Option Market Activity and Behavioral Finance [*]

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August 26, 2003

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ABSTRACT

This paper investigates the behavior of investors in the equity option market using a unique and detailed dataset of open interest and volume for all contracts listed on the Chicago Board Options Exchange over the 1990 through 2001 period. We find that for both calls and puts the short open interest of non-market maker investors is substantially larger than the long open interest. We also find that all types of non-market maker investors display trend-chasing behavior in their option market activity. In addition, we show that the least sophisticated group of investors substantially increased their purchases of calls on growth stocks during the stock market bubble of the late 1990s and early 2000 while none of the investor groups significantly increased their purchases of puts during the bubble in order to overcome short sales constraints in the stock market. Ideas from the behavioral finance literature are particularly helpful in explaining our results. In particular, a number of our findings are consistent with option market investors being loss averse, framing over narrow segments of their portfolios, and attempting to avoid financial decisions that they will later regret.

Although the seminal work of Black and Scholes (1972) and Merton (1973) has led to a great deal of research into methods for pricing and hedging of stock options, relatively little is known about how investors actually employ this important class of securities. This paper investigates the behavior of equity option market investors. We address a number of questions: What positions are undertaken in the option market? Does the use of the option market differ among investors with varying degrees of sophistication? How big is the option market relative to the underlying stock market? What triggers investor interest in options? Are behavioral factors important for understanding the use of these securities? Do option market investors chase trends or act as contrarians? How did the stock market bubble of the late 1990s and early 2000 affect investor activity in the option market? What strategies became more popular and how did the bubble impact the behavior of different types of investors? Does option market activity yield any insight into the development of the bubble? Does this activity give any indication of who contributed to the bubble?

We use a unique option dataset which makes it possible to effectively address these questions. Our dataset contains detailed daily open interest and volume information for all options listed at the Chicago Board Options Exchange (CBOE) from 1990 through 2001. All of the data are broken down by different types of investors. In addition, the open interest data provide long and short positions for each investor type. The volume data are classified according to whether an investor type is buying or selling and also according to whether it establishes new option positions or closes existing ones. Most other datasets, by contrast, provide only aggregate daily open interest and volume for each option.[1]

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[1] The Berkeley Options Database and the CBOE MDR data provide time-stamped trade-by-trade information on option transactions. They do not, however, break down option volume by different investor types or according to

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It is difficult to formulate predictions about option market activity with confidence. One reason that predictions are not straightforward is that the option market investors hold other financial instruments, including underlying stocks, and it seems likely that the basic factors that motivate investors to trade will lead to interactions between their option market and non-option market positions. Predictions are also complicated by the fact that the financial industry can use options to create precisely tailored payoffs that appeal to the behavioral predilections of investors. With these caveats in place, we will make four predictions at the outset that are consistent with standard economic theory, prior literature, and the observed behavior of investors in the stock market.

Our first prediction follows from the well known fact that long positions in stocks substantially exceed short positions. Since call options are effectively levered positions in the underlying stock, one might well expect non-market maker option investors to hold more calls long than short.

It is also reasonable to expect that non-market maker investors will hold more long put than short put positions. The main reason is that short-sales restrictions constitute an important limit to arbitrage in the stock market (Chen, Hong, and Stein (2002), D'Avolio (2002), Geczy, Musto, and Reed (2002), Lamont and Jones (2002), Ofek and Richardson (2003), and Diether, Malloy, and Scherbina (2002)), and buying puts is a way to overcome these restrictions. In addition, selling puts may be unpopular because such sales establish long positions in the underlying stock, but there are more straightforward ways to get long stock positions (e.g., just buy the stock or a call on the stock.)

whether it is being used to open a new option position or close an existing one. They also do not indicate whether option transactions are buyer or seller initiated – although an approximate classification into buyer and seller initiated can be achieved through the use of the Lee and Ready (1991) algorithm.

Our third prediction concerns positive feedback trading or the tendency to buy past winners and sell past losers. Positive feedback trading has the potential to explain a number of important financial phenomena such as excess volatility (Shiller, 1981), momentum (Jegadeesh and Titman, 1993), and return reversals (DeBondt and Thaler, 1985). Lakonishok, Shleifer, and Vishny (1992) investigate the conventional wisdom that institutions destabilize stock prices by herding and engaging in positive feedback trading. Although they find some evidence of institutional herding and positive feedback trading for small stocks, they also find that institutions neither herd nor follow positive feedback trading strategies in the larger stocks that tend to have options trading on them. More recently Grinblatt and Keloharju (2001) find that in Finland institutional investors also place relatively little weight on past returns when deciding whether to buy or sell a security while individual investors behave as contrarians insofar as they are more predisposed to sell than to buy stocks with large past returns. Based on this evidence, we would expect to see that public customers trade as contrarians in the option market and that firm proprietary traders are not influenced in their trading by past stock price behavior. This expectation is tempered, however, by the fact that there is also some evidence from the US market that institutional investors are momentum investors who tend to follow past prices (Grinblatt, Titman, and Wermers (1995)) and that there is a positive contemporaneous relationship between stock returns and changes in institutional ownership that is stronger than any trend-chasing effect (Nofsinger and Sias (1999) and Wermers (1999).)

It is important to note that since shares of stock are in fixed supply (at least in the short-run), all of the stock market studies provide information only on the relative desire to chase trends or place contrarian bets among the different types of investors. For example, if both institutional investors and individuals want to buy after price increases but this desire is stronger

for the institutional investors, then institutional investors will on net buy stock from individual investors after stock price increases. Since option contracts, by contrast, can be created whenever an investor wants to trade, both institutional investors and individuals can be net buyers of new calls after an underlying stock increases in price. All in all, the existing literature does not provide us with a clear cut prediction about whether individual investors and/or institutions will behave as trend-chasers or contrarians. We will not be surprised if the results are inconclusive.

Our final prediction is based on research into the bubble in growth stocks during the late 1990s and early 2000 which has emphasized the role of stock market short-sales constraints in inflating and maintaining the bubble (Ofek and Richardson (2003) and Brunnermeier and Nagel (2002)). In light of this widespread explanation of the very high valuations for growth stocks, it is natural to expect an increase in put buying on growth stocks during the late 1990s and early 2000 as investors make bets against the high-flying growth stocks that could not be made easily by shorting the stocks directly.

We begin our analysis by determining the average daily long and short, put and call open interest for different types of investors for various categories of stocks such as large capitalization stocks and value and growth stocks. We also determine for the different investor types and categories of stocks average daily volume of call and put purchases to open new positions as well as call and put sales to open new positions. We next regress each of these four volume categories on the underlying stock returns over various past horizons, underlying stock book-to-market (BM) ratios, and underlying stock volatilities. These regressions help us both to understand the factors that motivate option market activity and also to assess the extent to which the different investor types are trend-chasers or contrarians with respect to returns over various

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past horizons. We also use the regression results to investigate the impact on daily option

volume of shocks to the independent variables. The analyses are first performed over our entire

sample period from 1990-2001 and then over subperiods to see how option trading changed over

time. We focus on changes in option investor behavior during the stock market bubble of the

late 1990s and early 2000. We also repeat the analyses after dividing the options into those

written on underlying value and growth stocks. Here again, we are especially interested in

differences between options written on value and growth stocks during the bubble period. We

also investigate changes in investor behavior after the bubble started to burst.

Some of our key results are consistent with predictions from the behavioral finance and

economics literature.[2] We find that participants in the option market trade as loss averse

investors who engage in narrow framing so that they can feel "good" about their financial

decisions by avoiding outcomes that they will regret. *Loss aversion* is a central feature of

Kahneman and Tversky's (1979) prospect theory. Prospect theory investors obtain utility from

gains and losses rather than from total levels of wealth, and loss aversion corresponds to greater

sensitivity to losses than to gains. Thaler (1980) introduced the term *mental accounting* to refer

to the way people think about and evaluate their financial decisions. *Narrow framing* is a form

of mental accounting in which investors evaluate the performance of small subsets of their

portfolios rather than their portfolios as a whole as they would in standard economic theory.

Redelmeier and Tversky (1992), Kahneman and Lovallo (1993), Gneezy and Potters (1997),

Thaler, Tversky, Kahneman, and Schwarz (1997), Benartzi and Thaler (1999) and Rabin and

Thaler (2000) present various evidence that agents engage in narrow framing. Barberis and

Huang (2001) show that an asset pricing model in which loss averse investors frame narrowly on

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[2] In a seminal paper on behavioral finance and the option market, Stein (1989) shows that S&P 100 index options
are priced as if investors overreact to changes in the volatility of the underlying index. This paper, by contrast,
focuses on option activity rather than option prices and on options on individual stocks rather than on a stock index.

individual stock holdings can account for many important anomalies in the cross-section of stock returns. Recently, Barberis, Huang and Thaler (2003) argue that utility functions need to exhibit narrow framing to accommodate common attitudes to simple monetary gambles and that narrow framing provides an attractive avenue for addressing the equity premium puzzle.

Our first main finding is that, counter to the expectation laid out above, non-market maker investors have short call open interest positions that are larger than their long call open interest positions. In addition, short call positions are held substantially longer than long call positions which suggests that short call positions tend to be established as part of hedged positions with the underlying stocks rather than for direct speculation that the underlying stock price will fall. An important characteristic of these covered calls (i.e., short calls combined with long stocks) which tend to be out-of-the-money when they are established is that in comparison to holding the stock alone, they suffer losses in fewer states of the world and any losses that are incurred are less "painful". Consequently, this finding is consistent with option market investors being loss averse agents who frame narrowly over individual stocks and the options written on them rather than evaluating their portfolios as a whole. Investors who hold out-of-the-money covered calls are less likely to regret their investment than those who hold the stock alone, because they always do better with the covered call except when the stock generates a substantial gain. According to prospect theory, investors are willing to give up the potential for having large gains as long as in less desirable states they will end up doing better. From the point of view of standard economic theory, it is difficult to see why investors are attracted to covered calls. The financial industry recognizes the impact of behavioral factors on investor decision-making and aggressively caters to the desire to avoid regret by heavily marketing covered calls as a conservative and less painful way to take a long position on a stock.

It is also interesting to note that we see investors opening more new short call positions after periods of high returns on the underlying stock and that this effect is stronger for wealthier investors who presumably are more likely to hold the appreciated underlying stocks in their portfolios. Writing calls on appreciated stock is also consistent with loss aversion, narrow framing, and the house money effect (Thaler and Johnson (1990), Barberis, Huang, and Santos (2001), and Barberis and Huang (2001).) The reason is that the call writer only has to deliver the share (which already has a gain) if the share price increases further. Consequently, the call premium received serves to cushion any loss if the stock price declines, while the stock only has to be surrendered for less than its market value in situations where the investor has made a profit on it.

We also find, again counter to the non-behavioral prediction, that non-market maker investors have more short than long put open interest. Once again, behavioral considerations appear to play an important role in generating this result. Our discussions with option market investors indicate that out-of-the-money puts are often sold on stocks that are viewed as undervalued. The rationale they give is that if the stock price either goes up or only declines slightly over the life of the option, the investor ends up keeping the premium. If, on the other hand, the stock price declines below the strike price, then the investor is happy to buy a stock that was already considered undervalued at an even lower price (while retaining the put premium.) The fact that we observe considerably more short put open interest on value than growth stocks is consistent with this explanation. Once again, it seems that investors frame narrowly and focus on individual stocks and their corresponding options instead of thinking in terms of their portfolio as a whole. This narrow framing results in designing strategies that place a heavy emphasis on reducing losses or minimizing regret while heavily discounting gains.

We also examine whether different types of investors in the option market are trend-chasers or contrarians. The option market provides an interesting arena for investigating this question since, unlike stocks where the supply of shares at least in the short-run is fixed, new options can be easily created or destroyed. We find that all types of non-market maker investors are trend-chasers in their purchases of calls to open new positions. That is, the investors buy more calls to open new positions when the past returns on the underlying stock are relatively high. In addition, the trend-chasing behavior is not only a response to the returns during the preceding few weeks or months, but is observed for returns as far back as two years in the past. This suggests that investor sentiment about a stock is established over long horizons. One might well expect the relationship of past returns to the selling of calls to open new short positions to be just the opposite. We find, however, that the selling of calls to open new short positions is also positively related to past returns on the underlying stock. This may be the result of the behavioral factors driving call sales discussed above. A call is typically sold together with opening a long position on a stock or when investors already own the stock. The overall position can be viewed as a conservative way of owning a stock. Therefore, it is not surprising that the same trend-chasing behavior is observed for buying and selling call options. Finally, the sales of puts to open new short positions is negatively related to the past returns on the underlying stock over the past quarter. This result is also consistent with our behavioral explanation that selling puts becomes more attractive on beaten down stocks, and this strategy is implemented by contrarian investors.

We also examine option trading during the extraordinary period in the United States financial markets in the late 1990s and early 2000. There is a good deal of evidence that during this time period there was a speculative bubble in the stock market (Chan, Karceski, and

Lakonishok (2000).) Much of the available research on the bubble focuses on the role of short-sales constraints in allowing the stock prices to rise seemingly far above fundamental values (Ofek and Richardson (2003) and Brunnermeier and Nagel (2002).) Our focus, on the other hand, is on how different types of investors used the option market during the bubble. We find that the volume of calls purchased to open new positions by our least sophisticated investors was much higher during the height of the bubble period from 1998 through March 2000 than it was before or after this period. Furthermore, this increase among the least sophisticated investors was seen in call options written on growth but not value stocks. The volume of calls purchased to open new positions by the more sophisticated investors in our sample, on the other hand, did not rise during the bubble.[3] These results suggest that during the bubble the least sophisticated investors were speculating that the prices of growth stocks would continue to rise and that this contributed to the bubble while the more sophisticated investors were much less aggressive trend-chasers. We also find that the open buy put volume for all investor types did not rise during the bubble. Consequently, there is no evidence that investors used the option market during the bubble period to overcome short-sales constraints in the stock market. Apparently, there were not a lot of investors who wanted to take contrarian positions during the bubble period.

The remainder of the paper is organized as follows. Section I describes the data. The second section provides results on the level of option market activity. Section III investigates cross-sectional determinants of option market trading. The fourth section studies the bubble period, and Section V concludes.

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[3] It should be noted, however, that we measure volume in units of option contracts relative to the number of shares of the underlying stock outstanding. Since stock prices were in general higher during the bubble, option volume measured in terms of the dollar value of the transactions was also higher during the bubble.

I. Data

The main data for this paper were obtained from the CBOE. The data cover option open interest and trading volume broken down by different types of investors from the beginning of 1990 through the end of 2001. The open interest data provide a daily record of closing short and long open interest for all CBOE listed options. When a CBOE listed option is also listed on other exchanges, the open interest data is inclusive of all exchanges at which it trades. Options that trade only at exchanges other than the CBOE, however, are not included in the dataset. The trading volume data consists of daily information for all trades that actually occur at the CBOE. It is broken down into four categories: volume from buy orders that open new long positions (open buy volume), volume from sell orders that open new short positions (open sell volume), volume from buy orders that close existing short positions (close buy volume), and volume from sell orders that close existing long positions (close sell volume).

The Option Clearing Corporation (OCC) assigns one of three origin codes to each option transaction: F for firm proprietary traders, C for public customers, and M for market makers. An example of a firm proprietary trader would be an employee of Goldman Sachs trading for the bank's own account. An analyst at the CBOE further subdivided the public customer data into orders that originated from discount customers, full service customers, or other customers. Clients of E-Trade are an example of discount customers, and clients of Merrill Lynch are an example of full service customers. The other customers category consists of all OCC public customer transactions that are not designated by the CBOE analyst as originating from discount or full service customers.[4] In the empirical work below, we study option activity on individual

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[4] The other customer category includes option activity from transactions that originated from registered broker-dealer's personal accounts, foreign broker-dealer accounts, CBOE floor broker error accounts, and specialist

equities from the firm proprietary trader, discount customer, and full-service customer categories.

We obtain return, price, and number of shares outstanding data for the stocks that underlie the options from the Center for Research in Security Prices (CRSP). We use data from CRSP as well as COMPUSTAT to classify underlying firms into value and growth categories based upon their book-to-market (BM) equity ratios. In order to ensure that we are not using BM values before the data were actually available to investors, we assume a four month reporting lag for accounting data. Book value of equity is obtained from COMPUSTAT annual data, item #60. Market value of equity is computed by multiplying the CRSP share price and the number of shares outstanding. To calculate BM, the most recently available market value of equity is used.

II. Option Market Activity Levels

This section of the paper investigates the level of option market activity by examining option open interest and trading volume by different types of investors for options on various categories of underlying stocks.

A. Measuring Option Market Activity

We define a quantity that measures on a trade date the open interest on an underlying stock (delta-adjusted, so that we can compare option positions to stock positions) by one of the investor types as a percentage of the shares of the underlying stock outstanding. We denote this quantity, $OpenInterestPercentageShares_{s,t}^{k,i}$, where s is an underlying stock, t is a trade date, k is

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accounts as well as customers of brokerage houses that were not classified as discount or full service by the CBOE analyst.

a kind of open interest, and i is an investor type. The open interest kind k is either long call, long put, short call, or short put. The investor type i is either firm proprietary traders, discount customers, or full-service customers. Let $N_{s,t}^{Call}$ be the number of different call contracts listed on stock s on trade date t, $\Delta_{s,j,t}^{Call}$ be the delta of the jth call on underlying stock s on trade date t, and $N_{s,t}^{Shares}$ be the number of shares of stock s outstanding on trade date t. In addition, let $OpenInterest_{s,j,t}^{k,i}$ be the number of contracts of open interest of kind k for investor type i on the jth call on underlying stock s on trade date t. We then define $OpenInterestPercentageShares_{s,t}^{k,i}$ by

$$OpenInterestPercentageShares_{s,t}^{k,i} \equiv \left(\frac{\sum_{j=1}^{N_{s,t}^{Calls}} 100 \times OpenInterest_{s,j,t}^{k,i} \times \Delta_{s,j,t}^{Call}}{N_{s,t}^{Shares}} \right) \times 100. \qquad (1)$$

In this expression, the factor of 100 and the delta in the numerator convert the open interest into an equivalent number of shares of the underlying stock.[5] The final factor of 100 converts the quantity into a percentage.

We measure option volume in a similar way. For example, let $OptionVol_{s,j,t}^{k,i}$ be the option volume of kind k by investor type i on the jth call on underlying stock s on trade date t. Now k is either open buy call volume, open buy put volume, open sell call volume, or open sell put volume. We then define $OptionVolPercentageShares_{s,t}^{k,i}$ by

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[5] Each option contract is written on 100 shares of stock. In the empirical work we use Black-Scholes deltas for $\Delta_{s,j,t}^{Call}$. The volatility of the underlying asset for the Black-Scholes delta computation is set to the annualized sample volatility from its weekly log returns over the last 52 weeks excluding the two most extreme values. The assumptions of the Black-Scholes model are violated in a number of ways (e.g., the options are American rather than European and the volatility of the underlying stocks is not constant.) However, since most of our main results are not altered if we do not delta adjust at all, we believe the Black-Scholes model provides an adequate approximation to delta for our purposes.

$$OptionVolPercentageShares_{s,t}^{k,i} \equiv \left(\frac{\sum_{j=1}^{N_{s,t}^{Calls}} 100 \times OptionVol_{s,j,t}^{k,i} \times \Delta_{s,j,t}^{Call}}{N_{s,t}^{Shares}} \right) \times 100. \qquad (2)$$

To illustrate the computation of these measures, suppose that on June 1, 1998, XYZ has 23,000,000 shares outstanding and that firm proprietary traders have 120 contracts of long open interest in XYZ calls that expire in June 1998 with a strike price of $130 and 35 contracts of long open interest in XYZ calls that expire in July 1998 with a strike price of $125. Suppose further that on June 1, 1998 the Black-Scholes deltas of the June 1998 strike $130 call and the July 1998 strike $125 call are, respectively, 0.55 and 0.60. Then for firm proprietary traders, the long call open interest as a percentage of shares outstanding on XYZ for June 1, 1998 is 0.0378%. This percentage is computed as

$$OpenInterestPercentageShares_{XYZ,June1,1998}^{Long\ Call,\ Firm\ Prop.} = \left(\frac{100 \times 120 \times 0.55 + 100 \times 35 \times 0.60}{23,000,000} \right) \times 100$$
$$= 0.0378\%. \qquad (3)$$

B. Levels of Option Open Interest

Table I presents average daily long and short, put and call open interest as a percentage of shares of underlying stock outstanding over the 1990-2001 period. These averages are computed for four groups of underlying stocks: all those in the database, large stocks, large growth stocks, and large value stocks. Large stocks are defined as the those in the top 500 by market capitalizations in the CRSP universe as of the end of the previous calendar quarter. Large growth and large value stocks are defined at the end of each quarter as, respectively, the lowest and highest BM quartile of the 500 largest stocks by market capitalization. We focus on large stocks which account for the bulk of the market capitalization and most of the option activity.

The results for smaller companies are similar. In order to prevent the statistics from being too heavily influenced by smaller companies with fewer options or by periods of unusually high option activity, we use the following procedure to compute averages. First, for each trade date we use equation (1) to compute the delta-adjusted open interest for each underlying stock. Next for each calendar month we compute a market capitalization weighted average of the delta-adjusted open interest for each underlying stock on each trade date. Finally, we calculate a simple average over the months. All averages reported in the paper are computed in this way.[6]

We note first that option market activity represents a reasonably large fraction of activity in the underlying asset. For example, for large underlying stocks the average open interest aggregated across types of open interest and types of investors is about 0.56% of the shares outstanding. Although this may initially seem like a small quantity, the contracts are actively traded, and the annual option market turnover corresponds to contracts that control about 6% of the underlying shares.[7] Since the turnover in the market for the underlying shares is on the order of 60% a year and the three investor types that we examine do not comprise the entire option market, the option trading is appreciable when compared to the direct trading in the underlying stock.

We turn next to the question of whether investors take more long call or long put positions. For concreteness, in the discussion we focus on options on large underlying firms, but the findings are not much different for options on smaller stocks. On an average trade date for large underlying stocks, firm proprietary traders have long call open interest that controls

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[6] The results are not sensitive to reasonable variations in the procedure for computing the averages.
[7] We calculate this percentage in the following way. We first multiply the average daily open interest aggregated across types of open interest and types of investors for large stocks (i.e., 0.56%) by two, since there are two transactions for a given amount of open interest (one to open the position and the other to close it.) We then multiply this number by 5.3 (= 252/47.5), where 47.5 is the open interest-weighted average trade dates to turnover for large stocks which implies that 5.3 is the average number of times new positions are opened in a year.

0.042% of the underlying shares while they have long put open interest that controls only 0.014% of the underlying shares. Discount customers have an even stronger preference for long call positions. Their long call open interest controls 0.031% of the underlying shares while the long put open interest controls only 0.004% of the underlying shares. Overall, across our three types of investors, the long call open interest is about four times larger than the long put open interest.[8]

This finding is surprising, because it is more costly and difficult to go short than long in the stock market. For example, retail customers receive low interest rates on the proceeds from their short sales, and short stock positions can only be established on an uptick. In addition, it is sometimes difficult to borrow stocks to short, and this was especially true during the stock market bubble. At the same time there is no corresponding difference between the cost or difficulty of taking short and long positions in the option market by buying puts or calls.[9] Since we have seen that for a typical firm open interest in the option market is quite small in comparison to the number of shares of stock outstanding, it is easy to imagine that the difficulty of establishing short positions directly in stocks would result in a meaningful increase in the demand for long put relative to long call positions. However, as the results indicate, other forces, perhaps more behavioral in nature, make calls more attractive than puts. For example, financial analysts issue far more positive than negative recommendations on stocks. Insofar as investors want to follow these recommendations by taking positions in the option market, they will be

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[8] For each type of investor and for each type of underlying stock the long call open interest is statistically greater than the long put open interest at the one percent level using either a t-test for the difference in means or a Wilcoxon signed-rank test for the difference in medians.

[9] It might be thought that the obstacles to shorting in the stock market will be transferred to the option market through the following mechanism. When an investor buys a put to take a short position on a stock, the market-maker who sells the put will typically hedge his position by shorting the stock. Consequently, it might appear that any obstacles to shorting the stock will be transmitted through the market-maker to an option market investor who wants to buy a put. This is not the case, however, because option market-makers earn higher interest rates on the proceeds from their short sales and are able to short shares without actually locating anybody who is willing to lend them. On the latter point see Evans, Geczy, Musto, and Reed (2003).

inclined to buy calls rather than puts. Another factor that makes it more likely that investors will

buy calls rather than puts is that long call positions are easier to understand and manage than

long put positions. Since listed options on individual equities have an American style exercise

feature, investors holding these options must continually evaluate whether they should be

exercised. This decision is far easier for calls than puts, because it is never optimal to exercise

calls early, except possibly just before the underlying stock goes ex-dividend. There is no such

simplifying rule for deciding whether to exercise a put early.

We next examine the extent to which investors short call options. The small amount of

direct short selling of stocks as well as the relatively small number of long put positions suggest

that investors do not like to be short stocks. This aversion to shorting suggests that selling calls

may not be appealing, since such sales establish short positions in the underlying stock. Table I

documents, however, that over the 1990-2001 period the three types of investors in aggregate

have more short call open interest (an average of 0.245%) than long call open interest (an

average of 0.199) on large underlying stocks.[10] The greater propensity to sell calls short is

because of the full-service customers. Much of the short call open interest is likely generated

from the sale of covered calls, that is, from investors selling calls either on stocks they already

own or investors simultaneously selling calls and buying the underlying stock. The sale of such

covered calls is heavily promoted by brokers, and it is typically not framed as taking a short

position in the stock. Instead, it is marketed as a conservative way to take or maintain a long

position or as a way for investors to enhance the income generated from their portfolios. Brokers

argue that it is conservative because part of the cost of buying the stock is offset by the premium

received from selling the call, or, alternatively, because any loss suffered in the stock position is

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[10] This difference is statistically significant at the one percent level using either a t-test or the Wilcoxon signed-rank test.

wholly or partially offset by the call premium. Brokers typically suggest that clients enter into covered call positions by shorting calls that are 10 to 15 percent out-of-the-money. Consequently, relative to owning the stock, a covered call position results in an inferior payoff only if the underlying stock increases in value substantially. However, even in this case investors will not be losing money. This is illustrated in Figure 1 which depicts the profit to a covered call position. It seems that investors in covered call positions do not mind giving up some profit from their short position in the call when the stock price increases beyond the strike price, since they have already made a large profit in their stock position. In cases where the stock price does not go up by a lot, the covered call position results in a better outcome than just buying the stock. This result is consistent with loss aversion and mental accounting which have been identified by the behavioral finance/economics literature as important aspects of investor behavior.

Table I also reveals that over our entire time period of 1990-2001 there are no major differences in the average daily open interest as a percentage of shares outstanding for any of the groups of underlying stocks. This is true for all investor types. Even for the large growth and large value categories, the differences are for the most part on the order of 10 percent or less. For example, for the full-service customers, the average daily short call open interest as a percentage of shares outstanding is 0.211% and 0.190%, respectively, for large growth and large value underlying stocks. It is interesting to note, however, that the largest difference is for the short put open interest of full-service customers across the large growth and large value underlying stocks. In this case, the average daily short put open interest for large growth and large value stocks are, respectively, 0.047% and 0.068% which corresponds to full-service customers selling relatively more puts on beaten down stocks. Presumably, those investors view

the value stocks as relatively inexpensive. They sell puts reasoning that either the buyer will not exercise the put and they will just keep the premium or the buyer will exercise the puts in which case they will keep the premium and buy the stock at the strike price. Since the most liquid part of the market is for out-of-the-money options, the strike price will typically be below the current stock price which is already viewed as low. Therefore, behavioral considerations, such as minimizing regret, once more appear to be important in understanding the activity of investors in the option market.

We will see below that even though the open interest was reasonably constant across different types of underlying stocks during the entire sample period, that for some investor types during the bubble large differences in option market activity on growth and value stocks are observed.

C. Levels of Option Volume

Panels A-C of Table II report the average daily open volume as a percentage of shares outstanding over the 1990-2001 period for the three investor classes and four groups of underlying stocks. The four columns list this average for, respectively, buy call volume, buy put volume, sell call volume, and sell put volume. The first two columns represent options bought to establish fresh new long positions (and not to close out existing short positions), while the last two columns represent options sold to establish fresh new short positions (and not to close out existing long positions.) The first thing to note about Table II is that across all participants and groups of underlying stocks there is more opening volume on the buy side than the sell side for

both calls and puts.[11] At least for the calls for the full-service customers, this finding is somewhat unexpected, since Table I indicates that on average there is more call short open interest than long open interest. These findings imply that on average the full-service customers hold long call positions for substantially less time than short call positions.

Panels D-F of Table II report the average number of trade days the various investor classes hold long and short, call and put positions. Panel F of Table II shows that on average the full-service customers do hold their short option positions substantially longer than their long option positions. For example, they hold their short call positions an average of 54 days and their long call positions an average of 32 days. Panel E shows that discount customers also hold their short positions longer than their long positions, while Panel D indicates that firm proprietary traders hold their long and short positions for roughly the same amount of time. These findings suggest that the full-service and discount customers use their long option positions more heavily for short-term speculation, whereas their short option positions are used more for hedging or as part of longer-term investment strategies. Once again, no big differences across large growth and large values stocks are seen in the statistics reported in Table II. However, differences will emerge when we focus on the subperiods, especially the bubble period.

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[11] All of these differences are significant at the one percent level except for the cases of large value calls for firm proprietary traders and large value puts for full-service customers. In these two cases, the differences are close to statistically significant for both the t-test and the Wilcoxon signed-rank test.

III. Cross-Sectional Determinants of Option Market Activity

We turn next to an investigation of cross-sectional determinants of option market trading. We focus on past returns on the underlying stock over various horizons but also consider the book-to-market ratio and volatility as control variables.

We want to know what causes different types of investors to open brand new option positions. As a result, the dependent variables that we study are open buy call volume, open sell call volume, open buy put volume, and open sell put volume. These variables are computed by aggregating the respective option volume type on each underlying stock on each trade date for each investor class. As in the previous section, these variables are normalized so that they represent the equivalent percentage of shares of the underlying stock traded in the options market. The first set of explanatory variables are based on returns from the underlying stock: the same day return (*Rsameday*), the return from trade dates –1 through –5 (*Rweek*), from trade dates –6 through –21 (*Rmonth*), from trade dates –22 through –63 (*Rquarter*), from trade dates – 64 through –252 (*Ryear*), and from trade dates –253 through –504 (*R2years*). The log of the BM ratio and the volatility of the underlying stock are also used as explanatory variables. The volatility is computed as the annualized sample standard deviation of weekly log returns over the last 52 weeks excluding the two most extreme values.

Although we present results for all three classes of investors, we focus our discussion on the discount and full-service customers. We do this because option market professionals have indicated to us that it is not uncommon for firm proprietary traders to place orders to facilitate the trades of their customers. For example, suppose that a client of an investment bank wants to sell 10,000 IBM calls. It would not be unusual for one of the bank's proprietary traders to call

the designated primary market maker for IBM options to learn how much of the order can be filled. If the proprietary trader discovers that only a small portion of the order would be executed, he may well put in a substantial order for IBM calls to facilitate execution for the client.

Table III reports time-series averages of the intercept and slopes from daily Fama-MacBeth regressions of the cross-section of option volume on the explanatory variables for large underlying stocks over the 1990-2001 period. Autocorrelation adjusted *t*-statistics are provided in parentheses.[12] Panels A-C report the regression results for, respectively, firm proprietary traders, discount customers, and full-service customers. Panel D shows the time-series average of the daily cross-sectional standard deviations of the explanatory variables. Table IV reports the percentage impact on daily activity for the four types of open option volume from a positive one standard deviation shock to all of the return variables, to the short-term return variables, and to the long-term return variables.

A. Open Buy Call Volume

For open buy call volume, discount and full-service customers have significantly positive coefficients on the return variables for all past horizons from one week to two years.[13] Since long call positions increase in value when the price of the underlying stock increases, it appears that these option market investors develop positive sentiment on stocks that have done well over a variety of past horizons and bet in the option market that the stocks will continue to increase in value.[14] That is, discount and full-service customers appear to be trend-chasers. Moreover, the

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[12] The autocorrelation adjustment is made using the method in Chopra, Lakonishok and Ritter (1992).

[13] For the discount customers, the coefficient on the past week return is positive but only marginally significant with a *t*-Statistic of 1.83.

[14] Of course, it is possible that some of the new long call positions are part of larger strategies that include other options or the underlying stock. We doubt, however, that this is a major factor in the positive coefficient estimates. Covered calls are the most common hedged positions involving call options, and these involve short, not long, call positions. Therefore, hedging is not likely to have much of an impact on the results for open buy call volume.

impact is economically very large. A one standard deviation increase in past returns at all of the

past horizons increases daily open buy call volume for discount and full-service customers by

78% and 57%, respectively.   Investors are influenced not only by returns in the past quarter, but

are significantly impacted by longer horizon returns up to two years in the past. This implies that

the sentiment about a stock developed over extended periods of time influences investment

decisions. Discount customers, who are probably less sophisticated on average, seem to be

especially sensitive to sentiment developed over longer horizons. A one standard deviation

shock for the longer horizons (*Ryear-R2years*) increases the open buy call volume of discount

customers by 55%. The response of full-service customers is milder, 24%. In summary, higher

past returns increase the willingness of individual investors to buy calls.[15] This bet on an

increase in stock prices might also suggest that individuals are trend-chasers in the stock market

as well. As discussed earlier, previous studies that addressed trend-chasing in the stock market

had data that presented a number of challenges. In particular, they generally used quarterly data

on institutional ownership and studied positions in stocks which are in fixed supply, at least in

the short run. Our results shed new light on trend-chasing, because they are based on daily data

for a number of different types of investors, and because option contracts can be created at will.

The open buy call volume of firm proprietary traders is also positively impacted by past

returns. It does not, however, appear to be influenced by returns from the second year in the

past. As discussed above, the motivations of firm proprietary traders are more difficult to pin

down.

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[15] This finding contrasts with investor behavior in the stock market where Odean (1999) finds that the stock
purchases of customers of a discount broker are evenly split between prior winners and prior losers.

B. Open Sell Call Volume

As was evident from Tables I and II, open sell call volume is especially important for full-service customers. Our discussions with option professionals indicate that most of this volume results from investors writing covered calls.[16] Investors tend to view selling calls on stocks with gains as a conservative, income enhancing strategy, and behavioral considerations suggest that investors have stronger incentives to write calls on stocks they hold which have gains than those they hold which have losses. Specifically, prospect theory maintains that a gain made on an investment that has already done well does not provide as much of an increase in utility as an equivalent gain on an investment that has done relatively poorly. Consequently, prospect theory predicts that investors are more likely to sell calls on their stocks that have done well than to sell calls on stocks that have done poorly. Indeed, selling a call on a stock that has decreased in value is particularly unattractive to a prospect theory investor if the strike price is below the price that was originally paid for the stock, since such a sale guarantees that the investor will lose money on the position. Standard economic theory, on the other hand, predicts that (aside from tax considerations) the price at which a stock is bought is irrelevant. Calls are also sold simultaneously with buying a stock. To the extent that investors are trend-chasers, they will flock to stocks that have done well. These considerations lead us to expect to see a positive impact of past stock returns on the sale of call options.

The results are consistent with this prediction. For full-service customers, all of the coefficients on past returns are positive and significant. The coefficients on longer term returns are highly significant. The overall impact of a one standard deviation increase in returns is a very large 63%.

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[16] For simplicity, we refer both to investors simultaneously writing a call and buying the underlying stock and also to investors writing calls on stocks that they already own as writing covered calls. The latter is sometimes instead referred to as call overwriting.

The less wealthy discount customers are less likely to own the underlying stock. Hence, the impact of past returns is less obvious. Indeed some of the coefficients of past returns are negative, and the overall impact of a one standard deviation shock to past returns is less than half of the impact for full-service customers.

C. Open Buy Put Volume

In general, the activity in puts is not very large. For example, the open interest in long puts is smaller than for the other categories. One important motivation for buying puts is the belief that the price of the underlying stock is going to decrease. Investors also buy protective puts when they already hold a stock. Such a strategy limits losses while also allowing investors to participate in upside potential if the stock increases in value. As in the case of covered calls, discount customers probably have less of a propensity than full-service customers to buy protective puts.

The results reveal that discount investors buy more (fewer) new puts on underlying stocks that have increased (decreased) in value in the past. This is expected from prospect theory insofar as investors are insuring (i.e., locking in) gains on stocks that have increased in price and refraining from insuring stocks that have losses.[17] Full-service customers also buy more (fewer) new puts on underlying stocks that have increased (decreased) in value in the past, although clear evidence for this effect is limited to returns that are more than three months in the past. Since discount customers are more likely to be buying naked long put positions, it appears that there is a stronger strain of contrarian investing among them. It should, however, be remembered that buying puts, surprisingly, is not a very popular activity. As a result, it appears that the average

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[17] This is akin to Odean's (1998) finding that in the stock market discount customers sell winners to lock in gains and hold losers to avoid realizing losses.

investor in the option market is a trend-chaser (from the open buy call volume regressions), but that there is some evidence of contrarian investing as well, especially among the discount customers.

D. Open Sell Put Volume

Relative to buying puts, there is a lot of activity in selling puts. Indeed, the discount and full-service investors have more short than long put open interest. Table III reveals that for these investors the coefficients for returns on the underlying stock through the past quarter are negative while the coefficients for longer term returns are positive. This finding suggests that these investors believe that weakness in an underlying stock in the past quarter is temporary. The results in Table IV also illustrate that investors sell puts on stocks that performed poorly in the last quarter but had strong performance in the more distant past. The investors presumably sell the puts reasoning that if the stock price increases they will just keep the premium while if it declines further and the puts are exercised, they do not mind owning the stock at an even lower price. (The price will be lower if the puts are sold out-of-the-money which is typically the case.) The behavioral considerations discussed earlier suggest that there would be an increased desire to sell puts after disappointing returns on the underlying stock and that is indeed what we find here.

Finally, we note that higher volatility for the underlying stock is positively related to more opening of all types of option positions by all types of investors. This is not surprising, because higher volatility stocks tend to get more attention and because option premia are increasing in volatility. Indeed, a one standard deviation shock to underlying stock volatility

increases the open buy call volume for full-service customers by 97%. Since returns over the past two years are present in the regressions, we are hesitant to make any strong interpretation of the coefficients on the BM variable which is highly correlated with past returns. We think it is perhaps best simply to regard BM as a control for past returns that are not explicitly included in our list of explanatory variables.

To summarize, the results in this section are consistent with explanations of decision making from the behavioral finance literature. Option market investors appear to exhibit loss aversion, narrow framing, and mental accounting.

IV. Option Market Activity During the Bubble

This section of the paper explores changes in option market activity over time by the three classes of investors with a special emphasis on the stock market bubble of the late 1990s and early 2000. We will compare option market activity by the different investor classes during the bubble period with their activity before and after the bubble. This will enable us to explore how investors changed their behavior during the bubble and how different investor classes contributed to the bubble. In order to simplify the discussion, we define 1990-1994 as the pre-bubble period, 1995-1997 as the beginning of the bubble, 1998-March 2000 as the height of the bubble, and April 2000-2001 as the post-bubble period. Figure 2 plots the price to book ratio of the Russell 1000 growth stocks divided by the price to book ratio of the Russell 1000 value stocks from 1990 through 2001. This ratio peaked at the height of the bubble, suggesting excessive valuation of growth stocks relative to value stocks. This plot can be seen to increase

throughout the bubble and to peak at the end of the period which we have defined as the height of the bubble. It then declines sharply in the post-bubble period.

A. Option Market Activity Through Time

Table V reports the average daily open volume as a percentage of shares outstanding for each of the three investor types and subperiods of 1990-2001. The open buy call volume for the discount investors approximately doubles from the pre-bubble period to the beginning of the bubble and increases by about another 50 percent from the beginning of the bubble to the height of the bubble. It then falls by a factor of three from the height of the bubble to the post-bubble period. This pattern suggests that the least sophisticated investors in the market substantially increased their options market speculation that stock prices would rise throughout the bubble and then dramatically cut their option market bets that stock prices would increase after the bubble burst. This evidence is consistent with these investors acting as trend-chasers rather than contrarians. By contrast, the full-service customer open buy call volume is stable from the pre-bubble to the beginning of the bubble period and then falls a bit at the height of the bubble and more substantially in the post-bubble period. Hence, it appears that the full-service customers did not increase their option market speculation that stock prices would increase during the bubble period, but that they may have scaled back their normal level of positive option market bets during the post-bubble period. Finally, the bubble is essentially a non-event for the firm proprietary traders. Their open buy call volume gradually decreased throughout the four subperiods.

The discount customers increased their activity substantially across other types of option positions as well. They probably increased their activity in covered calls which are a

conservative way of taking a long position on a stock. However, the main interest of the discount customers is in buying calls which constitutes 56% of their option activity during the bubble. We conjecture that this activity of discount customers contributed to an increase in stock prices as market-makers who sold the calls to the discount customer hedged their positions by buying stocks. Presumably, discount customers were buying stocks directly as well, thus contributing further to the bubble.

One of the most interesting results in Table V relates to the put activity of full-service customers. There is a vast literature on the difficulties of establishing short positions in the stock market. Ofek and Richardson (2003) even suggest that short sales constraints were a major contributor to the stock market bubble. Our results, however, reveal that at the height of the speculative bubble option market investors had no special appetite for short positions. We see no major increase in volume that opens long put positions. Apparently, in such unique periods it is not easy to be contrarian.

The regressions reported in Table III above indicate that when the entire sample period from 1990-2001 is studied all three investor classes appear to be trend chasers insofar as they initiate more (fewer) new long call positions when the underlying stock price increases (decreases). Table VI re-runs the open buy call volume regressions for the three investor groups for each of the four subperiods of 1990-2001, and Table VII reports the percentage impact of positive one standard deviation shocks to past returns of different horizons.

For the discount and full-service investors (Panels B and C of Table VI) the results for the various subperiods are less consistent than the results for the entire sample. Many of the coefficients on past returns are negative. For example, in the last subperiod just the coefficients for the longer horizons, *Ryear* and *R2years*, are positive. Table VII shows that overall, a one

standard deviation shock to past returns had a positive impact on activity. However, for the non-bubble subperiods, this result is driven by investor trend-chasing longer horizon returns. For shorter horizon returns, investors tend to be contrarian.

The results for the height of the bubble period definitely stand out. The coefficient on past returns are all positive and highly significant for discount and full-service customers. Discount customer showed especially strong trend-chasing behavior. For them, the magnitude of the coefficients are quite a bit larger than when the regression is run for the entire period, and a one standard deviation shock to past returns during the bubble period resulted in an 154% increase in trading activity. Noteworthy, is the huge impact on activity related to longer horizon returns (*Ryear-R2year*), where a one standard deviation shock resulted in almost doubling the activity. The results strongly suggest that the least sophisticated investors contributed to the run up in prices of stock that performed well in the past, which during this period of time happened to be technology companies or growth companies in general.

The full-service customers, based on the results in Table V, did not increase their activity in options during the bubble. However, Table VI and Table VII reveal that these more sophisticated investors did not escape the frenzy of the bubble. The full-service customers definitely chased the better performing stocks and a one positive standard deviation shock to past returns resulted in almost a doubling of their trading activity.

A dramatic change in the behavior of the discount and full-service investors is observed after the bubble. The overall impact of past returns is relatively small and investors became somewhat contrarian with respect to short term returns (up to one quarter in the past.) Interestingly, the impact of longer term returns is still significant and relatively large, although much smaller than during the bubble period.

The motives of firm proprietary traders are more difficult to sort out. As discussed above part of their activity is related to facilitating the trades of their larger clients. The results in Table VI and Table VII show that the bubble did not impact their behavior in terms of chasing past winners.

Table VIII runs regressions like those in Table VI but with open sell call volume rather than open buy call volume as the dependent variable. For the discount and full-service customers the coefficients on the past return variables are substantially larger during the height of the bubble than during any of the other three subperiods. This is most likely due to these investors writing calls on appreciated stocks that they already owned or opening "conservative" new long positions by buying the underlying stock and covering it by shorting a call. It is interesting to note that there is much more consistency in the positive sign for the coefficients of the return variables in Table VIII than in Table VI. This is probably because full-service customers, due to behavioral influences such as caring about the price at which they bought an underlying stock, like to write call options on appreciated stocks. Therefore, the willingness of full-service customers to write call options is less period specific than buying call options. For example, whereas (from Table VII) a one standard deviation positive shock to returns results in only a 15% increase in open buy call volume for full-service customers during the post bubble period, such a shock produces a 46% increase in open buy sell volume for these customers after the bubble. The long call results in Table VI, on the other hand, are more closely tied to the sentiment of the full-service customers which varied over the subperiods. On the other hand, in Table VIII we see less consistency in the positive signs for the coefficients for the return variables for the discount customers. This is probably, because the less wealthy discount customers are relatively less likely to own the underlying stock, and, thus are less affected by the

past performance of the stock. For the firm proprietary traders there is no clear difference between the coefficients on the past return variables during the height of the bubble and during the other periods.

B. Value Versus Growth

Since the speculation during the stock market bubble of the late 1990s and early 2000 was concentrated in growth stocks, we next investigate the trading by the three investor classes of options written on large growth and large value stocks in the four subperiods from 1990-2001. As above, large growth stocks are defined as those in the bottom BM ratio quartile among the 500 largest market capitalization firms. Large value stocks are defined as those in the top BM ratio quartile among the 500 largest market capitalization firms.

Tables IX contains for each investor group and each of the four subperiods the average daily open volume as a percentage of shares outstanding separately for underlying growth and value stocks. Panels B and E of Table IX shows that for discount customers, for all of the subperiods, the most important activity is buying calls. The activity in the other three types of option positions is much smaller. Discount customer open buy volume for calls on underlying growth stocks doubled from the pre-bubble to the beginning of the bubble periods and doubled again during the height of the bubble. It then dropped by nearly a factor of four from the height of the bubble to the post-bubble period. These results are consistent with discount customers chasing returns and perhaps contributing to the bubble. Interestingly, their activity drops substantially when the markets start to correct. Panel E of Table IX, on the other hand, indicates that discount customers did not increase their activity in value stocks during the bubble period. As can be seen in Panel D of Table V, according to the Russell indexes, value stocks suffered

their worst performance relative to growth stocks during the bubble period. Thus, the option market evidence is that during the bubble period discount customers dramatically increased their speculation that underlying growth stocks would increase in price without increasing at all their speculation that underlying value stocks would increase in price. This activity probably contributed to mispricing of value stocks relative to growth stocks and to the bubble. It is also interesting to note from Panel B of Table IX that during the height of the bubble discount customers markedly increased their selling of calls on growth stocks. This is consistent with our earlier discussion, that selling calls is one leg of creating a more conservative long position in a stock. However, the main activity of discount customers during the bubble was in buying calls. Their sell call activity was relatively small. Although not of great economic significance, a small population of discount customers behaved as contrarians as evidenced by the jump in buy put activity on underlying growth stocks during the bubble. However, it is very clear that overall discount customers were not betting that stock prices would decline.

Full-service customers, at least relative to discount customers, show a relatively mild increase in buy call activity on underlying growth stocks during the bubble. The volume increased from 0.00382% in the pre-bubble period to 0.00482% during the height of the bubble. The increase in the activity in other options was in general milder. The results for options on value stocks are quite different. Relative to the earlier periods, there is a noticeable reduction in buy call activity during the bubble. A similar pattern is observed for other options as well. However, for options on both value and growth stocks, there is much less activity in the post-bubble period when the market underwent a substantial correction.

Contrary to the activity of discount and full-service customers, for firm proprietary traders the bubble period seems to be a non-event in terms of their option activity. In summary,

discount customers were most impacted by the dramatic rise in the stock market and increased substantially their activity in growth stocks which performed especially well during that period. Full-service customers responded in a similar fashion to discount customers, although their response was much milder. Neither of these types of investors found value stocks of interest during the bubble, and, thus, decreased their activity in this segment of the market.

C. Cross-Sectional Determinants of Activity

We have seen that the activity in options on value stocks dropped for full-service customers during the bubble and showed little change for discount customers. The results in Tables X and XI enable us to judge the extent of trend chasing of value and growth companies. The coefficients in Table X are positive and generally highly significant for open buy call volume on growth stocks for both discount and full-service customers for past returns of all horizons. The results for value stocks are in general similar, although the coefficients are less significant and sometimes even negative.

Table XI shows that a one standard deviation shock to past returns had a huge impact on the activity of options on growth stocks for discount customers with a jump of 211% in open buy call volume. The corresponding statistic for options on value companies is 50%. Full-service customers also showed substantial trend chasing activity on options of growth stocks, 109%, whereas the impact on options of value stocks was 51%. These results are consistent with the notion that individuals were engaged in substantial trend chasing across the board. This trend chasing, however, was not homogenous across investor types and stock characteristics. Trend chasing was much more pronounced by the discount customers which tend to be on average less sophisticated. In addition, past price changes have a bigger impact on growth companies which

in our study are defined by book-to-market (BM). According to Lakonishok, Shleifer, and Vishny (1994) companies with low BM are companies that had excellent past performance over a long period of time. They excelled in their operating performance as well as the returns they generated for their shareholders. The group also includes companies with shorter records and extreme growth expectations. Thus, BM can be viewed as a sentiment proxy. Investors during the bubble were chasing the past returns of companies with positive investment sentiment.

Finally, firm proprietary traders, unlike the other investors, did not particularly favor growth stocks with high returns. The coefficients for both growth and value stocks are in general positive and significant in Table X. Table XI reveals that if anything firm proprietary traders were chasing to a greater extent value companies with positive past returns. So, at least relative to the other investors, the firm proprietary traders exhibited somewhat contrarian behavior. Although, as discussed above, their motives are difficult to judge.

We also run regressions with open sell call volume as the dependent variable, and the results are reported in Table XII. From our previous results we know that full-service customers are particularly active in selling calls, and they tend to sell calls on stocks that have increased in price. Hence, we do not expect to find a big difference in sensitivity to past returns for call options written on value versus growth stocks. What counts more is whether an investor's stock holding resulted in a gain or loss and not so much the overall market's perception about the stock. The results in the table are consistent with our conjecture. When the coefficient estimates reported in the table for full-service customers are converted into impacts on trading activity from shocks to the return variables, we find that a one standard deviation shock to all past return variables results for the full-service customers in a 104% versus a not much different 84% change in call options sold for growth and value stocks, respectively.

V. Conclusion

Despite the tremendous amount of research over the past three decades into methods for pricing and hedging stock options, very little is known about how investors actually use these securities. This paper takes advantage of a unique and detailed data set of open interest and volume for all CBOE traded options over the 1990 through 2001 period to document the usage of the equity option market by firm proprietary traders, customers of discount brokers, and customers of full-service brokers. A number of our results are consistent with central ideas from the behavioral finance literature – loss aversion, mental accounting/narrow framing, and regret avoidance. Although behavioral influences are well documented in laboratory settings, their existence in real financial markets has not been as decisively demonstrated. We provide direct evidence about the importance of behavioral considerations in financial markets.

We analyze the importance of various option positions for non-market maker investors. Surprisingly, we find that long put positions are comparatively unimportant. In fact, long put open interest is only one quarter as large as long call open interest. We expected to see more interest in long put positions because of the cost and relative difficulty of taking short positions in individual stocks. Even during the bubble period, when establishing short positions in many high-flying stocks was very difficult, we do not see any increase in the importance of long put positions. The relative lack of interest in long put positions may be explained by the focus of financial analysts on buy recommendations and the scarcity of sell recommendations. Moreover, long put positions are more difficult to manage than long call positions. In any event, our results

do not support the view that limitations on short sales were an important contributing factor in the development of the recent stock market bubble.

We also find that long call positions are less prevalent among non-market makers than short call positions. Assuming that the options are not systematically mispriced, standard economic theory does not predict the prominence of short calls. There are more natural ways to take a short position, such as buying a put. Their popularity can be explained by the fact that many short calls are held together with long positions in the underlying stocks. These covered call positions are heavily promoted by brokers as a conservative way to take or maintain a long position in the stock. Typically, the investor shorts a call that is 10 to 15 percent out-of-the-money. Consequently, relative to owning the stock alone, the covered call position results in a better outcome if the stock price declines or increases modestly. It results in an inferior payoff only if the underlying stock increases in value substantially. In many cases investors sell calls when they already have a large gain on the underlying stock. It is difficult to see how the popularity of covered calls can be explained if investors rationally evaluate their portfolios as a whole. Instead, the popularity of short call positions is consistent with loss aversion, narrow framing, and the house money effect which have been identified by the behavioral finance/economics literature as important aspects of investor behavior.

Another interesting finding is that for retail investors short put open interest is more than 50% higher than long put open interest. In addition, short put open interest is especially high for value stocks. This result is consistent with some contrarian investors being attracted to short put positions on stocks that they believe are favorable investments. Typically, the short put positions are established out-of-the-money. Hence, if the stock does relatively well, the put will not be exercised, and the seller will keep the premium. If the stock does relatively poorly, the seller of

the put will end up acquiring the stock at the strike price. Being forced to buy the stock at the strike price will not be perceived as painful, however, because the seller of the put liked the stock when it was priced above the strike price. Once more behavioral considerations such as narrow framing and loss aversion can explain the popularity of selling puts.

We also examine whether different types of investors in the option market are trend-chasers or contrarians. Previous studies in this area that examined the behavior among individual and institutional investors in the stock market have been inconclusive. The stock market studies have been handicapped by the fact that (at least in the short-run) the supply of stock is fixed. Consequently, one can only measure the relative desire of different classes of investors to trend-chase or to act as contrarians. In addition, for the most part, stock holding data have only been available on a quarterly basis. By contrast, in the option market contracts can be created and destroyed at will, and we have holding data on a daily basis.

We find that firm proprietary traders, customers of discount brokers, and customers of full-service brokers all display trend-chasing behavior in their purchases of calls to open new positions. That is, all three types of investors purchase more calls to open new positions when the past returns on the underlying stocks are higher. Furthermore, the trend-chasing behavior is not only in response to returns over the last few weeks or months but rather extends as far back as two years into the past. This fact suggests that investor sentiment about stocks is established over long horizons. Investors also sell more calls to open new short positions when past returns on the underlying stock are relatively high. This result is consistent with covered call positions being a conservative way of owning stock. Full-service customers are much more influenced by past price changes relative to discount customers. This can be explained by full-service customers selling calls on appreciated stocks that they own. Selling calls on stocks which have

suffered losses is not attractive to our investors. Doing so would lock in losses and force investors to face up to their mistakes. When it comes to selling puts, retail investors prefer stocks that did poorly in the last quarter, but well over a longer time period. Hence, they seem to prefer to sell puts on stocks that might be perceived as temporarily depressed. Overall, behavioral considerations rather than standard economics theory seems to be helpful in understanding investor behavior.

Finally, we assess option trading during subperiods of 1990 through 2001 with a focus on the period of the stock market bubble in the late 1990s and early 2000. We find that the volume of calls purchased to open new positions by our least sophisticated investors increases substantially during the stock market bubble from 1998 through the beginning of 2000. Furthermore, this increase was a result of flocking to options on growth stocks. In fact, these investors increased their option volume on growth stocks by a factor of four at the height of the bubble but did not increase their activity in value stocks at all. In addition, during the bubble period discount customers became much more sensitive to past price changes and thus exhibited much stronger trend-chasing behavior than in other periods. Full-service customers, the most sophisticated retail investors, did not increase their overall activity in options during the bubble. However, during the bubble, they somewhat increased their activity in call options on growth companies and decreased their activity in options on value stocks. Interestingly, in terms of trend-chasing behavior, the bubble left its impact on full-service customers whose appetite for options on strongly performing stocks increased substantially. In contrast with the behavior of the other investors, the bubble was a non-event for firm proprietary traders. None of the investor groups showed any substantial increase in put purchases during the bubble period. Such purchases would have been expected if short sales constraints in the stock market were

preventing investors from betting against stocks which they viewed as overvalued. It appears that even when appropriate securities are available, investors have a hard time mustering the courage to bet against a stock market bubble.

References

Barberis, Nicholas, and Ming Huang, 2001, Mental accounting, loss aversion, and individual stock returns, *Journal of Finance* 56, 1247-1292.

Barberis, Nicholas, Ming Huang, and Tano Santos, 2001, Prospect theory and asset prices, *Quarterly Journal of Economics* 116, 1-53.

Barberis, Nicholas, Ming Huang, and Richard Thaler, 2003, Individual Preferences, Monetary Gambles and the Equity Premium, Working Paper, University of Chicago.

Benartzi, Shlomo, and Richard Thaler, 1999, Risk aversion or myopia? Choices in repeated gambles and retirement investments, *Management Science* 45, 364-381.

Black, Fischer, and Myron Scholes, 1972, The pricing of options and corporate liabilities, *Journal of Political Economy* 81, 637-659.

Brunnermeier, Markus K., and Stefan Nagel, 2002, Arbitrage and its limits: Hedge funds and the technology bubble, Working Paper, Princeton University and London Business School.

Chan, Louis K. C., Jason Karceski, and Josef Lakonishok, 2000, New paradigm or same old hype in equity investing? *Financial Analysts Journal*, 23-36.

Chen, Joe H., Harrison Hong, and Jeremy C. Stein, 2002, Breadth of ownership and stock returns, *Journal of Financial Economics* 66, 171-205.

Chopra, Navin, Josef Lakonishok and Jay R. Ritter, 1992, Measuring abnormal performance: Do stocks overreact?, *Journal of Financial Economics* 31, 235-268.

D'Avolio, G., 2002, The market for borrowing stock, *Journal of Financial Economics* 66, 271-300.

DeBondt, Werner and Richard Thaler, 1985, Does the stock market overreact? *Journal of Finance* 40, 793-805.

Diether, K. B., C. J. Malloy, and A. Scherbina, 2002, Differences of opinion and the cross-section of stock returns, *Journal of Finance* 57, 2113-2141.

Evans, Richard, Chris Geczy, David Musto, and Adam Reed, 2003, Failure is an option: Impediments to short selling and option prices, working paper, University of Pennsylvania.

Geczy, Chris C., David K. Musto, and Adam V. Reed, 2002, Stocks are special too: An analysis of the equity lending market, *Journal of Financial Economics* 66, 241-269.

Gneezy, Uri, and Jan Potters, 1997, An experiment on risk taking and evaluation periods, *Quarterly Journal of Economics* 112, 631-645.

Grinblatt, Mark, and Matti Keloharju, 2001, What makes investors trade? *Journal of Finance* 56, 589-616.

Grinblatt, Mark, Sheridan Titman, and Russ Wermers, 1995, Momentum investment strategies, portfolio performance, and herding: A study of mutual fund behavior, *American Economic Review* 85, 1088-1105.

Jegadeesh, Narasimhan, and Sheridan Titman, 1993, Returns to buying winners and selling losers: Implications for stock market efficiency, *Journal of Finance* 48, 65-91.

Kahneman, Daniel, and Dan Lovallo, 1993, Timid choices and bold forecasts: A cognitive perspective on risk taking, *Management Science* 39, 17-31.

Kahneman, Daniel, and Amos Tversky, 1979, Prospect theory: An analysis of decision under risk, *Econometrica* 47, 263-291.

Lakonishok, Josef, Andrei Shleifer, and Robert Vishny, 1992, The impact of institutional trading on stock prices, *Journal of Financial Economics* 32, 23-43.

Lakonishok, Josef, Andrei Shleifer, and Robert Vishny, 1994, Contrarian investment, extrapolation, and risk, *Journal of Finance* 49, 1541-1578.

Lamont, Owen A., and Chris M. Jones, 2002, Short sales constraints and stock returns, *Journal of Financial Economics* 66, 207-239.

Lee, Charles M. C., and Mark J. Ready, 1991, Inferring trade direction from intraday data. *Journal of Finance* 46, 733-746.

Merton, Robert C., 1973, Theory of rational option pricing, *Bell Journal of Economics and Management Science* 4, 141-183.

Nofsinger, John, and Richard Sias, 1999, Herding and feedback trading by institutional and individual investors, *Journal of Finance* 54, 2263-2295.

Odean, Terrance, 1998, Are investors reluctant to realize their losses? *Journal of Finance* 53, 1775-1798.

Odean, Terrance, 1999, Do investors trade too much? *American Economic Review* 89, 1279-1298.

Ofek, Eli, and Matthew Richardson, 2003, Dotcom mania: The rise and fall of internet stock prices, *Journal of Finance* 58, 1113-1137.

Rabin, Matthew, and Richard Thaler, 2000, Anomalies: Risk aversion, *Journal of Economic Perspectives* 15, 219-232.

Redelmeier, Daniel, and Amos Tversky, 1992, On the framing of multiple prospects, *Psychological Science* 3, 191-193.

Shiller, Robert, 1981, Do stock prices move too much to be justified by subsequent dividends? *American Economic Review* 71, 421-436.

Stein, Jeremy, 1989, Overreactions in the options market, *Journal of Finance* 44, 1011-1023.

Thaler, Richard, 1980, Toward a positive theory of consumer choice, *Journal of Economic Behavior and Organization* 1, 39-60.

Thaler, Richard, and Eric Johnson, 1990, Gambling with the house money and trying to break even: The effects of prior outcomes on risky choice, *Management Science* 36, 643-660.

Thaler, Richard, Amos Tversky, Daniel Kahneman, and Alan Schwarz, 1997, The effect of myopia and loss aversion on risk taking: An experimental test, *Quarterly Journal of Economics* 112, 647-661.

Wermers, Russ, 1999, Mutual fund herding and the impact on stock prices, *Journal of Finance* 54, 581-622.

Table I: Average Daily Open Interest as a Percentage of Shares Outstanding, 1990-2001

This table reports the average daily open interest of individual stock options traded at the Chicago Board Options Exchange (CBOE) during 1990-2001. The data were obtained directly from the CBOE and include information on the type of investor behind each transaction. Here, three types of investors, firm proprietary traders, customers of discount brokers and customers of full service brokers, are analyzed. All refers to all stocks with CBOE traded option contracts and available stock price data on CRSP. Large refers to the largest 500 market capitalization stocks in the CRSP universe at the end of the previous calendar quarter. Large growth (value) stocks are those in the lowest (highest) book-to-market equity ratio quartile of the 500 largest stocks based on the ratios at the end of each quarter. For the calculation of average, average daily delta-adjusted open interest as a percentage of shares outstanding is first calculated for each underlying stock. Then, for each calendar month, market capitalization weighted average daily open interests are calculated over each group for each investor type. Finally, the average across all calendar months during 1990-2001 is calculated and reported in this table.

Underlying Stocks	Type of Open Interest			
	Long Call	Long Put	Short Call	Short Put
Panel A: Firm Proprietary Traders				
All	0.041%	0.014%	0.030%	0.010%
Large	0.042%	0.014%	0.031%	0.010%
Large Growth	0.044%	0.015%	0.032%	0.011%
Large Value	0.039%	0.019%	0.041%	0.011%
Panel B: Discount Customers				
All	0.032%	0.004%	0.025%	0.009%
Large	0.031%	0.004%	0.023%	0.008%
Large Growth	0.039%	0.004%	0.027%	0.009%
Large Value	0.032%	0.004%	0.024%	0.010%
Panel C: Full-Service Customers				
All	0.130%	0.031%	0.195%	0.048%
Large	0.126%	0.029%	0.191%	0.046%
Large Growth	0.134%	0.032%	0.211%	0.047%
Large Value	0.159%	0.036%	0.190%	0.068%

Table II: Average Daily Open Volume as a Percentage of Shares Outstanding and Average Turnover Time in Trade Dates, 1990-2001

This table reports the average daily trading volume and average turnover time of individual stock options traded at the Chicago Board Options Exchange (CBOE) during 1990-2001. Only those transactions that are used to open new positions are included in this table. The data were obtained directly from the CBOE and include information on the type of investor behind each transaction. Here, three types of investors, firm proprietary traders, customers of discount brokers and customers of full service brokers, are analyzed. All refers to all stocks with CBOE traded option contracts and available stock price data on CRSP. Large refers to the largest 500 market capitalization stocks in the CRSP universe at the end of the previous calendar quarter. Large growth (value) stocks are those in the lowest (highest) book-to-market equity ratio quartile of the 500 largest stocks based on the ratios at the end of each quarter. For the calculation of average, average daily delta-adjusted open trading volume as a percentage of shares outstanding is first calculated for each underlying stock. Then, for each calendar month, market capitalization weighted average daily open trading volumes are calculated over each group for each investor type. Finally, the average across all calendar months during 1990-2001 is calculated and reported in this table. The average trade dates to turnover is calculated by simply dividing the average daily open interest by the average daily open trading volume.

Underlying Stocks	Buy Call	Buy Put	Sell Call	Sell Put
Panel A: Firm Proprietary Trader Average Daily Open Volume				
All	0.00078%	0.00032%	0.00065%	0.00026%
Large	0.00077%	0.00032%	0.00064%	0.00026%
Large Growth	0.00070%	0.00032%	0.00057%	0.00028%
Large Value	0.00084%	0.00038%	0.00079%	0.00027%
Panel B: Discount Customers Average Daily Open Volume				
All	0.00071%	0.00016%	0.00032%	0.00012%
Large	0.00067%	0.00016%	0.00029%	0.00011%
Large Growth	0.00085%	0.00017%	0.00036%	0.00014%
Large Value	0.00056%	0.00014%	0.00026%	0.00010%
Panel C: Full-Service Customers Average Daily Open Volume				
All	0.00407%	0.00137%	0.00360%	0.00109%
Large	0.00383%	0.00130%	0.00339%	0.00102%
Large Growth	0.00391%	0.00133%	0.00359%	0.00107%
Large Value	0.00443%	0.00133%	0.00357%	0.00125%
Panel D: Firm Proprietary Trader Average Trade Dates to Turnover				
All	53	43	46	38
Large	55	44	48	38
Large Growth	63	46	56	40
Large Value	46	51	51	43
Panel E: Discount Customers Average Trade Dates to Turnover				
All	45	23	79	73
Large	46	23	81	71
Large Growth	46	22	73	63
Large Value	56	32	92	105
Panel F: Full-Service Customers Average Trade Dates to Turnover				
All	32	23	54	44
Large	33	23	56	45
Large Growth	34	24	59	44
Large Value	36	27	53	54

Table III: Large Stock Regressions 1990-2001

This table reports the time-series average coefficients from Fama-MacBeth cross-sectional regressions of daily trading volume on various independent variables for large underlying stocks during 1990-2001. Large underlying stocks are the largest 500 market capitalization stocks in the CRSP universe at the end of the previous calendar quarter. Explanatory variables are returns of underlying stocks, the same day return (*Rsameday*), the return from trade dates –1 through –5 (*Rweek*), from trade dates –6 through –21 (*Rmonth*), from trade dates –22 through –63 (*Rquarter*), from trade dates –64 through –252 (*Ryear*), and from trade dates –253 through –504 (*R2years*). In addition, the log of the book-to-market equity ratio and the volatility of the underlying stock are also used as explanatory variables. Autocorrelation adjusted t-statistics are provided in parentheses. In Panels A-C, the regression results for, respectively, firm proprietary traders, customers of discount brokers and customers of full service brokers, are reported. In Panel D, the time-series average of the daily cross-sectional standard deviations of the explanatory variables is reported.

Dependent Variable	Intercept	Rsameday	Rweek	Rmonth	Rquarter	Ryear	R2years	ln(B/M)	Volatility
				Independent Variables					
			Panel A: Firm Proprietary Traders						
Open Buy Call Volume	-0.0002	0.0074	0.0048	0.0023	0.0011	0.0005	0.0000	0.0002	0.0048
	(-1.69)	(5.03)	(4.85)	(3.96)	(2.71)	(3.20)	(-0.09)	(4.08)	(5.69)
Open Sell Call Volume	-0.0001	0.0064	0.0025	0.0016	0.0010	0.0007	0.0002	0.0002	0.0038
	(-1.26)	(4.78)	(2.55)	(2.81)	(3.03)	(5.39)	(2.43)	(5.18)	(6.02)
Open Buy Put Volume	-0.0001	-0.0057	-0.0017	0.0000	0.0001	0.0001	0.0002	0.0001	0.0019
	(-1.39)	(-8.04)	(-6.23)	(-0.01)	(0.80)	(1.63)	(3.82)	(5.54)	(7.21)
Open Sell Put Volume	-0.0001	-0.0074	-0.0015	-0.0003	0.0000	0.0001	0.0001	0.0000	0.0014
	(-1.76)	(-11.36)	(-6.47)	(-1.63)	(0.49)	(3.83)	(2.51)	(4.09)	(9.38)
			Panel B: Discount Customers						
Open Buy Call Volume	-0.0013	0.0023	0.0007	0.0006	0.0006	0.0008	0.0005	0.0000	0.0062
	(-16.40)	(4.11)	(1.83)	(2.59)	(3.94)	(9.49)	(8.49)	(0.65)	(24.17)
Open Sell Call Volume	-0.0007	0.0066	0.0009	-0.0002	-0.0002	0.0001	0.0002	0.0000	0.0037
	(-26.70)	(22.79)	(6.25)	(-1.89)	(-2.98)	(3.12)	(7.03)	(2.18)	(33.10)
Open Buy Put Volume	-0.0003	-0.0005	0.0004	0.0002	0.0001	0.0002	0.0001	0.0000	0.0014
	(-11.98)	(-3.08)	(4.12)	(2.69)	(1.75)	(7.83)	(5.88)	(-1.96)	(20.13)
Open Sell Put Volume	-0.0003	-0.0023	-0.0008	-0.0004	-0.0001	0.0001	0.0001	0.0000	0.0015
	(-20.65)	(-17.60)	(-11.24)	(-8.54)	(-5.04)	(4.44)	(7.36)	(0.33)	(26.96)
			Panel C: Full-Service Customers						
Open Buy Call Volume	-0.0048	0.0411	0.0089	0.0050	0.0030	0.0021	0.0010	0.0005	0.0360
	(-13.68)	(8.23)	(2.64)	(2.95)	(2.53)	(4.98)	(4.11)	(4.80)	(18.28)
Open Sell Call Volume	-0.0035	0.0496	0.0145	0.0051	0.0018	0.0015	0.0011	0.0003	0.0285
	(-13.43)	(14.20)	(5.61)	(3.70)	(2.15)	(4.45)	(4.55)	(4.02)	(19.02)
Open Buy Put Volume	-0.0015	-0.0278	-0.0031	-0.0004	0.0003	0.0009	0.0006	0.0002	0.0117
	(-14.28)	(-17.94)	(-3.69)	(-0.53)	(0.95)	(7.32)	(5.32)	(4.89)	(21.25)
Open Sell Put Volume	-0.0016	-0.0188	-0.0061	-0.0019	-0.0005	0.0002	0.0007	0.0002	0.0118
	(-10.01)	(-15.35)	(-5.61)	(-2.74)	(-1.65)	(1.75)	(5.25)	(5.93)	(18.26)
			Panel D: Average Standard Deviation						
		0.0224	0.0488	0.0843	0.1344	0.2832	0.3335	0.8200	0.1027

Table IV: Percentage Impact on Daily Volume of One Standard Deviation Shock to Independent Variables, Large Stocks 1990-2001

This table reports the percentage impact on daily volume of one standard deviation shocks to independent variables. The numbers in this table are based on the Fama-MacBeth regressions results reported in Table III. The impact is calculated as the sum of the products of coefficients and standard deviations for all relevant independent variables divided by the average daily trading volume for each investor type.

Volume Variable	Dependent Vars. Receiving Positive One Std. Dev. Shock		
	Rweek-R2years	Rweek-Rquarter	Ryear-R2years
Panel A: Firm Proprietary Traders			
Open Buy Call Volume	93.99	74.34	19.65
Open Sell Call Volume	102.38	60.55	41.82
Open Buy Put Volume	7.42	-22.34	29.76
Open Sell Put Volume	-8.63	-35.36	26.73
Panel B: Discount Customers			
Open Buy Call Volume	78.28	23.46	54.83
Open Sell Call Volume	30.41	1.28	29.13
Open Buy Put Volume	77.86	25.58	52.28
Open Sell Put Volume	-34.82	-77.97	43.15
Panel C: Full-Service Customers			
Open Buy Call Volume	57.18	32.93	24.26
Open Sell Call Volume	63.22	40.54	22.68
Open Buy Put Volume	24.36	-10.53	34.90
Open Sell Put Volume	-23.22	-52.16	28.95

Table V: Large Stock Average Daily Open Volume as a Percentage of Shares Outstanding and Stock Index Returns for Subperiods of 1990-2001

Panels A through C of this table reports the average daily trading volume of individual stock options traded at the Chicago Board Options Exchange (CBOE) for large underlying stocks during subperiods of 1990-2001. Only those transactions that are used to open new positions are included in this table. The data were obtained directly from the CBOE and include information on the type of investor behind each transaction. Three types of investors, firm proprietary traders, customers of discount brokers and customers of full service brokers, are analyzed. The large underlying stocks are the largest 500 market capitalization stocks in the CRSP universe at the end of the previous calendar quarter. For the calculation of average, daily average delta-adjusted open trading volume as a percentage of shares outstanding is first calculated for each underlying stock. Then, for each calendar month, daily market capitalization weighted average open trading volumes are calculated over each group for each investor type. Finally, the average across all calendar months during each subperiod is calculated and reported in this table. Panel D reports the annualized return for the S&P 500 index, the Russell 1000 growth index, and the Russell 1000 value index for the subperiods. The data on the S&P 500 index are from Standards and Poor's, and the data on the Russell indexes are from the Frank Russell Company.

Time Period	Type of Open Volume			
	Buy Call	Buy Put	Sell Call	Sell Put
Panel A: Firm Proprietary Traders				
1990-1994	0.00091%	0.00034%	0.00078%	0.00029%
1995-1997	0.00077%	0.00024%	0.00062%	0.00020%
1998 - March 2000	0.00065%	0.00028%	0.00055%	0.00020%
April 2000 - 2001	0.00050%	0.00042%	0.00041%	0.00035%
Panel B: Discount Customers				
1990-1994	0.00047%	0.00014%	0.00018%	0.00006%
1995-1997	0.00082%	0.00018%	0.00029%	0.00011%
1998 - March 2000	0.00119%	0.00023%	0.00049%	0.00021%
April 2000 - 2001	0.00034%	0.00009%	0.00034%	0.00011%
Panel C: Full-Service Customers				
1990-1994	0.00432%	0.00141%	0.00388%	0.00103%
1995-1997	0.00433%	0.00137%	0.00353%	0.00104%
1998 - March 2000	0.00380%	0.00125%	0.00316%	0.00114%
April 2000 - 2001	0.00165%	0.00095%	0.00207%	0.00078%
Panel D: Average Annualized Return				
	S&P 500	Growth	Value	
1990-1994	8.34%	8.92%	8.23%	
1995-1997	27.12%	26.34%	27.40%	
1998 - March 2000	20.67%	30.33%	9.81%	
April 2000 - 2001	-13.98%	-31.50%	0.31%	

Table VI: Large Stock Regressions with Open Buy Call Volume as Dependent Variable for Subperiods of 1990-2001

This table reports the time-series average coefficients from Fama-MacBeth cross-sectional regressions of daily open buy call option trading volume on various independent variables for large underlying stocks during subperiods of 1990-2001. Large underlying stocks are the largest 500 market capitalization stocks in the CRSP universe at the end of the previous calendar quarter. Explanatory variables are returns of underlying stocks, the same day return (*Rsameday*), the return from trade dates –1 through –5 (*Rweek*), from trade dates –6 through –21 (*Rmonth*), from trade dates –22 through –63 (*Rquarter*), from trade dates –64 through –252 (*Ryear*), and from trade dates –253 through –504 (*R2years*). In addition, the log of the BM ratio and the volatility of the underlying stock are also used as explanatory variables. Autocorrelation adjusted t-statistics are provided in parentheses. In Panels A-C, the regression results for, respectively, firm proprietary traders, customers of discount brokers and customers of full service brokers, are reported.

Time Period	Intercept	Rsameday	Rweek	Rmonth	Rquarter	Ryear	R2years	ln(B/M)	Volatility
				Independent Variables					
				Panel A: Firm Proprietary Traders					
1990-1994	-0.00029	0.01120	0.00758	0.00362	0.00165	0.00078	0.00006	0.00030	0.00655
	(-0.86)	(3.57)	(3.41)	(2.77)	(1.78)	(2.01)	(0.27)	(3.61)	(3.31)
1995-1997	-0.00044	0.00595	0.00429	0.00193	0.00103	0.00034	-0.00033	0.00004	0.00498
	(-4.66)	(2.87)	(3.97)	(3.98)	(2.74)	(2.20)	(-2.68)	(0.74)	(9.61)
1998 - March 2000	-0.00011	0.00461	0.00202	0.00107	0.00056	0.00048	0.00016	0.00015	0.00348
	(-1.36)	(2.53)	(2.74)	(2.48)	(3.17)	(3.04)	(1.41)	(2.60)	(6.38)
April 2000 - 2001	0.00004	0.00239	0.00124	0.00041	0.00023	0.00030	0.00014	0.00000	0.00141
	(0.35)	(3.00)	(4.36)	(2.06)	(2.04)	(6.36)	(1.90)	(-0.06)	(6.68)
				Panel B: Discount Customers					
1990-1994	-0.00064	0.00215	0.00033	0.00063	0.00064	0.00021	0.00004	-0.00003	0.00457
	(-13.63)	(2.99)	(0.65)	(2.15)	(3.17)	(3.30)	(0.76)	(-2.24)	(20.95)
1995-1997	-0.00164	0.00212	-0.00040	-0.00060	-0.00030	0.00073	0.00060	0.00011	0.00940
	(-18.13)	(1.51)	(-0.42)	(-1.20)	(-0.76)	(5.06)	(6.09)	(3.14)	(20.84)
1998 - March 2000	-0.00283	0.00615	0.00401	0.00257	0.00206	0.00248	0.00132	-0.00007	0.00892
	(-10.32)	(4.07)	(4.21)	(4.43)	(8.26)	(9.65)	(7.51)	(-1.95)	(12.10)
April 2000 - 2001	-0.00034	-0.00196	-0.00068	-0.00025	-0.00002	0.00021	0.00030	0.00004	0.00153
	(-8.60)	(-4.66)	(-3.55)	(-2.25)	(-0.40)	(8.01)	(7.85)	(3.38)	(12.36)
				Panel C: Full-Service Customers					
1990-1994	-0.00519	0.05502	0.01482	0.00937	0.00630	0.00309	0.00092	0.00092	0.04506
	(-6.78)	(5.15)	(2.01)	(2.53)	(2.40)	(3.38)	(1.71)	(4.24)	(10.92)
1995-1997	-0.00616	0.04728	0.00586	0.00142	-0.00084	-0.00030	0.00013	0.00011	0.04455
	(-20.70)	(7.06)	(1.31)	(0.59)	(-0.48)	(-0.68)	(0.42)	(0.52)	(27.42)
1998 - March 2000	-0.00510	0.02975	0.00795	0.00450	0.00345	0.00407	0.00269	0.00070	0.02740
	(-12.36)	(5.21)	(2.43)	(3.09)	(4.57)	(10.00)	(8.17)	(4.39)	(13.90)
April 2000 - 2001	-0.00084	0.00457	-0.00201	-0.00072	-0.00024	0.00064	0.00076	-0.00006	0.00575
	(-5.99)	(2.10)	(-2.72)	(-1.64)	(-1.07)	(6.58)	(4.96)	(-0.67)	(16.78)

Table VII: Percentage Impact on Daily Open Buy Call Volume of One Standard Deviation Shock to Independent Variables, Large Stocks Subperiods 1990-2001

This table reports the percentage impact on daily open buy call option volume of one standard deviation shocks to independent variables. The numbers in this table are based on the Fama-MacBeth regressions results reported in Table VI. The impact is calculated as the sum of the products of coefficients and standard deviations for all relevant independent variables divided by the daily average trading volume for each investor type.

Subperiod	Dependent Vars. Receiving Positive One Std. Dev. Shock		
	Rweek-R2years	Rweek-Rquarter	Ryear-R2years
Panel A: Firm Proprietary Traders			
1990 - 1994	125.50	99.07	26.43
1995 - 1997	64.20	65.94	-1.74
1998 - March 2000	69.14	40.35	28.80
April 2000 - 2001	50.96	25.02	25.94
Panel B: Discount Customers			
1990 - 1994	48.18	32.81	15.37
1995 - 1997	36.26	-13.60	49.86
1998 - March 2000	153.91	58.00	95.91
April 2000 - 2001	31.01	-16.86	47.88
Panel C: Full-Service Customers			
1990 - 1994	82.06	54.67	27.39
1995 - 1997	5.80	6.77	-0.97
1998 - March 2000	86.43	32.44	53.99
April 2000 - 2001	14.68	-11.57	26.25

Table VIII: Large Stock Regressions with Open Sell Call Volume as Dependent Variable for Subperiods of 1990-2001

This table reports the time-series average coefficients from Fama-MacBeth cross-sectional regressions of daily open sell call option trading volume on various independent variables for large underlying stocks during subperiods of 1990-2001. Large underlying stocks are the largest 500 market capitalization stocks in the CRSP universe at the end of the previous calendar quarter. Explanatory variables are returns of underlying stocks, the same day return (*Rsameday*), the return from trade dates –1 through –5 (*Rweek*), from trade dates –6 through –21 (*Rmonth*), from trade dates –22 through –63 (*Rquarter*), from trade dates –64 through –252 (*Ryear*), and from trade dates –253 through –504 (*R2years*). In addition, the log of the BM ratio and the volatility of the underlying stock are also used as explanatory variables. Autocorrelation adjusted t-statistics are provided in parentheses. In Panels A-C, the regression results for, respectively, firm proprietary traders, customers of discount brokers and customers of full service brokers, are reported.

Time Period	Intercept	Rsameday	Rweek	Rmonth	Rquarter	Ryear	R2years	ln(B/M)	Volatility
				Independent Variables					
				Panel A: Firm Proprietary Traders					
1990-1994	-0.0002	0.0076	0.0048	0.0031	0.0016	0.0014	0.0003	0.0005	0.0054
	(-0.68)	(2.64)	(2.18)	(2.45)	(2.24)	(5.16)	(1.60)	(5.98)	(3.67)
1995-1997	-0.0003	0.0094	0.0019	0.0010	0.0007	-0.0002	-0.0002	-0.0001	0.0035
	(-2.99)	(5.35)	(2.07)	(2.10)	(1.75)	(-0.95)	(-1.78)	(-1.10)	(8.35)
1998 - March 2000	-0.0001	0.0022	0.0002	0.0000	0.0005	0.0006	0.0006	0.0002	0.0028
	(-0.63)	(1.15)	(0.17)	(-0.05)	(1.77)	(3.77)	(4.01)	(3.04)	(5.94)
April 2000 - 2001	0.0001	0.0033	0.0000	0.0001	0.0002	0.0002	0.0001	0.0000	0.0011
	(0.55)	(4.67)	(-0.04)	(0.76)	(1.92)	(6.45)	(2.43)	(0.03)	(6.90)
				Panel B: Discount Customers					
1990-1994	-0.0005	0.0052	0.0008	-0.0001	-0.0001	0.0000	0.0001	0.0000	0.0029
	(-17.10)	(15.44)	(4.64)	(-0.71)	(-1.26)	(-1.23)	(1.69)	(-0.93)	(24.19)
1995-1997	-0.0009	0.0090	0.0009	-0.0009	-0.0010	0.0000	0.0003	0.0001	0.0055
	(-22.04)	(11.25)	(2.19)	(-4.07)	(-4.93)	(0.51)	(4.66)	(4.09)	(25.14)
1998 - March 2000	-0.0012	0.0084	0.0014	0.0005	0.0004	0.0005	0.0003	0.0000	0.0045
	(-17.59)	(15.77)	(5.42)	(2.66)	(3.68)	(7.63)	(5.28)	(-2.00)	(20.63)
April 2000 - 2001	-0.0004	0.0042	0.0003	0.0000	0.0000	0.0001	0.0002	0.0000	0.0018
	(-12.67)	(11.13)	(1.85)	(-0.43)	(0.07)	(3.04)	(6.82)	(1.63)	(20.09)
				Panel C: Full-Service Customers					
1990-1994	-0.0043	0.0619	0.0212	0.0095	0.0042	0.0018	0.0013	0.0005	0.0377
	(-7.38)	(8.61)	(3.64)	(3.03)	(2.31)	(2.43)	(2.50)	(3.04)	(11.95)
1995-1997	-0.0036	0.0564	0.0124	0.0008	-0.0025	0.0000	0.0004	0.0002	0.0310
	(-21.68)	(11.28)	(4.95)	(0.56)	(-2.13)	(-0.09)	(1.68)	(1.27)	(28.70)
1998 - March 2000	-0.0034	0.0386	0.0115	0.0042	0.0027	0.0030	0.0017	0.0005	0.0207
	(-12.52)	(8.22)	(5.71)	(4.25)	(5.37)	(9.77)	(6.40)	(3.78)	(13.30)
April 2000 - 2001	-0.0010	0.0166	0.0023	0.0012	0.0010	0.0012	0.0008	-0.0001	0.0073
	(-5.74)	(7.76)	(2.25)	(2.52)	(4.05)	(9.51)	(5.42)	(-1.17)	(15.10)

Table IX: Large Growth (Low BM) and Large Value (High BM) Stock Average Daily Open Volume as a Percentage of Shares Outstanding for Subperiods of 1990-2001

This table reports the average daily trading volume of individual stock options traded at the Chicago Board Options Exchange (CBOE) for large growth underlying stocks during subperiods of 1990-2001. Only those transactions that are used to open new positions are included in this table. The data were obtained directly from the CBOE and include information on the types of investor behind each transaction. Three types of investors, firm proprietary traders, customers of discount brokers and customers of full service brokers, are analyzed. Large growth (value) stocks are those in the lowest (highest) book-to-market equity ratio quartile of the 500 largest stocks based on the ratios at the end of each quarter. For the calculation of the averages, daily average delta-adjusted open trading volume as a percentage of shares outstanding is first calculated for each underlying stock. Then, for each calendar month, daily market capitalization weighted average open trading volumes are calculated over each group for each investor type. Finally, the average across all calendar months during each subperiod is calculated and reported in this table.

Time Period	Type of Open Volume			
	Buy Call	Buy Put	Sell Call	Sell Put
Panel A: Firm Proprietary Traders, Large Growth Underlying Stocks				
1990-1994	0.00073%	0.00029%	0.00057%	0.00028%
1995-1997	0.00075%	0.00021%	0.00064%	0.00020%
1998 - March 2000	0.00067%	0.00027%	0.00057%	0.00019%
April 2000 - 2001	0.00055%	0.00068%	0.00046%	0.00056%
Panel B: Discount Customers, Large Growth Underlying Stocks				
1990-1994	0.00046%	0.00012%	0.00019%	0.00007%
1995-1997	0.00092%	0.00018%	0.00036%	0.00012%
1998 - March 2000	0.00188%	0.00033%	0.00070%	0.00031%
April 2000 - 2001	0.00050%	0.00014%	0.00044%	0.00015%
Panel C: Full-Service Customers, Large Growth Underlying Stocks				
1990-1994	0.00382%	0.00133%	0.00384%	0.00102%
1995-1997	0.00440%	0.00137%	0.00370%	0.00103%
1998 - March 2000	0.00482%	0.00150%	0.00384%	0.00134%
April 2000 - 2001	0.00216%	0.00105%	0.00237%	0.00094%
Panel D: Firm Proprietary Traders, Large Value Underlying Stocks				
1990-1994	0.00105%	0.00045%	0.00107%	0.00036%
1995-1997	0.00080%	0.00029%	0.00067%	0.00016%
1998 - March 2000	0.00066%	0.00031%	0.00059%	0.00016%
April 2000 - 2001	0.00056%	0.00043%	0.00045%	0.00032%
Panel E: Discount Customers, Large Value Underlying Stocks				
1990-1994	0.00070%	0.00021%	0.00026%	0.00010%
1995-1997	0.00049%	0.00008%	0.00023%	0.00008%
1998 - March 2000	0.00054%	0.00009%	0.00025%	0.00012%
April 2000 - 2001	0.00032%	0.00008%	0.00032%	0.00011%
Panel F: Full-Service Customers, Large Value Underlying Stocks				
1990-1994	0.00633%	0.00185%	0.00469%	0.00159%
1995-1997	0.00382%	0.00101%	0.00330%	0.00102%
1998 - March 2000	0.00312%	0.00096%	0.00260%	0.00114%
April 2000 - 2001	0.00175%	0.00086%	0.00204%	0.00086%

Table X: Regressions with Open Buy Call Volume as Dependent Variable, 1998-3/2000

This table reports the time-series average coefficients from Fama-MacBeth cross-sectional regressions of daily open buy call option trading volume on various independent variables for large underlying stocks during the stock market bubble period of 1998-March 2000. Large underlying stocks are the largest 500 market capitalization stocks in the CRSP universe at the end of the previous calendar quarter. Large growth (value) stocks are those in the lowest (highest) book-to-market equity ratio quartile of the 500 largest stocks based on the ratios at the end of each quarter. Explanatory variables are returns of underlying stocks, the same day return (*Rsameday*), the return from trade dates –1 through –5 (*Rweek*), from trade dates –6 through –21 (*Rmonth*), from trade dates –22 through –63 (*Rquarter*), from trade dates –64 through –252 (*Ryear*), and from trade dates –253 through –504 (*R2years*). In addition, the log of the BM ratio and the volatility of the underlying stock are also used as explanatory variables. Autocorrelation adjusted t-statistics are provided in parentheses. In Panels A-C, the regression results for, respectively, firm proprietary traders, customers of discount brokers and customers of full service brokers, are reported.

Underlying Stocks	Independent Variables								
	Intercept	Rsameday	Rweek	Rmonth	Rquarter	Ryear	R2years	ln(B/M)	Volatility
Panel A: Firm Proprietary Traders									
Large	-0.0001	0.0046	0.0020	0.0011	0.0006	0.0005	0.0002	0.0002	0.0035
	(-1.36)	(2.53)	(2.74)	(2.48)	(3.17)	(3.04)	(1.41)	(2.60)	(6.38)
Large, Growth	0.0003	0.0060	0.0013	0.0009	0.0004	0.0004	-0.0002	0.0001	0.0019
	(1.84)	(3.06)	(1.61)	(2.24)	(1.49)	(2.40)	(-1.52)	(1.42)	(4.62)
Large, Value	0.0000	0.0041	0.0039	0.0023	0.0010	0.0000	0.0009	0.0009	0.0036
	(0.05)	(1.19)	(3.88)	(2.47)	(3.75)	(0.07)	(3.90)	(3.39)	(3.45)
Panel B: Discount Customers									
Large	-0.0028	0.0062	0.0040	0.0026	0.0021	0.0025	0.0013	-0.0001	0.0089
	(-10.32)	(4.07)	(4.21)	(4.43)	(8.26)	(9.65)	(7.51)	(-1.95)	(12.10)
Large, Growth	-0.0085	0.0124	0.0074	0.0047	0.0041	0.0046	0.0014	-0.0017	0.0098
	(-7.61)	(3.94)	(4.07)	(3.77)	(7.25)	(7.42)	(5.23)	(-5.95)	(6.69)
Large, Value	-0.0005	0.0034	0.0026	0.0010	0.0002	-0.0003	0.0004	0.0002	0.0036
	(-7.79)	(3.53)	(4.10)	(2.90)	(0.66)	(-2.56)	(3.64)	(2.93)	(10.91)
Panel C: Full-Service Customers									
Large	-0.0051	0.0297	0.0080	0.0045	0.0035	0.0041	0.0027	0.0007	0.0274
	(-12.36)	(5.21)	(2.43)	(3.09)	(4.57)	(10.00)	(8.17)	(4.39)	(13.90)
Large, Growth	-0.0117	0.0336	0.0065	0.0066	0.0063	0.0068	0.0012	-0.0021	0.0218
	(-7.80)	(4.53)	(1.83)	(3.06)	(5.90)	(7.10)	(2.43)	(-4.77)	(9.60)
Large, Value	-0.0008	0.0338	0.0120	0.0031	0.0020	-0.0022	0.0037	0.0036	0.0196
	(-1.79)	(4.18)	(3.07)	(1.56)	(1.25)	(-2.96)	(3.88)	(5.09)	(7.75)

Table XI: Percentage Impact on Daily Open Buy Call Volume of One Standard Deviation Shock to Independent Variables for Different Types of Underlying Firms, 1998-3/2000
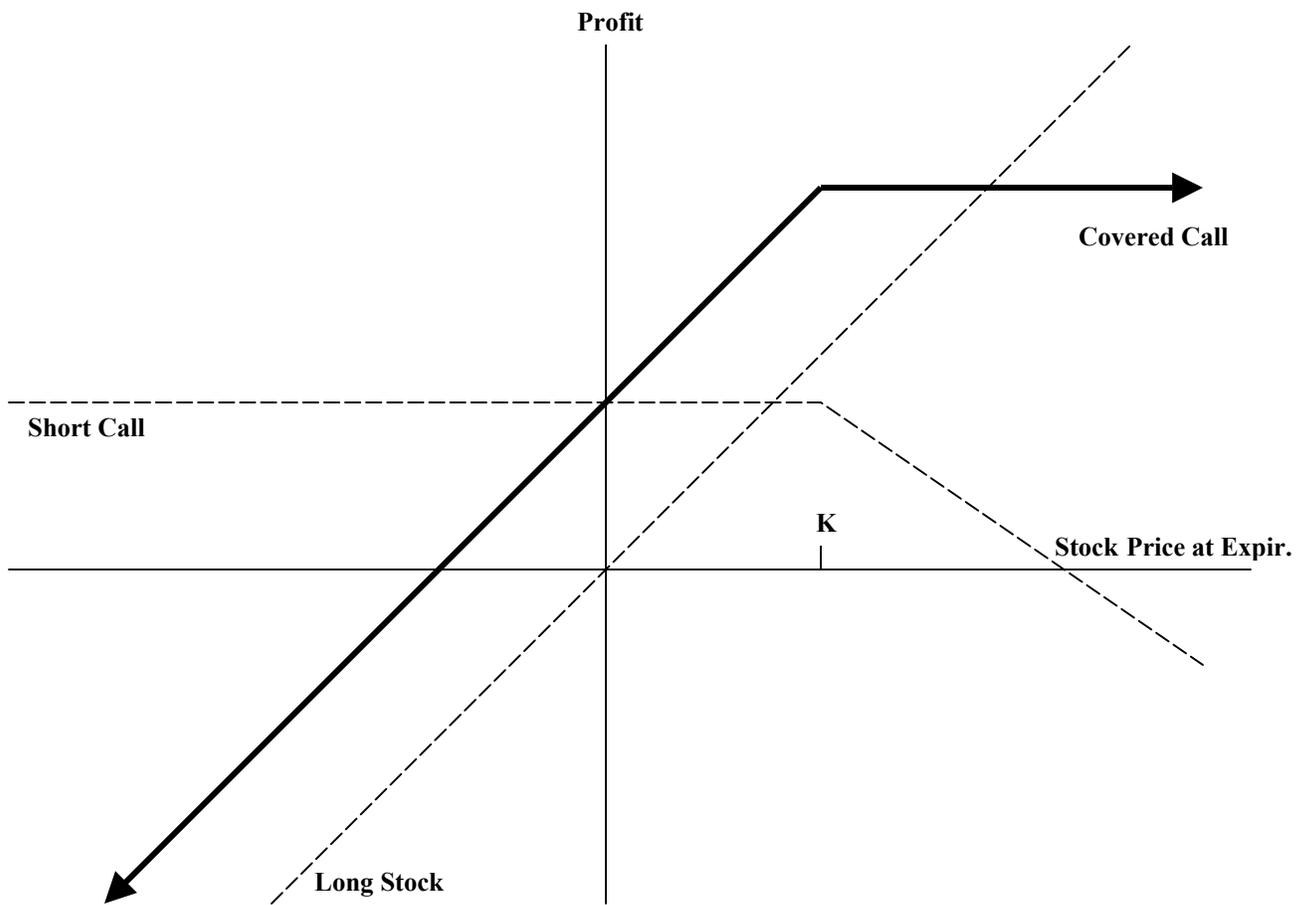
This table reports the percentage impact on daily open buy call option volume of one standard deviation shocks to independent variables. The numbers in this table are based on the Fama-MacBeth regressions results reported in Table X. The impact is calculated as the sum of the products of coefficients and standard deviations for all relevant independent variables divided by the daily average trading volume for each type. Large underlying stocks are the largest 500 market capitalization stocks in the CRSP universe at the end of the previous calendar quarter. Large growth (value) stocks are those in the lowest (highest) book-to-market equity ratio quartile of the 500 largest stocks based on the ratios at the end of each quarter.

| Underlying Stocks	Dependent Vars. Receiving Positive One Std. Dev. Shock		
	Rweek-R2years	Rweek-Rquarter	Ryear-R2years
Panel A: Firm Proprietary Traders			
Large	80.14	48.82	31.32
Large, Growth	49.66	38.85	10.81
Large, Value	119.08	83.95	35.13
Panel B: Discount Customers			
Large	173.05	70.16	102.89
Large, Growth	210.95	94.02	116.92
Large, Value	50.40	46.73	3.67
Panel C: Full-Service Customers			
Large	96.77	39.24	57.53
Large, Growth	109.12	48.08	61.04
Large, Value	51.28	38.41	12.87

Table XII: Regressions with Open Sell Call Volume as Dependent Variable, 1998-3/2000

This table reports the time-series average coefficients from Fama-MacBeth cross-sectional regressions of daily open sell call option trading volume on various independent variables for large underlying stocks during the stock market bubble period of 1998-March 2000. Large underlying stocks are the largest 500 market capitalization stocks in the CRSP universe at the end of the previous calendar quarter. Large growth (value) stocks are those in the lowest (highest) book-to-market equity ratio quartile of the 500 largest stocks based on the ratios at the end of each quarter. Explanatory variables are returns of underlying stocks, the same day return (*Rsameday*), the return from trade dates −1 through −5 (*Rweek*), from trade dates −6 through −21 (*Rmonth*), from trade dates −22 through −63 (*Rquarter*), from trade dates −64 through −252 (*Ryear*), and from trade dates −253 through −504 (*R2years*). In addition, the log of the BM ratio and the volatility of the underlying stock are also used as explanatory variables. Autocorrelation adjusted t-statistics are provided in parentheses. In Panels A-C, the regression results for, respectively, firm proprietary traders, customers of discount brokers and customers of full service brokers, are reported.

Underlying Stocks	Independent Variables								
	Intercept	Rsameday	Rweek	Rmonth	Rquarter	Ryear	R2years	ln(B/M)	Volatility
Panel A: Firm Proprietary Traders									
Large	-0.00007	0.00215	0.00021	-0.00003	0.00055	0.00063	0.00063	0.00018	0.00282
	(-0.63)	(1.15)	(0.17)	(-0.05)	(1.77)	(3.77)	(4.01)	(3.04)	(5.94)
Large, Growth	0.00000	0.00283	-0.00099	0.00028	0.00048	0.00064	0.00050	0.00002	0.00116
	(-0.02)	(2.01)	(-1.03)	(0.41)	(1.14)	(2.01)	(2.65)	(0.35)	(2.53)
Large, Value	-0.00023	0.00218	0.00267	0.00043	0.00061	0.00001	0.00085	0.00075	0.00460
	(-1.23)	(0.65)	(2.36)	(0.61)	(1.48)	(0.02)	(3.50)	(3.15)	(5.38)
Panel B: Discount Customers									
Large	-0.0012	0.0084	0.0014	0.0005	0.0004	0.0005	0.0003	0.0000	0.0045
	(-17.59)	(15.77)	(5.42)	(2.66)	(3.68)	(7.63)	(5.28)	(-2.00)	(20.63)
Large, Growth	-0.0026	0.0115	0.0017	0.0005	0.0007	0.0009	0.0003	-0.0004	0.0055
	(-11.59)	(11.51)	(3.75)	(1.34)	(3.59)	(7.56)	(3.73)	(-5.49)	(13.77)
Large, Value	-0.0003	0.0054	0.0017	0.0005	0.0000	-0.0004	0.0000	0.0001	0.0022
	(-3.58)	(8.43)	(3.50)	(2.77)	(0.23)	(-5.90)	(-0.19)	(1.88)	(9.29)
Panel C: Full-Service Customers									
Large	-0.0034	0.0386	0.0115	0.0042	0.0027	0.0030	0.0017	0.0005	0.0207
	(-12.52)	(8.22)	(5.71)	(4.25)	(5.37)	(9.77)	(6.40)	(3.78)	(13.30)
Large, Growth	-0.0075	0.0505	0.0129	0.0060	0.0042	0.0047	0.0002	-0.0012	0.0175
	(-8.24)	(10.33)	(5.53)	(4.29)	(4.73)	(6.53)	(0.44)	(-5.53)	(10.55)
Large, Value	-0.0009	0.0366	0.0129	0.0038	0.0022	-0.0005	0.0039	0.0032	0.0167
	(-2.22)	(5.19)	(4.14)	(2.83)	(2.07)	(-0.97)	(5.10)	(5.87)	(8.07)

Figure 1. Profit to covered call position as a function of the stock price at expiration. The bold line depicts the profit at expiration to a covered call position as a function of the stock price at expiration. The covered call position consists of one long share of stock held in combination with one short call position with strike price K.
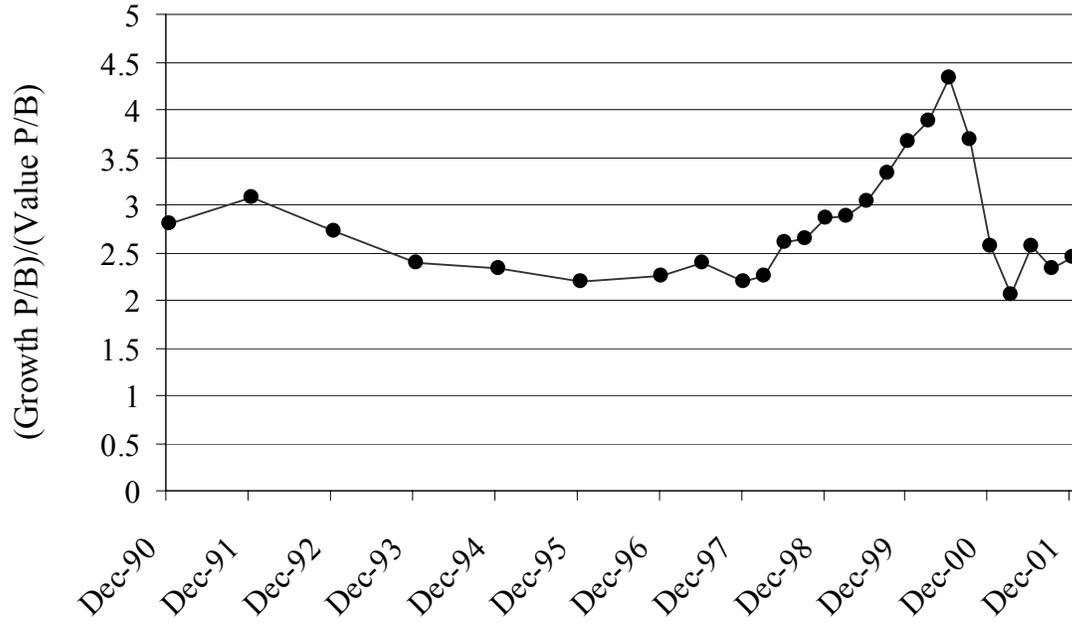
Figure 2: Price to book ratio of growth stocks divided by price to book ratio of value stocks, 1990 through 2001. This figure depicts the ratio of market capitalization to book value for the Russell 1000 growth stocks divided by the same ratio for the Russell 1000 value stocks from 1990 through 2001. The data used to construct the figure are from the Frank Russell Company.