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A Comparison of Transaction Costs between Competitive Market Maker and Specialist Market Structures*

This study compares bid-ask spreads for equity options in two market structures: the American Stock Exchange (AMEX) specialist structure and the Chicago Board Options Exchange (CBOE) competitive market maker structure. When trading volume is low, the specialist structure is associated with significantly smaller spreads. As volume rises, this difference appears to diminish. These results are consistent with those of Grossman and Miller.

I. Introduction

The transaction characteristics of alternative market structures have attracted increasing interest among the academic community and market regulators. For example, models by Grossman and Miller (1988) and by Glosten (1989) show that a specialist can enhance liquidity when trading volume is low or when adverse selection problems are large. Empirical studies by Kamara (1988), Stoll and Whaley (1990), and Vijh (1990) document important differences between call auction and specialist markets, between organized exchanges and over-the-counter markets, and between the liquidity of stock and options markets. Recent evidence that transaction costs are related to market structure has also been a consideration in several Securities and Exchange Commission (SEC) rule changes.

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To reduce investor transaction costs, the SEC has proposed changes in the registration process for secondary offerings, institutional trading requirements, and the allocation plan for options.

This article provides additional evidence on the relation between market structure and transaction costs through an empirical comparison of competitive market maker and specialist markets. Specifically, the bid-ask spread and some properties of transaction prices for equity call options are compared in two market structures: the specialist structure of the American Stock Exchange (AMEX) and the competitive market maker structure of the Chicago Board Options Exchange (CBOE). Equity options provide a special opportunity to contrast these different market structures because of a regulatory barrier. The trading of most equity options is governed by the options "allocation plan." This rule, administered by the Securities and Exchange Commission, effectively grants an exchange an exclusive franchise for trading a particular option. These options cannot be traded on another exchange, nor can these rights be traded among exchanges.

This regulatory barrier helps resolve an important identification problem. Under competitive conditions, if the risk characteristics of an asset suggest it would be more efficiently traded in a particular market structure, then competition between structures will pressure the asset to trade in the most efficient structure. In this case, it may be hard to distinguish between transaction cost differentials due to market structure from those due to the characteristics of the underlying asset. The barrier imposed by the allocation plan helps to insure that the risk characteristics of the options are similar and that the measured differences between the AMEX and the CBOE reflect the alternative market structures.

Relative to previous empirical comparisons of market structures, this study offers three important advantages. First, most studies have a much more limited ability to control for different characteristics of the underlying securities. For example, the comparison of bid-ask spreads between firms traded on the New York Stock Exchange (NYSE) and the Toronto Stock Exchange by Tinic and West (1974) and the comparison of price volatility between U.S. and Brazilian firms by Cohen, Maier, Ness, Okuda, Schwartz, and Whitcomb (1977) have a common problem: there may be important differences in the listing requirements and risk characteristics in the securities they examine. A related problem affects Stoll and Whaley (1990). As they observe, the higher variance of the call auction at the open may be a result of information accumulating between the close and the open. If the market has not had the opportunity to respond to the information, it is possible that opening prices are intrinsically more volatile than closing prices, independent of market structure.

A second advantage offered by this study is that the bid-asked spreads in both market structures are explicitly related to trading volume. Grossman and Miller (1988) show that a specialist structure is preferable when trading volume is relatively low and that an open outcry structure is preferable when volume is relatively high. This implies the cross-sectional variation in spreads between structures will be a function of trading volume. This approach differs from Baesel, Shows, and Thorp (1983) and from Vijh (1990). Baesel, Shows, and Thorp report that the average bid-ask spread for a sample of CBOE options is lower than for a sample of AMEX options. In a similar comparison, Vijh reports that the specialist structure for NYSE stocks has lower average spreads and a larger fraction of trades executed between the prevailing bid and ask prices than the CBOE competitive market maker structure for options on these stocks. Neither study, however, investigates whether the difference in spreads between these structures is related to trading volume.

A third advantage offered by this study is a more precise measure of bid-ask spreads. The data employed in this analysis are the continuous sequence of bid, ask, and transaction prices. These data permit an examination of the bid-ask spread in effect when a trade is executed and the location of the transaction price within the spread. With the exception of Vijh (1990), previous comparisons of market structures have employed more aggregated measures of transaction costs.[1]

The results of this study suggest several interesting differences between the AMEX and the CBOE market structures. First, when trading volume is low, the specialist structure has lower bid-ask spreads than competitive market maker structure. As volume rises, however, this difference appears to diminish. These findings are consistent with Grossman and Miller (1988). Second, the transaction prices in the specialist market structure are closer to the midpoint of the bid and ask prices. This finding is consistent with Vijh (1990) and suggests a simple comparison of bid-ask spreads will understate the difference between these structures. Third, the distributions of trade size and transaction prices differ between the two structures. Consistent with Vijh (1988), the competitive market maker structure is associated with a greater fraction of trades at the ask price, and these trades are of a smaller size. While it is possible this difference reflects the management of adverse selection problems, the measured adverse selection compo-

1. For example, averaged bid-ask spreads were employed by Tinic and West (1974) and by Baesel, Shows, and Thorp (1983). Averaged spreads were also utilized by Hamilton (1978) and by Dubofsky and Groth (1986) in their investigations of different trading procedures for National Association of Security Dealers Automated Quotation (NASDAQ) stocks.

nent of the spread appears small for both the AMEX and the CBOE samples.

These findings have important implications for the regulatory debate about the options allocation plan. The SEC has proposed to eliminate the allocation plan and permit direct competition among the options exchanges. The exchanges oppose this proposal. Since the AMEX and the CBOE receive about 30% and 50%, respectively, of the trading volume in equity options, evidence showing an important difference in transaction costs between these two structures provides a strong economic reason to eliminate this regulatory barrier. Investor transaction costs would be reduced as options migrate to their most efficient market structure.

The organization of this study is as follows. The characteristics of the AMEX and CBOE market structures and recent theories pertaining to these structures are described in Section II. Section III provides summary statistics for several measures of bid-ask spreads and factors predicted to affect spreads. Section IV presents regression estimates of transaction costs differentials between the AMEX and the CBOE. A summary is presented in Section V.

II. The Characteristics of the AMEX and CBOE Market Structures

The trading structures at the AMEX and the CBOE employ different structural arrangements.[2] The CBOE structure consists of mobile floor broker/dealers, called competitive market makers, who are free to seek out the best profit opportunities. In addition, each CBOE option has an order book official. These officials are employed by the exchange to display the highest bid and lowest ask prices and to record limit orders for later execution. The AMEX structure combines the features of the specialist and competitive market maker environments. The AMEX structure has mobile floor broker/dealers but also has a specialist for each option.

There are two important differences between the AMEX and the CBOE market structures. First, the specialist is a major participant in the trading process. The order book official is an observer who records prices and limit orders. Second, relative to the competitive market maker, the specialist may have information and execution advantages. The specialist may have exclusive knowledge of the limit order book and can participate as both a broker and a dealer on the same day. The competitive market maker is restricted to acting as either a broker or a dealer for any particular security on the same day; he cannot do both on the same day.

2. Although the AMEX trades stocks in addition to options, it is primarily an options exchange. On January 3, 1986, the price of an AMEX seat to trade only options was $115,000 while the seat price to trade both options *and* stocks was $155,000.

The ability of options investors to substitute between these two trading structures is severely limited by the regulatory environment. The market structure for most equity options is governed by the options allocation plan. The allocation plan was initiated in 1980 and operates much like the National Football League draft. From the pool of available options, each exchange takes turns selecting options.[3] Each exchange then has an exclusive franchise for trading the selected option. These options cannot be traded on another exchange, nor can these rights be traded among exchanges. Options on over-the-counter (OTC) stocks, however, were explicitly exempt from the allocation plan. These options, which began trading in June 1985, offer some evidence that transaction costs are related to market structure. While the trading volume of the OTC options is relatively low, the AMEX has received over 75% of the volume of these options.

Certain implications of the models by Grossman and Miller (1988) and by Glosten (1989) appear to be consistent with the evidence from the OTC options. The Grossman and Miller model predicts that when the intrinsic risk of an asset is low (real estate is a good example), a broker market will emerge. As the intrinsic risk rises, other things constant, so does the demand for liquidity, and centralized markets emerge with a specialist or batch call structure. Assets with a high level of risk, such as futures contracts on commodities and Treasury bonds, create extreme demand for liquidity and are traded in a competitive market maker structure. The Grossman and Miller model thus represents the optimal trading structure as a function of the underlying demand for liquidity and predicts that the transactions efficiency of a trading structure is related to trading volume. Intuitively, a specialist structure is preferred when trading volume is relatively low because it can minimize the impact of order flow innovations. When volume is high, a competitive market maker structure is preferred because forcing all trades through the specialist can create a bottleneck.

The model by Glosten (1989) relates the liquidity of market structures to the management of adverse selection problems. While extreme adverse selection among traders can cause a competitive market maker structure to shut down, Glosten shows that a profit-maximizing specialist may decide to keep the market open. The intuition of his model is that the specialist takes a long-run view. Although the specialist may suffer initial losses by trading with more informed agents, these trades provide him with information. If there are sufficient liquidity traders, the specialist may more than offset his losses by profitably exploiting

3. To be considered for options trading, the underlying stock must have at least 7 million shares outstanding, 6,000 stockholders, a price greater than $10 per share, and a trading volume in the past year exceeding 2.4 million shares. In addition, the firm must be free of default for at least 1 year and have earned at least $1 million in each of the 8 previous quarters.

this additional information in trades with the liquidity traders. Glosten develops this intuition to show that, other things constant, a specialist market will have greater liquidity under moderate or severe adverse selection.

An empirical comparison of the AMEX and CBOE bid-ask spreads, however, is likely to be affected by two institutional factors. First, a sufficiently high trading volume could reduce the bid-ask spread to the minimum spread.[4] Other things constant, this lower bound forces the transaction costs to be the same in both structures. Second, conversations with AMEX specialists suggest that as the option volume rises more floor broker/dealers are induced into trading the option. This causes the specialist structure to appear more like a competitive market maker structure and suggests the effects of trading structure may be more evident at low volume levels when the specialist is an active participant in the market.

The regulatory environment created by the allocation plan presents an interesting opportunity to compare the transaction costs of these two market structures. The next section employs several measures of bid-ask spreads to provide an initial analysis of these structures.

III. Sample Description and Summary Statistics

To analyze the AMEX and CBOE market structures, a sample of options was selected according to three criteria. First, the options were contained in the 1986 January/February/April expiration cycle. Second, the AMEX options trade exclusively at AMEX and the CBOE options, exclusively at CBOE. Third, continuous bid, ask, and transaction price data had to be available for at least one of two sample periods, either January 10–15, 1986, or April 7–11, 1986. These criteria produced a sample of 26 AMEX options and 15 CBOE options. Since a stock usually has multiple options with several strike prices and expiration dates, the sample is further restricted to options that are at-the-money and have the nearest expiration date.[5] The determination of the at-the-money option was based on the stock price at the beginning of each period; the expiration dates for the January and April samples are January 18 and April 19, respectively. The options in the sample are listed in the Appendix, and there are minor differences in

4. The minimum tick size is 1/8 for options greater than $3.00, and 1/16 otherwise. Virtually all the observations in this study have a 1/16 tick size.

5. This restriction tends to produce the single-most actively traded option. For example, in the sample of April options, the trading volume in the near-term calls is roughly 50% of all call option trading. The at-the-money options constitute roughly 50% of the trading volume in the near-term calls.

the options contained in the January and April samples as a result of ex-dividend dates.[6]

It is possible this sampling procedure provides a slight bias toward the CBOE sample having lower average transaction costs. Since trading in listed options started in April 1973 at the CBOE and January 1975 at the AMEX, the CBOE had the first selection of the available options. Five of the 15 options in the CBOE subsample were listed on the CBOE before the AMEX initiated options trading. The results of this study, however, are not sensitive to the exclusion of these five options.

The intraday bid, ask, and transactions prices used to analyze these samples were obtained from the Securities Industry Automation Corporation. These data have been checked for outliers and filtered in three ways. First, about 0.7% of the quotes have a zero bid price. This lower bound may truncate the spread and bias it toward zero; hence, all observations with a zero bid price have been excluded. Second, the observations from three firms involved in significant takeover speculation (Crown Zellerbach, Sperry, and Texaco) were excluded to minimize the variation in the adverse selection component of the spread. Third, there were several instances when transaction prices were unavailable. To insure a comparable data series, all observations for Motorola in the April subperiod and for Grumman and Pitney Bowes in the January subperiod were deleted because the transaction prices were unavailable.

To investigate whether transaction costs are different between the AMEX and CBOE market strucures, four measuers of bid-ask spreads are examined: the quoted bid-ask spread based on *all* quotes, the current bid-ask spread, and two measures of the effective spread. The current bid-ask spread is defined as the quoted spread in effect when a trade is executed. If the time series of observations consists of a bid-ask quote, a bid-ask quote, and then a trade, the series for the quoted bid-ask spread would contain both quotes, while the series for the current spread would ignore the first quote and only use the second quote. The two measures of the effective spread are defined as

$$\text{effective spread-1} = \max[\text{transaction price}_t - \text{bid price}_t, \\ \text{ask price}_t - \text{transaction price}_t],$$

6. The stock price will fall by roughly the amount of the dividend on the ex-date. This violates an assumption of the Black-Scholes model and makes it difficult to compute the implied standard deviation. Observations prior to the ex-date are excluded for firms with an ex-day prior to expiration. Specifically, observations from Procter and Gamble prior to January 16, 1986, and observations from Alaskan Airlines prior to January 13, 1986, are excluded.

and

$$\text{percentage effective spread-2} = 2|[\text{transaction price}_t - (\text{bid}_t + \text{ask}_t)/2]|/(\text{ask}_t - \text{bid}_t).$$

The definition of effective spread-1 is from Vijh (1990). Like the current spread, the effective spread-1 and the percentage effective spread-2 measures are also constructed from the bid and ask prices in effect when a trade was executed. For the AMEX options, the bid and ask prices are the quotes from the option specialist. The CBOE quotes are the "inside quotes," the highest bid price, and the lowest ask price available from the trading crowd. In both structures, the bid and ask quotes are for one contract.

Although these measures are not independent, they provide a more accurate measurement of bid-ask spreads by allowing the quotes associated with trades to differ from those not associated with trades and by allowing trades between the quoted bid and the ask. The percentage effective spread-2 measure has a natural interpretation as the proportion of the spread paid by the options trader. If a transaction occurs at the bid or the ask, the percentage effective spread-2 will equal 1.0; transactions at the midpoint make the percentage effective spread-2 equal to zero. Relative to the effective spread-1 measure, however, the percentage effective spread-2 measure may understate the true effective spread. To illustrate this tendency, suppose the bid price is 1/2, the ask price is 3/4, and a trade occurs at 11/16. The effective spread-1 is 3/16, and the percentage effective spread-2 is 1/8 divided by the spread. The difference between 3/16 and 1/8 occurs because the percentage effective spread-2 measure assumes the transactions are symmetrically distributed around the midpoint of spread. This implies the effective bid price is 9/16, the same distance from the midpoint as the transaction price. The effective spread-1 measure does not impose this assumption, and the effective bid price would remain at 1/2. Sample estimates of the four measures are presented in table 1.

The results in table 1 show that average bid-ask spreads are lower for the AMEX options for each of the four measures. The mean bid-ask spread is 20.2 cents for the AMEX options and 23.9 cents for the CBOE options; the mean values for the current spread are 17.2 and 18.6 cents. The mean effective spread-1 measure, which incorporates transactions inside the quotes, is 13.7 cents at the AMEX and 16.6 cents at the CBOE. In addition, the mean percentage effective spread-2 measure indicates that in a round-trip transaction an options trader will pay, on average, 68.7% of the quoted spread for the AMEX trades and 92.8% for the CBOE trades.

While these statistics suggest that transaction costs are related to market structure, theoretical models have shown bid-ask spreads to

TABLE 1 Summary Statistics for Alternative Measures of Bid-Ask Spreads

Bid-Ask Spread Measure by Exchange	Mean	Standard Deviation	Skewness	Excess Kurtosis	No. of Observations
Bid-ask spread:					
AMEX	.202	.103	.711	.096	3,938
CBOE	.239	.154	.772	−.064	3,622
Current bid-ask spread:					
AMEX	.172	.091	.798	.272	3,396
CBOE	.186	.134	1.246	.517	3,941
Effective spread-1:					
AMEX	.137	.080	1.945	8.260	3,396
CBOE	.166	.134	3.633	34.12	3,941
Percentage effective spread-2:					
AMEX	.687	.594	2.887	25.10	3,396
CBOE	.928	1.409	23.71	807.9	3,941

Note.—This table is based on observations from 26 AMEX and 15 CBOE near-term, at-the-money call options. The data contain bid, ask, and transaction prices for options between January 10–15 and April 7–11, 1986. The bid-ask spread, current bid-ask spread, and the effective spread-1 measures are expressed in dollars. The measures of the bid-ask spread are defined as follows:

bid-ask spread = ask − bid, based on all observed bid and asked quotes;
current bid-ask spread = ask − bid, based on the quotes in effect for each transaction;
effective spread-1 = max[transaction price − bid price, ask price − transaction price];

and

percentage effective spread-2 = 2|[transaction price (bid + ask)/2)]|/(ask − bid).

The effective spread-1 and percentage effective spread-2 measures are based on the quotes in effect for each transaction.

be affected by other factors. For example, the models by Stoll (1978) and by Ho and Stoll (1980) show transaction costs are positively related to the price of a security and its volatility and negatively related to its trading volume. The models by Copeland and Galai (1983) and by Glosten and Milgrom (1985) show that greater adverse selection will increase the spread. Easley and O'Hara (1987) show that adverse selection is correlated with the trade size, so larger trades, other things constant, will generate larger transaction costs. Finally, models by Grossman and Miller (1988) and by Glosten (1989) show the liquidity of an asset is related to the market structure. Although these models were developed for equity markets, their predictions pertain to generic securities and should be directly applicable to options.

Table 2 presents summary statistics for the factors predicted to influence bid-ask spreads. Specifically, the option price, the daily trading volume, the trade size, and the daily volatility are examined. The option price is computed as the average of the bid and ask prices. The relatively low mean prices of $1.30 for the CBOE options and $1.14 for the AMEX options are a consequence of the sampling procedure selecting near-term, at-the-money options. The daily trading volume

TABLE 2 Summary Statistics for Factors Determining Bid-Ask Spreads

Factor by Exchange	Mean	Standard Deviation	Skewness	Excess Kurtosis	No. of Observations
Price:					
AMEX	1.144	.848	1.266	1.034	3,396
CBOE	1.297	.978	1.763	3.517	3,941
Daily volume:					
AMEX	298.3	387.3	2.379	6.299	216
CBOE	368.6	544.3	2.899	9.568	121
Contracts per trade:					
AMEX	18.97	37.22	8.233	106.1	3,396
CBOE	11.32	28.96	15.37	405.8	3,941
Daily return standard deviation:					
AMEX	10.25	9.217	5.455	47.97	216
CBOE	9.453	5.330	.956	1.325	121

NOTE.—This table is based on observations from 26 AMEX and 15 CBOE near-term, at-the-money call options. The data contain bid, ask, and transaction prices for options between January 10–15 and April 7–11, 1986. The variables are defined as follows:

price = (ask + bid)/2, measured in dollars and based on the quotes in effect for each transaction;
daily volume = average number of contracts traded per day, per option;
contracts per trade = number of contracts/number of trades;

and

daily return standard deviation = average implied standard deviation per day, per option.

Each trade generates an observation for the price variable and for the contracts per trade variable. The daily volume and the daily option return standard deviation are variables that are computed daily. For each day an option is traded, one observation is generated for these variables.

is the number of contracts for a particular option that are traded in a given day. The mean daily volume of 368.6 contracts per day for the CBOE options and 298.3 for the AMEX options. Despite the higher volume of the CBOE options, the average number of contracts per trade is much smaller. The AMEX sample averages 18.97 contracts per trade while the CBOE sample averages 11.32 contracts per trade. Like trading volume, the implied standard deviation of the option return is also measured daily.[7] This measure incorporates the underlying stock volatility and the degree to which the option is in-the-money. The evidence in table 2 suggests the implied standard deviations of the option returns are somewhat smaller for the CBOE sample.

7. The implied standard deviation of the option return is constructed as the (stock price/call price) × hedge ratio × implied standard deviation of the stock return. The implied standard deviation of the stock return is computed from the Black-Scholes model using the settlement price for the stock, the average of the last available bid and ask quote for the option price, and the 30-day commercial paper interest rate. If the standard deviation was computed from the option transaction returns, it would likely induce a positive correlation between transaction costs and volatility: the higher the transaction costs, the higher the measured volatility.

An implication of the summary statistics in table 2 is that the difference in transaction costs between the AMEX and the CBOE may be larger than indicated by table 1. While the higher CBOE price is consistent with the larger spreads for the CBOE sample, the CBOE sample also contains a lower average implied option return standard deviation, higher trading volume, and a smaller trade size. Other things being constant, these last three factors are predicted to make the transaction costs at the CBOE lower than those at the AMEX.

Another perspective on transaction cost differentials is provided by an analysis of the relation between trade size and the location of the trade within the spread. Table 3 classifies trade executions into five categories: trades below the bid, at the bid, between the bid and the ask, at the ask, and greater than the ask. As noted by Vijh (1988), the distribution of CBOE put and call transaction prices is skewed toward the ask price and the trade size is skewed toward the bid price. The results in table 3 are consistent with Vijh's findings but also reveal a sharp contrast between the AMEX and CBOE subsamples. For the CBOE sample, 22.51% of the trades occur at the bid price and 40.12% at the ask price; the mean trade size is 14.13 contracts at the bid but only 7.82 at the ask. In contrast, the AMEX sample is more symmetric. An average of 26.00% of the trades occur at the bid and 32.33% at the ask; the average trade size is 17.50 contracts at the bid and 17.32 at the ask.

These results have two implications. First, since a large fraction of the AMEX trades occur between the bid and ask, the bid-ask spread is not a sufficient statistic for a comparison of transaction costs between these two structures. Second, it appears that the market structures at the AMEX and the CBOE generate substantially different transaction processes. Relative to the AMEX sample, the CBOE sample is associated with a larger fraction of trades at the ask, and these trades are of a smaller size.[8] Since the risk to a market maker of selling at the ask (a short call position can generate an unbounded loss) may exceed the risk of buying at the bid (the loss is limited to the premium paid), it is possible that the differences in transaction size at the ask price result either from inventory management concerns or from adverse selection problems. These possibilities are examined in the next section by estimating the adverse selection component of the spread and by investigating the differential relation between spreads and trading volume, a proxy for inventory sensitivity.

Overall, the summary statistics provide initial evidence that bid-ask

8. Contingency table tests for the independence of the fraction of trades in each category from market structure generate a $\chi^2_{(4)}$ value of 242; pairwise *t*-tests for all categories except trades below the bid indicate the AMEX trade size is significantly larger than the CBOE.

TABLE 3 **A Categorical Analysis of the Distribution of Transaction Price and Trade Size**

Measure by Exchange	Trades below the Bid	Trades at the Bid	Trades between the Bid and Ask	Trades at the Ask	Trades above the Ask
No. of trades:					
AMEX	17	883	1,360	1,098	38
CBOE	113	887	1,162	1,581	198
% trades:					
AMEX	.50	26.00	40.05	32.33	1.12
CBOE	2.87	22.51	29.48	40.12	5.02
No. of contracts per trade:					
AMEX	12.94	17.50	21.32	17.32	19.34
CBOE	9.39	14.13	14.63	7.82	8.28

NOTE.—This table is based on transactions from 26 AMEX and 15 CBOE near-term, at-the-money call options. There are 3,396 observations for the AMEX sample and 3,941 observations for the CBOE sample. The data contain bid, ask, and transaction prices for options between January 10–15 and April 7–11, 1986. The bid and ask prices are the quoted bid and ask in effect when the trades were executed.

spreads are related to market structure. The following section develops an empirical model to measure the difference in spreads between these two structures after controlling for other factors predicted to affect spreads.

IV. Estimation of Transaction Cost Differentials

To estimate the difference in transaction costs between the CBOE competitive market maker structure and the AMEX specialist structure, the bid-ask spreads are represented as a function of the option price, option return standard deviation, trading volume, trade size, and market structure. Following Grossman and Miller (1988), the differences in bid-ask spreads between market structures are measured with a dummy variable for the trading structure and an interaction variable between the trading structure and volume. This dummy variable, DAMEX, is zero if the option is traded on the CBOE and one if traded on the AMEX. The dummy variable measures the differential transaction costs when volume is constrained to zero and the interaction variable measures the differential effect of trading volume in the two structures. Since previous studies have employed a variety of functional forms for trading volume and for the option price, separate Box-Cox transformations are estimated for these two variables.

This empirical model is estimated for three measures of transactions cost: the quoted bid-ask spread, the current bid-ask spread, and the effective spread-1 measure. Specifications involving the percentage, rather than the level, of transaction costs were rejected as a result of instability associated with options with a price close to zero.[9] Estimates of the price and volume coefficients incorporate the Box-Cox transformations, which were separately obtained from a nonlinear least squares procedure.[10]

The regression coefficients for this empirical model are presented in table 4. The positive coefficients for price and the negative coefficients for trading volume in each specification are consistent with virtually all previous empirical studies.[11] The positive volatility coefficients are consistent with the studies by Benston and Hagerman (1974) and by Branch and Freed (1977). The positive trade size coefficients for the quoted bid-ask spread and the current spread specifications are consistent with the model by Easley and O'Hara (1987). For the effective spread-1 specification, the trade size coefficient is negative but less than one standard error below zero.

The evidence in table 4 suggests a difference in transaction costs between the AMEX and the CBOE that is consistent with Grossman and Miller (1988). The *t*-statistics for the DAMEX dummy variable are more than four standard errors below zero. The *t*-statistics for the AMEX dummy-volume interaction coefficient are more than two standard deviations above zero. The negative DAMEX coefficient implies that when volume is low the bid-ask spreads for AMEX options are less than those at the CBOE. For the quoted bid-ask spread specification, this difference is roughly 30% of the average spread. The positive interaction coefficient implies that an increase in volume will cause the bid-ask spreads at the CBOE to decrease faster than those at the AMEX. This also suggests that inventory concerns may be more important for the CBOE options. If the trading volume is sufficiently high, the interaction term becomes dominant and the CBOE spreads would, other things constant, be predicted to be lower than the AMEX spreads. This differential relation between transaction costs and trading volume provides a sharp contrast to Baesel, Shows, and Thorp (1983), who report average spreads at the AMEX to be insignificantly higher than those at the CBOE.

The *t*-statistics in table 4 are adjusted for conditional heteroscedasticity and serial correlation following White (1980) and Hansen (1982).

9. For example, in a specification search involving data from September 1985, the R^2 from a regression examining the percentage spread fell from .6 to .3 after omitting 1% of the observations. The observations deleted were those with the lowest price, or, alternatively, those with the highest percentage spread.

10. The Box-Cox parameters appear to be less than one, indicating a departure from linearity. The *t*-statistics for the hypothesis that these parameters are equal to 1.0 for the quoted, current, and effective spread-1 specifications (without a correction for serial correlation or heteroscedasticity) are -23.5, -14.7, and -14.1 for trading volume and -32.7, -17.7, and -8.7 for the option price.

11. See, e.g., Demsetz (1968), Tinic (1972), Tinic and West (1972, 1974), Benston and Hagerman (1974), Branch and Freed (1977), the SEC (1986), and Neal (1987).

TABLE 4 Estimates of the Relation between Market Structure and Three Measures of the Bid-Ask Spread

Independent Variable	Dependent Variable: Quoted Bid-Ask	Current Bid-Ask	Effective Spread-1
Intercept	.3178	.2895	.2563
	(23.19)	(25.25)	(19.22)
Price (λ_1)	.0972	.0889	.0739
	(25.02)	(23.50)	(16.86)
Option return standard deviation	.0016	.0011	.0009
	(2.69)	(2.40)	(2.23)
Trade size*	.0662	.0102	−.0023
	(2.14)	(3.57)	(−.91)
Volume (λ_2)	−.0084	−.0048	−.0064
	(−12.67)	(−15.07)	(−9.83)
Volume (λ_2) × DAMEX	.0022	.0014	.0027
	(2.84)	(3.49)	(3.37)
DAMEX	−.0680	−.0551	−.0742
	(−5.09)	(−4.53)	(−4.96)
λ_1	.2789	.5206	.6183
λ_2	.2666	.3481	.2560
$\bar{R}^2$	.48	.50	.37
No. of observations	7,560	7,337	7,337

NOTE.—The t-statistics are in parentheses. The standard errors for all regressions are adjusted for conditional heteroskedasticity and serial correlation following White (1980) and Hansen (1982). Estimates of the Box-Cox parameters, λ_1 and λ_2, were separately obtained from a nonlinear least squares procedure. The measures of bid-ask spreads are as follows:

quoted bid-ask spread = ask − bid, based on all observed bid and asked quotes;
current bid-ask spread = ask − bid, based on the quotes in effect for each transaction;

and

effective spread-1 = max[transaction price − bid price, ask price − transaction price], based on the quotes in effect for each transaction.

Each measure is related to market structure and to other factors that determine bid-ask spreads in the following regression:

$$\text{bid-ask spread}_t = B_0 + B_1(\text{price}_t^{\lambda_1} - {}^1)/\lambda_1 + B_2\sigma_t + B_3\,\text{trade size}_t + B_4(\text{volume}_t^{\lambda_2} - {}^1)/\lambda_2 + B_5[(\text{volume}_t^{\lambda_2} - {}^1)/\lambda_2] \times \text{DAMEX}_t + B_6\,\text{DAMEX}_t + u_t.$$

The DAMEX variable is one if the option is traded on the AMEX and zero if traded on the CBOE. This table is based on observations from 26 AMEX and 15 CBOE near-term, at-the-money call options. The data contain bid, ask, and transaction prices for options between January 10–15 and April 7–11, 1986. The option price is computed as the average of the bid and ask. The option return standard deviation and volume are average daily values. For a given day, and a given option, each transaction cost observation is associated with the same average values for the option return standard deviation and volume. In the quoted bid-ask spread specification, all reported bid-ask spreads are used, and the trade size variable also represents an average daily value.

* The trade size is measured in hundreds of contracts.

Since the data have both time-series and cross-sectional characteristics, the data are sorted by option, date, and time prior to estimating the autocorrelation coefficients. The autocorrelation coefficients for six lags are estimated from observations that do not overlap across options or across subperiods. These estimates are then employed in the construction of the covariance matrix. White's NR^2 test suggests the residuals are conditionally heteroscedastic; the squared residuals are a positive function of the option price and a negative function of trading volume and market structure (the CBOE residuals tend to be larger).

An important issue in table 4 is the interpretation of the t-statistics. The large number of observations is generated from only 41 options. Multiple observations from the same option may cause the significance levels to be overstated. To assess the impact of multiple observations, the regressions were reestimated when the data were aggregated into two observations for each option. Specifically, for each of the January and April subperiods, weights were constructed that measured the fraction of time a quoted spread, current spread, or an effective spread-1 was in effect. The results from these weighted regressions, available on request, are similar to those in table 4. In particular, the DAMEX coefficient is negative and between 1.90 and 3.37 standard errors below zero, and the DAMEX $\times$ volume interaction coefficient is positive and between 1.19 and 2.14 standard errors above zero. The statistical inference in table 4 does not appear to be a consequence of multiple observations for the same options.

It is also possible that the results in table 4 are consistent with the model by Glosten (1989). To investigate whether differences in adverse selection could explain the differential transaction costs, the adverse selection component of the spread is estimated following Glosten and Harris (1988). Glosten and Harris represent the observed change in price as a function of order processing costs, adverse selection, information innovations, and round-off error. Specifically,

$$\Delta\text{price}_t = c_0\Delta Q_t + c_1\Delta(Q_tV_t) + z_0Q_t + z_1Q_tV_t + u_t.$$

In this notation, Q_t is an indicator variable that is $+1$ if the transaction at time t is a buy and -1 if a sell. The transaction size is represented by V_t. The error term, u_t, incorporates information innovations and round-off error. Under the assumption that trades at the ask are buys and trades at the bids are sells, the sequence of quotes and trade prices permits a direct application of this model.[12]

Glosten and Harris show that $2(z_0 + z_1V)$ is a measure of the adverse

12. I am grateful to Larry Harris for this suggestion. Glosten and Harris (1988) did not directly estimate this specification because their data contained only transaction prices.

selection component of the spread. Separate estimates of z_0, z_1, and the average trade size for each option, however, suggest that the adverse selection component of the spread is small. The mean estimate of $2(z_0 + z_1\overline{V})$, averaged over the 41 options, is only .5 cents, or about 3% of the average spread. This point estimate is statistically insignificant and is similar to the estimate of .15 cents that is reported in Vijh (1990) for a much larger sample of CBOE options.

Collectively, this evidence has several important implications. First, the results in table 4 are consistent with the model by Grossman and Miller (1988) and do not appear to be a consequence of systematic differences in adverse selection between the two samples. The average estimated adverse selection component of the spread is much smaller than estimated differential transaction cost for low-volume options. Second, evidence of differential transaction costs suggest it may be necessary for models of market making to distinguish between specialist and competitive market maker structures. Regarding these structures as close substitutes, as in Kyle (1985) and in Glosten and Milgrom (1985), can obscure important distinctions between these structures. Third, from a policy perspective, granting an exchange an exclusive franchise for trading a particular option forces investors to pay higher transaction costs. This evidence reinforces the findings in Neal (1987) and the SEC (1986) that options that are eligible to trade on multiple exchanges have lower bid-ask spreads than options restricted to a single exchange. More generally, as discussed in Pagano and Roell (1990), exchanges in Europe and some developing countries are considering a variety of structural changes. Since transaction costs are an important factor in the design of market structures, these exchanges should consider a specialist structure for securities with relatively low trading volume.

V. Summary

This study compares the costs of transacting in two market structures for equity options: the AMEX specialist system and the CBOE competitive market maker system. Equity options provide an interesting comparison of these market structures because of the options allocation plan. In a manner similar to the National Football League draft, the allocation plan grants an exclusive franchise for trading a particular option and helps to insure the risk characteristics of the options are similar. The results of this comparison suggest the AMEX specialist structure has smaller transaction costs for low-volume options. This difference appears to diminish as volume rises. These results are consistent with a model by Grossman and Miller (1988). The AMEX structure also has a larger fraction of trades executed inside the quotes.

These findings have strong implications for regulatory policies and much of the current research in market microstructure. For example, many market microstructure models regard specialist and competitive market maker structures to be close substitutes. Evidence of systematic differences in transaction costs and the properties of transaction prices casts some doubt on these assumptions. The policy implications of these results strongly suggest that the continued sanctioning of monopoly rights to trade options is at the expense of economic efficiency. The allocation plan forces options investors to pay higher transaction costs than they would pay in a fully competitive options market. The investing public will be well served by the elimination of this regulatory barrier.

Appendix

Sample of AMEX and CBOE options

AMEX Options	*CBOE Options*
Aetna Life & Casualty	Atlantic Richfield*
Ahmanson (H.F.) & Co.	Bell Atlantic
Alaska Air Group	Cullinet
American Cyanamid	Eastman Kodak*
Bausch & Lomb	Exxon Corp.*
Bell South Corp.	Federal Express
Chesebrough-Pond's, Inc.	Grumman Corp.
Dart & Kraft, Inc.	Halliburton Co.
E. F. Hutton	Home Stake Mining
Goodyear Tire and Rubber	International Paper*
Gould, Inc.	LAC Minerals
Greyhound Corp.	Minnesota Mining and Manufacturing*
Lilly (Eli) & Co.	Pepsico, Inc.
Manufacturer's Hanover	Texas Instruments
Motorola, Inc.	Winnebago Industries, Inc.
Phelps Dodge Corp.	
Pitney Bowes	
Procter and Gamble	
Rorer Group	
Sara Lee Corp.	
Sonat, Inc.	
TRW	
U.S. Steel	
Walgreen Co.	
Warner-Lambert Co.	
Westinghouse Electric Corp.	

* Indicates option was listed on CBOE before AMEX commenced options trading.

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