Univariate Characteristics	106
Table 4.c SPDR Spreads and Depth Measures	107
Table 4.d SPDR Adverse Selection Model	108

Part 1:

Dissertation Introduction

The seminal work of Akerlof (1970) provides insight into the world of imperfect information. Akerlof demonstrates the possibility of market failure when agents interact in markets where information sets differ across participants. Market makers and specialists are exposed to the asymmetrical information problem outlined in Akerlof (1970), because they trade with informed agents in an environment of anonymity.

For example, Kyle (1985) suggests market makers increase the bid-ask spread when trading with informed agents, where it is generally accepted that the bid-ask spread consists of three costs. These include the inventory holding, order-processing, and adverse selection components. The inventory holding component of the bid-ask spread compensates the market maker for holding securities in amounts above or below the desired equilibrium level. The order-processing component compensates the market maker for costs associated with transacting orders such as labor and clearing costs. The third component is the adverse selection component, which compensates market makers for the level of informed trading in the security. This dissertation examines adverse selection costs in several contexts and this analysis provides the depth of this work. I discuss each essay below.

Market makers are exposed to two types of informed trading in the securities market. First, they are exposed to trading on firm specific information and second, they are exposed to trading by market participants who possess knowledge regarding impending order flow. If an informed agent trades on either type of information, the market maker is forced to match the order at an inferior price. The prevailing price is inferior because it

does not reflect the information that is known by the informed agent and unknown to the market maker.

The small costs associated with the bid-ask spread are significant when considered on a macro scale. Take IBM for example, which is currently trading around \$80, and currently¹ has an average daily trading volume of around 7,000,000 shares. A one tenth of a percent increase (.1%) in the bid-ask spread results in an eight cents increase in spread. This increase may seem trivial at the per trade level, but when considered in the context of the total volume, the true costs come into perspective. An eight-cent increase in the bid-ask spread increases trading costs by \$560,000 for each trading day, and for an average year containing 252 trading days, the total increase in trading costs is \$141,120,000.

This dissertation examines adverse selection costs, depth, and bid-ask spreads in several contexts. The first essay addresses the liquidity and trading quality changes of 120 NASDAQ equities that began cross trading on the AMEX under Unlisted Trading Privileges. I employ a Seemingly Unrelated Regression to examine the liquidity and trading quality impact of AMEX entry. This essay is the first examination of AMEX entry into trading NASDAQ equities. The results of this essay have implications for regulatory policy towards cross trading, and will influence future decisions regarding cross-trading venue choices.

¹According to Yahoo-finance.com the average daily volume on July 30, 2003 was 7,288,1136 shares.

The second essay examines adverse selection costs and liquidity of exchange traded funds (ETFs) relative to a matched sample of equity securities. I also examine how basket security concentration influences costs associated with informed trading. The second essay contributes to the microstructure literature in several ways. This is the first examination of adverse selection costs in exchange traded funds, and it is the first comparison of depth and spreads between exchange traded funds and a matched portfolio of equities. It is also the first examination of the factors that contribute to adverse selection costs in exchange traded funds. For example, the results of this essay have the potential to directly impact the trading decisions of individual and institutional investors, and have implications for investment management firms that sponsor the creation of exchange traded fund products.

The third essay examines the impact of the introduction of nine Sector Standard and Poor Depository Receipts (Sector SPDRs) on the underlying securities. I employ a Seemingly Unrelated Regression model to measure the changes in liquidity of the underlying equities around the introduction of the Sector Standard and Poor Depository Receipts. I examine the extent to which uninformed traders migrate from trading in the underlying securities to the basket securities. This is the first examination of the liquidity impact of Sector specific exchange traded fund on the underlying equities. This essay also examines the migration of informed trader between security types and should aid in future exchange traded fund design.

Part 2: Unlisted Trading Privileges and Market Quality

I. Introduction:

Equity markets are comprised of a multitude of exchanges and trading venues that have become increasingly competitive over the past two decades. This increased competition has been promoted by the Securities and Exchange Commission (SEC) and has come at the demand of the investing public. In the neo-classical sense, exchange competition is a beneficial force that tends to reduce the monopoly profits of individual exchanges. In support of traditional arguments, research suggests that trading costs decrease with the entrance of market competitors (Cohen and Conroy (1990), and Van Ness, Van Ness, and Hsieh (1999). However, other studies have suggested that market efficiency may decrease with the entrance of an exchange competitor. Amihud and Mendelson (1996) explain why market competition is a double-edged sword: “the effect of multimarket trading . . . is ambiguous because of the conflicting effects of competition and fragmentation. On one hand, multimarket trading may generate liquidity improvements due to enhanced intermarket competition. On the other hand, it may hurt liquidity because it induces fragmentation of the order flow between markets”. Thus, the argument for exchange competition is not one-sided; rather it must be considered in light of the benefits induced by competition and the costs associated with order flow fragmentation.

Two determinants of multi-exchange trading efficiency are the linkages among and the transparency across exchanges. These determinants have profound effects on the efficiency of the “market” in which the security trades. Weak links between exchanges result in a decreased probability of order flow interaction between markets, which hampers price discovery. The transparency between exchanges is also an important factor

determining the efficiency of a multi-exchange trading environment. Profit opportunities may arise when orders on one exchange are not posted to another.

Order flow fragmentation has become an issue of increasing regulatory interest since the elimination of NYSE Rule 390² and the establishment of the national market system. On March 21, 2000, Arthur Levitt described³ transparency across and the linkages among market centers as the “pillars” of the national market system. Linkages among market centers play an important role in security market efficiency. Weak intermarket linkages lead to order flow fragmentation, which often result in increased trading costs, and which in turn increase the cost of equity capital (Amihud and Mendelson (1986) and Amihud, Mendelson, and Lauterbach (1997)). Order flow fragmentation occurs when orders in one market do not interact with orders in a competing market (Stoll 2001). Thus, markets that are poorly integrated, or fragmented, may experience increased difficulty in executing orders (Lee 1993).

The linkages among and the transparency across markets were issues of concern in the recent cross-listing of NASDAQ listed securities on the American Stock Exchange. On August 12, 2002, the American Stock Exchange (Amex) began trading nine NASDAQ Stock Market (NASDAQ) listed securities under unlisted trading privileges (UTP). By November 21, 2002 a total of 120 NASDAQ listed equities were available to be cross-traded on the Amex under unlisted trading privileges (UTP). UTP allow shares to be

² Prohibited NYSE member firms and affiliated persons from trading NYSE-listed stocks off the exchange.

³ Taken from in a speech given in Washington DC on March 10, 2000, entitled "Visible Prices, Accessible Markets, Order Interaction".

cross-listed on exchanges other than the primary exchange and these privileges are granted under the Securities Act of 1933.

These cross listings provide the unique opportunity to study the impact of cross-trading and order flow fragmentation on price discovery and trading costs. The results of this investigation suggest that the investing public perceives cross-listing to be a net positive benefit to traders of the cross-listing equities. I find positive abnormal returns on days when positive news is released regarding Amex UTP cross-listing. Non-parametric sign tests also indicate positive and significant changes in equity returns on these days.

I also examine the liquidity of the securities around their cross-listing dates and find that bid-ask spreads decrease significantly while depth does not change. While controlling for changes in trading volume, price, and return standard deviation, quoted spreads decrease by 17.9% (t -statistic 3.25) on average. Dollar depth experiences an insignificant average decrease of .3% (t -statistic -.10). The increase in liquidity is in contrast to that of a matched sample of equities in which liquidity does not change.

The remainder of the work proceeds as follows. In section Ia., a brief discussion of the national market system is provided. Section II discusses the history of the Amex's pursuit of unlisted trading privileges. Section III reviews the literature related to order-splitting and market fragmentation. Section IV contains the hypothesis development, and section V, discusses the research methodology. In sections VI and VII I present the results of the analysis. In section VIII I discuss the implication of the empirical results, and in the final section, IX, I present the conclusions of the study.

Ib. Market Competition:

In 1975, Congress passed an amendment⁴ to the Securities and Exchange act of 1934, section 11A, which paved the way for the National Market System (NMS). The NMS was established to accomplish the following goals: i) provide economically efficient executions; (ii) promote fair competition among brokers and dealers, among exchange markets, and between exchange markets and markets other than exchange markets; (iii) make quotation and transaction information publicly available; (iv) provide investors with the opportunity to obtain best execution; and (v) offer the opportunity to obtain trade execution without dealer participation, to the extent consistent with economically efficient executions and opportunity to obtain best execution.⁵ One of the significant outcomes of the establishment of the NMS was the elimination of the off-board trading rules, such as Rule 390 of the NYSE. Rule 390 prohibited NYSE members from transacting in NYSE-listed securities off the NYSE. The elimination of these restrictions paved the way for the development of a system of linked markets and was the impetus for the increase in exchange competition. These regulatory changes have led to the rise of Electronic Communication Networks (ECNs) and increased competition among existing exchanges.

II. The American Stock Exchange and Unlisted Trading Privileges:

On December 17, 2001, the Amex filed a petition with the Securities and Exchange Commission, pursuant to Section 19(b)(1) of the Securities act of 1934, to trade

⁴ For an excellent review of the US market regulatory environment see Beny (2001).

⁵ 15 U.S.C. § 78k-1(a)(1).

NASDAQ securities under unlisted trading privileges. The Amex planned to trade all stocks that were included in the NASDAQ 100 index and all NASDAQ listed equities included in the SandP 500 index.

Prior to the SEC's approval of the Amex filing on August 2, 2002, several groups cited concerns regarding the entry of the Amex into UTP trading of NASDAQ securities. The SEC received two letters addressing the issue of delayed execution. The first letter was submitted by Knight Trading Group, who expressed concern over Amex entry for two reasons⁶. First, Knight suggested the possible disruption of the national market system, and further contended that Amex trading would undermine the firm quote rule. Under the proposed rules, Amex traders would be allowed to trade national market securities without providing automatic execution. Knight argued that this would give Amex traders the ability to gain an informational advantage by monitoring trading and quoting activities of national market securities without the obligation of automatic execution. Orders sent to the Amex by NASDAQ market makers were to be provided no guarantee of automatic execution.

The SEC received a second comment letter from a congressional panel on May 20, 2002.⁷ The congressional panel expressed similar concerns regarding the ability of Amex members to delay execution. They further contended that this ability would increase the incidence of "locked" and crossed markets. The panel suggested that the market with the

⁶ See SEC Release Number 34-46305 (August, 2 2002) and SEC letter from Michael T. Dorsey, Senior Vice President, General Counsel, and Secretary, Knight, to Commission (February 28, 2002).

⁷ See SEC letter from Congresswoman Judy Biggert, Congressmen Mike Ferguson, Walter B. Jones, Mike Rogers, Ed Royce, and Patrick Tiberi to The Honorable Harvey Pitt, Chairman, Commission (May 29, 2002).

least sophisticated technology would gain an advantage, because of the ability to monitor market activity without the requirement of automatic execution.

In addition to the concerns of the ability of Amex members to delay execution, the interaction between order flow on the Amex and order flow on the NASDAQ was an issue of concern. The Amex does not trade NASDAQ securities via the inter-market trading system (ITS), and there is no “official” inter-market linkage system for NASDAQ securities. Furthermore, the Amex does not participate in the NASDAQ’s SuperMontage.

Despite the issues raised in the two comment letters, the Amex was granted the proposed rule change on August 2, 2002. On August 12, 2002 the Amex began trading nine NASDAQ listed stocks under unlisted trading privileges, with the intention of adding an additional 111 securities. The only halt of Amex UTP trading came on the close of trading, August 14, 2002, when the Amex was informed of a filing with the SEC. This filing had the effect of automatically staying the SEC’s previous approval of UTP trading on the Amex⁸.

The filing was submitted by Knight Trading Inc. in response to the method in which Amex’s UTP trading would interact with other markets⁹. Since Knight Trading’s filing was not directed at the SEC’s approval of the Amex’s UTP trading, the SEC issued an order denying the petition for review. This allowed the Amex to resume trading on August 27, 2002. The roll out process continued, including twelve groupings, with the

⁸ See letter to Jonathan G. Katz, Secretary, Commission, from John J.D. McFerrin-Clancy, Schlam Stone and Dolan, dated August 15, 2002.

⁹ See Securities Exchange Act of 1934 Release No. 46409.

last group of 10 securities being added on November 21, 2002. Table 2.a contains the roll out schedule for the 120¹⁰ equities.

(Table 2.a here)

The absence of an integrated trading system may lead to market fragmentation, such that traders in one market cannot directly observe the order flow in orthogonal markets¹¹. Delays in reporting and slow interaction between market centers increase the probability of fragmentation, which creates the opportunity for traders to split strategically their orders between markets. Weak market interaction combined with the perceived threat of the Amex member's ability to delay execution could result in poor market quality. As a result of delayed order execution and the absence of an integrated trading system, market participants could respond with larger bid-ask spreads and decreased depth. Both larger bid-ask spreads and decreased depth represent an increased cost of trading, and in turn, a higher cost of equity.

III. Order Splitting and Market Fragmentation:

The literature on order splitting has provided great insight into multi-market trading activity. Chowdry and Nanda (1991) develop a theoretical model where traders can choose to trade between markets. The model indicates that in the presence of small liquidity traders, informed agents will optimally transact in the market where small liquidity traders trade. The theoretical model of Bernhardt and Hughson (1997) suggests

¹⁰ During the initial roll out process, the securities that comprise the NASDAQ 100 changed. The securities that were added to the NASDAQ 100, and subsequently traded on the Amex, are not included in this study.

¹¹ See Boehmer and Boehmer (2003) for a discussion of order flow fragmentation between NYSE and Amex cross listings of Exchange Traded Funds.

that trading costs can increase when traders are able to split their orders between markets. They show that in a multi-market trading environment, market makers set less competitive price schedules and earn strictly positive profits. Menkveld (2003) provides empirical support for the theoretical models of Chowdry and Nanda (1991) and Bernhardt and Hughson (1997). Menkveld examines the market for Dutch stocks that trade in both Amsterdam and New York, and finds that traders split their orders between markets during the hours in which both markets are open. Additionally, he finds that traders who strategically split their orders are privately informed traders.

The literature on fragmentation has provided mixed results. According to Lee (1993), a fully integrated market is one in which all price-relevant information is available at each location and is communicated quickly to the entire market. Stoll (2001) suggests several factors that could make competition from satellite markets more effective. First, quote and transaction price transparency should make it possible for a satellite market to credibly guarantee that the price in the primary market is being matched. Second, satellite markets should pay for order flow in addition to matching prices. Third, technological changes should make the satellite markets better competitors. Fong, Madhavan, and Swan (2001) study the determinants of off-market trading using data from the Australian stock market, and find that off-market trading is positively related to trading volume, bid-ask spreads, and index inclusion. However, they find off-market trading to be negatively related to market depth and option listing.

Several works have documented the benefit of market consolidation. Models of trading activity (e.g. Pagano 1989a and 1989b) suggest that consolidation of order flow benefits traders and results in positive externalities. Arnold, Hersch, Mulherin, and Netter (1999) examine consolidation of the regional exchanges and find that consolidation attracts market share and leads to lower bid-ask spreads. Several studies document the costs associated with fragmented non-centralized trading. Madhavan (1995) shows that fragmented markets are price inefficient and should exhibit higher levels of price volatility than do consolidated markets. Lee (1993) examines the cost of execution across the NASDAQ, NYSE, and several regional exchanges, and finds that the execution price of similar trades can differ significantly based on location of execution. Easley, Kiefer, and O'Hara (1996) examine "cream-skimming" that occurs between orders on the Cincinnati and NYSE exchanges. They find that diversion of orders between markets is not "benign" and document differences in information across exchanges.

However, several works document the benefits of non-centralized trading. Battalio (1997) examines the bid-ask spread before and after a third market dealer (Madoff) enters the market. The study documents a decrease in the bid-ask spread, and finds that trading costs do not increase after entry. Fong, Madhavan, and Swan (2001), using data from the Australian stock market, find that alternative trading exhibits lower price impact for block trades than the consolidated electronic limit order book. They conclude that the existence of an alternative-trading venue (upstairs market) leads to a Pareto improvement because no set of market participants was harmed at the expense of others, while total market quality improved. Boehmer and Boehmer (2003) examine the market quality for

ETFs that cross-listed on the NYSE from the Amex under unlisted trading privileges. They document double-digit percentage declines in quoted, effective, and realized spreads. They also find that quoted depth increases across all market centers after the NYSE begins UTP trading of ETFs. DeFontnouvelle et al. (2000) examine option cross-listings and find effective spreads and quoted bid-ask spreads decrease after multi-listing.

IV. Hypotheses Development:

The inability of order flow to interact contemporaneously across parallel markets causes order flow fragmentation. Because transactions do not occur in one central market, the order flow that occurs at time t in a primary market may not interact with order flow that occurs in a competing market at time t . Order flow fragmentation does not exist in a single market trading environment. Thus, the central question is which trading framework is better, a centralized market or market of competing exchanges.

One argument often made by centralized trading proponents is that market liquidity is enhanced in a single exchange market. Centralized trading, it is argued, increases the probability of order interaction, thereby improving trading costs (i.e. lowering bid-ask spreads and enhancing market depth). It is also argued that the price impact of a trade is lower in a single exchange market (Amihud and Mendelson (1996)). On the other hand, if trading takes place across markets, there is a reduced probability of order interaction. Order interaction increases with market transparency and with the improvement of market linkages.

Proponents of centralized trading also argue that it improves price discovery. They suggest that satellite markets free-ride from the information production of the primary market. The primary market is not afforded compensation and this process results in a decreased propensity by the primary market to offer the service. This problem is magnified with poor information linkages across markets. Amihud and Mendelson (1996) argue:

“multimarket trading...may reduce liquidity because it can cause fragmentation when a security's order flow is split among a number of markets that are not perfectly coordinated...the number of bids and offers to buy and sell the security in each market declines, as does the aggregate trading volume, relative to a regime under which the entire order flow is consolidated in one market...an order of a given size sent to a market for execution will find fewer limit orders or quotes available on the other side at any given price. Both the price impact of the order and the bid-ask spread it faces in each market will tend to be higher than if trading were confined to a single market.”(pp. 1434)

The structure of UTP trading on the Amex has increased the probability of order fragmentation in UTP securities because of the separation of interaction between trading that occurs on the Amex and trades that occur in other markets. Since the Amex does not participate in the NASDAQ SuperMontage, and the linkage between the AMEX and NASDAQ is considered weak, one could expect a significant impact on the liquidity of cross-listing securities. This leads to the first hypothesis tested in this work:

Hypothesis I

The Amex entry into cross-trading NASDAQ securities has lead to no change in market quality or trading costs. Alternatively, the entry of the Amex may have decreased or increased the trading costs.

The second hypothesis tested in this work is related to adverse selection. Securities dealers are exposed to the asymmetrical information problem outlined by Akerlof (1970) because they trade with informed agents in an environment of anonymity. Kyle (1985) suggests that market makers increase their bid-ask spreads when trading with informed agents, where the bid-ask spread is defined as the difference between the prevailing ask and bid price at any time t .

It is generally accepted that the bid-ask spread consists of three cost components: inventory holding costs, order-processing costs, and adverse selection costs. The inventory holding component of the bid-ask spread compensates the market maker for holding securities in amounts above or below the desired equilibrium level. The order-processing component allows the market maker to cover the costs associated with completing orders. The third component is the adverse selection component, which compensates market makers for the level of informed trading in the security. Furthermore, market makers are exposed to two types of informed trading in the securities market. First, they are exposed to trading on firm-specific information. Second, they are exposed to trading by market participants who possess knowledge regarding impending order flow. If an informed agent trades on either type of information, the market maker is forced to match the order at a price that does not reflect the information that is known by the informed agent.

Weak market interaction combined with the perceived threat of Amex members' abilities to delay execution could lead to increases in the adverse selection component of the bid-ask spread. This leads to the second hypothesis that is tested in this work:

Hypothesis II

The entry of the Amex into cross-trading NASDAQ securities has lead to no increase in the costs associated with informed trading, as defined by the adverse selection component of the bid-ask spread. Alternatively, the entry of the Amex may have decreased or increased the costs associated with informed trading.

V. Methodology:

Va. Data:

All transactions data are collected from The New York Stock Exchange Trade and Quote (TAQ) database, and are filtered using methods similar to those used in and Lipson and Mortal (2003). I exclude the following data points:

- Non-positive prices and quotes
- All quotes with a time stamp before 9:30am or after 4:00pm
- Quotes with zero sized bid or offer depths
- Trading prices and midpoint greater than 50% over their previous level

Buys and sells are classified using the methodology of Lee and Ready (1990). I excluded Bond ETF spreads because they are unlikely to exhibit characteristics that are indicative of those of equity funds. Security price, volume and daily price data are collected from The Center for Research in Securities Prices (CRSP) database. Quote and trade data are

collected for each firm for 30 days prior to (“pre-period”) trading and 30 days after the beginning of trading (“post-period”) of the firm’s equity on the Amex.

Vb. Event Study:

The market reaction to the announcement of Amex entry into UTP trading of NASDAQ-listed securities is evaluated. Abnormal returns associated with the announcement of UTP trading are compared across announcement types¹². If positive abnormal returns are associated with favorable SEC announcements, this would provide evidence that market participants expect a positive net benefit¹³ to accrue to the owners of the equities. Positive benefits could be derived from decreased trading costs (i.e. decreased spreads and increased liquidity), which arise because of increased competition. However, if negative abnormal returns are found, this may suggest that market participants expect increased trading costs from the entrance of the new competitor.

The event dates used in this study can be found in Table 2.b. These dates include: the initial filing date, the date when the filing appeared in the Federal Register, the date when the SEC granted the UTP request, the date when the SEC suspended UTP trading privileges, and the date when the SEC rescinded the suspension.

¹² For instance, the initial SEC announcement that granted the Amex UTP privileges would be considered a public announcement in favor of the Amex gaining UTP privileges, while the SEC suspension of the Amex UTP trading privileges would be considered a public announcement against the Amex continuing its UTP trading activities.

¹³ If the entry of the Amex represents a decrease in trading costs, the required rate of return on the security would decrease and the current value of the security would increase (Amihud and Mendelson (1986) and Amihud, Mendelson, and Lauterbach (1997)). If Amex entry results in larger bid-ask spreads and/or lower levels of liquidity, the required rate of return on the securities would increase and the current value of the security should decrease.

The standard market model is used to derive one-day (0) abnormal returns. Abnormal returns are calculated as: $AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt}$, where R_{it} is the return to firm i on day t , $\hat{\alpha}_i$ is an intercept term estimated using the prior 250 trading days returns, $\hat{\beta}_i$ is the market beta for the i th firm estimated using the prior 250 trading days returns, and R_{mt} is the market return on day t . A non-parametric sign rank test is also performed on the one-day abnormal returns. The sign test indicates the proportion of firms in the sample that have positive returns on each event day, and is free of the distributional assumptions made by parametric tests.

(Table 2.b here)

Table 2.b includes the results of the event study analysis. On the day that the American Stock exchange filed with the Securities and Exchange Commission for Unlisted Trading Privileges there were no discernable abnormal returns. Furthermore, 52% of the firms had positive abnormal returns with a sign rank t statistic¹⁴ of .40. When the American Stock Exchange was granted unlisted trading privileges, on August 2, 2002, the one-day abnormal returns of the sample NASDAQ firms was .03% (t statistic = .734). On this date, 76.1% (t statistic = 5.22) of the firms had positive returns.

¹⁴ The sign rank t statistic is calculated using the following formula: $t_{\text{sign}} = \frac{(P - .5)}{\sqrt{\frac{.25}{N}}}$. Where p is percentage of firms with positive abnormal returns, and N is the number of firms in the sample.

The market reaction to the announcement of the suspension is associated with a decrease in the abnormal returns of the NASDAQ sample, but the decrease is not significant at traditional significance levels.

The significance of the abnormal returns on the days when the Securities and Exchange Commission suspended the unlisted trading privileges of the Amex is difficult to interpret. At first it would seem that this event should be associated with significant negative abnormal returns, but the suspension of Amex UTP trading was the result of a filing by Knight Trading. Given Securities and Exchange Commission Rules, the suspension was automatic. Actually, the Securities and Exchange Commission found Knight Trading's petition to lack merit, and, in effect, its filing was not a credible threat to Amex UTP trading of NASDAQ equities

In general, the results indicate that the investing public perceives the Amex's entry into trading NASDAQ securities as a net positive benefit. In conjunction with the test of market perception of Amex entry, an analysis of the bid-ask spread and liquidity changes must also be presented. The analysis of the cost of trading is discussed in the next section.

Vc. Trading Costs:

Two spread estimates are employed in this analysis, and are similar to those used in Boehmer and Boehmer (2003). The first measurement, the quoted spread, is calculated as $QS_t = Ask_t - Bid_t$, where Ask_t is the ask price at time t and Bid_t is the bid at time t . This measure of the spread does not consider trades that take place inside the best bid-best offer quote. Lee (1993), Huang and Stoll (1996) suggest the use of the effective spread,

which is calculated as $ES = 2|p_t - MP_t|$, where p_t is the price at time t , and MP_t is the quote midpoint at time t . This estimate is often used to proxy for the total price impact of trades. These measures of the spread are paired with additional control variables to examine pre and post UTP trading costs using an OLS framework. The specification is discussed below.

Vd. Liquidity Analysis:

The entry of the Amex into the trading of NASDAQ stocks represents increased competition to NASDAQ dealers. Dealers may respond to increased competition by lowering quoted depth¹⁵. Empirical research suggests that quoted bid-ask spreads tend to increase in price and volatility. However, spreads tend to decrease as trading volume increases (Demsetz (1968), Tinic (1972), Benston and Hagerman (1974), and Hamilton (1978)). To examine any change in liquidity, I employ a multivariate analysis of spreads and depth, while controlling for price level, return volatility, and trading volume changes. Because of possible negative correlation between the error terms in the specifications of spreads and depth, I estimate a Seemingly Unrelated Regression¹⁶ of the following form:

$$\begin{aligned} \text{LogSpreadRatio}_j &= \alpha_{s0} + \beta_{s1}\text{LogVolumeRatio}_j + \beta_{s2}\text{LogPriceRatio}_j + \beta_{s3}\text{LogStdDevRatio}_j + \varepsilon_{sj} \\ \text{LogDepthRatio}_j &= \alpha_{d0} + \beta_{d1}\text{LogVolumeRatio}_j + \beta_{d2}\text{LogPriceRatio}_j + \beta_{d3}\text{LogStdDevRatio}_j + \varepsilon_{dj} \\ \text{where } E[\varepsilon_{sj}\varepsilon_{dj}] &\neq 0 \end{aligned}$$

¹⁵ Chou and Lee (2003) find that for three NYSE decimalization pilot stocks, both spreads and quotes decreased after tick size restrictions were removed. Their results suggest that the decreased profit from smaller spreads was met with a decrease in depth.

¹⁶ This model is similar to the one employed in Kumar, Sarin, and Shastri (1998).

LogSpreadRatio_j is calculated two ways. First, it is the natural log of the ratio¹⁷ of the average quoted spread in the post-period to the average quoted spread in the pre-period. Second, it is the natural log of the average effective spread in the post-period to the average quoted spread in the pre-period. This measure is calculated for each of the j firms. LogDepthRatio_j is the natural log of the ratio of the post-period dollar depth to the pre-period dollar depth. The independent variables LogPriceRatio_j , LogStdDevRatio_j , and LogVolumeRatio_j represent the ratio of the average post period to pre price, return standard deviation, and daily volume for firm j , respectively. The pre-period is defined as the thirty days preceding the cross-listing of firm j on the Amex, and the post-period is the thirty days following the cross-listing of the firm j on the Amex. The model is constructed such that the intercepts capture the change in the dependent variable around cross-listing date t for firm j .

Ve. Control Sample:

To provide an estimate of changes in market liquidity during the sample period, I compare the trading costs of the cross-listed securities to those in a control sample. To create the control sample, I match equities based on price, shares outstanding, and trading volume. The process of selection includes the following steps. For each Amex UTP cross-listed share, I identify all non-cross-listed shares on the NASDAQ, Amex, and NYSE. Each equity from this set is then matched with one equity from the cross-listing

¹⁷ The sample consists of 30 days before and 30 days after the entry of the Amex for each group of NASDAQ equities. The quoted spread represents the difference between the ask price and the bid price. The effective spread, $2|P_t - M_t|$, is twice the absolute difference between the price and the quoted mid-point. Dollar depth is the sum of the depth at the bid and ask prices, and represents the number of shares multiplied times the prevailing price.

set using trading volume, price, and return standard deviation. Average daily volume¹⁸, stock price, and shares outstanding are averaged over 60 days, centered on the day of cross-listing for both matching and cross-listing firms.

This matching method is similar to the one employed by Clarke and Shastri (2001). Matching firms must have traded for more than one year and not undergone a suspension of trading during the sixty-day window immediately preceding the cross-listing. Firms that minimize the following expression are selected at the matching equities:

$$\text{Matching Score} = \left(\frac{\text{Price}_i^{\text{non-UTP}} - \text{Price}_i^{\text{UTP}}}{\frac{\text{Price}_i^{\text{non-UTP}} + \text{Price}_i^{\text{UTP}}}{2}} \right)^2 + \left(\frac{\text{Std}_i^{\text{non-UTP}} - \text{Std}_i^{\text{UTP}}}{\frac{\text{Std}_i^{\text{non-UTP}} + \text{Std}_i^{\text{UTP}}}{2}} \right)^2 + \left(\frac{\text{Volume}_i^{\text{non-UTP}} - \text{Volume}_i^{\text{UTP}}}{\frac{\text{Volume}_i^{\text{non-UTP}} + \text{Volume}_i^{\text{UTP}}}{2}} \right)^2$$

The matched portfolio acts as a benchmark for drawing conclusions regarding spread and depth changes. The values obtained from the matching process are presented in table 2.c.

(Table 2.c here)

The average price of the 120 UTP cross-listing NASDAQ securities is \$20.86 and the average price of the matching securities is \$21.04. The mean standard deviation of the cross-listing firms is 4.91% and the average daily return standard deviation for the matched sample is 4.97%. The average adjusted volume for the cross-listing firms was

¹⁸ Volume in dealer markets is overstated because of inter-dealer trading (see Anderson and Dyl (2003)). NASDAQ volume is adjusted to sixty percent of its original amount to facilitate matching across exchanges.

5,237,199 shares and the average volume of the matched sample was 4,835,896. The matching criterion are not significantly different between the cross-listing firms and the matched sample. The insignificant differences in the matching criteria, in addition to the low average matching score of .0723, indicates that the firms included in the two samples are similar along the pre-specified attributes. This matching score is low relative to other studies that implement this methodology. For example, Van Ness, Van Ness, and Warr (2003) set a cut-off score for values of this measure at 2.

(Table 2.d here)

VI. Liquidity:

Average quoted spreads decrease from 5.33 cents to 4.75 cents and this decrease is significant at the 10% level (t value=1.95). The average effective spread decreased from 3.24 cents to 3.10 cents, although this difference between the effective spreads is not significant at traditional significant levels. For the control sample, the effective and quoted spreads decreased from 15.35 cents to 15.23 cents and from 6.92 cents to 6.60 cents, respectively. However, the changes in effective and quoted spreads are not significant at the traditional critical values. In nine of the twelve cross-listing groupings, the quoted spread decreases are significant at the 1% level. This is direct evidence that the changes in spreads cannot be attributed to a clustering among the cross-listing groupings.

The results of the multivariate liquidity analysis are reported in Table 2.d. Panel A contains seemingly unrelated regression results for the cross-listing firms, and panel B contains the estimates from the control sample firms. The intercept from the specification using quoted spreads and depth indicates that the quoted spread decreased 17.9% from the pre-listing period to the post-listing period. The intercept from the dollar depth and effective spread specifications indicate that there was no economic or statistically significant change from the pre-listing to post-listing period in the cross-listing sample. Panel B contains the estimates from the matched sample of firms. The intercepts from the quoted spread, effective spread, and dollar depth equations are all economically and statistically insignificant. The liquidity analysis indicates that the liquidity of the matched sample of equities did not exhibit a significant change from the pre-period to the post-period. This, taken with the results from the cross-listing sample, indicates that the liquidity of the cross-listing firms increased while the liquidity of a matched sample of equities did not change. In the next section, I discuss the impact that cross-listing had on the adverse selection component of the bid-ask spread.

VII. Adverse Selection:

I examine adverse selection cost changes around the cross-listing dates for the cross-listing firms and for a matched sample of control firms. To estimate the level of adverse selection, I employ the method of Lin, Sanger and Booth (1995), which decomposes the spread into adverse selection and order processing components. This methodology estimates the proportion of the effective spread that can be attributed to adverse selection. Similar to George, Kaul, and Nimalendran (1991), Lin, Sanger, and Booth (1995) assume

that the specialist's inventory holding costs are zero, but they allow for a persistence parameter that captures the probability of trade reversal. The intuition behind the model is that quotes are revised to reflect information contained in the previous transaction.

The adverse selection and persistence parameters are estimated from the following equations:

$$\begin{aligned} Q_{t+1} - Q_t &= \lambda Z_t + \varepsilon_{t+1} \\ Z_{t+1} &= \theta Z_t + \eta_{t+1} \\ Z_t &= P_t - Q_t \end{aligned}$$

where Q_t is the quote midpoint at time t , P_t is the transaction price at time t , ε_{t+1} and η_{t+1} are random error terms, and λ is the proportion of the effective spread that is attributed to adverse selection. Clark and Shastri (2003) and Van Ness, Van Ness, and Warr (2001) both find that the adverse selection estimates from the Lin, Sanger, and Booth model are highly correlated with the adverse selection cost estimates produced from other market microstructure spread decomposition models. Using these adverse selection cost estimates, I estimate the following model:

$$\text{LogAdverseRatio}_j = B_0 + B_1 \text{LogPriceRatio}_j + B_2 \text{LogVolumeRatio}_j + B_3 \text{LogStdDevRatio}_j + \varepsilon_j,$$

where LogAdverseRatio_j is the natural log of the ratio of the average adverse selection cost of the bid-ask spread in the post-period to the average adverse selection cost of the bid-ask spread in the pre-period for each firm j . The independent variables LogPriceRatio_j , LogStdDevRatio_j , and LogVolumeRatio_j represent the ratio of the average pre to post period price, return standard deviation, and daily volume for firm j ,

respectively. The pre-period is defined as the thirty days preceding the cross-listing of firm j on the Amex, and the post-period is the thirty days following the cross-listing of the firm j on the Amex.

(Table 2.e here)

The adverse selection model produced estimates ranging from zero to one for the 120 NASDAQ cross-listing firms over the entire sample period. The mean value of the adverse selection component estimate was 43%. The mean dollar spread adverse selection cost estimate was around one cent for the sample period.

Table 2.e contains the parameter estimates of the adverse selection model¹⁹. The intercept from the regression indicates that adverse selection costs do not change from pre-period to post-period. Adverse selection costs in the control sample increased by .038%, and are not significant at traditional significance levels. The results indicate that the adverse selection component of the bid-ask spread in the cross-listing shares did not increase due to informed trading costs. This result provides direct evidence that the ability of Amex member firms to delay execution had no impact on the perceived level of informed trading in the cross-listed firms.

VIII. Impact of UTP Trading:

The liquidity analysis indicates that the liquidity of the NASDAQ 100 increased from the pre-period to the post-period, while the liquidity of the matched sample remained

¹⁹ The adverse selection component estimates are constrained to a 0-1 interval.

unchanged. Furthermore, the adverse selection analysis suggests that the adverse selection component of the bid-ask spread of the cross-listing shares does not increase due to informed trading costs.

These findings suggest that order flow fragmentation has not increased the trading costs of the cross-listed equities. Furthermore, the ability of Amex floor brokers to delay execution had no impact on adverse selection component of the bid-ask spread. In this instance, UTP trading acted as a beneficial economic force that lead to a decrease in the underlying trading cost of the cross-listed securities.

IX. Conclusion:

Is exchange competition a beneficial force that decreases the monopoly rents that exchanges extract from market participants, or does exchange competition hamper order flow and decrease market transparency?

On August 12, 2002 the Amex began cross-trading NASDAQ registered securities. This event provides the opportunity to study the impact of cross-listing (exchange competition) on trading costs and liquidity. The results of an event study indicate that the cross-listing of the NASDAQ securities represents a value creating event. Cross-listing firms' abnormal returns are positive on the days when positive news is released regarding Amex UTP cross-listing. The price reactions can be explained by decreased trading costs decreasing the cost of equity capital, which allow firms to finance projects at lower costs

of capital. This results also indicate that investors perceive the benefits of exchange competition to exceed any cost associated cross-listing.

In addition to the event study, I use several measures of market liquidity to measure the impact of the entrance of the Amex into trading NASDAQ securities. Quoted spreads significantly decrease when they are cross-listed on the Amex, while there was no impact on effective spreads. Furthermore, the adverse selection component of the bid-ask spread does not significantly change over the cross-listing period.

In general, my findings suggest that exchange competition is perceived as a net positive benefit to the investing public. However, cross-listings should be supported by strong exchange linkages, which support market transparency. The results of this study indicate that the entrance of an exchange competitor resulted in a significant reduction in trading costs.

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Appendix 1

Table 2.a
Cross-Listing Dates

Date	Number of Firms Added
August 12 th , 2002	9
August 29 th , 2002	12
September 5 th , 2002	6
September 12 th , 2002	14
September 26 th , 2002	10
October 10 th , 2002	6
October 22 nd , 2002	2
October 24 th , 2002	15
October 31 st , 2002	12
November 7 th , 2002	14
November 15 th , 2002	10
November 21 st , 2002	10
Total	120

Table 2.b
Event Study

Date	Event Description	Day (0) AR	Day (-1,0) CAR	Sign test
December 17, 2001	Files With SEC	-0.006 (.131)	.0056 (.524)	.524 (.40)
August 2, 2002	Acceptance by SEC	0.030 (.734)	1.015 (.672)	.761*** (5.22)
August 12, 2002	Trading Begins	0.006 (.623)	-.0382* (-1.62)	.625** (2.4)
August 15, 2002	SEC Suspends Trading	-0.012 (.292)	.0032 (.421)	.321*** (-3.6)
August 23, 2002	SEC Rejects Suspension	0.039 (.679)	.0124 (0.05)	.882*** (7.6)
*** indicates significance 1% level				
** indicates Significance 5% level				
* indicates Significance 10% level				
t-statistic in parentheses				

Table 2.c
Matching Scores

		Mean	Median	Standard Deviation	Min	Max
Price	UTP	20.86	16.79	15.89	0.72	65.95
	Non-UTP	21.04	17.09	15.91	0.63	73.56
Std	UTP	0.049	0.044	0.022	0.016	0.130
	Non-UTP	0.049	0.044	0.023	0.019	0.157
Volume	UTP	5,237,199	2,558,667	8,424,255	288,369	59,444,221
	Non-UTP	4,835,896	2,339,169	9,013,898	296,683	88,704,786
Matching Score		0.073	0.0255	0.140	0.00054	1.00

Table 2.d
Univariate Spread, Depth, and Adverse Selection Cost Measures

S and P 500	Mean	Standard Deviation	Min	Max
LogQuotedRatio _j	-0.1513	0.5249	-1.9999	1.9686
LogEffectiveRatio _j	-0.0191	0.0981	-.71213	1.8032
LogDepthRatio _j	-0.0173	0.0541	-.89125	1.5915
LogPriceRatio _j	0.0568	0.2713	-0.6609	1.7160
LogStdDevRatio _j	-0.1336	0.3228	-1.0941	0.9436
LogVolumeRatio _j	-0.0218	0.3925	-2.5211	0.8436
LogLSBRatio	-.03751	.02681	-1.9843	.78623

Table 2.e
Spreads and Depth Measures

Panel A	<u>UTP Cross Listing Firms</u>		
	Quoted Spread	Effective Spread	Dollar Depth
Intercept	-.179** (-3.25)	-.0019 (.0366)	-0.0032 (-.10)
LogPriceRatio	.273 (1.63)	.176 (.974)	0.234 (1.59)
LogStdDevRatio	.251* (1.94)	.29687*** (2.74)	-0.441*** (-4.0)
LogVolumeRatio	-.223 (-1.10)	-.211 (-1.256)	0.684*** (7.25)
System R²	.091	.138	
Cross-Correlation (Error-term)	-.178	-.0724	
*** indicates significance 1% level			
** indicates Significance 5% level			
* indicates Significance 10% level			

Table 2.f
Spreads and Depth Measures Controls

Panel B	<u>Control Firms</u>		
	Quoted Spread	Effective Spread	Dollar Depth
Intercept	0.054 (.200)	0.007 (.811)	-0.031 (-.721)
LogPriceRatio	0.422*** (4.05)	0.405*** (5.10)	0.428*** (6.10)
LogStdDevRatio	0.216** (2.78)	0.213** (2.10)	-0.260*** (-3.96)
LogVolumeRatio	-0.068 (-.971)	0.0029 (.512)	0.384*** (3.79)
System R²	0.083	0.138	
Cross-Correlation (Error-term)	-0.209	-0.099	
*** indicates significance 1% level			
** indicates Significance 5% level			
* indicates Significance 10% level			

Table 2.g
Adverse Selection Model

	UTP Cross Listing Firms	Control Firms
	Averse Selection	Averse Selection
Intercept	-.0551 (-1.13)	0.038 (.691)
LogPriceRatio	.78 (.751)	0.493 (.892)
LogStdDevRatio	.56 (.348)	0.621 (1.19)
LogVolumeRatio	-.23 (-.320)	-0.38* (1.892)
Adj R²	.051	0.014
F-Test	2.51	1.55

Part 3: Adverse Selection and Exchange Traded Funds

I. Introduction:

The theoretical work of Gorton and Pennacchi (1993), Kumar and Seppi (1994) and Subrahmanyam (1991) predict lower adverse selection costs in basket securities relative to individual equities. In this study, I examine the adverse selection costs and liquidity of exchange traded funds (ETFs) using a matched sample of equity securities and equity ETFs. I also explore exchange traded funds specific factors that influence their liquidity and adverse selection costs. Several studies have examined adverse selection costs in closed end mutual funds (Chen, Jiang, Kim and McInish (2003), Clark and Shastri (2001), Neal and Wheatley (1998)), but none have examined these costs in exchange traded funds.

Exchange traded funds (ETFs) are structured differently from closed ends mutual funds. While many closed end mutual funds trade at a discount or premium to net asset value, exchange traded funds are easily created and redeemed. The ability to create and redeem ETFs reduces the difference between the price of the ETF and its net asset value. ETFs are excellent basket securities to use in an informed trading study because they do not suffer from large deviation from net asset value (NAV), and thus little uncertainty exists regarding their liquidation value.

The results of the analysis indicate that exchange traded funds have significantly lower effective and quoted spreads. Effective spreads are 6.6 cents lower, and quoted spreads are 13.16 cents lower. ETFs also have \$1,475,700 more quoted dollar depth than do the equities in the control sample. An extended liquidity analysis between ETFs and equity

securities indicates that sector concentrated ETFs, and ETFs that hold securities from the broad market, have significant lower quoted spreads and significantly higher quoted depth than do a matched sample of equities.

In general, baskets that hold international securities have the highest spreads, followed by equities, followed by sector ETFs, and broad based ETFs have the lowest spreads and highest quoted depth. I also find evidence that the number of securities that the ETF holds decreases the bid-ask spread. The results support the concentrated basket hypothesis, which conjectures that industry concentration results in reduced liquidity and higher adverse selection costs.

The remained of the work proceeds as follows: In section II, I discuss the history, trading mechanics, and general characteristic of exchange traded funds. Section III contains a review of theories of basket security trading and explores past studies that have examined informed trading in closed end mutual funds. Section IV contains the hypotheses development and in section V, I discuss the methods employed to test these hypotheses. In section VI, I discuss the results of the analysis. In the final section I conclude the work.

II. Exchange Traded Funds:

Exchange traded funds, or ETFs, are passively managed index funds that allow investors to trade a basket of securities in one transaction. ETFs trade intra-day and allow investors to earn returns that are very similar to those of an underlying index. The popularity of ETFs has steadily increased since their introduction in the early 1990s.

As of June 2004 there are over 150 ETFs listed on the American Stock Exchange, and the Financial Research Corporation predicts that total assets held by ETFs will reach anywhere between \$500 billion to \$1 trillion by the year 2007. In 2002 the QQQ had the second highest volume on the AMEX, NASDAQ, NYSE or regional exchanges, while the SPDR ranked ninth.

ETFs are lauded for their continuous trading during exchange hours, low premium/discounts, tax efficiency, diversification benefits, and transparency. Unlike open-ended mutual funds, which are priced at the end of the day, ETFs trade continuously throughout the day. Because of the ability to create and redeem ETFs, their price tends to approximate the net asset value (NAV) of the index²⁰. For instance, since its inception, the average deviation of the Standard and Poor Depository Receipt's (SPDR) price from its NAV has been only .0006%²¹. The deviation has been .0004% for the DIA and .0006% for the QQQ. The deviation of exchange traded funds is much smaller than those found in closed end mutual funds. The average discount of all closed-end mutual fund on June 30, 2001 was 4.8% and the average discount on equity closed-end funds was 11.1%. Annual expense ratios of exchange traded funds are often lower than those of mutual funds, because of decreased costs associated with marketing and distribution. Index ETFs are passively managed and, on average, produce lower levels of capital gains than would be produced by an actively managed fund.

²⁰ See Small (2003) for an empirical analysis of determinants of the price deviations in exchange traded funds.

²¹ This figure was calculated using market close net asset values and prices (See Small (2003)).

The first U.S. exchange-traded fund²², was created as a result of action taken by Leland, O'Brien, Rubenstein Associates, who lobbied the SEC for the creation of an SandP 500 tracking instrument named the Index Trust SuperUnit. The original SuperTrust was terminated in 1996, but The American Stock Exchange (Amex) took advantage of the SuperTrust Order to petition for, and receive, an SEC Order in 1992 to create a stand-alone SandP 500 Index-based ETF as a unit investment trust. This unit is commonly known as the Standard and Poor Depository Receipt, or SPDR (Novakoff 2000). Some of the most popular ETFs include the Dow Jones Industrial Average (Diamonds, DIA), and the NASDAQ 100 index (Qubes, QQQ).

There are three principal legal structures of index exchange traded funds²³. First, ETFs can take the form of exchange traded open-ended index mutual funds (OETFs). OETFs are allowed to use derivatives and can make loans to produce income. This form of ETF is registered under the Securities and Exchange Commission's Investment Company Act of 1940. Dividends are paid quarterly in cash and are reinvested in the fund until distribution to investors. Examples include iShares and Sector Select SPDRs. The second form of ETF, is the exchange-traded unit investment trust (UETFs). UETFs are also registered under the Securities and Exchange Commission's Investment Company Act of 1940. Dividends are not reinvested in the fund and are paid quarterly in cash disbursements. Examples of this form include Diamonds, SPDRs, and Qubes. The third form is the exchange-traded grantor trust. ETFs of this form are not required to register under the Securities and Exchange Commission's Investment Company Act of 1940.

²² Exchange traded funds began in Canada. The first fund was listed on the Toronto Stock Exchange in 1989.

²³ This and other information about ETFs can be found at Etfconnect.com.

Owners of these ETFs are granted the voting rights of the underlying shares. Dividends are not reinvested in the index and are distributed to shareholders quarterly. An example of this form is the HOLDR funds.

An ETF is created when an investor deposits securities and a creation unit is issued. This process of creation and redemption works to limit the deviation of ETF price from the ETFs net asset value. The average creation unit multiple is 50,000, and share creation units range from 25,000 to 600,000 (AMEX 2002).

Recent exchange traded funds related research has included work by Boehmer and Boehmer (2003), who study the effects on thirty exchange traded funds as they were cross listed on the NYSE. Elton, Gruber, Comer, and Li (2002) examine deviations in the SPDRs returns from the returns of an index fund. Hasbrouck (2000) studies price discovery in the SPDR as well as several sector exchange traded funds. Hedge and McDermott (2004) examine the liquidity of the component stocks of the NASDAQ 100 and the Dow Diamonds upon their introduction. Lipson and Mortal (2003) study the impact of SPDRs on the underlying securities. Poterba and Shoven (2002) examine the tax effects of exchange traded funds. Small (2003) examines the deviations in the prices of ETF prices from their net asset values. Van Ness, Van Ness, and Warr (2003) also study the impact of the introduction of the Dow Diamonds on the market quality of the underlying securities.

III. Literature Review:

IIIa. Theory:

Theoretical models predict that traders of ETFs will incur lower adverse selection costs relative to trading in equities. Subrahmanyam (1991) provides a model that demonstrates how markets in basket securities can provide a preferred trading medium for uninformed liquidity traders. A positive benefit accrues to uninformed liquidity traders because security-specific components of adverse selection tend to be diversified away in basket securities. Consequently, market makers are exposed to lower levels of informed trading and as a result, adverse selection is decreased in basket securities. Subrahmanyam's theory holds that liquidity traders are allowed to realize their trades more efficiently by trading in basket securities because their losses to informed trading are reduced.

Research by Gorton and Pennacchi (1993) also examines liquidity trading and informed agents. They present a model where liquidity traders form initial portfolios with knowledge of their future participation in markets where informed traders are present. The presence of the informed traders places the liquidity trader at a disadvantage, and the liquidity traders' utilities are increased with the introduction of baskets securities. Liquidity traders can effectively reduce their expected losses of trading with informed agents if they choose to trade in basket securities.

The models of Subrahmanyam (1991) and Gorton and Pennacchi (1993) posit reduced levels of adverse selection costs in exchange traded funds. Below I review the empirical evidence produced by mutual funds studies.

IIIb. Evidence:

The empirical evidence regarding adverse selection costs in basket securities has been mixed. Neal and Wheatley (1998) estimate the adverse selection component of the bid-ask spread for 17 mutual funds and a control sample of 17 common stocks. Estimates from the Glosten and Harris (1988) model average 19% for the funds and 34% for the control stocks. Neal and Wheatley find that estimates from the George, Kaul, and Nimalendran (1991) model average 52% and 65%, for funds and control stocks. The small difference between estimates of the adverse selection component of the spread for equities and closed end mutual funds presents a problem for Neal and Wheatley. They state: “Adverse selection arises primarily from factors *other* than a firm’s current liquidation value.”(p.123) They also suggest that the adverse selection spread decomposition models that they employ may be mis-specified. Later, I argue that this finding is not puzzling and can be explained by common factors in the portfolio of underlying securities. Work by Chen et al. (2002) finds evidence of decreased levels of adverse selection in closed-end mutual funds. Using a sample of funds listed on the NYSE between 1994 and 1999, they find adverse selection costs to be significantly lower for the closed end mutual funds than for the control sample of equities. Clark and Shastri (2001) examine the effects of ownership structure, the expense ratio²⁴, portfolio turnover, and discount to net asset value on information asymmetry in closed-end mutual funds. They find block ownership significantly impacts adverse selection costs in closed end mutual funds, while the other factors are not significant. They also find that adverse selection costs of these funds are, on average, fifty percent lower than those in a matched set of equities.

²⁴ The expense ratio represents the ratio of a fund's expenses to its assets.

While it has generally been accepted that the adverse selection costs of basket securities are lower than those of individual equities, previous research has provided conflicting evidence. The next section develops the hypotheses that are tested in this work, and explains how these hypotheses extend prior works on adverse selection and basket securities.

IV. Hypothesis Development:

The theoretical predictions of Gorton and Pennacchi (1993), Kumar and Seppi (1994) and Subrahmanyam (1991) suggest that adverse selection costs of basket securities are lower than those in a matched sample of equities. These theoretical predictions and evidence from previous works lead to the first two hypotheses:

Ho (1): Adverse selection costs the same in basket securities (ETFs) as in a matched sample of equities.

Ho (2): The liquidity of basket securities (ETFs) is the same as that of a matched sample of equities (e.g. lower bid-ask spreads and higher quoted depth)

One factor of particular interest is the migration of informed trading to sector-specific exchange-traded funds. Informed traders, who possess firm-specific material nonpublic information, may choose to migrate from individual securities to industry specific baskets, because the return characteristics of the basket are likely to be similar to those of

the individual security and may allow trading on information without detection²⁵. This would provide informed traders a preferred venue for trading on material non-public information. Also as a result of possible legal scrutiny of trading the underlying equities, informed agents may prefer to trade in assets that mask their intentions. Furthermore, they may choose to trade in securities that have the lowest probability of revealing the non-public information. This conjecture leads to the third, and fourth hypothesis

Ho (3): Industry concentrated basket securities do not exhibit higher costs associated with informed trading than baskets of broad market securities.

Ho (4): Industry concentrated basket securities are no less liquid than baskets of broad market securities. (e.g. higher bid-ask spreads and lower quoted depth)

As the number of securities that a security basket holds increases, the costs associated with adverse selection should be diversified away. However, on the other hand, the costs associated with reconstitution increases. This cost could result in a divergence of the price of the ETF and its underlying basket's NAV. These possibilities lead to the fifth and sixth hypothesis:

Ho (5): Trading costs associated with informed trading do change as the number of securities that a basket securities holds increases.

²⁵ For example, suppose there exists a "basket security" that is focused in the pharmaceutical industry. Informed traders with firm level information from this industry may prefer to trade in the "basket security" to avoid detection of the SEC. Industry focused baskets are likely to exhibit return characteristics that are similar to those of the underlying securities. The return characteristics of ETFs and underlying securities may become even more correlated with certain security selection methods used by ETFs.

Ho (6): *The liquidity of the basket securities does not change as the number of securities the basket holds increases.*

Furthermore, as the industry concentration of a basket security increases informed agents propensity to trade in that basket should also increase. This leads to the final two hypotheses:

Ho (7): *Trading costs associated with informed trading leads to no significant change as the securities in the basket are diversified.*

V. Method:

Va. Adverse Selection:

Kyle (1985) suggests market makers increase the bid-ask spread when trading with informed agents. In practice, market makers are exposed to two types of informed trading in the securities market. First, they are exposed to trading on firm specific information. Second, they are exposed to trading by market participants who possess knowledge regarding impending order flow²⁶. If an informed agent trades on either type of information, the market maker is forced to match the order at an inferior price. The prevailing price is inferior because it does not reflect the information that is known by the informed agent and unknown to the market maker.

²⁶An example is front running by a trading firm.

To estimate the level of adverse selection, I employ two spread decomposition methodologies, and one alternative measure that uses order arrival rates to calculate the probability of informationally generated trading.

First, I follow the method of Lin, Sanger and Booth (1995), which decomposes the bid-ask spread into order processing and adverse selection components. Second, I employ a variant of the decomposition method of George, Kaul, and Nimalendran (1991), which also decomposes the spread into adverse selection and order processing components. The third method is an alternative measure of adverse selection, which is developed in Easley, Kiefer, O'Hara and Paperman (1996). This model uses order arrival rates to calculate the probability of informed trading. Each method is discussed in more detail below.

The Lin, Sanger and Booth (1995) adverse selection and persistence parameters are estimated from the following equations:

$$\begin{aligned} Q_{t+1} - Q_t &= \lambda Z_t + \varepsilon_{t+1} \\ Z_{t+1} &= \theta Z_t + \eta_{t+1} \\ Z_t &= P_t - Q_t \end{aligned}$$

where Q_t is the quote midpoint at time t , P_t is the transaction price at time t , ε_{t+1} and η_{t+1} are random error terms, and λ is the proportion of the effective spread that is attributed to adverse selection. Clark and Shastri (2001) and Van Ness, Van Ness, and Warr (2001) find that the adverse selection estimates from the Lin, Sanger, and Booth model are highly correlated with the adverse selection cost estimates produced from other market microstructure spread decomposition models.

George, Kaul, and Nimalendran (1991) (GKN) define transactions returns as:

$$R_t = E_t + \pi \left(\frac{S_q}{2} \right) (Q_t - Q_{t-1}) + (1 - \pi) \left(\frac{S_q}{2} \right) Q_t + U_t,$$

The GKN's methodology estimates the realized spread S_{Bi} as:

$$S_{Bi} = 2\sqrt{-Cov(RD_{Bi,t}, RD_{Bi,t-1})}.$$

where $RD_{Bi,t}$ is defined as the difference between transaction returns $R_{Ti,t}$ and returns based on unobservable true prices $R_{mi,t}$ for security i at time t . GKN suggest that the bid price subsequent to a transaction should be used as the unobservable true price. The GKN technique overcomes the assumption of price independence but their process for decomposing the bid-ask spread is based on two key assumptions. They assume that the sequence of buys and sell order are serially uncorrelated, and they assume that the quoted spread is constant across transactions. Kim and Ogden (1996) provide evidence that the GKN estimates of the adverse selection and order processing costs are biased. Another criticism of the GKN model is that it assumes a constant spread for each security. Alford and Jones (1996) implement a variant of the model that allows the quoted spread to vary with each observation. They specify the model as:

$$\Delta R_{it}^D = \pi_0 + \pi_1 (S_{it} / 2) (Q_t - Q_{t-1})$$

where $\Delta R_{it}^D = R_{it}^D - R_{it(t-1)}^D$ and $R_{it}^D = R_{it}^T - R_{it}^Q$. Q_t takes the value of one when the transaction is a purchase and -1 when the transaction is a sale. R_{it}^T is the return for stock i at time t based on the vector of prices, and R_{it}^Q is the return for security i at time t derived from the vector of quoted mid-points. π_1 represents the order processing component of the bid-ask spread, and $(1 - \pi_1)$ is the adverse selection component of the bid-ask spread.

Easley, Kiefer, O'Hara, and Paperman (1996) derive a model that provides an estimate of the level of informed trading. The model derives estimates of the probability of informationally driven trading, and can be estimated using only daily number of buys (B) and sells (S). Under the assumptions of the model, good news arrives with probability $1 - \delta$ and bad news arrives with probability δ . News arrives on informative days, which are assumed to occur with probability α , with nature determining their occurrence. μ is the arrival rate of trades that can distinguish between good news and bad news days, and ε signifies the arrival rate of trades that cannot distinguish between good and bad new days. The probability of observing B and S on a day of length t is:

$$L(B, S | \theta) = (1 - \alpha) * e^{-\varepsilon t} \frac{(\varepsilon t)^B}{B!} \frac{(\varepsilon t)^S}{S!} + \alpha \delta * e^{-\varepsilon t} \frac{(\varepsilon t)^B}{B!} e^{-(u + \varepsilon)T} \frac{[(u + \varepsilon)T]^S}{S!} \\ + \alpha (1 - \delta) * e^{-(u + \varepsilon)T} \frac{[(u + \varepsilon)T]^B}{B!} e^{-\varepsilon t} \frac{(\varepsilon t)^S}{S!}$$

If the series is independent, the likelihood of the observed values over I days is the product of the likelihoods:

$$L(M | \theta) = \prod_{i=1}^I L(\theta | B_i, S_i)$$

The probability of informed trading (PIN) given by the expression:

$$PIN = \frac{\alpha v}{\alpha u + 2\varepsilon}$$

Vb. Data:

All transactions data are collected from The New York Stock Exchange Trade and Quote (TAQ) database, and are filtered using methods similar to those used in and Lipson and Mortal (2003). I exclude the following data points:

- Non-positive prices and quotes
- All quotes with a time stamp before 9:30am or after 4:00pm
- Quoted with zero sizes bid or offer sizes
- Trading prices and midpoint greater than 50% over their previous level

Buys and sells are classified using the methodology of Lee and Ready (1990). I excluded Bond ETF's spreads because they are unlikely to exhibit characteristics that are indicative of those of equity funds. Data are collected for all trading days in 2003. Spreads, adverse selection cost estimates, and control variables are averaged over the examination period, which produces one observation for each exchange trades fund variable. Price, volume, and return data are collected from Center for Research in Security Prices (CRSP) database. Classification for industry, broad market, and international ETFs are taken from the American Stock Exchange's website, and ETF security holding information is obtained from Morningstar.

Vc. Matching Methodology:

To examine the levels of adverse selection between equities and ETFs, I develop a matching sample of equity securities. The matching method is similar²⁷ to the one imposed in Clarke and Shastri (2001) and in Huang and Stoll (1996). However, I match

²⁷ Unlike Clarke and Shastri (2001), I do not match on market capitalization, because the market capitalization of ETFs and the market capitalization of equities do not capture the same factor.

on price, volume and return volatility. First, available matching equities are identified from TAQ, and volume, return, and price data are obtained from CRSP.

The data are averaged daily over all trading days in 2003, and the equity security that minimizes the following objective is selected as the matching equity:

$$\text{Matching Score} = \left(\frac{\text{Price}_i^{\text{non-etf}} - \text{Price}_i^{\text{etf}}}{\frac{\text{Price}_i^{\text{non-etf}} + \text{Price}_i^{\text{etf}}}{2}} \right)^2 + \left(\frac{\text{Volume}_i^{\text{non-etf}} - \text{Volume}_i^{\text{etf}}}{\frac{\text{Volume}_i^{\text{non-etf}} + \text{Volume}_i^{\text{etf}}}{2}} \right)^2 + \left(\frac{\text{STD}_i^{\text{non-etf}} - \text{STD}_i^{\text{etf}}}{\frac{\text{STD}_i^{\text{non-etf}} + \text{STD}_i^{\text{etf}}}{2}} \right)^2$$

(Table 3.a here)

Price is the end of day price of the security averaged over the year, *STD* is the daily standard deviation of daily returns estimated over the year, and *Volume*²⁸ is the daily volume of security averaged daily over the year. This process provides one matched security to each ETF.

The values obtained from the matching process are presented in table 3.a. The average price of the ETFs is \$48.15 and the average price of the matching securities is \$40.18. The mean daily return standard deviation of the ETFs is 1.30% and the mean daily return standard deviation for the matched sample is 1.645%. The average volume for the ETFs was 1,455,758 shares and the average volume of the matched sample was 1,050,153. The average matching score of .5361 suggests that the firms included in the two samples are similar along the pre-specified attributes. For example, Van Ness, Van Ness, and Warr

²⁸ NASDAQ volume is adjusted to sixty percent of its original amount to facilitate matching across exchanges. Volume in dealer markets is overstated because of inter-dealer trading. (see Anderson and Dyl (2003)).

(2003) set a cut of score for values of this measure at 2. The matched portfolio acts as a benchmark for drawing conclusions regarding spread and adverse selection costs in the cross-security analysis.

I also create a second sample of matching firms through a random selection process. First, I delete all firms listed in the CRSP database that have reported returns on fewer than 240 days for 2003. I further restrict the sample to firms listed on the NYSE and AMEX, the primary exchanges where ETFs trade. Including only firms listed on these two exchanges should control for any exchange effects associated with spreads and depth quotation. This reduction procedure reduces the universe of matching securities to 4006 firms. Every thirty-sixth firm is chosen as the matching firm, which results in 111 controls firms, each of which is matched to an ETF. I estimate of the following liquidity analysis using both samples, and the results for the random sample are presented in Appendix.

VI. Liquidity Analysis:

After selecting the matching firms, estimates of the bid ask spread and a dollar depth measurement are employed in the analysis. The first measure, the quoted spread, is calculated as $QS_t = Ask_t - Bid_t$, where Ask_t is the ask price at time t and Bid_t is the bid at time t . This measure of the spread does not consider trades that take place inside the best bid-best offer quote. Lee (1993), Huang and Stoll (1996) suggest the use of the effective spread, which is calculated as $ES = 2|p_t - MP_t|$, where p_t is the price at time t , and MP_t is the quote midpoint at time t . I also estimate dollar depth, which is the sum of the depth

at the bid and ask prices, and represents the number of shares multiplied times the prevailing price. All three measures are used in the estimation of the first liquidity specification. The model is estimated as:

$$Liquidity_i = \alpha_i + \beta_1 Price_i + \beta_2 SD_i + \beta_3 Vol_i + \beta_4 ETF_i + e_i .$$

Where $Liquidity_i$ takes the value of the quoted spread, the effective spread, and dollar depth for each firm i . $Price$ is the end of day price of the security averaged over the year, SD is the daily standard deviation of daily returns estimated over the year, Vol is the daily volume of security averaged daily over the year, and ETF is a binary variable that takes the value of unity when the security is an exchange traded fund.

(Table 3.b and 3.c here)

The results of the liquidity analysis can be found in table 3.c. The binary variables ETF is negative and significant in the quoted spread regression. Quoted spreads are 9 cents lower than those in a matched sample of equities, while controlling for price, volume and standard deviation. The coefficient estimate on ETF in the effective spread regression indicates that effective spreads are 1 cent lower in exchange traded funds, however, this value is not statistically significant. The ETF coefficient estimate in the dollar depth specification indicated that ETFs have \$1,475,700 more dollar depth than do a matched sample of equities. The positive and significant coefficient estimate on the ETF binary variable in the dollar depth specification and the negative and significant coefficient

estimate on *ETF* in the quoted spread analysis suggest that exchange traded funds exhibit higher levels of liquidity than a matched sample of equities.

I extend the previous model to allow for industry concentration effects to measure further the spread differential between exchange traded funds and equities. This model estimation allows an examination of the relationship between industry concentration and security liquidity. I estimate the following OLS model:

$$Liquidity_i = \alpha_i + \beta_1 Price_i + \beta_2 SD_i + \beta_3 Vol_i + \beta_4 International_i + \beta_5 Sector_i + \beta_6 Broad_i + e_i$$

Where *Liquidity* takes the value of the quoted spread, the effective spread, and dollar depth for each firm *i*. *Price* is the end of day price of the security averaged over the year, *SD* is the daily standard deviation of daily returns estimated over the year, *Vol* is the daily volume of security averaged daily over the year, *International* is a binary variable that takes the value of one when the ETF primarily holds non-U.S. denominated securities, *Sector* is a binary variable that takes the value of one when the ETF primarily holds securities in the same industry sector, *Broad* is a binary variable that takes the value of one when the ETF primarily holds securities from many diverse industry groups, and *Equity* is a binary variable that takes the value of one when the security is an equity securities.

The results of the analysis can be found in table 3.d. As expected, industry concentration has a significant impact on basket security liquidity. The quoted spread analysis

indicates that internationally concentrated baskets have higher quoted spreads than do equities, while sector and broad market baskets both have lower quoted spreads. But broad market baskets have the lowest quoted spreads in the group. This result is consistent with the concentration hypothesis, because the concentration hypothesis suggests that as industry basket concentration the liquidity of the basket decreases. The coefficient estimate on *sector* suggests that sector concentrated ETFs have quoted spreads that are, on average, 11.56 cents lower than those in a matched sample of equities. The coefficient estimate on *broad* indicates that broad market ETFs have, on average, quoted spreads which are 18.47 cents lower than those of a matched sample of equities. Further, the parameter estimates on these variables in the dollar depth specification, indicate that sector ETFs have \$1,653,800 more dollar depth and broad market ETFs have \$2,793,500 more dollar depth than the matched sample of equities. Again, both results support the concentration hypothesis.

(Table 3.d here)

To explore further the relationship between ETF concentration and adverse selection costs, I estimate the adverse selection components of the bid-ask spread for each exchange traded fund and security using the Lin, Sanger, and Booth (1995) and a variant of the George, Kaul, and Nimalendran (1991) decomposition methods, and I also derive estimates for the Easley, Kiefer, O'Hara, and Paperman (1996) model. The following OLS specification is estimated for the ETFs and the matched sample of equities:

$$Adverse\ Selection_i = \alpha_i + \beta_1 Price_i + \beta_2 SD_i + \beta_3 Vol_i + \beta_4 ETF_i + e_i$$

Where *Price* is the end of day price of the security averaged over the year, *SD* is the daily standard deviation of daily returns estimated over the year, *Vol* is the daily volume of security averaged daily over the year, and *ETF* is a binary variable that takes the value of unity when the security is an exchange traded fund. The dependent variable *Adverse selection* takes the value of the three adverse selection/informed trading models (Lin, Sanger, and Booth (1995), George, Kaul, and Nimalendran (1991), and Easley, Kiefer, O'Hara, and Paperman (1996)).

(Table 3.e here)

The results of the adverse selection estimation are shown in Table 3.e. In the Lin, Sanger, and Booth and in the Alford and Jones (1996) variant of George, Kaul and Nimalendran (1991) the coefficient estimate on ETF is negative and significant, but the coefficient estimate in the Easley et al. specification is not significant. However, a single binary variable specification does not capture the dynamics of the concentration hypothesis. Again, I extend the single binary model to allow for industry concentration effects to measure further the adverse selection cost differential between exchange traded funds and equities. The estimated model is:

$$Adverse\ Selection_i = \alpha_i + \beta_1 Price_i + \beta_2 SD_i + \beta_3 Vol_i + \beta_4 International_i + \beta_5 Sector_i + \beta_6 Broad_i + e_i$$

Where *Price* is the end of day price of the security averaged over the year, *SD* is the daily standard deviation of daily returns estimated over the year, *Vol* is the daily volume of security averaged daily over the year, *International* is a binary variable that takes the value of one when the security primarily holds non-U.S. denominated securities, *Sector* is a binary variable that takes the value of one when the ETF primarily holds securities in the same industry sector, *Broad* is a binary variable that takes the value of one when the ETF primarily holds securities from many diverse industry groups, and *Equity* is a binary variable that takes the value of one when the security is an equity. The dependent variable *AS* takes the value of the three adverse selection/informed trading models (Lin, Sanger, and Booth (1995), a variant of George, Kaul, and Nimalendran (1991), and Easley, Kiefer, O'Hara, and Paperman (1996)).

(Table 3.f here)

The industry concentration adverse selection model estimates are included in table 3.f. The Lin, Sanger, Booth coefficient estimates on *Sector* are negative and significant, and the coefficient estimate on *Broad* is also negative and significant. The coefficient estimates suggest that, on average, sector ETFs adverse selection costs are 1.77 cents less and broad market ETFs are 2.56 cents less than a matched sample of equity securities. The estimates of the Easley, Kiefer, O'Hara, and Paperman (1996) suggest that international ETFs have significantly higher levels of informed trading, while broad market ETFs have significantly lower levels of informed trading than a matched set of equities. The results suggest that international concentrated basket securities have the

highest adverse selection costs, followed by equities, followed by sector concentrated baskets, which are followed by broad market baskets. These results support the concentration hypothesis, with the exception of the international baskets. Because of the information asymmetry that exists across national borders, the securities that these baskets hold exhibit larger adverse selection costs than do the equities in the control sample, even after the diversification benefits are taken into account. However, the concentration hypothesis works quite well explaining the adverse selection costs in the domestic securities.

The second section of this work contains estimates from an intra-exchange traded fund examination of liquidity and adverse selection. The models in this section are constructed to capture factors that contribute to exchange traded fund's liquidity and adverse selections costs. The first model that is estimated is the basic liquidity model, and it takes the following form:

$$Liquidity_i = \alpha_i + \beta_1 Price_i + \beta_2 SD_i + \beta_3 Vol_i + \beta_4 International_i + \beta_5 Number_i + \beta_6 Herfindahl_i + \beta_7 Sector_i + e_i$$

Liquidity takes the value of the quoted spread, the effective spread, and dollar depth for each firm *i* averaged for every observation over 2003. *Price* is the end of day price of the security averaged over the year, *SD* is the daily standard deviation of daily returns estimated over the year, *Vol* is the daily volume of security averaged daily over the year, *International* is a binary variable that takes the value of unity when the exchange traded fund holds primarily non-U.S. securities, *Sector* is a binary variable that takes the value of unity when the exchange traded fund is a sector/industry fund, *Number* is the number

of securities that the ETF holds in its portfolio, and *Herfindahl* is a concentration measure of the top five holding of the ETF.

(Table 3.g)

The results of the ETF liquidity analysis are presented in table 3.g. *Broad* is the reference group for the binary variables *International* and *Sector*. The coefficient estimates on *International*, in the quoted spread specification, indicates that while controlling for volume, price, and standard deviation exchange traded funds that hold international securities have quoted spreads that are 8.5 cents higher, on average, than ETFs that hold broad market securities. The quoted spread analysis indicated no significant difference between the quoted spreads of *Sector* ETFs and *Broad* market ETFs. The effective spread analysis indicates that as the number of securities increases the effective spread decreases. Further more, in the dollar depth analysis, the dollar depth of ETFs that hold international securities is \$2,306,800 dollars less than those that hold broad market securities. These results further provide evidence that concentration influences the liquidity of basket securities.

The second model is the adverse selection model, and it takes the following form²⁹

²⁹ To test for non-linearity in the relationship between the number of securities a basket security holds and adverse selection costs, the model is also estimated including a variable that measures the number of securities squared. However, the results of the analysis do not quantitatively differ from those presented here.

$$Adverse\ Selection_i = \alpha_i + \beta_1 Price_i + \beta_2 SD_i + \beta_3 Vol_i + \beta_4 International_i \\ + \beta_5 Number_i + \beta_6 Herfindahl_i + \beta_7 Sector_i + e_i$$

The dependent variable *Adverse Selection* takes the value of the three adverse selection/informed trading models (Lin, Sanger, and Booth (1995), George, Kaul, and Nimalendran (1991), and Easley, Kiefer, O'Hara, and Paperman (1996)). *Price* is the end of day price of the security averaged over the year, *SD* is the daily standard deviation of daily returns estimated over the year, *Vol* is the daily volume of security averaged daily over the year, *International* is a binary variable that takes the value of unity when the exchange traded fund holds a significant portion of non-U.S. securities, *Sector* is a binary variable that takes the value of unity when the exchange traded fund is a sector/industry fund, *Number* is the number of securities that the ETF holds in its portfolio, and *Herfindahl* is a concentration measure of the top five holding of the ETF. The intra-exchange traded fund adverse selection costs analysis suggests that foreign and sector ETFs, on average, exhibit higher adverse selection costs than do ETFs that wide spectrum of securities from many industries. The intra-exchange traded fund liquidity analysis suggest that ETFs hold international securities, on average, exhibit larger spreads and less depth than do ETFs that wide spectrum of securities from many industries.

(Table 3.h)

Table 3.h contain the estimates from the intra-ETF adverse selection analysis. The coefficient estimate on *International* in the Lin, Sanger, and Booth estimation indicates that exchange traded funds that hold international securities have, on average, adverse

selection costs that are 2.53 cents higher than ETFs that hold broad market securities. The coefficient estimate on *Sector* indicates that ETFs that hold securities concentrated in one industry also have significantly higher adverse selection costs than do ETFs that hold securities from many industries. Estimates from the Easley, Kiefer, O'Hara, and Paperman (1996) specification suggest that foreign securities exhibit increases informed trading cost. The intra-exchange traded fund adverse selection costs analysis suggests that foreign and sector ETFs, on average, exhibit higher adverse selection costs than do ETFs that contain a wide spectrum of securities from many industries. Again, these results support the concentration hypothesis.

VII. Conclusion:

This essay examines adverse selection costs and liquidity of exchange traded funds (ETFs) using a matched sample of equity securities and equity ETFs, and also explores exchange traded funds specific factors that influence their liquidity and adverse selection costs.

The results of the analysis indicate that exchange traded funds have significantly lower effective and quoted spreads than a matched sample of equities. Effective spreads are 6.6 cents lower, and quoted spreads are 13.16 cents lower than the sample of equities. ETFs also have \$1,475,700 more quoted dollar depth than do the equities in the control sample. An extended liquidity analysis between ETFs and equity securities indicates that sector concentrated ETFs and ETFs that hold securities from the broad market have significant lower quoted spreads and significantly higher quoted depth than do a matched sample of equities.

In general international baskets have the highest spreads, followed by equities, followed by sector ETFs, and broad based ETFs have the lowest spreads and highest quoted depth. I also find some support that the number of securities that the ETF holds decreases the bid-ask spread. The results support the concentrated basket hypothesis, which conjectures that industry concentration results in reduced liquidity and higher adverse selection costs.

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Appendix 2

Table 3.a
ETF Matching Scores

		Mean	Median	Standard Deviation	Min	Max
Price	ETF	48.1581	42.32	32.3625	2.58	132.96
	Non-ETF	40.1842	31.25	44.1634	3.14	384.28
Volume	ETF	1,455,758	85,392	8,362,245	2,662	77,513,826
	Non-ETF	1,050,153	70,871	5,750,729	3,097	58,394,344
STD	ETF	.01317	.0011	.0038	.007	.0034
	Non-ETF	.01645	.0157	.0053	.004	.0268
Matching Score		.5361	.1759	.658	.0067	2.10

Table 3.b
Exchange Traded Fund Univariate Characteristics

ETFs	Mean	Standard Deviation	Max	Min
Quoted Spreads	.224	.144	.782	.017
Effective Spreads	.177	.111	.540	.023
Depth	2,160,100	2,087,584	12,209,540	58,834
Number	260	473	2891	11
Foreign	.231	.423	1	0
Sector	.490	.502	1	0
Broad	.277	.449	1	0
LSB	3.2	.132	1	0
GKN	12.4	.02	1	0
Easley et al.	.122	.076	.465	0

Table 3.c
Exchange Traded Fund and Equity Spread Analysis

	Spreads and Depth		
	Quoted Spread	Effective Spread	Dollar Depth
Intercept	.1316** (2.20)	.0663** (2.037)	1,535,400** (1.95)
Price	.0003*** (9.20)	.002*** (10.36)	933,400* (1.65)
SD	2.67 (.87)	.696 (.418)	-96,370,700** (-2.49)
Volume	-4.16E-08*** (-4.25)	-2.43E-08*** (-4.56)	-.04 (-1.47)
ETF	-.09*** (-3.12)	-.011408 (-.72)	1,475,700*** (3.669)
Adjusted R²	.3508	.4029	.2538
F Value	27.97***	34.93***	17.06***

t-statistic in Parentheses
* indicates Significance 10% level
** indicates Significance 5% level
*** indicates significance 1% level

Table 3.d
Exchange Traded Fund and Equity Spread Extended Analysis

	Spreads and Depth		
	Quoted Spread	Effective Spread	Dollar Depth
Intercept	.12** (2.21)	.068** (2.077)	1,538,600** (2.027)
Price	.003*** (10.41)	.0021*** (10.16)	393,400 (.9719)
SD	1.85 (.622)	.4623 (.27411)	-83,954,800** (-2.14)
Volume	-4.18e-08*** (-4.43)	-2.45e-08*** (-4.57)	-.038 (-1.34)
International	.043882 (1.00)	.0205 (.828)	-18,500 (-.07)
Sector	-.1156*** (-3.50)	.015482 (.4153)	1,653,800*** (4.407)
Broad	-.1847*** (-4.2)	-.008250 (-.7411)	2,793,500*** (4.155)
Adjusted R²	.403	.4060	.338
F Value	23.149***	23.35***	17.4533***

t-statistic in Parentheses
* indicates Significance 10% level
** indicates Significance 5% level
*** indicates significance 1% level

Table 3.e
Exchange Traded Fund and Equity Adverse Selection Analysis

	Adverse Selection Analysis		
	Lin, Sanger, and Booth	GKN-Alford and Jones	Easley et al.
Intercept	.046*** (4.889)	.102 (1.55)	.0969*** (4.7518)
Price	8.31E-05 (1.415)	.002*** (3.16)	2.39E-05 (.225)
SD	-.1966 (-.40)	2.77 (.971)	.690 (.721)
Volume	-4.44E-09*** (2.855)	-3.12e-08*** (-3.90)	7.79E-09*** (2.77)
ETF	-.01644*** (-3.5755)	-.084*** (-3.22)	.0002 (.8231)
Adjusted R²	.077	.270	.025
F Value	5.40***	19.23***	1.29

t-statistic in Parentheses
** indicates Significance 10% level*
*** indicates Significance 5% level*
**** indicates significance 1% level*

Table 3.f
Exchange Traded Fund and Equity Adverse Selection Extended Analysis

	Adverse Selection Costs		
	Lin, Sanger, and Booth	GKN-Alford and Jones	Easley et al.
Intercept	.0451*** (4.89)	.097 (1.59)	.090567*** (4.56)
Price	.00012* (2.00)	.002*** (4.06)	.00011 (1.29)
SD	-.2848 (-.584)	2.33 (.812)	.5851 (.5914)
Volume	-4.46e-09*** (-2.892)	-3.13e-08*** (-3.80)	7.80e-09*** (2.788)
International	.00559 (.78)	.029389 (.610)	.0347* (1.656)
Sector	-.0177*** (-3.29)	-.1109*** (4.365)	-.006528 (-.583)
Broad	-.025648*** (-3.56)	-.1514*** (4.288)	-.01432* (-1.94)
Adjusted R²	.116	.320	.054
F Value	4.4883***	16.18***	1.26

t-statistic in Parentheses
* indicates Significance 10% level
** indicates Significance 5% level
*** indicates significance 1% level

Table 3.g
Intra-ETF Liquidity Analysis

	Spreads and Depth		
	Quoted Spread	Effective Spread	Dollar Depth
Intercept	.192213*** (3.098)	.0166*** (3.11)	3,732,400*** (4.47)
Price	.0011** (2.138)	.001** (2.59)	75,800 (.099)
Volume	-4.03e-10 (-.3939)	-5.97e-10 (-.511)	-.003* (-1.83)
SD	-1.98 (-.644)	-1.611 (-.7011)	-80,356,600* (-1.776)
International	.08588** (1.993)	.0325 (.9500)	-2,306,800*** (3.548)
Sector	-.0134 (-.453)	-.021 (-.5309)	-259,100 (-.373)
Herfindahl	4.06e-08 (1.587)	3.28e08 (1.409)	2.54*** (6.574)
Number	-2.63e-05 (-1.20)	-4.56e-05** (-2.14)	1,009 (.9343)
Adjusted R²	.10	.21	.29
F Value	1.63	3.846	5.91
<i>t-statistic in Parentheses</i>			
<i>* indicates Significance 10% level</i>			
<i>** indicates Significance 5% level</i>			
<i>*** indicates significance 1% level</i>			

Table 3.h
Intra-ETF Adverse Selection Analysis

	Adverse Selection Costs		
	Lin, Sanger, and Booth	GKN-Alford and Jones	Easley et al.
Intercept	.013* (1.722)	.1036* (1.838)	.0658 (.0903)
Price	.00001 (1.32)	.001*** (2.65)	.0003** (2.257)
Volume	-5.31e-10** (-2.74)	-2.99e-08** (-2.09)	5.80e-09 (.843)
SD	-.42 (-.80)	-.793 (-1.25)	2.665 (1.567)
International	.0253*** (2.97)	.1049** (2.60)	.0369* (1.71)
Sector	.0095** (2.033)	.005 (.203)	.000876 (.0435)
Herfindahl	4.92e-06 (.37)	4.05e-08** (2.36)	-8.86e-08*** (-7.466)
Number	1.49e-06 (.70)	3.39e-06 (.8514)	1.46e-06 (.9526)
Adjusted R²	.12	.147	.096
F-Test	1.93*	2.45**	5.10***
<i>t-statistic in Parentheses</i>			
<i>* indicates Significance 10% level</i>			
<i>** indicates Significance 5% level</i>			
<i>*** indicates significance 1% level</i>			

Appendix 2.a

Robustness

Table 3.i
Exchange Traded Fund and Equity Spread Analysis (Random Sample)

	Spreads and Depth		
	Quoted Spread	Effective Spread	Dollar Depth
Intercept	.091*** (5.27)	.0328 (1.21)	2,036,100 (1.23)
Price	.0007*** (4.14)	.002** (2.75)	56,900** (2.96)
Standard Deviation	1.01* (1.89)	.243** (2.38)	-150,631,100** (-10.64)
Volume	-3.76E-09* (-1.99)	-1.78E-07*** (-6.92)	-.0006* (-1.59)
ETF	-.0531*** (-4.94)	-.02691 (-1.25)	6,302,500*** (3.58)
System R²	.4905	.3786	.1584
F Value	10.48***	15.61***	21.96***

t-statistic in Parentheses
* indicates Significance 10% level
** indicates Significance 5% level
*** indicates significance 1% level

Table 3.j
ETF and Equity Spread Extended Analysis (Random Sample)

	Spreads and Depth		
	Quoted Spread	Effective Spread	Dollar Depth
Intercept	.101*** (3.01)	.0354 (1.27)	2,031,200** (2.02)
Price	.00065*** (9.36)	.0027*** (8.34)	45,200* (1.9719)
SD	1.022* (1.96)	.2513* (2.12)	-145,237,100** (-7.25)
Volume	-3.69e-09*** (2.38)	-1.79e-07*** (-6.12)	-.00063* (-1.72)
International	.07284* (1.86)	.0372 (.694)	-56,500 (-.58)
Sector	-.1507** (-2.15)	-.00531 (-1.12)	1,209,700*** (4.40)
Broad	-.1662*** (-3.24)	-.0189* (1.97)	3,501,400*** (5.23)
Adjusted R²	.5512	.3816	.2841
F Value	15.95***	17.48***	22.43***

t-statistic in Parentheses
* indicates Significance 10% level
** indicates Significance 5% level
*** indicates significance 1% level

Table 3.k
ETF and Equity Adverse Selection Extended Analysis (Random Sample)

	Adverse Selection Costs		
	Lin, Sanger, and Booth	GKN-Alford and Jones	Easley et al.
Intercept	.0313** (2.51)	.0151 (1.24)	.0425* (1.66)
Price	.00502*** (5.14)	.0004*** (3.16)	.0031 (.76)
SD	-.763 (-1.76)	4.25* (1.72)	.4577* (1.951)
Volume	-7.37e-10*** (-8.964)	-2.52e-07*** (-4.41)	5.82e-08*** (6.17)
International	.003* (1.89)	.04664 (.567)	.1189 (.942)
Sector	-.0092** (-2.65)	-.1443*** (7.61)	.006528** (2.393)
Broad	-.01257*** (-5.36)	-.135*** (3.57)	-.0232* (-1.78)
Adjusted R²	.157	.295	.071
F Value	3.694***	9.46***	4.71***

t-statistic in Parentheses
* indicates Significance 10% level
** indicates Significance 5% level
*** indicates significance 1% level

**Part 4: The Liquidity Impact of Concentrated Basket Security
Introduction**

I. Introduction:

The popularity of index products has increased exponentially since the introduction of the first U.S. exchange traded fund, the Standard and Poor Depository Receipt, in 1993. As of December 2003 the NASDAQ 100 Index Tracking Stock (QQQ) and Standard and Poor Depository Receipt (SPDR) have average daily volumes of 86,000,000 and 50,000,000 shares, respectively.

As of June 2003, 153 ETFs trade on U.S. exchanges. There are twenty-four broad market, thirty-five foreign focused, and fifty sector or industry specific exchange traded funds³⁰. Among the newest additions to the family of sector specific exchange traded funds are the Select Sector Standard and Poor Depository Receipts (Sector SPDRs). The equities that comprise the sector SDPRs are selected from the universe of SandP 500 firms. For example, if the nine Sector SDPRs were purchased in balance to the weighting of the underlying equities within the SandP 500 index, the returns would replicate the return on the SandP 500 index. The Sector SRDR exchange traded funds allow investors the opportunity to over or under weight sectors based on expected performance.

Of particular interest to market participants and regulators is the impact of the introduction of basket securities on the underlying securities. The principle issue surrounds the impact of the basket's introduction on the liquidity and bid-ask spread of the underlying equities. Several studies have examined this issue (see Lipson and Mortal (2003), Van Ness, Van Ness, and Warr (2003), and Hegde and McDermott (2003)). However, this is the first study to examine the impact of the introduction of concentrated

³⁰ The remaining ETFs are bond and REIT funds.

baskets on the underlying securities. In particular, this study documents the liquidity and adverse selection changes in the underlying securities around the introduction of the S and P 500 sector exchange traded funds (Sector-SDPRs).

Around the introduction date of the SPDR Sector ETFs, I find that the underlying equities quoted spreads increase by 3% while dollar depth decreases by 6%, while controlling for volume, standard deviation, and price. Estimates of the adverse selection component of the bid ask spread increase by 2.17%. The results of this investigation suggest that uninformed traders, traders who do not possess non-public information, migrate from trading in the underlying securities to the baskets securities. The concentrated basket hypothesis, which conjectures that informed traders migrate to the Sector-SDPR baskets because they are industry concentrated, is not supported. The results of this study support those of early basket introduction studies.

The remainder of this work proceeds as follows. In section II, I discuss the underlying theory of adverse selection in basket securities. Section IIb. examines the results of previous studies. In section III, I explore the hypotheses of this essay, and in section IV I discuss the methods employed to test these hypotheses. The final section, V, concludes the work.

II. Literature Review

IIa.Theory:

According to Subrahmanyam (1991), liquidity traders are allowed to realize their trades more efficiently by trading in basket securities. Adverse selection costs are reduced in baskets because these costs tend to be diversified across asset classes. As a result, basket securities offer lower levels of potential losses to informed trading. As uninformed traders migrate to basket securities, the ratio of informed agents trading in the underlying securities increases and market makers respond with increased bid-ask spreads. Gorton and Pennacchi (1993) present a model where liquidity traders form initial portfolios with knowledge of their future participation in markets where informed traders are present. The presence of the informed traders places the liquidity trader at a disadvantage, and the liquidity traders' utilities are increased with the introduction of baskets securities. Liquidity traders can effectively reduce their expected losses of trading against informed agents if they trade in the basket securities. Below I discuss the evidence that has been presented in the literature on basket trading.

IIb.Evidence:

Several studies have examined the introduction of security baskets on the underlying equities. Lipson and Mortal (2003) examine the effect of Standard and Poor Depository Receipt (SPDR) introduction on the underlying securities of the index. They document a negligible effect on the liquidity of the underlying stocks, but report a reduction in quoted depth. Lipson and Mortal also report an increased adverse selection component of the bid-ask spread in the underlying equities after the introduction of the SPDR exchange

traded fund. Van Ness, Van Ness, and Warr (2003) examine the impact of the introduction of the Dow Jones Industrial (DIA) exchange traded fund on the underlying equities. They document increased bid-ask spreads in the underlying equities, but find no significant change in adverse selection costs. Hegde and McDermott (2003) examine the introduction³¹ of the Nasdaq 100 (QQQ) exchange traded fund on the liquidity and adverse selection costs of the underlying stocks. They document decreased adverse selection costs and increased liquidity in the underlying equities³². Ackert and Tian (1999) find that mispricing of index options decreases after the introduction of the Standard and Poor 500 (SPDR) fund. Jegadeesh and Subrahmanyam (1993) examine the impact of the introduction of S and P 500 futures contracts on the bid-ask spread of the underlying securities. They find a significant increase in the spreads of the underlying securities and no significant change in their adverse selection costs.

III. Hypotheses:

The introduction of a broad-based basket security is expected to have an impact on the underlying securities different from that of the introduction of a sector specific fund. With the introduction of a broad based basket security, uninformed trades are expected to migrate to the basket security and informed traders are expected to continue to trade in the underlying asset. This in turn, increases the costs of trading in the underlying

³¹ Hegde and McDermott (2003) also examine the introduction of the Diamonds (DIA). Their findings are consistent with those of Van Ness, Van Ness and Warr (2003).

³² Hegde and McDermott's results are counter to the predictions of Subrahmanyam. However, they are easily explained by my conjectures in section III. If the correlations among the underlying equities and the Nasdaq 100 index are large compared to those in a broad based fund, informed traders are more likely to migrate to the basket security.

securities because market makers increase the bid-ask spread and decrease quoted depth when the probability of trading with informed agents increases.

Given the high concentration of individual equities in sector specific exchange traded funds, and because of the high correlation between the returns of the underlying equities in sector funds, the return characteristics of the basket are expected to have higher correlations with the underlying securities than the underlying securities in a broad based basket. This in turn leads to increased levels of informed trading in the sector specific baskets. Also as a result of possible legal scrutiny of trading the underlying equities, informed agents may prefer to trade in assets that mask their intentions. Furthermore, informed traders prefer trade in securities that have the lowest probability of revealing the non-public information. This conjecture leads to the two hypotheses that are tested in this work:

Ho (1): The introduction of industry concentrated basket securities will lead to the migration of informed trading from the underlying securities to the concentrated basket, resulting in an increase in the liquidity of the underlying securities. (e.g lower bid-ask spreads and greater quoted depth.)

Ho (2): The introduction of industry concentrated basket securities will lead to the migration of informed trading from the underlying securities to the concentrated basket, resulting a decrease in the adverse selection costs of the underlying securities.

Broad market baskets securities allow uninformed traders to reduce their expected losses associated with informed trading. The introduction of a broad market basket security should decrease the likelihood of uninformed trading in the individual securities and would result in a transition of uninformed trading to the basket security from the underlying securities. This would result in decreased liquidity of the individual securities. On the other hand, the introduction of a concentrated basket security may attract informed traders, and decrease the costs of informed trading in the underlying securities.

IV. Method:

IVa. Data.

All transactions data are collected from The New York Stock Exchange Trade and Quote (TAQ) database, and are filtered using methods similar to those used in and Lipson and Mortal (2003). I exclude the following data points:

- Non-positive prices and quotes
- All quotes with a time stamp before 9:30am or after 4:00pm
- Quoted with zero sizes bid or offer sizes
- Trading prices and midpoint greater than 50% over their previous level

Less than 1 percent of the observations are removed using these filters.

Buys and sells are classified using the methodology of Lee and Ready (1990).

Transaction data is collected for 30 trading days before and 30 trading days after the day of introduction of the introduction of the SPDR-Sector ETFs. December 22, 1998, the day of SPDR-Sector ETF introductions, is excluded from the analysis. Daily price, volume, and return data are collected from Center for Research in Security Prices (CRSP)

database, and the underlying securities of the S and P 500 were obtained from Standard and Poor's Securities Inc.

IVb. Matching:

I create a matched portfolio to act as a benchmark for drawing conclusions regarding spread and depth changes around the introduction of the Sector-SDPR ETFs. To provide an estimate of changes in market liquidity during the sample period, I compare the trading costs of the underlying securities to those in the control sample. Average daily volume³³, stock price, and shares outstanding are averaged over the 60 days, centered on the day of the sector SPDR introduction for both matching and cross-listing firms. The matching method is similar to the one employed by Clarke and Shastri (2001). Matching firms³⁴ must have traded for more than one year and not undergone a suspension of trading during the sixty-day window immediately preceding the introduction of the basket security. Firms that minimize the following expression are selected at the matching equities:

$$\text{Matching Score} = \left(\frac{\text{Price}_i^{\text{non-S\&P}} - \text{Price}_i^{\text{S\&P}}}{\frac{\text{Price}_i^{\text{non-S\&P}} + \text{Price}_i^{\text{S\&P}}}{2}} \right)^2 + \left(\frac{\text{Std}_i^{\text{non-S\&P}} - \text{Std}_i^{\text{S\&P}}}{\frac{\text{Std}_i^{\text{non-S\&P}} + \text{Std}_i^{\text{S\&P}}}{2}} \right)^2 + \left(\frac{\text{Volume}_i^{\text{non-S\&P}} - \text{Volume}_i^{\text{S\&P}}}{\frac{\text{Volume}_i^{\text{non-S\&P}} + \text{Volume}_i^{\text{S\&P}}}{2}} \right)^2$$

The matched portfolio acts as a benchmark for drawing conclusions regarding spread and depth changes. The values obtained from the matching process are presented in table 4.a.

³³ Volume in dealer markets is overstated because of inter-dealer trading (see Anderson and Dyl (2003)). NASDAQ volume is adjusted to sixty percent of its original amount to facilitate matching across exchanges.

³⁴ I take every fifth firm as a matching firm, because of the size of the sample. This results in a control sample of 100 firms.

The values obtained from the matching process are presented in table 4.a. The average price of the firms in the Standard and Poor 500 index is \$49.15, and the average price of the matching securities is \$37.30. The mean daily standard deviation of the Standard and Poor 500 index is .159%, and the average daily return standard deviation for the matched sample is 2.05%. The average volume for the firms in the Standard and Poor 500 index is 1,257,528 shares and the average volume of the matched sample was 1,525,896. The average matching score of .3137 suggests that the firms included in the two samples are similar along the matching criteria, but some of the individual matched sample's attributes are significantly different from those of the S and P 500 index. The matched portfolio acts only as a benchmark for drawing conclusions regarding changes in spreads of other securities in the market.

(Table 4.a here)

IVc. Changes In Liquidity:

Two spread estimates are employed in this analysis. The first measurement, the quoted spread, is calculated as $QS_t = Ask_t - Bid_t$, where Ask_t is the ask price at time t and Bid_t is the bid price at time t . The effective spread has been suggested as a more accurate measure³⁵, because the quoted spread does not consider trades that take place inside the best bid offer quote. The effective spread is calculated as $ES = 2|p_t - MP_t|$, where p_t is the price at time t , and MP_t is the quote midpoint at time t . These measures of the spread

³⁵ See Stoll and Schenzler (2004).

are used in the regression analysis described below. I also use dollar depth, which is the sum of the depth at the bid and ask prices, and represents the number of shares multiplied by the prevailing price.

The introduction of the sector SPDR funds is expected to influence the bid-ask spread and depth in the underlying equities, because of informed traders preference to trade in concentrated basket securities. To examine changes in liquidity, I employ a multivariate analysis of spreads and depth, while controlling for price level, return volatility, and trading volume changes. Because of possible negative correlation between the error terms in the specifications³⁶ of spreads and depth, I estimate a seemingly unrelated regression³⁷ of the following form:

$$\begin{aligned}\text{LogSpreadRatio}_j &= \alpha_{s0} + \beta_{s1}\text{LogVolumeRatio}_j + \beta_{s2}\text{LogPriceRatio}_j + \beta_{s3}\text{LogStdDevRatio}_j + \varepsilon_{sj} \\ \text{LogDepthRatio}_j &= \alpha_{D0} + \beta_{D1}\text{LogVolumeRatio}_j + \beta_{D2}\text{LogPriceRatio}_j + \beta_{D3}\text{LogStdDevRatio}_j + \varepsilon_{Dj} \\ \text{where } E[\varepsilon_{sj}\varepsilon_{Dj}] &\neq 0\end{aligned}$$

LogSpreadRatio_j is calculated for each firm in two ways. First, it is the natural log of the ratio of the average quoted spread in the post-period to the average quoted spread in the pre-period. Second, it is calculated as the natural log of the average effective spread in the post-period to the average effective spread in the pre-period. *LogDepthRatio_j* is the natural log of the ratio of the post-period dollar depth to the pre-period dollar depth. The independent variables *LogPriceRatio_j*, *LogStdDevRatio_j*, and *LogVolumeRatio_j* represent the ratio of the average post to pre period price, return standard deviation, and daily volume for firm *j*, respectively. The pre-period is defined as the thirty days preceding the

³⁶ See Lee et al. (1993).

³⁷ This model was employed in Kumar, Sarin, and Shastri (1998)

Sector-SPDR introduction and the post-period is the thirty days following the Sector-SPDR introduction. The model is constructed such that the intercepts capture the change in the dependent variable around Sector-SPDR introduction for each firm j .

Glosten and Milgrom (1985), Stoll (1978) and Kumar, Sarin, and Shastri (1998)) has shown that depth tends to decrease with increases in price and volatility and tends to increase with increases in trading volume, while spreads are negatively related to volume and price and positively related to volatility³⁸.

(Table 4.b and 4.c here)

The results of the liquidity analysis are shown in Table 4.c. After the introduction of the Sector-SPDR ETFs, average quoted spreads increase 3%, and average effective spreads increase 1.1%, and dollar depth decreases 6.39% while controlling for changes in volume, price and standard deviation, The results from the control firm analysis indicate that there was no significant change in dollar depth or quoted spreads while the effective spreads experienced a significant decrease of .8% ($t\text{-value}=1.78$).

The decrease in depth and the increase in spreads suggest that uninformed traders migrated to the basket securities, and because of this migration, market makers increased the bid-ask spreads and decreases liquidity. This result further suggests that informed traders did not migrate in numbers large enough to increase the liquidity of the

³⁸ See also Demsetz (1968), Tinic (1972), Bentson and Hagerman (1974), and Hamilton (1978)

underlying shares. This in turn suggests that the issuance of concentrated basket securities does increase the liquidity of the underlying securities.

IVd. Adverse Selection:

I use a bid-ask spread adverse selection decomposition methodology to detect changes in the adverse selection component of the bid-ask spread. Since informed traders are predicted to migrate to the basket security, the adverse selection component of the bid-ask spread should decrease with the introduction of a concentrated basket security.

To estimate the level of adverse selection, I employ the method of Lin, Sanger and Booth (1995), which decomposes the spread into adverse selection and order processing components. This methodology estimates the proportion of the effective spread that can be attributed to adverse selection. Similar to George, Kaul, and Nimalendran (1991), Lin, Sanger, and Booth (1995) assume that the specialist's inventory holding costs are zero, but they allow for a persistence parameter that captures the probability of trade reversal. The intuition behind the model is that quotes are revised to reflect information contained in the previous transaction.

The adverse selection and persistence parameters are estimated from the following equations:

$$\begin{aligned}Q_{t+1} - Q_t &= \lambda Z_t + \varepsilon_{t+1} \\Z_{t+1} &= \theta Z_t + \eta_{t+1} \\Z_t &= P_t - Q_t\end{aligned}$$

where Q_t is the quote midpoint at time t , P_t is the transaction price at time t , ε_{t+1} and η_{t+1} are random error terms, and λ is the proportion of the effective spread that is attributed to adverse selection. Clark and Shastri (2001) and Van Ness, Van Ness, and Warr (2001) both find that the adverse selection estimates from the Lin, Sanger, and Booth model are highly correlated with the adverse selection cost estimates produced from other market microstructure spread decomposition models. Using these adverse selection cost estimates, I estimate the following model:

$$\text{LogAdverseRatio}_j = B_0 + B_1 \text{LogPriceRatio}_j + B_2 \text{LogVolumeRatio}_j + B_3 \text{LogStdDevRatio}_j + \varepsilon_j,$$

where LogAdverseRatio_j is the natural log of the ratio of the average adverse selection cost of the effective spread in the post-period to the average adverse selection cost of the effective spread in the pre-period for each firm j . The independent variables LogPriceRatio_j , LogStdDevRatio_j , and LogVolumeRatio_j represent the ratio of the average post to pre period price, return standard deviation, and daily volume for firm j , respectively. The pre-period is defined as the thirty days preceding the Sector-SPDR introduction, and the post-period is the thirty days following the Sector-SPDR introduction.

(Table 4.d here)

The results of the adverse selection analysis are included in Table 4.d. The intercept coefficient estimates indicate that adverse selection costs in the underlying securities increase after the introduction of the Sector-SPDR ETFs. Adverse selection costs increase by 2.17% after the introduction of the Sector-SPDR ETFs. There is no significant change

in the adverse selection costs of the sample firms. Again, the adverse selection results suggest that uninformed traders migrated to the basket securities.

In general these results support the traditional view that uninformed traders migrate from trading in the underlying securities and trade in the security baskets. The concentrated basket hypothesis, which conjectures that informed traders migrate to the Sector-SDPR baskets because they are industry concentrated, is not supported in this framework. This suggests that the introduction of a concentrated basket security does not result in a significant migration of informed trading to this newly formed trading instrument. A migration of this type would increase the liquidity of the underlying securities, because the cost associated with informed trading would decrease and uninformed traders would benefit.

These results also suggest that the constancy of the basket has little impact on the reaction of informed agents. It is possible that informed agents shifted their trading to options on the concentrated baskets. However, this conjecture is not tested in this work. Furthermore, the results suggest that the introduction of basket securities reduces the liquidity of the underlying securities. Both issues warrant the attention of market participants who trade the underlying securities of the newly formed basket securities.

V. Conclusion:

Do informed agents migrate to industry concentrated basket securities in sufficient numbers to mitigate the movement of uninformed traders? I examine the effect of the

introduction of the Sector-SPDR exchange traded funds on the underlying securities liquidity and informed trading costs, and I find evident that informed agents do not migrate to the concentrated basket securities in sufficient numbers to mitigate the effects of uninformed trader migration.

Around the introduction of the Sector-SPDR exchange traded funds I find that quoted spreads of the underlying securities increase by 3% while dollar depth decreases by 6%. I also find that Lin, Sanger, Booth (1995) estimates of the adverse selection component of the bid ask spread increase 2.17% around the introduction Sector-SPDR exchange traded funds.

The results of this investigation support the traditional view that uninformed traders migrate from trading in the underlying securities and trade in the security baskets. The concentrated basket hypothesis, which conjectures that informed traders migrate to the Sector-SDPR baskets because they are industry concentrated, is not supported.

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Appendix 3

Table 4.a
SPDR Matching Scores

		Mean	Median	Standard Deviation	Min	Max
Price	S and P 500	49.15	42.71	24.20	5.44	293.90
	Control	37.30	35.95	16.77	5.59	70.29
Std	S and P 500	.00159	.00631	.0013	.000124	.0291
	Control	.02051	0.0015	0.0061	0.0087	0.068
Volume	S and P 500	1,257,528	719,201	2,001,178	38,163	19,236,032
	Control	1,525,896	664,564	3,413,055	282,944	14,299,493
Matching Score		.3137	.1081	.2152	.000198	1.97

Table 4.b
S and P 500 Univariate Characteristics

S and P 500	Mean	Standard Deviation	Min	Max
LogQuotedRatio _j	0.03	0.10	-0.54	0.39
LogEffectiveRatio _j	0.02	0.12	-0.68	0.68
LogDepthRatio _j	-0.01	0.25	-0.69	1.88
LogPriceRatio _j	0.01	0.13	-0.78	0.38
LogStdDevRatio _j	0.10	0.30	-1.31	1.52
LogVolumeRatio _j	0.16	0.32	-0.89	1.79

Table 4.c
SPDR Spreads and Depth Measures

Panel A	S and P 500 Firms		
	Quoted Spread	Effective Spread	Dollar Depth
Intercept	.0301*** (6.02)	.011247* (1.91)	-.06339*** (-5.23)
LogPriceRatio	.325*** (9.66)	.3487*** (8.82)	.3357*** (4.12)
LogStdDevRatio	.047915*** (2.98)	.05866** (3.11)	-.04 (-1.04)
LogVolumeRatio	-0.024 (-1.56)	.0167 (.90)	.3207*** (8.30)
System R ²	.1823	.1668	
Cross-Correlation (Error-term)	-.26290	-.005	
Panel B	Control Firms		
	Quoted Spread	Effective Spread	Dollar Depth
Intercept	.0124 (.912)	-.0082* (1.781)	.0191 (.1.10)
LogPriceRatio	.428*** (4.78)	.5487*** (9.81)	.453*** (5.61)
LogStdDevRatio	.08121*** (3.93)	.0319** (2.87)	-.172 (-.731)
LogVolumeRatio	-0.024* (-1.89)	.0201 (.67)	.7812*** (5.29)
System R ²	.193	.159	
<i>t-statistic in Parentheses</i>			
<i>* indicates Significance 10% level</i>			
<i>** indicates Significance 5% level</i>			
<i>*** indicates significance 1% level</i>			

Table 4.d
SPDR Adverse Selection Model

	S and P 500 Firms	Control Firms
	Averse Selection	Averse Selection
Intercept	.0217*** (2.78)	-.0001 (1.12)
LogPriceRatio	-.44*** (-2.60)	.0512 (.895)
LogStdDevRatio	.0788 (.96)	.1034* (1.66)
LogVolumeRatio	-.12370 (-1.52)	-.1512 (-.931)
Adj R²	.0094	.0153
F-Test	2.55*	1.13
<i>t-statistic in Parentheses</i>		
<i>* indicates Significance 10% level</i>		
<i>** indicates Significance 5% level</i>		
<i>*** indicates significance 1% level</i>		

Part 5: Limiting Factors and Future Research

I. Limiting Factors:

Several factors limit the ability of researches to examine the microstructure characteristics of the security markets in the United States. First, publicly available data are limited. For example, all buys and sells in the order book are not available to the public and are not disseminated on a historical basis. Thus, researchers are left to make inferences about market liquidity from a small sub-set of the order book.

Second, market trades are not assigned an indicator for buys or sells. The researcher must construct a method that extracts the most probable motivation behind the trade. Furthermore, the researcher must determine if the transaction was a buy or a sell using an algorithm which is known to not perfectly designate buys and sells properly. Again this limits research in certain areas.

Third, the motivations behind any given trade are not known. For example, the researcher does not know if a trade occurs because the trader is informed about the value of the security or is just trading to obtain liquidity. From a post trade perspective, it is very difficult to distinguish trades that were made by informed agents versus those made by uninformed agents. This further limits the ability of researches to examine the dynamics behind the movements in stock prices and their ability to study the underlying liquidity of the market.

II. Future Research:

The results raise several more questions related to security market liquidity. In the first essay I examine the liquidity impact of cross-listing of NASDAQ listed equities on the Amex. In light of previous research my results suggest more study is needed on the benefits and cost of Unlisted Trading Privilege security cross-listings. I find a slight increase in liquidity after cross-listing, while previous research finds significant increases in liquidity. More research is needed to explain the differences between the results of previous works and the results of the first essay. The differences may be explained by different market structures but more analysis is needed to determine if this is an appropriate explanation.

In the second essay I examine adverse selection costs and liquidity of basket securities. However, I examine these characteristics in equity only baskets. For example, I do not include baskets securities that hold bonds. Of particular interest is how do informed trading costs differ between bond ETFs and equity funds? Do informed traders prefer to trade the equity baskets? What impact do these factors have on the underlying securities liquidity?

The third essay examines the impact that the introduction of basket securities has on the liquidity of the underlying securities. I find that the introduction of a concentrated basket does not lead to an increase in the liquidity of the underlying securities. More study is needed on the costs associated with the introduction of basket securities. Do the cost increases, associated with reduced liquidity in the underlying, outweigh the utility gain

associated with trading the security basket? If these costs do exceed the benefits, basket security introduction leads to a net increase in trading costs!

Vita

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