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Comparative Analysis of ETF and Common Stock Intraday Bid-Ask Spread Behavior

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Abstract

In this study we approach the issue of ETF similarity with common stock with regards to their intraday bid-ask spread behavior. We use 18 stocks and 18 ETFs listed in the US to examine if the well documented in the literature J-shaped pattern of stocks bid-ask spread during the trading day is present in both stocks and ETFs today, which will help us understand better the stock characteristics of ETFs. We find that the factors identified as affecting stocks, activity, risk, information and competition, also influence ETFs but the impact is smaller. We also document elevated bid-ask spreads at the opening of the trading day with the stock spread being higher than ETFs almost twofold. The spreads taper during the day for both ETFs and stocks but increase around closing time for ETFs only, which means that the documented J-shaped pattern is present only in ETFs. This paper extends the work of Chelley-Steeley and Park (2011) who study intraday bid-ask spread behavior for London listed ETFs and of Ascioglu, Aydogdu, Chou and Kugele (2006) who study a sample of ETFs, NYSE and NASDAQ stocks intraday bid-ask spread components. The documented pattern in the prior literature is for NYSE listed stocks, the McInish and Wood (1992) study documented for the first time the J-shaped pattern a while ago. The tapering pattern is detected for NASDAQ stocks by Chan, Christie and Schultz (1995) who suggest that the non-J-shaped pattern is due to the different trading venue.

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1 Introduction

Exchange Traded Funds (ETFs) have gained popularity in recent years due to their indexing strategy, tax efficiency and resemblance to stocks. ETFs are similar to stocks in that they are listed and trade on an exchange and pay out dividends, but they are different from stocks in that they do not have short-sale constraints and that they follow an indexing strategy and as such do not have company specific risk because they are diversified portfolios of stocks. However, the similarity with stocks is assumed and very infrequently questioned. In this study we approach the issue of ETF similarity with common stock with regards to their intraday bid-ask spread behavior relative to factors which are identified in the literature to be important for stocks - activity, risk, information and competition. We use 18 US listed stocks and 18 US listed ETFs to examine if the well documented in the literature J-shaped pattern of stocks bid-ask spread during the trading day is present in both stocks and ETFs today. This paper extends the work of Chelley-Steeley and Park (2011) who study intraday bid-ask spread behavior for London listed ETFs and of Ascioglu, Aydogdu, Chou and Kugele (2006) who study a sample of ETFs, NYSE and NASDAQ stocks intraday bid-ask spread components.

We find that the four factors that affect stocks also influence in a similar fashion ETFs but the impact is smaller. This most likely is due to the indexing strategy followed by ETFs. We also document elevated bid-ask spreads at the opening of the trading day with the stock spread being higher than ETFs almost twofold. The spreads taper during the day for both ETFs and stocks but increase around closing time for ETFs only.

2 Literature Review

McInish and Wood (1992) document for the first time the J-shaped pattern of stocks' bid-ask spread during the trading day. They study all NYSE listed stocks with quotes on the Consolidated Quotation System for the period January 1, 1989 to June 30, 1989. They also attempt to determine whether factors influencing spreads over day or longer than a day periods also influence intraday spreads. The factors that they examine are – activity, risk, information and competition. These factors have been used in previous studies to explain bid-ask spreads of stocks.

A study by Chan, Chung and Johnson (1995) confirms the U-shaped pattern of bid-ask spread for NYSE stocks but does not find the same pattern in actively traded CBOE options. The authors find that for options the high opening bid-ask spreads diminish and stay level during the day.

Another study, by Chan, Christie and Schultz (1995), which focuses on NASDAQ stocks does not document neither U-shaped nor J-shaped intraday bid-ask spread pattern. They document that the bid-ask spread diminishes towards the end of the trading day. They suggest that the reason might be due to the difference in NYSE and NASDAQ trading systems.

Naturally, the majority of intraday bid-ask spread behavior studies are focused on stocks. Recently, however, ETFs have gained popularity due to their indexing strategy and strong resemblance to stocks. Studies by Nguyen (2010) and Li, Klein and Zhao (2012) have started examining the intraday behavior of ETFs recently. Therefore, the area of ETFs is under-research and an investigation of intraday ETF patterns is needed. A study by Chelley-Steeley and Park (2011)

focuses on London listed ETFs and document that ETFs have lower bid-ask spreads than stocks and that ETF bid-ask spreads are elevated at market open but not at market close. In this study we extend the knowledge in the field of intraday bid-ask spread behavior by examining whether the four factors identified in the prior literature, activity, risk, information and competition as affecting the stock bid-ask spread also impact on intraday basis the ETF bid-ask spread - after all ETFs trade on exchanges as stocks.

However, most ETFs are passive indexer funds which means that some of the four factors might not have the same impact on ETFs than they do on stocks. After all stocks have idiosyncratic risk in addition to market risk, whereas because of their indexing strategy ETFs might have mostly market risk. The different nature of risk would potentially attract different kinds of investors. Ascioglu, Aydogdu, Chou and Kugele (2006) study a sample of ETFs, NYSE and NASDAQ stocks intraday bid-ask spread by decomposing it into adverse selection and inventory holding components. They document that ETF spreads are smaller relative to stock spreads and that the information asymmetry is smaller for ETFs, which can be interpreted as suggesting that informed investors have relatively smaller advantage over non-informed investors in ETFs than in common stock.

Therefore, this study extends the work of Chelley-Steeley and Park (2011) and Ascioglu, Aydogdu, Chou and Kugele (2006) by examining US based ETFs and also by using different data sample and methodology (Aydogdu et al, 2006 use NYSE's TAQ (Trades and Quotes) database whereas we use QuantQuote data). This study expands our understanding of how ETFs, these relatively new investment vehicles compare to stocks.

3 Methodology

There are many different definitions of the bid-ask spread. Also, different studies use either the spread (Chan, Christie and Schultz, 1995) or the time-weighted spread (McInish and Wood, 1992; Chan, Chung and Johnson, 1995; Chelley-Steeley and Park, 2011). Therefore, in this study we use both the spread and the time-weighted spread. The bid-ask spread is defined as:

$$BAS = [(ask - bid)/(ask + bid)/2], \quad (1)$$

And the time weighted bid-ask spread as:

$$BAStw = \sum_{i=1}^{N} \frac{BAS_i (t_{i+1} - t_i)}{(T' - t_1)}, \quad (2)$$

Where the full interval measured in seconds is (t_1,T') and there are 'i' number of quotation updates and each quotation update has a bid-ask spread.

Activity - has been discussed by Amihud and Mendelson (1980). They suggest that market-makers have a target inventory level and if trading activity changes, which can be measured with volume or trade size, would cause the spread to increase or decrease relative to the benchmark inventory level of the ETF. Therefore, we expect similar to McInish and Wood (1992) to have an inverse relation between trading activity and spreads, but is the relation higher or lower for stocks or ETFs is an empirical question which we will attempt to determine.

H1-0: Stocks' bid-ask spread relation to trading activity is weaker than the relation of trading activity with ETFs' bid-ask spread.

Risk, is another factor discussed by Benston and Hagerman (1974) and Stoll (1978) in its systematic and idiosyncratic variety which if increased would increase bid-ask spread. However, considering that ETFs do not have an idiosyncratic risk component due to their indexing nature we expect that the impact of risk on ETF spreads would be weaker than the impact on stock spreads.

H2-0: Stocks' bid-ask spread relation to risk is weaker than the relation of risk with ETFs' bid-ask spread.

Information, as discussed by Glosten and Milgrom (1985) and Hasbrouck (1988), if more of it reaches the market (i.e. the more quotes are placed) the higher the spread since it is perceived that the information is of private variety. Considering that ETFs are most often traded by institutional (informed) investors, whereas stocks can be traded by both institutional and uninformed (noise) traders, we expect that the impact of information on ETFs spreads would be stronger.

H3-0: Stocks' bid-ask spread relation to information is weaker than the relation of information with ETFs' bid-ask spread.

Competition, as discussed by Benston and Hagerman (1974), has an inverse relation with stock spreads. Therefore, which one the impact on ETFs spreads or stock spreads by competition is an empirical question and as such we do not have a prediction (H4-0).

H4-0: Stocks' bid-ask spread relation to competition is weaker than the relation of competition with ETFs' bid-ask spread.

The regression equation which analyzes these four factors' relation to the bid-ask spread is defined in McInish and Wood (1992) as follows:

$$\begin{aligned} BAS_{i,t} = {} & b_0 + b_1\,TRADES_{i,t} + b_2\,SIZE_{i,t} + b_3\,RISK1_{i,t} + b_4\,RISK2_{i,t} + b_5\,NSIZE_{i,t} \\ & + b_6\,REGIONAL_{i,t} + b_7\,PRICE_{i,t} \\ & + 12 \text{ Interval Dummy Variables (numbered 1-9 and 11-13)} \\ & + 4 \text{ Weekday Dummy Variables} + e_{i,t} \end{aligned} \tag{3}$$

Where 'trades' is the square root of the number of transactions in each stock or ETF in interval 't', 'size' is the square root of the average number of shares per trade for each stock or ETF in interval 't', 'risk1' is the average of the standard deviation of the equally weighted average bid-ask spread for each stock or ETF in interval 't', 'risk2' is the ratio of the standard deviation of the equally weighted average of the bid-ask spread for each stock or ETF in interval 't' minus the 'risk1' measure and the standard deviation of the standard deviation of the equally weighted average of the bid-ask spread for each stock or ETF in interval 't', 'nsize' is the ratio of the 'size' measure for each stock or ETF minus the average of the 'size' measure and the standard deviation of the 'size' measure, 'regional' is the square root of the ratio of the number of shares traded on exchanges other than the main trading venue of each stock or ETF and the number of shares traded on the

main trading venue for each stock or ETF, 'price' is the square root of the average price, the interval dummy variables are for each 30 min period during the trading day except one, weekday dummy variables are for each of the trading day of the week except one and '$e_{i,t}$' is the error term.

We estimate the regression for ETFs and stocks separately and by comparing the variable coefficients we can test the four hypotheses. 'trades' and 'size' variables can be used to test hypothesis H1-0, 'risk1' and 'risk2' variables can be used to test hypothesis H2-0, 'nsize' variable can be used to test hypothesis H3-0, and 'regional' variable can be used to test hypothesis H4-0. For example, if parameter 'b_4' for the stock estimation is greater than the 'b_4' for the ETF estimation then we would fail to reject hypothesis H3-0.

Table 1. List of Companies and ETFs Used in the Study

	Companies			ETFs		
	Name	Symbol	Exchange	Name	Symbol	Exchange
1	American Express Company	AXP	NYSE	iShares Core U.S. Aggregate Bond ETF	AGG	NYSEARCA
2	Chevron Corporation	CVX	NYSE	Vanguard Total Bond Market ETF	BND	NYSEARCA
3	E I Du Pont De Nemours And Co	DD	NYSE	iShares MSCI Emerging Markets ETF	EEM	NYSEARCA
4	Dow Chemical Co	DOW	NYSE	iShares MSCI EAFE ETF	EFA	NYSEARCA
5	General Electric Company	GE	NYSE	SPDR Gold Shares	GLD	NYSEARCA
6	General Motors Company	GM	NYSE	iShares Core S&P Mid	IJH	NYSEARCA
7	International Business Machines Co	IBM	NYSE	iShares Core S&P 500 ETF	IVV	NYSEARCA
8	International Paper Co	IP	NYSE	iShares Russell 1000 Value ETF	IWD	NYSEARCA
9	Johnson & Johnson	JNJ	NYSE	iShares Russell 1000 Growth ETF	IWF	NYSEARCA
10	The Coca-Cola Co	KO	NYSE	iShares Russell 2000 ETF	IWM	NYSEARCA
11	3M Co	MMM	NYSE	PowerShares QQQ	QQQ	NASDAQ
12	Altria Group Inc	MO	NYSE	SPDR S&P 500 ETF	SPY	NYSEARCA
13	Merck & Co., Inc.	MRK	NYSE	Vanguard FTSE Developed Markets ETF	VEA	NYSEARCA
14	Procter & Gamble Co	PG	NYSE	Vanguard Dividend Appreciation ETF	VIG	NYSEARCA
15	Sears Holdings Corp	SHLD	NASDAQ	Vanguard REIT ETF	VNQ	NYSEARCA
16	AT&T Inc.	T	NYSE	Vanguard S&P 500 ETF	VOO	NYSEARCA
17	United States Steel Corporation	X	NYSE	Vanguard Total Stock Market ETF	VTI	NYSEARCA
18	Exxon Mobil Corporation	XOM	NYSE	Vanguard FTSE Emerging Markets ETF	VWO	NYSEARCA

Note: Companies and ETFs are sorted alphabetically.

4 Data

The data are millisecond intraday from QuantQuote and cover the period March 21, 2014 to April 17, 2014. We study 18 firms and ETFs that are widely traded. The list of companies and ETFs is provided in alphabetical order in Table 1. Seventeen of the stocks are listed on the New York Stock Exchange (NYSE) whereas one, Sears Holdings Corp, is listed on NASDAQ. Similarly, seventeen of the ETFs are listed on NYSEARCA exchange, whereas one, the Powershares ETFs, the Cubes, is listed on NASDAQ. These ETFs and stocks are some of the largest, well-recognized and most frequently traded securities in the US.

5 Analysis

In the McInish and Wood (1992) study the NYSE stock exchange is used as the standard however after we examine the trading and quote activity of the stocks and ETFs Direct Edge seems to be the most popular trading venue. The trading activity break down per exchange is provided in Table 2. Clearly the most trading activity is conducted on the Direct Edge exchange. Therefore, in contrast to the McInish and Wood (1992) who use the NYSE as the main exchange we use Direct Edge as the main exchange.

Table 2. Firms and ETFs Trading Activity per Exchange.

	Companies	**ETFs**
	N	**N**
American Stock Exchange Options	701,559	25,473,428
Chicago Mercantile Exchange (CME)	39,947	1,730,163
London International Financial Futures Exchange (LIFFE)	459,072	
London Traded Options Market	174	18,846
[Removed Jan 10, 2001] New York Stock Exchange Options (NYO)	242,042	26,974,725
Pacific Stock Exchange Options (PAO)	17,644	783,655
Vancouver Options Exchange (VAO)	9,775	1,850,764
Non-exchange-based Over The Counter Market	79,127	8,910,131
Stockholm Options Market	299	643,404
Direct Edge	**769,375**	**51,417,840**
Lava Trading	113,716	7,353,978
Boston Options Exchange	183,135	24,910,672
NYFIX Euro Millenium	67,732	9,542,463
NASDAQ Options Market	141,358	10,189,221
UBS ATS	117,925	11,076,111

The summary statistics for the bid-ask spreads are provided in Table 1. The average company bid-ask spread is 0.00024, whereas the average ETF bid-ask spread is 0.00012. The time weighted firm and ETF bid-ask spreads are 0.00012 and 0.00006, respectively. Clearly the bid-ask spread for stocks is higher than the bid-ask spread for ETFs, similar to the findings of Chelley-Steeley and Park (2011) for London listed ETFs. Also the parametric and non-parametric tests for equality in the mean bid-ask spreads clearly reject the hypothesis that they are equal for both BAS and time weighted BAS. Ascioglu, Aydogdu, Chou and Kugele (2006) do not find that ETF spreads are consistently higher than NYSE and NASDAQ stock spreads.

Table 3. Variables Summary Statistics.

Panel A. Summary Statistics.

Companies								
Variable	**N**	**Mean**	**Median**	**Minimum**	**Maximum**	**Std Dev**	**Skewness**	**Kurtosis**
bas	7796	0.00024	0.00023	0.00018	0.00088	0.00004	5.88012	53.67255
bastw	7800	0.00012	0.00011	0.00006	0.00073	0.00003	5.30228	73.54843
trades	7796	110.06465	107.62899	50.15974	243.77654	24.45354	0.62962	0.61413
size	7796	5.95453	5.74201	3.46741	25.31219	1.31639	3.41662	28.48972
RISK1	7796	0.00018	0.00014	0.00006	0.00174	0.00011	4.45921	32.59897
RISK2	7796	-0.01401	-0.29664	-0.96103	12.38715	0.88634	4.45921	32.59897
NSIZE	7796	-0.01329	-0.01337	-0.01431	-0.00534	0.00054	3.41662	28.48972
regional	2363	2.23013	2.00148	0.00000	28.39420	1.29762	6.02421	86.59076
PRICE	7796	64.64097	64.60648	37.57935	82.37761	4.54900	0.01547	0.38683
ETFs								
Variable	**N**	**Mean**	**Median**	**Minimum**	**Maximum**	**Std Dev**	**Skewness**	**Kurtosis**
bas	7796	0.00012	0.00012	0.00009	0.00019	0.00001	1.52630	7.52212
bastw	7800	0.00006	0.00006	0.00003	0.00011	0.00001	0.36419	0.94681
trades	7796	147.09173	143.83150	54.18487	290.64583	39.41592	0.36983	-0.34406
size	7796	6.05561	5.77708	2.95969	22.32589	1.49700	2.11106	9.23405
RISK1	7796	0.00006	0.00006	0.00004	0.00069	0.00002	16.18479	466.61477
RISK2	7796	-0.00882	-0.12007	-1.35936	39.34950	0.98182	16.18479	466.61477
NSIZE	7796	-0.01746	-0.01760	-0.01908	-0.00897	0.00078	2.11106	9.23405
regional	5489	2.36660	2.32229	0.15318	13.75103	0.71832	1.36826	15.64441
PRICE	7796	120.82379	120.77719	91.28009	141.73460	5.30600	0.07014	0.40355

Panel B. Tests for Equality in Means.

	Test for difference in means parametric	Test for difference in means non-parametric	Test for difference in means non-parametric
	t-test	Wilcoxon signed rank sum test	Kolmogorov-Smirnov Two-Sample Test
	Pr > |t|	**Pr > |t|**	**Pr > |t|**
bas	<.0001	<.0001	<.0001
bastw	<.0001	<.0001	<.0001

Additionally, when we examine the bid-ask spread behavior during the trading day visually (results not reported in the interest of brevity but available upon request from the authors), for not-time weighted and time weighted bid-ask spread, respectively), the documented J-shaped pattern by McInish and Wood (1992) and Chan, Chung and Johnson (1995) is present in ETFs but not in stocks. In stocks the pattern of diminishing bid-ask spread is similar to the pattern documented by Chan, Christie and Schultz (1995) in that it is high at first and then diminishes. This is surprising considering that Chan, Christie and Schultz (1995) study NASDAQ listed stocks whereas in our sample all but one of the analyzed stocks are NASDAQ listed, all the rest are listed on the NYSE. Chan, Christie and Schultz (1995) suggest that the pattern of the bid-ask spread is due to the different listing venue.

Before we proceed with the multivariate analysis we examine the relation among the independent variables. The correlation table is not reported in the interest of brevity but available upon request from the authors. There appears to be a strong correlation between 'risk1' and 'risk2', and 'size' and 'nsize'. Therefore, we will estimate two regression models excluding the highly correlated variables to address the possible effects of multicollinearity. McInish and Wood (1992) acknowledge the fact that there is multicollinearity but do not exclude variables in their analysis.

Table 4 provides the regression results for equation (3), which will help us test the four hypotheses. We estimate two model specifications of the equations due to the high correlation among the 'trade', 'size' and 'nsize', and 'risk1' and 'risk2' variables by excluding the highly correlated variables. We use the methodology developed by Clogg, Petkova and Haritou (1995) to test for statistical difference among the regression coefficients of the stocks and ETFs regressions. The test statistics is specified as follows:

$$Z = \frac{(\beta_{firms} - \beta_{ETFs})}{\sqrt{(\beta_{firms} SE_{\beta_{firms}} + \beta_{ETFs} SE_{\beta_{ETFs}})}}, \quad (4)$$

Where β_{firms} and β_{ETFs} are the regression coefficients from the firms and ETF regressions and SE are the corresponding standard errors.

The regression results suggest that with regards to hypothesis H1-0, the coefficients on the 'size' variables are greater in absolute value than the coefficients for ETFs. The firms' coefficient on 'size' is 0.00000565 and statistically significant whereas the coefficient for ETFs is a statistically significant 0.00000039 from the BAS regressions, and the difference between these two coefficients is also statistically significant. Results are similar in the time-weighted BAS regressions. This suggests rejection of H1-0. In terms of hypothesis H2-0, the coefficients on the 'risk2' variables are greater than the coefficients in the ETF regression. The 'risk2' regression coefficient in the BAS regression is statistically significant 0.00002896 for firms, whereas the ETFs' regression coefficient is also statistically significant but 0.00000339. The difference between these two coefficients is statistically significant and the results for the time-weighted BAS regressions are similar. This suggests rejection of H2-0. Addressing hypothesis H3-0, the coefficient on the 'nsize' variable is greater than the value of the coefficient for ETFs. The firms' coefficient for the BAS regression is 0.00000039 whereas the same coefficient for ETFs is 0.00075288, both being statistically significant and the difference between the two is also statistically significant. Results are similar for the time weighted BAS regressions. This suggests rejection of H3-0. When using the regression results to examine hypothesis H4-0, the coefficient on the 'regional' variable is greater than the value of the coefficient for ETFs. The BAS regression coefficient on the 'regional' variable for firms is 0.00000242 and statistically significant whereas the coefficient of ETFS is 0.00000028 also statistically significant in both model specifications. The difference is statistically significant and the results in the time-weighted BAS regressions are similar to the BAS regression results. This suggests rejection of H4-0. Combined, the results from testing the four hypotheses lead to the conclusion that ETFs respond less to the factors identified to impact stocks. Probably, the best idea is to attempt to identify factors that uniquely impact ETFs.

The regression results on the time of the day variables suggest that in the beginning of the day both companies and ETFs are more likely to have higher spreads whereas towards the end of the day

lower spreads are more likely. Using the test on the statistical significance of the difference between the regression coefficients – the regression coefficients on ETFs are again smaller than company regression coefficients, which again suggests a different response to factors of ETFs relative to stocks. The same can be said with regards to the day of the week effect, where the Thursday dummy variable is only statistically significant and again lower for ETFs.

6 Robustness Tests

There are about 7,800 bid-ask spread observations whereas there are only 2,363 observations for the 'regional' variable for stocks. Similarly, for ETFs the number of spread variable observations is about 7,800 whereas the observations of the 'regional' variable are about 5489. This results in running the regressions on smaller number of observations due to many lost observations due to the smaller number of observations for the 'regional' independent variable. Therefore, as a robustness, we repeat the regression analysis by excluding this variable and thus using a larger number of observations. The results for the restricted model are presented in Table 6. The results are similar even though we reduced the number of independent variables and increased the sample size.

7 Conclusions

ETFs have gained popularity in recent years due to their indexing strategy and resemblance to stocks. However, the similarity with stocks is assumed and very infrequently questioned. In this study we approach the issue of ETF similarity with common stock with regards to their intraday bid-ask spread behavior. We use intraday data for 18 stocks and 18 ETFs to examine is the well documented in the literature J-shaped pattern of stocks bid-ask spread during the trading day also present in ETFs today. This study extends the work of Chelley-Steeley and Park (2011) and Ascioglu, Aydogdu, Chou and Kugele (2006) by examining US based ETFs and also by using different data sample and methodology.

We find that the factors identified as affecting stocks, activity, risk, information and competition, also influence ETFs but the impact is smaller. We also document elevated bid-ask spreads at the opening of the trading day for both stocks and ETFs; however, the stock spread is twice as large as the ETFs bid-ask spread. The spreads taper during the day for both ETFs and stocks but increase around closing time for ETFs only, which means that the documented J-shaped pattern is present only in ETFs. The documented pattern in the prior literature is for NYSE listed stocks, the McInish and Wood (1992) study documented for the first time the J-shaped pattern a while ago. The tapering pattern is detected for NASDAQ stocks by Chan, Christie and Schultz (1995) who suggest that the non-J-shaped pattern is due to the different trading venue. Only one of the stocks in our analysis is NASDAQ listed and the rest are all NYSE listed, which means that listing is not a factor for the bid-ask spread pattern for stocks.

Table 4. Regression Results Based on Equation (3) and BAS and BAStw as Dependent Variables.

		Model 1						Model 2						
	Companies			ETFs				Companies			ETFs			
Variable	**Parameter Estimate**	**Pr > |t|**	**Standard Error**	**Parameter Estimate**	**Pr > |t|**	**Standard Error**	**z**	**Parameter Estimate**	**Pr > |t|**	**Standard Error**	**Parameter Estimate**	**Pr > |t|**	**Standard Error**	**z**
Intercept	**0.00059481**	**<.0001**	0.00001740	**0.00024837**	**<.0001**	0.00000184	**3.33**	**0.00027058**	**<.0001**	0.00001105	**0.00021903**	**<.0001**	0.00000145	0.90
trades	-0.00000002	0.3784	0.00000003	**0.00000001**	**<.0001**	0.0000000017	**-1.39**	-0.00000002	0.3784	0.00000003	**0.00000001**	**<.0001**	0.0000000017	**-1.39**
size								**0.00000738**	**<.0001**	0.00000044	**0.00000039**	**<.0001**	0.00000004	**3.86**
RISK1								**0.22925000**	**<.0001**	0.00649000	**0.21304000**	**<.0001**	0.00353000	0.34
RISK2	**0.00002896**	**<.0001**	0.00000082	**0.00000339**	**<.0001**	0.00000006	**5.23**							
NSIZE	**0.01799000**	**<.0001**	0.00108000	**0.00075288**	**<.0001**	0.00007988	**3.90**							
regional	**0.00000242**	**<.0001**	0.00000049	**0.00000028**	**0.0002**	0.00000008	**1.95**	**0.00000242**	**<.0001**	0.00000049	**0.00000028**	**0.0002**	0.00000008	**1.95**
PRICE	**-0.00000186**	**<.0001**	0.00000015	**-0.00000101**	**<.0001**	0.00000001	**-1.56**	**-0.00000186**	**<.0001**	0.00000015	**-0.00000101**	**<.0001**	0.00000001	**-1.56**
int1	**0.00005480**	**<.0001**	0.00000346	**0.00000797**	**<.0001**	0.00000030	**3.38**	**0.00005480**	**<.0001**	0.00000346	**0.00000797**	**<.0001**	0.00000030	**3.38**
int2	**0.00001195**	**0.0004**	0.00000337	**0.00000307**	**<.0001**	0.00000029	**1.38**	**0.00001195**	**0.0004**	0.00000337	**0.00000307**	**<.0001**	0.00000029	**1.38**
int3	**0.00000870**	**0.0101**	0.00000337	**0.00000095**	**0.0010**	0.00000029	**1.42**	**0.00000870**	**0.0101**	0.00000337	**0.00000095**	**0.001**	0.00000029	**1.42**
int4	0.00000382	0.2450	0.00000328	0.00000007	0.8122	0.00000029	1.06	0.00000382	0.245	0.00000328	0.00000007	0.8122	0.00000029	1.06
int5	0.00000238	0.4871	0.00000342	0.00000017	0.5412	0.00000028	0.77	0.00000238	0.4871	0.00000342	0.00000017	0.5412	0.00000028	0.77
int6	0.00000226	0.5223	0.00000353	-0.00000019	0.5185	0.00000029	0.86	0.00000226	0.5223	0.00000353	-0.00000019	0.5185	0.00000029	0.86
int7	0.00000180	0.5961	0.00000340	-0.00000022	0.4550	0.00000029	0.81	0.00000180	0.5961	0.00000340	-0.00000022	0.455	0.00000029	0.81
int8	0.00000094	0.7768	0.00000332	-0.00000007	0.8145	0.00000030	0.57	0.00000094	0.7768	0.00000332	-0.00000007	0.8145	0.00000030	0.57
int9	0.00000069	0.8397	0.00000343	0.00000006	0.8441	0.00000029	0.41	0.00000069	0.8397	0.00000343	0.00000006	0.8441	0.00000029	0.41
int11	-0.00000290	0.3768	0.00000328	**-0.00000085**	**0.0032**	0.00000029	-0.66	-0.00000290	0.3768	0.00000328	**-0.00000085**	**0.0032**	0.00000029	-0.66
int12	**-0.00000663**	**0.0305**	0.00000306	**-0.00000084**	**0.0033**	0.00000029	-1.28	**-0.00000663**	**0.0305**	0.00000306	**-0.00000084**	**0.0033**	0.00000029	-1.28
int13	**-0.00002099**	**<.0001**	0.00000314	**-0.00000225**	**<.0001**	0.00000028	**-2.30**	**-0.00002099**	**<.0001**	0.00000314	**-0.00000225**	**<.0001**	0.00000028	**-2.30**
M	-0.00000137	0.4973	0.00000202	**-0.00000120**	**<.0001**	0.00000017	-0.10	-0.00000137	0.4973	0.00000202	**-0.00000120**	**<.0001**	0.00000017	-0.10
T	-0.00000154	0.4581	0.00000208	**-0.00000087**	**<.0001**	0.00000017	-0.37	-0.00000154	0.4581	0.00000208	**-0.00000087**	**<.0001**	0.00000017	-0.37
Th	**-0.00000443**	**0.0227**	0.00000194	**0.00000096**	**<.0001**	0.00000018	**-1.82**	**-0.00000443**	**0.0227**	0.00000194	**0.00000096**	**<.0001**	0.00000018	**-1.82**
F	0.00000147	0.4827	0.00000209	**0.00000191**	**<.0001**	0.00000017	-0.24	0.00000147	0.4827	0.00000209	**0.00000191**	**<.0001**	0.00000017	-0.24
Adj R-sq			0.7974			0.8155				0.7974			0.8155	
N			1470			5438				1470			5438	

Note: Bold indicates significance at least at the 10% confidence level.

References

Amihud, Y., & Mendelson, H. (1980). Dealership market: Market-making with inventory. *Journal of Financial Economics*, *8*(1), 31-53.

Ascioglu, A., Aydogdu, M., Chou, R. K., & Kugele, L. P. (2006). An analysis of intraday patterns in ETF and common stock spreads. Working paper, Bryant University.

Benston, G. J., & Hagerman, R. L. (1974). Determinants of bid-asked spreads in the over-the-counter market. *Journal of Financial Economics*, *1*(4), 353-364.

Chan, K., Chung, Y. P., & Johnson, H. (1995). The intraday behavior of bid-ask spreads for NYSE stocks and CBOE options. *Journal of Financial and Quantitative Analysis*, 30(03), 329-346.

Chan, K. C., Christie, W. G. & Schultz, P. H. (1995). Market structure and the intraday pattern of bid-ask spreads for NASDAQ securities. *The Journal of Business,* 68(1), 35-60.

Chelley-Steeley, P., & Park, K. (2011). Intraday patterns in London listed exchange traded funds. *International Review of Financial Analysis*, 20(5), 244-251.

Clogg, C. C., Petkova, E., & Haritou, A. (1995). Statistical methods for comparing regression coefficients between models. *American Journal of Sociology*, 100(5), 1261-1293.

Glosten, L. R., & Milgrom, P. R. (1985). Bid, ask and transaction prices in a specialist market with heterogeneously informed traders. *Journal of financial economics*, *14*(1), 71-100.

Hasbrouck, J. (1988). Trades, quotes, inventories, and information. *Journal of Financial Economics*, *22*(2), 229-252.

Li, M., Klein, D., & Zhao, X. (2012). Empirical analysis of ETF intraday trading. *Financial Services Review*, 21(2), 149.

McInish, T. H. & Wood R. A. (1992). An analysis of intraday patterns in bid/ask spreads for NYSE stocks. *The Journal of Finance*, 47(2), 753-764.

Nguyen, V. T. (2010). An Intraday Analysis of Exchange Traded Fund Markets. Working Paper, University of Mississippi. Retrieved from: http://faculty. bus. olemiss. edu/rvanness/Speakers/2004-2005/van-essay3a. pdf, on October 1.

Stoll, H. R. (1978). The pricing of security dealer services: An empirical study of NASDAQ stocks. *The Journal of Finance*, *33*(4), 1153-1172.