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## LISTING CRITERIA FOR THE MULTIPLE LISTING OF EQUITY OPTIONS

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*Equity options are listed on the American Stock Exchange, Chicago Board Options Exchange, Philadelphia Stock Exchange, Pacific Stock Exchange, International Securities Exchange, and Boston Stock Exchange. This study identified the criteria for selection of options for listing over the August-September 1999, 2000-2002, and 2003-2005 periods. Trading volume and size were the primary selection criteria for all three periods. Volatility was a selection criterion during the preperiod (1997-1998) only. No clearly defined selection criteria emerged for listings on the third exchange in 2000-2002 or on two or three exchanges in 2003-2005.*

### INTRODUCTION

Options are traded throughout the world both in European countries, and in more distant locations such as India, Greece, and Romania. In the U.S., options may be listed on up to six exchanges including the American Stock Exchange (AMEX), Chicago Board Options Exchange (CBOE), Philadelphia Stock Exchange (PHLX), Pacific Stock Exchange (PCX), International Securities Exchange (ISE), and Boston Stock Exchange (BOX). Equity options listings commenced in 1973 with options on IBM and Johnson & Johnson stock being among the earliest listings on the Chicago Board Options Exchange. An examination of the criteria used to list options on exchanges over time may provide insight into the development of the U.S. options market and thereby provide a framework for the evolution of options markets in other countries.

The first milestone (until 1998) in equity options listings was the initial listing decision that determined the criteria to select or reject options for listing. A single empirical study determined that the stock underlying listed options had higher long-term volume, long-term volatility, short-term volume, and market capitalization from 1973-1991 (Mayhew & Mihov, 2004). The second milestone was the widespread adoption of multiple listing, or the listing of options on several exchanges from August-September 1999 to the present. The nature of multiple listing changed over time from the listing of options on a second exchange in August-September 1999 to listings on three, four and five exchanges from 2000-2002, and three to six exchanges in 2003-2005 (two new options exchanges the International Securities Exchange and the Boston Options Exchange started trading options in 2000, and 2003 respectively). The assumption that higher volume, volatility, and market capitalization that predicted listings on a single exchange has to be tested for an environment dominated by multiple listing as the relative dominance of these criteria may have shifted over time.

There may be subperiods in which one or more of these criteria dominate. For example, Mayhew and Mihov (2004) partitioned their sample into subperiods from 1973-1978, 1980-1984, 1985-1990, and 1991. In the first subperiod, size dominated followed by volatility during the second subperiod, and size and short-term trading volume during the final two periods. There is need for empirical examination to identify such subperiods in a multiple listing environment. Fine

distinctions need to be drawn by establishing the parameters for listing on two, three, four, five, or six exchanges. For example, if it is established that market capitalization is a determinant of the multiple listing decision, the next question is the level of market capitalization for optioned stock listed on two, three, four, five, or six exchanges. Accordingly, this study commences with an identification of the criteria used for multiple listing on 2-6 exchanges. This is followed by specification of the ranges for the predictors over distinct time periods. Empirical investigations during the post-2000 period are rare. The Berkeley Options Database, the standard source of options data since 1973, ends in 1996. There is a paucity of literature using post-1996 options data. This study is unique in its usage of post-2000 Options Industry Council data. This offers the obvious advantage that current data captures the dynamics of contemporary financial markets more effectively. Electronic trading may only be examined by post-1999 data as it did not exist before 2000.

### Review of Literature

Option listing decisions are made by exchanges with a committee on each exchange being charged with the responsibility for selection with input from the entire membership. Our discussion of relevant literature is subdivided into two sections. First, we describe the regulatory environment pertaining to options listings. This is followed by a detailed examination of Mayhew and Mihov's (2004) findings of the criteria relevant for initial options listing.

### Regulatory Environment for Options Listings

On options exchanges, market makers are compensated for the function of making options available to customers. From 1975-1985, options exchanges enjoyed a monopoly position by ensuring that options were listed on a single exchange. Spreads charged by individual exchanges rose in the absence of competitive pressure (Securities and Exchange Commission, 2000). Early attempts at multiple listing were successfully thwarted by the exchanges. In 1976, at the urging of the Securities and Exchange Commission (henceforth SEC), the first multiple listing occurred on Boise-Cascade stock trading on both the Philadelphia and Chicago Board Options Exchanges. A year later, options on 22 stocks were multiple listed. These options were systematically delisted. Alarmed by

the potential for jeopardy to the future of multiple listing, the SEC imposed a moratorium on new options listings pending a report on the potential effects of multiple listing, with new listings being assigned to a single exchange through an Allocation Plan implemented in May, 1980. In 1989, the SEC decided to support multiple listing passing Rule 19-c, barring exchanges from establishing any practice that prevented multiple listing.

Yet, Rule 19-c was not enforced for a decade. Danis (1992) examined multiple listing effects on two datasets from 1985-1992. She found increases in spreads on three of four option classes studied suggesting that multiple listing effects had not come to fruition as of 1992. Rule 19-c was finally enforced in 1999, with the Justice Department filing a suit against the American Stock Exchange wherein exchanges was forbidden from "maintaining, or renewing an agreement to limit competition among themselves by not listing equity options that were previously listed on another exchange (De Fontnouvelle et al., 2003; United States of America vs. American Stock Exchange: 2000:2). The suit was settled upon the exchanges accepting a consent decree to substantially reform and monitor the options markets with a view toward increasing competition.

The exchanges entered into an options campaign designed

to attract other exchanges into purchasing options that had hitherto been single listed. Although the duration of the campaign was just a single month (August-September, 1999) its close saw the transfer of 37% of all equity options (puts and calls combined) from single to multiple listing (De Fontnouvelle et al., 2003).

Several studies observed spread reductions following multiple listing. De Fontnouvelle et al. (2003) observed that multiple listing was the most powerful predictor of the reduction in spreads both in the immediate aftermath of multiple listing and one year later for both put and call options. Mayhew (2002) found that for 1620 matched pairs (matched by industry) of newly delisted options, quoted spreads on the CBOE expanded after delisting with a highly significant mean change of .02277 ( $p < .01$ ) between the pre-and post-delisting periods. Battalio et al. (2004) found that spreads narrowed from 100 percent to 56.56 percent a year after the commencement of the options campaign, and a further 35.59 percent a year and a half later. Spreads narrowed still further with the advent of electronic trading. Average quoted spreads on the first 22 options subjected to electronic trading at the CBOE decreased by 20% over a 20-day trading period. Effective spreads decreased by 17% (SEC, 2004). Figure 1 provides a visual timeline of these developments.

**Figure 1: Timeline for Regulatory Changes in the Options Market, 1975-2000**

1973	1980	1989	February 1999	September 1999	2000
Equity options listing begins	Allocation Plan goes into effect	Rule 19-c passed by SEC	Justice Dept files suit against AMEX	Options Campaign	Campaign Trading Begins

## Empirical Research on Options Listings

Literature on options listings is sparse, with the Mayhew and Mihov (2004) study being the sole empirical study covering the period 1973-1996. They specified a logit model of option listing (a dummy variable with values of 1 for selected options and 0 for non-selected options) as a function of stock characteristics including volume, volatility, and size. Volume had a long-term and short-term component, with the long-term component being measured over the past 250 days, and the short-term component over the past 30 days. Given that options listings could be either due to permanent stock characteristics or changing market conditions, it was considered necessary to include the long-term component as a measure of the former and the short-term component as an indicator of the latter. They placed structural breaks in their model to cover regulatory changes over four time periods, i.e., 1973-1977, 1980-1985, 1985-1991, and 1991-1996.

The first period was considered the period of introduction of options listing, followed by the moratorium, the expansion of listing to include OTC stocks, finally, the beginning of limited multiple listing. Volatility and short-term volume emerged as the most significant predictors over all time periods. With the exception of the 1985-1991 period, long-term volume was a significant predictor in the other time periods. This suggests that exchanges list volatile, heavily traded stocks. Regarding volume, as the coefficient on long-term volume

declined over time that on short-term volume increased supporting the position that as options markets grow and mature, exchanges make the transition from listing based on permanent stock characteristics to changing market conditions. Size was significant until 1991, which suggests a natural progression of listing large optioned stocks first and smaller optioned stocks in the future.

## Hypotheses Development

It would be useful to extend Mayhew and Mihov's (2004) selection criteria for initially listing options on one exchange in the pre-1996 era to the listing of options on multiple exchanges in the post-1999 period. If option volume, volatility, and market capitalization are the selection variables for listing options on one exchange, it may follow that these very criteria are used for listing on more than one exchange with possible variations over time periods. Our analysis will be conducted over three distinct time periods to conform to changes in the nature of multiple listing. During the options campaign of August-September 1999, multiple listing was primarily listing on a second exchange. From October 1999-2002, multiple listing evolved to listing on up to five exchanges with the opening of the International Securities Exchange in 2000. Listing venues expanded to six exchanges from 2003-2005 with the advent of trading on the Boston Exchange. Figure 2 depicts these subperiods.

**Figure 2: Flow of Multiple Listings over Time Periods**

Pre-period	Period 1	Period 2	Period 3
	2-Exchange Listing	3- Exchange Listings	4-6 Exchange Listings
Prior to August 1999	Aug.-Sep. 1999	1999-2002	2003-2005

### Effect of Volume on Multiple Listing

Committee members select options on the basis of their future profit potential. Intuitively, they make forecasts of option trading demand, first selecting options with a history of the highest trading volume. When multiple listing first began during the options campaign, options on such heavily traded stock must have been listed on the second exchange and continued to be listed on third or higher exchanges in subsequent time periods. The demand for options is derived in the sense that the demand for an option is based upon demand for the underlying stock. For example, options on IBM stock may be considered to be in high demand because of the reputation of IBM. Therefore, option trading volume must be directly related to stock trading volume. As long as the options market is viewed as a substitute venue for the trading to the stock market, demand for both types of volume will demonstrate similar influences. Investors who own the underlying stock will raise the demand for options as they wish to write covered calls. Finally, large trading volume in the stock market renders hedging easier for options market makers lowering transaction costs for options (Mayhew & Mihov, 2004). To the extent that stock trading volume is permanently influenced by options trading demand, long-term volume should be a determinant of multiple listing on two or more exchanges.

Yet, as more stocks become multiple listed, there may be listings of less heavily traded optioned stock which may be subject to heterogeneous beliefs regarding future trading demand. Committee members may diverge in their forecasts of future trading demand with certain members favoring listing and others being more cautious. Short-term trading volume may be a proxy for listing decisions based on such heterogeneous beliefs.

**Hypothesis 1:** Exchanges chose to multiple list options whose stock had higher trading volume during the options campaign period, 2000-2002, and 2003-2005.

### Effect of Volatility on Option Listings

Mayhew and Mihov (2004) set forth several arguments to support the thesis that exchanges will prefer to list highly volatile optioned stock. Investors may consider the options market to be a substitute location to the stock market for trading. If they have heterogeneous beliefs about a stock's volatility, with estimates of volatility varying more for highly volatile than less volatile stocks, those that believe that the stock's volatility is excessive may choose to trade in the options market instead thereby increasing the demand for the option for stocks with high volatility, and in turn, the likelihood that those options will be listed. Investors who hedge risk in the options markets will choose to hedge highly volatile stocks

over less volatile stocks. Finally, gamblers who enter the options markets with the hope of profiting excessively will prefer highly volatile stocks.

**Hypothesis 2:** Exchanges chose to multiple list options whose underlying stock had higher volatility during the options campaign period, 2000-2002, and 2003-2005.

### Effect of Size on Option Listings

Large firms are more visible and better known. For example, options on Dell and Microsoft were listed on several exchanges as soon as the options campaign commenced in 1999, making them among the first options to be multiple listed (De Fontnouvelle, et al., 2003). Therefore, size may be considered to be a factor in selecting stocks for multiple listing. The most common proxy for size is market capitalization defined as the product of price and the number of shares outstanding.

**Hypothesis 3:** Exchanges chose to multiple list options whose underlying stock had higher market capitalization during the options campaign period, 2000-2002, and 2003-2005.

The above discussion provides direction for this study. First, we will classify options on the basis of being listed on two or more exchanges. Next, we will test hypotheses to establish the selection criteria for multiple listing. Finally, we will define ranges for the selection variables obtained in the first step.

## METHODOLOGY

### Data and Sample Characteristics

Using data provided by the Options Industry Council, we identified the underlying stock for options that remained single listed (non-selected) and those that became multiple listed during the options campaign. Monthly volume figures from the Options Industry Council's historical volume time series were compared to obtain the month of listing on each exchange. For example, options on Amgen stock are listed on all six exchanges. They were listed on the AMEX before August 1999, on the CBOE and PCX during the options campaign, i.e. September 1999, on the PHILX in December 1999, the ISE in January 2001 and the BOX in February 2004. Archer Daniels Midland's options were listed on five exchanges in this order: before August 1999 on the PCX, November 1999 on the CBOE and PHILX, September 2001 on the ISE, and July 2004 on the AMEX. CRSP (Center for Research in Security Prices) data on price, volume, volatility, and number of shares outstanding for 250 days prior to the date of multiple listing was extracted. Market capitalization was computed as the product of price and

the number of shares outstanding. Short-term volume was obtained as the daily volume for 30 days prior to multiple listing.

### Analytic Procedure

Preliminary hypotheses testing consisted of bootstrap resampling multiple comparison tests to compare means of selected and non-selected optioned stock followed by discriminant analysis to identify the predictors that differentiated between listings on 1-6 exchanges. These results were confirmed by logistic regressions which was adapted from Mayhew and Mihov's (2004) formulation.

$$\text{pr}(\text{LST}) = \beta_1 \text{VOL} + \beta_2 \text{VLT} + \beta_3 \text{MCAP} + \beta_4 \text{ABSVOL} \quad (1)$$

$\text{pr}(\text{LST})$  = probability of multiple listing

$\text{VOL}$  = long-term volume of the underlying stock

$\text{VLT}$  = Volatility of the underlying stock

$\text{MCAP}$  = natural logarithm of market capitalization of the underlying stock

$\text{ABSVOL}$  = short-term volume of the underlying stock

For regressions involving the listing of options on four exchanges, the dependent variable,  $\text{LST}$ , the probability of listing on the fourth exchange, was binary coded with 0 for options listed on 3 exchanges, and 1 for options listed on 4 exchanges. Options selected for listing on the fourth exchange were drawn from those listed on 3 exchanges, so that those that remained listed on 3 exchanges became options that were none selected for the fourth exchange. For regressions involving the listing of options on five exchanges,  $\text{LST}$ , the probability of listing on the fifth exchange was binary coded with 0 for options listed on 4 exchanges, and coded 1 for options listed on 5 exchanges.  $\text{LST}$  was coded with 0 for options listed on 5 exchanges, and coded 1 for options listed on 6 exchanges. The procedure was repeated for options listed on six exchanges. These relationships are depicted in equations 2-4.

$$\text{pr}(\text{LST}_{3,4}) = \beta_1 \text{VOL} + \beta_2 \text{VLT} + \beta_3 \text{ABSVOL} + \beta_4 \text{MCAP} \quad (2)$$

Table 1: Results of Discriminant Analysis During the Preperiod, 1997-1998

Variable	Coefficient	Significance
Volume	.0	.00028*
Volatility	14.51	.0042*
Market Capitalization	.039	.0400*

Bootstrap resampling methods were used to perform multiple comparisons of means of predictor variables for listings on up to two exchanges during the options campaign, up to five exchanges during 2000-2002 subperiod and up to six exchanges from 2003-2005. Bootstrap resampling was chosen to permit the normality assumption to be relaxed so that differences between predictor variables of optioned stock may be tested for significance using multiplicity-adjusted bootstrap  $p$  values. Estimations of means are conducted with the implicit assumption that residuals come from an unspecified distribution. To account for the character of the unspecified distribution, a pooled collection of residuals is sampled with

$$\text{pr}(\text{LST}_{4,5}) = \beta_1 \text{VOL} + \beta_2 \text{VLT} + \beta_3 \text{MCAP} + \beta_4 \text{ABSVOL} \quad (3)$$

$$\text{pr}(\text{LST}_{5,6}) = \beta_1 \text{VOL} + \beta_2 \text{VLT} + \beta_3 \text{MCAP} + \beta_4 \text{ABSVOL} \quad (4)$$

$\text{pr}(\text{LST})$  = probability of multiple listing on 3 of 4 exchanges, 4 or 5 exchanges, 5 or 6 exchanges

$\text{VOL}$  = long-term volume of the underlying stock

$\text{VLT}$  = Volatility of the underlying stock

$\text{MCAP}$  = natural logarithm of market capitalization of the underlying stock

$\text{ABSVOL}$  = short-term volume of the underlying stock

Results of the logistic models were tested by regressing option volumes for the six-month period following multiple listing on probabilities of successful prediction of multiple listing by the above models. The probability that the model presented in equations 1-4 successfully predicted the likelihood of multiple listing was initially obtained. The underlying stock's volume, volatility, market capitalization, and short-term volume were extracted using the CRSP database for the six-month period following multiple listing. Option volumes for the volume of options traded on 2-6 exchanges for the same period were obtained from the Options Industry Council. Option volumes were regressed on the probabilities to test if the logit models successfully predicted the probability of multiple listing. Ranges of optioned stock characteristics were obtained for each predictor variable over every subperiod.

### Results

Preliminary analysis consisted of comparing optioned stock selected and non-selected for multiple listing during the preperiod of 1997-98. As Mayhew and Mihov (2004) had examined listings from 1973-1996, and this study commenced with the options campaign of 1999, the preperiod of 1997-98 needed to be examined to determine if any or all of the predictor variables significantly discriminated between selected and non-selected optioned stock. Results of the logistic discriminant analysis are shown in table 1. With 77.55% of the cases classified correctly, all three predictors, volume, volatility, and market capitalization were significant ( $p < .05$ ).

replacement.  $P$  values are computed from the bootstrap sample, the process is repeated and a single-step adjusted  $p$ -value for any test is the percentage of samples for which  $\min p^*_{j1} \leq p_{j1}$  (Westfall et al., 1999).

In table 2 below, mean volumes and market capitalizations were significantly different for single and multiple (two-exchange) listings during the options campaign, three and four, four and five exchange listings from 2000-2002, and three and four, four and five, and five and six exchange listings from 2003-2005. From 2003-2005, market capitalization showed inexplicable reversal of sign with listings on two exchanges having higher mean market capitalizations than those on three

exchanges. Volatility did not show significant differences between any 2 exchange listings over any subperiod.

**Table 2: Pairwise Comparison of Means Using Bootstrap Resampling During the Options Campaign, 2000-2002, and 2003-2005**

Variable	Period	Exchanges	Difference Between Means
Volume	Options Campaign	1 and 2	1,132,462***
	2000-2002	1 and 2	192,845
	2000-2002	2 and 3	13,447
	2000-2002	3 and 4	322,701*
	2000-2002	4 and 5	810,943*
	2003-2005	1 and 2	37,315
	2003-2005	2 and 3	-68,451
	2003-2005	3 and 4	133,340*
	2003-2005	4 and 5	698,948***
	2003-2005	5 and 6	3,001,075***
Volatility	Options Campaign	1 and 2	0
	2000-2002	1 and 2	-0001
	2000-2002	2 and 3	0080
	2000-2002	3 and 4	-0090
	2000-2002	4 and 5	-0300
	2003-2005	1 and 2	-0040
	2003-2005	2 and 3	-0010
	2003-2005	3 and 4	-0010
	2003-2005	4 and 5	-0230
	2003-2005	5 and 6	0010
Market Capitalization (in thousands)	Options Campaign	1 and 2	148,347,150***
	2000-2002	1 and 2	330,110
	2000-2002	2 and 3	1,301,790
	2000-2002	3 and 4	30,789,40***
	2000-2002	4 and 5	19,770,220***
	2003-2005	1 and 2	41,958,410***
	2003-2005	2 and 3	-37,388,250***
	2003-2005	3 and 4	7,211,200**
	2003-2005	4 and 5	18,392,320***
	2003-2005	5 and 6	143,719,260***

\*Significant p values

Logistic regression results (see table 3) indicate that for the options campaign, volume (both long-term and short-term) and market capitalization were significant in explaining the probability of multiple listing. In table 3 below, both long-term and short-term volumes have been rounded to 0 from 5 decimal places. From 2000-2002, these predictor variables were only significant for listing on four and five exchanges. Also, from

2003-05, the predictors only explained the criterion for listings on four, five, and six exchanges. The selection variables did not explain the selection of options for listing on two or three exchanges. Hence, hypotheses 1-3 were fully supported for the options campaign, and partly supported for the other two subperiods. Hypothesis 2 was not supported. Volatility did not significantly explain listings during any subperiod.

**Table 3: Results of Logistic Regression to Establish the Criteria for Multiple Listing**

Regression of the Probability of Multiple Listing on Volume, Volatility, and Market Cap						
Variable	Options Campaign Multiple Listing	2000-2002 4 Exch.	2000-2002 5 Exch.	2003-2005 4 Exch.	2003-2005 5 Exch.	2003-2005 6 Exch.
Volume	0*	0*	0*	0*	0*	0*
Volatility	-0.67	-2.25*	-1.34	-1.12	1.55	-0.91
Logarithm of Market Capitalization	.015*	.0002*	0.032*	0.077*	0.017*	0.16*
Short-Term Volume	0*	0*	0*	0*	0*	0*
N	242	70	100	235	192	240

\*significant p values

**Table 4: Regressions of Option Volumes During the Six-Month Period Following Multiple Listing on Probabilities of Successful Prediction of Multiple Listing**

Variable	Options Campaign	2000-2002 4 Exchanges	2000-2002 5 Exchanges	2003-2005 4 Exchanges	2003-2005 5 Exchanges	2003-2005 6 Exchanges
Constant	7.72	2.78	0.06	-4.11	9.15	0.00
Probabilities	2.33*	6.30*	0.12*	14.16*	0.65*	10.20*
R <sup>2</sup>	0.97	0.98	0.98	0.96	0.96	0.89

\*significant p values

**Table 5: Descriptive Statistics for Optioned Stock Selected for Listing During the Options Campaign, 2000-2002, and 2003-2005**

Panel A: Options Campaign (Variable)	Stock Selected for Multiple Listing (Mean)	Standard Deviation	Maximum	Minimum
Volume	1,331,874	221,486	2,068,880	377,164
Market Capitalization	159,793,440	22,301,430	192,951,400	108,492,650
Panel B: 2000-2002	Stock Selected For Listing on 4 Exchanges			
Volume	733,244	308,514	3,848,874	200,812
Market Capitalization	51,026,020	18,134,840	92,013,190	12,104,910
	Stock Selected For Listing on 5 Exchanges			
Volume	1,544,187	616,960	4,850,000	410,076
Market Capitalization	70,796,240	36,773,400	143,383,970	23,772,740
Panel C: 2003-2005	Stock Selected for Listing on 4 Exchanges			
Volume	541,475	139,396	1,345,493	159,886
Market Capitalization	20,191,940	3,682,560	26,926,600	14,142,590
	Stock Selected for Listing on 5 Exchanges			
Volume	1,240,423	435,889	3,782,366	360,720
Market Capitalization	38,584,260	5,373,690	51,730,150	27,461,400
	Stock Selected for Listing on 6 Exchanges			
Volume	4,241,498	833,647	6,046,236	1,139,608
Market Capitalization	182,303,520	8,648,520	200,028,160	161,404,710

Market capitalization is listed in 1000's

In table 4, all logistic regression results were confirmed as the probability of multiple listing from the underlying stock's volume, and market capitalization significantly predicted option volumes in the six months following multiple listing. Table 5 establishes the parameters of underlying stock volume and market capitalization for options selected for listing over all three subperiods. Volatility is not shown as it was not found to be a significant predictor of the probability of multiple listing in any of the subperiods under consideration. Specifically, the table depicts the descriptive statistics including range, mean and standard deviation for optioned stock selected for listing on two exchanges in August-September 1999, four and five exchanges in 2000-2002, and four, five, and six exchanges in 2003-2005.

### Conclusions and Practical Implications

It may be questioned whether there is a need for this study at all to the extent that the exchanges would provide information about the basis of their selection choices. In personal communication (Mayhew & Mihov, 2004) it was found that the exchanges were forthcoming in general terms, i.e. they stated that they used volume or volatility but did not have qualifying information about specific subperiods such as the vanishing of size from 1991-1996, only for it to reappear immediately after that subperiod. We have undertaken to provide specific information about a series of subperiods and the number of exchanges on which multiple listing has occurred. We have established that long and short-term trading volume and size of the underlying stock formed the criteria for selection of options listed on two or more exchanges during the options campaign, four or five exchanges from 2000-2002, and five or six exchanges from 2003-2005. Given the earlier time line of events and empirical findings that we constructed in figure 2 we can create a revised time line to incorporate these findings. None of the variables were significant predictors in every time period from 1973-2005. 1997 represents a structural break in that the decision shifted from whether options should be listed or not to whether they should be single or multiple

listed. Long-term volume and size appeared to be the most stable predictors. Both, with the exception of a single period, significantly predicted the probability of listing from 1973-1996 and the probability of multiple listing from 2-6 exchanges from August-September 1999- 2005.

As long as the options market is a substitute venue for trading to the stock market, it is possible that investors on all exchanges who own the underlying stock are raising the demand for options listed as they wish to write covered calls. Large trading volume in the stock market renders hedging easier for the options market makers lowering transaction costs for options regardless of the number of exchanges on which they are listed (Mayhew & Mihov, 2004). There does not appear to be any explanation for the lack of significance of long-term volume from 1985-1991. The lack of significance of size from 1991-96 may be due to listing at the end of the listing cycle, with large optioned stock having been selected so that listing was occurring on smaller stocks (Mayhew & Mihov, 2004). Short-term volume appeared to be significant in all periods, except at the end of the listing cycle, possibly because new exchanges are initially faced with technological and regulatory changes that prevent listing, and begin to list as these restraints are relaxed. In this regard, exchanges did show some response to changing market conditions (Mayhew & Mihov, 2004) for initial, single listings but not for multiple listings as short-term volume was a significant predictor of the probability of multiple listing in all subperiods.

The most surprising finding is the disappearance of volatility as a criterion from the options campaign period-2005. Exchanges chose more volatile stocks for initial single and very early multiple listing on two exchanges (see column 5, covering the 1997-98 period) but did not continue to select them for multiple listing on a higher (four or more) number of exchanges. Future research should test the arguments to support the inclusion of volatility as a selection criterion. It is possible that one or more of these arguments do not hold under modern market conditions. The first argument was that investors may consider the options market to be a substitute

venue to the stock market for trading. If they have heterogeneous beliefs about a stock's volatility, with estimates of volatility varying more for highly volatile than less volatile stocks, those that believe that the stock's volatility is excessive may choose to trade in the options market instead thereby increasing the demand for the option for stocks with high volatility, therefore, the likelihood that those options will be listed. This may be tested empirically by relating

heterogeneous expectations of volatility (measured by the standard deviation of volatility estimates on selected stock) to put and call volumes of selected and non-selected optioned stock. The second argument was that investors who hedge risk in the options markets will choose to hedge highly volatile stocks over less volatile stocks. The volatility of optioned selected and non selected stock may be related to hedge ratios.

Figure 3: Flow of Multiple Listings and Empirical Findings Over Time Periods

1973-1977 Decision: Listing vs. No Listing Criteria	1980-1985 Decision: Listing vs. No Listing Criteria	1985-1991 Decision: Listing vs. No Listing Criteria	1991-1996 Decision: Listing Vs. No Listing Criteria	1997-1998 Decision: Single Vs. Multiple Listing on 2 Exch. Criteria	Options Campaign, Aug-Sept 1999 Decision: Single vs. Multiple Listing on 2 Exch. Criteria	2000-2002 Decision: Multiple Listing on 4 and 5 Exch	2003-005 Decision: Multiple Listing on 4, 5, and 6 Exch.
Long-term Volume	Long-Term Volume	---	Long-Term Volume	Volume	Long-Term Volume	Long-Term Volume	Long-Term Volume
Short-term Volume	Short-Term Volume	Short-Term Volume	---		Short-Term Volume	Short-Term Volume	Short-Term Volume
Volatility	Volatility	Volatility	Volatility	Volatility	---		
Size Mayhew & Mihov, 2004)	Size (Mayhew & Mihov, 2004)	Size (Mayhew & Mihov, 2004)	(Mayhew & Mihov, 2004)	Size (Current Study)	Size (Current Study)	Size (Current Study)	Size (Current Study)

The predictor variables did not explain listing on the second or third exchange from 2000-2002 or 2003-2005. Multiple comparison tests did not find significant differences between means for listings on one, two, or three exchanges. There does not appear to be any immediate explanation for this phenomenon. Exchanges may have used different criteria for listing on the second or third exchange. Future research must isolate these multiple listings to detect their determinants.

The endogeneity of the listing decision has been recognized throughout this study. Although this appears apparent in that listings on a exchange depend on characteristics of the underlying stock rather than the option, it was not recognized in early options studies. A series of studies (Danis, 1992; Khoury & Fischer, 2002; Neal, 1992) used option price, volume, volatility and market capitalization as predictors of bid-ask spreads. It was only recently with Danis's (2003) subsequent work on spreads and Battalio, Hatch and Jennings's (2004) testing of the existence of a National Market System that stock rather than option characteristics began to appear in the literature as predictors of spreads.

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