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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 document major stylized facts about the option market activity of three types of non-market maker investors over this time period and also investigate how their trading changed during the stock market bubble of the late 1990s and early 2000. Our key findings are: (1) non-market maker investors have about four times more long call than long put open interest, (2) these investors have more short than long open interest in both calls and puts, (3) each type of investor purchases more calls to open brand new positions when the return on underlying stocks are higher over horizons ranging from one week to two years into the past, (4) the least sophisticated group of investors substantially increased their purchases of calls on growth but not value stocks during the stock market bubble of the late 1990s and early 2000, and (5) none of the investor groups significantly increased their purchases of puts during the bubble period in order to overcome short sales constraints in the stock market.

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1. Introduction

The seminal work of Black and Scholes (1972) and Merton (1973) generated an explosion of research into methods for computing theoretical option prices and hedge ratios. By contrast, relatively little is known about the trading of this important class of securities. This paper uses a unique option dataset to investigate investor behavior in the equity option market. There are two main goals. The first is to document major empirical facts about the option market activity of different types of investors. The second is to investigate changes in option market activity during the stock market bubble of the late 1990s and early 2000.

The dataset contains detailed daily open interest and volume information for each equity option listed at the Chicago Board Options Exchange (CBOE) from 1990 through 2001. All of the data are broken down by different types of investors: firm proprietary traders, customers of full-service brokers, and customers of discount brokers. The open interest data provide both 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 the investor type establishes brand new option positions or closes existing ones. Most other datasets, by contrast, provide only aggregate daily open interest and volume for each option.¹

Our analysis begins by determining the average daily long and short, put and call open interest for different types of investors and various categories of stocks such as large capitalization stocks and value and growth stocks. We also compute for the different investor types and categories of stocks average daily volume of purchases and sales of both calls and puts

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 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.

that open new positions. Next, each of these four volume categories is regressed on the underlying stock returns over various past horizons, underlying stock book-to-market (BM) ratios, and underlying stock volatilities in order to understand the factors that drive option market activity. 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 are especially interested in changes in the behavior of the different investor types during the stock market bubble of the late 1990s and early 2000.

Our first set of finding about option market activity pertains to the entire sample period from 1990 through 2001. We summarize several of them here. First, non-market maker investors have about four times more long call than long put open interest. Second, for both calls and puts the three investor types in aggregate have more short than long open interest. Third, the differences in open interest and trading volume across options with underlying growth and value stocks are small. Fourth, all investor types buy more calls to open new positions after positive returns on underlying stocks at horizons from one week to two years in the past. For the most part, a similar relation also holds between past returns and the selling of new calls and the buying and selling of new puts. A noteworthy exception, however, is that sales of puts to open new short positions are negatively related to returns on the underlying stock for short horizons up to one quarter in the past.

Given the diversity of the participants and the complexity of the instruments in the option market, there are surely a number of factors which yield the empirical regularities that we document. Although formal testing for the contributions of various factors lies beyond the scope of this paper, when presenting our findings we do make some suggestions about what might be

generating them. For example, behavioral factors may play an important role in producing greater short than long open interest for calls and puts. As we explain below, the high level of short call open interest is consistent with loss-averse investors who focus on individual investments rather than their aggregate portfolios preferring covered calls (which consist of long stock positions combined with short call positions) to long stock positions. Regret avoidance might partially explain the high level of short put open interest. This would be the case if investors sell out-of-the-money puts on stocks that they believe are trading at attractive prices, reasoning that either the stock will sink below the strike price and they will buy the stock even more cheaply or the stock will remain above the strike price and they will just keep the put premium. As another example, trend-chasing may account for the fact that all three investor types buy more calls to open brand new long positions after positive returns on the underlying asset over a variety of past horizons.

We also establish a number of key facts about option market activity during the stock market bubble of the late 1990s and early 2000. First, the volume of calls purchased by customers of discount brokers to open brand new positions was highly elevated for underlying growth stocks, but there was no corresponding increase for underlying value stocks. Second, in contrast to the discount customers, there was no increase in call purchases to open new positions for firm proprietary traders or customers of full-service brokers. Third, even though open buy call volume did not increase for the full-service customers, the positive relationship between open buy call volume and past returns strengthened for this group of investors. Finally, the purchase of puts to open new positions did not increase for any of the investor classes during the bubble.

We will argue below that discount customers are probably the least sophisticated of the three groups of option investors. Consequently, our results from the bubble period suggest that the least sophisticated investors were speculating that the price of growth stocks would continue to rise and that their speculation contributed to the bubble. More sophisticated investors, by contrast, at most had a mild bet that the price of the growth stocks would continue to go up. The fact that the open buy put volume did not increase for any of the investor groups during the bubble is consistent with there having been little appetite for betting against the bubble, even though it would have been easy to do so by purchasing puts. Hence, our results provide a different perspective on the bubble than Ofek and Richardson (2003) which argues that the existence of short sales constraints contributed to the development of the bubble and that the loosening of those constraints played a role in deflating it. At the same time, our results tend to reinforce Brunnermeier and Nagel's (2003) finding that hedge funds rode rather than attacked the bubble. It seems that even sophisticated investors do not want to take contrarian positions during a bubble.

In addition to other research on the bubble, our paper is also related to a broader literature that studies investor behavior in the stock market. In a recent paper Barber, Odean, and Zhu (2003) investigate the stock market activity of investors at a discount and full-service brokerage house. They find that discount and full-service customers are contrarians over short horizons but trend-chasers over longer horizons. Although broadly consistent with these findings, our result on the relationship between option activity and past returns on the underlying stock differ along several important dimensions. Beyond the obvious fact that we study the option rather than the stock market, our results may also have greater generality since they are derived from all discount and full-service traders in the market rather than from those at a single discount or full-

service brokerage house.² It is also important to note that since the supply of stock is fixed (at least in the short-run), stock market studies provide information on the *relative* desire of different groups of market participants to trend-chase or act as contrarians. For example, if both individuals and institutions become more positive on stocks after price increases but the institutions become more bullish than the individuals, then the institutions will buy stock from the individuals. In this case, the individuals will appear to be contrarians, even though price run-ups make both parties more positive about stocks. In the option market, on the other hand, it is easy to create and destroy contracts, so we can get a clearer picture of different groups' *absolute* desire to trend-chase or act as contrarians. That is, in the option market it is possible to find that both individuals and institutions act as either trend-chasers or contrarians. Consequently, the fact that in Barber, Odean, and Zhu (2003) discount investors act as contrarians with respect to returns over the most immediate past two quarters but in our work they act as trend-chasers is consistent with discount customers becoming more bullish on stocks that have done well over the last six months (and hence buying brand new calls on them) but not becoming as bullish as other investors (and hence selling stock to the more bullish stock market participants.)³

The remainder of the paper is organized as follows. Section 2 discusses the data. The third section defines our measures of option market activity. Section 4 investigates the level and cross-sectional determinants of option market trading over our entire sample period. The fifth section examines changes during the bubble period, and Section 6 concludes.

² In addition, we present results for firm proprietary traders.

³ There also have been a number of papers that investigate whether institutions and individuals are trend-chasers or contrarians in the stock market (e.g., Lakonishok, Shleifer, and Vishny (1992), Grinblatt, Titman, and Wermers (1995), Nofsinger and Sias (1999), Wermers (1999), and Grinblatt and Keloharju (2001).) These papers also measure relative rather than absolute trend-chasing and collectively have yielded inconclusive results.

2. 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

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 maintain that among the three groups of option investors, the firm proprietary traders have the highest level of sophistication, the full-service customers have an intermediate level of sophistication, and the discount customers have the lowest level of sophistication. Evidence that the firm proprietary option traders have the highest level of sophistication is provided in Poteshman and Serbin (2003) which demonstrates that firm proprietary traders never engage in irrational early exercise of stock options while the full-service and discount customers do so with some regularity. One reason to believe that full-service option traders are on average more sophisticated than discount option traders is that most hedge funds trade through full-service brokerage houses. In addition, Pan and Poteshman (2003) find that full-service option traders have a greater propensity than discount option traders to open new long call (put) positions before stock price increases (decreases). Further evidence that full-service option customers are more sophisticated than discount option customers is provided in Mahani and Poteshman (2003) which shows that discount customers have a greater propensity for entering option positions that load up on growth stocks relative to value stocks in the days leading up to earnings announcements despite the fact that at earnings announcements value stocks outperform growth stocks by a wide margin. (LaPorta, Lakonishok, Shleifer, and Vishny, 1997)

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

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

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 number 60. Market value of equity is computed by multiplying the CRSP share price and the number of shares outstanding. When calculating BM, the most recently available market value of equity is used.

3. 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 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 j th 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 j th call on underlying stock s on trade date t . We then define $OpenInterestPercentageShares_{s,t}^{k,i}$ by

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

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 j th 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

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

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

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 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.

open interest as a percentage of shares outstanding on XYZ for June 1, 1998 is 0.0378%. This percentage is computed as

$$OpenInterestPercentageShares_{XYZ, June 1, 1998}^{Long Call, Firm Prop.} = \left(\frac{100 \times 120 \times 0.55 + 100 \times 35 \times 0.60}{23,000,000} \right) \times 100 \quad (3)$$

$$= 0.0378\%.$$

Finally, it should be noted that (holding other things fixed) stock price changes will not substantially impact our measures, but stock price changes would have an important impact on variables defined to gauge option market activity in dollar terms.

4. Investor behavior in the option market: 1990-2001

This section of the paper characterizes option market activity over our entire data period from 1990 to 2001. We begin by examining option open interest and trading volume by different types of investors for options on various categories of underlying stocks. We then investigate some cross-sectional determinants of option market trading.

4.1. Levels of option open interest

Table 1 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 those in the top 500 by market capitalization 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 on 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 next evaluate 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

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.

underlying stocks, full-service customers have long call open interest that controls 0.126% of the underlying shares while they have long put open interest that controls only 0.029% of the underlying shares. Discount customers have an even stronger relative preference for long call positions. Their long call open interest controls 0.031% of the underlying shares while their 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 somewhat 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, the difference between the cost or difficulty of taking short and long positions in the option market by buying puts or calls is not as large.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 inclined to buy

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).

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. Table 1 reports 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 Although the difference in long and short call open interest is not as great as that between long call and long put open interest, it should be noted that to some extent market makers manage risk by setting prices to balance the long and short demands of non-market maker investors for each type of option. Consequently, when considering the difference between long and short open interest for calls (or puts), it should be understood that the difference which is observed is that which survives market maker efforts to balance the demand for long and short positions. On the other hand, any impact of this effect is moderated by the fact that market makers can hedge any net option positions which they hold by buying or selling the underlying stock.

The greater propensity to sell calls short is due to the full-service customers. Since covered call positions (i.e., long stock combined with short call positions) are heavily promoted by the brokers who work at the full-service investment firms, the elevated level of short call open

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

interest may be generated from the sale of covered calls. That is, an important source of the short call open interest may be investors selling calls on stocks they already own or simultaneously selling calls and buying the underlying stock. Brokers do not typically frame the call sale as taking a short position in the stock. Instead, it is marketed together with the stock position 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 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 alone, 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 long stock and covered call positions. Figure 1 makes it clear that in comparison to a long position in the stock, covered call positions (1) lose money in fewer states of the world, (2) when losing, lose less than the stock, and (3) underperform the stock only when the stock and the covered call both have large gains. Hence, if the elevated level of short calls for the full-service customers is largely the result of covered call positions, the behavior of the full-service customers is consistent with loss aversion and mental accounting which have been identified by the behavioral finance/economics literature as important determinants of investor decision-making (see Thaler (1980), Kahneman and Tversky (1979), Benartzi and Thaler (1999), Rabin and Thaler (2000), Barberis and Huang (2001), Barberis, Huang, and Thaler (2003), Thaler and Johnson (1990), and Barberis, Huang, and Santos (2001).)

Table 1 also reveals that over our entire time period of 1990-2001 there are no major differences in open interest for value and growth stocks. This is true for all investor types. 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 growth and value underlying stocks. It is interesting to note, however, that the largest percentage difference is observed for the short put open interest of full-service customers on growth and value stocks. In this case, the average daily short put open interest for growth and value stocks are, respectively, 0.047% and 0.068% which corresponds to full-service customers selling relatively more puts on stocks which might be perceived as relatively undervalued. Our discussions with option market participants suggest that one factor that may help explain this difference is that some investors like to sell out-of-the-money puts on stocks which they consider to be cheap. They view it as a win-win situation which will minimize regret. These investors apparently reason that either the buyer will not exercise and they will just keep the put premium or the buyer will exercise in which case they will keep the premium and buy the stock at a price lower than the current price which they already perceive to be attractive. Hence, behavioral considerations may explain the relatively elevated level of put sales on value stocks.

We will see below that even though the open interest is similar across different types of underlying stocks over the entire sample period, during the stock market bubble of the late 1990s and early 2000 there were large differences in option market activity on growth and value stocks for some investors.

4.2. Levels of option volume

Panels A-C of Table 2 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 brand new long positions (and not to close out existing short positions), while the last two columns represent options sold to establish brand new short positions (and not to close out existing long positions.) The first thing to note about Table 2 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 1 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 2 report the average number of trade days the various investor classes hold long and short, call and put positions. Panel F of Table 2 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 on large stocks an average of 56 days and their long call positions on large stocks an average of only 33 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

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.

positions are used more for hedging or as part of longer-term investment strategies. Once again, no major differences are seen across growth and value stocks in the statistics reported in Table 2. However, differences will emerge when we focus on subperiods, especially the bubble period.

4.3. 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 book-to-market ratios and volatility as control variables.

We want to know what motivates 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 subsections, these variables are normalized so that they represent the equivalent percentage of shares of the underlying stock traded in the option market. The first set of explanatory variables are based on returns from the underlying stock: the same day return ($R_{sameday}$), the return from trade dates -1 through -5 (R_{week}), from trade dates -6 through -21 (R_{month}), from trade dates -22 through -63 ($R_{quarter}$), from trade dates -64 through -252 (R_{year}), and from trade dates -253 through -504 (R_{2years}). 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 it is not uncommon for firm

proprietary traders to place orders to facilitate the trades of their customers. Hence, it is more difficult to interpret the results for this class of investors. 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 at reasonable prices. If the firm proprietary trader discovers that only a portion of the order can be executed, he might facilitate the execution for the client by placing an order to buy some IBM calls.

Table 3 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 4 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.

4.3.1. Cross-sectional determinants of 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 It appears that these option market investors develop positive sentiment on stocks that have done well over

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.

the past 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 impact is economically very large. Table 4 indicates that 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 suggests that the sentiment about a stock developed over extended periods of time influences investment decisions. The discount customers 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.

Consistent with our results, Barber, Odean, and Zhu (2003) show that discount and full-service investors are also generally trend-chasers in the stock market over the past 12 quarters. They do find, however, that full-service and discount customers are contrarians over the first couple of quarters in the past. This finding in Barber, Odean, and Zhu (2003) might suggest that we should also find contrarian behavior with respect to returns over the past couple of quarters. In fact, we find trend-chasing at these horizons. There is not, however, necessarily a conflict between the results. As explained above, since stocks are in fixed supply (at least in the short-run), stock market studies measure relative trend-chasing among different types of investors.

¹⁴ Of course, 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.

Option contracts, on the other hand, can be easily created and destroyed. As a result, our findings document absolute trend-chasing by the various investor groups.

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.

4.3.2. Cross-sectional determinants of open sell call volume

As was evident from Tables 1 and 2, short calls are especially important for full-service customers. Table 3 indicates that for the full-service customers, all of the coefficients on past returns from the open sell call volume regression 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%.

Several factors may be contributing to the positive relationship between past returns and open sell call volume for the full-service customers. First, full-service investors may be placing contrarian bets by selling calls on stocks that have had high past returns. We are somewhat skeptical, however, that this is an important explanation. Since the profit to selling calls cannot exceed the call premium, buying puts would be a more natural way for investors to make contrarian bets. In addition, Table 2 shows that full-service customer hold their short call positions twice as long as their long call positions. This fact suggests that, relative to long call positions, short call positions are in general not being entered into for the purpose of short-term speculation.

A second possibility is that the positive relationship between open sell call volume and past returns comes from the full-service customers selling calls on stocks in their portfolios that have gains. 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 their 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 end up losing money on the position. Hence, our finding of a positive impact of past stock returns on the sale of call options is consistent with prospect theory. Brokers also aggressively market covered calls as a conservative way to take a long position in a stock. As a result, some of the trading behind the positive coefficients probably comes from investors who purchase stock to bet that prices will continue to increase while offsetting part of the purchase price by simultaneously selling calls.

In Barber, Odean, and Zhu's (2003) sample, the average discount customer account holds 25% fewer individual stocks than the average full-service customer account. Consequently, prospect theory would suggest a weaker relationship for the discount customers. Table 3 indicates that the relationship for the discount customers is indeed weaker. In fact, some of the coefficients of past returns are negative for the discount customers, and the overall impact of a one standard deviation shock to past returns is less than half of the impact for full-service customers.

A third factor that may contribute to the positive relationship between open sell call volume and past returns for the full-service customers is the desire of market makers to avoid large inventories of either short or long call positions. If positive returns cause the full-service customers to trend-chase by buying calls, then market makers may raise the prices of the calls in order to avoid building up too large of an inventory of short calls. The higher call prices might in turn induce some full-service investors to sell calls. The similarity between the regression coefficients on the returns at various past horizons for the full-service customers in the open buy call volume and open sell call volume regressions is consistent with the market maker price adjustment mechanism contributing to the positive relationship between open sell call volume and past returns. Since the full-service customers constitute the largest part of the market, the market maker inventory mechanism described here is likely to show its effect most clearly for the full-service customers. It should be kept in mind, however, that any impact of the mechanism on the regression coefficients will be moderated by the fact that market makers can manage the risk they face when holding non-zero net option positions by hedging with the underlying stock.¹⁵

4.3.3. Cross-sectional determinants of open buy put volume

In general, the activity in puts is not very large. Recall that Table 1 indicates that for discount and full-service customers the open interest in long puts is smaller than for any of the other three categories. Table 3 reports that discount investors buy more (fewer) new puts on underlying stocks that have increased (decreased) in value in the past. This is expected from

¹⁵ It should also be noted that even if the mechanism were very powerful and forced the regression coefficients to be the same in the open buy call volume and open sell call volume regressions, it would not force the coefficients to any particular positive or negative values. Consequently, the fact that the coefficients are reliably positive suggests that the trend-chasing and covered call factors may be important.

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.¹⁶ 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 despite the cost and difficulty of shorting stocks directly, buying puts, surprisingly, is a relatively unpopular activity.

4.3.4. Cross-sectional determinants of open sell put volume

Relative to buying puts, there is a lot of activity in selling puts. Indeed, Table 1 shows that the discount and full-service investors have more short than long put open interest. Table 3 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 is consistent with these investors believing that weakness in an underlying stock in the past quarter is temporary. The results in Table 4 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 may be selling 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 buying the stock at an even lower price.¹⁷

¹⁶ 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.

¹⁷ The purchase price for the stock will be lower if the puts are sold out-of-the-money which is typically the case.

4.3.5. *Other variables*

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.

5. Investor behavior in the option market during the stock market 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 to see how different investor classes might have 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.

5.1. Option market activity through time

Table 5 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 option 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 appears to be 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 across the other types of option positions as well. They increased their selling of calls to open new positions. This may correspond to an increase in covered call positions which can be viewed as 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. It may well be the case that discount customers were buying stocks directly as well, thus contributing further to the bubble.

One of the most interesting results in Table 5 relates to the put activity of full-service customers. There is a large 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 3 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 6 re-runs the open buy call volume regressions for the three investor groups for each of the four subperiods of 1990-2001, and Table 7 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 6) 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, R_{year} and R_{2years} , are positive. Table 7 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 for the most part driven by investor trend-chasing longer horizon returns. For shorter horizon returns, investors sometimes are 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 ($R_{year}-R_{2year}$), 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 stocks that performed well in the past, which during this period of time happened to be growth companies.

The full-service customers, based on the results in Table 5, did not increase their activity in options during the bubble. However, Table 6 and Table 7 reveal that these more sophisticated investors did not escape the frenzy of the bubble completely. 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 buys of calls to open new positions.

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 6 and Table 7 show that the bubble did not impact their behavior in terms of chasing past winners.

Table 8 runs regressions like those in Table 6 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 may be due to 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 simultaneously shorting calls.¹⁸ It is interesting to note that there is much more consistency in the positive sign for the coefficients of the return variables in Table 8 than in Table 6. 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 7) 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

¹⁸ It is possible that another factor is market makers raising call prices in order to manage inventories which results in call sales.

shock produces a 46% increase in open buy sell volume for these customers after the bubble. The long call results in Table 6, on the other hand, are probably more closely tied to the sentiment of the full-service customers which varied over the subperiods. On the other hand, in Table 8 we see less consistency in the positive signs for the coefficients for the return variables for the discount customers. This may be because 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.

5.2. 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.

Table 9 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 9 shows that for the 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 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. A natural way to interpret this behavior is that the discount customers are strategy-chasing as in Barberis and Shleifer (2003). That is, they buy calls on growth stocks as long as this produces profits, but switch away from the strategy once it becomes unprofitable.

Panel E of Table 9, 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 5, 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 9 that during the height of the bubble discount customers markedly increased their selling of calls on growth stocks. Some of these call sales may correspond to covered calls which, as discussed above, are marketed as conservative long positions in stocks. However, the main activity of discount customers during the bubble was in buying calls. Their call selling activity was small on a relative basis. Although not of great economic significance, a small population of discount customers behaved as contrarians as evidenced by the small jump in put buying activity on underlying growth stocks during the bubble. However, it seems 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 even smaller. 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 behavior 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 substantially increased 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 investors types found value stocks of interest during the bubble, and, thus, decreased their activity in this segment of the market.

5.3. Cross-sectional determinants

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. Tables 10 and 11 report the results of regressions run during the bubble period for underlying value and growth stocks when open buy call volume is the dependent variable. These tables enable us to judge the extent of trend-chasing of value and growth companies. The coefficients in Table 10 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 11 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 discount customers who tend to be less sophisticated on average. 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 10. Table 11 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 12. 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. We conjecture that 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 this 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, respectively, growth and value stocks.

6. Conclusion

Despite the tremendous amount of research over the past three decades into methods for computing the prices and hedge ratios of stock options, very little is known about how investors actually trade these securities. This paper takes advantage of a unique and detailed data set of open interest and volume for all CBOE traded options to investigate the option market behavior of firm proprietary traders, customers of discount brokers, and customers of full-service brokers. We examine both the entire period covered by the data set, 1990-2001, and also subperiods with a focus on the stock market bubble of the late 1990s and early 2000. Although we do not formally investigate the factors that produce the empirical regularities that we document, we do make some suggestions about what might be lying behind our results.

We find that long put positions are comparatively unimportant. In particular, long put open interest is only one quarter as large as long call open interest. We expected to see relatively more long put positions because of the cost and difficulty of taking short positions directly in individual stocks. We also find that long call positions are less prevalent among our three investor types than short call positions. The popularity of short calls may result from their use in covered call position in which they are held together with long positions in underlying stocks. Covered call positions are heavily promoted by brokers as a conservative way to undertake or maintain long stock positions. Typically, the investor shorts a call that is 10 to 15 percent out-of-the-money. In this case, relative to owning the stock alone, a covered call position produces a better outcome when the stock price declines or increases modestly. It yields an inferior outcome only when the underlying stock increases in value substantially. As a result, the large number of observed short call positions is consistent with loss aversion and narrow framing which have been identified by the behavioral finance and economics literature as important aspects of investor behavior.

Another interesting finding is that for discount and full-service investors short put open interest is at least 50% higher than long put open interest. Furthermore, 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 trading at attractive prices. Short put positions are typically established out-of-the-money, so that the strike price is below the current stock price. Investors who undertake these short put positions may view them as a win-win situation. If the stock stays above the strike price, the seller just keeps the put premium. If the stock goes below the strike price and the counter-party exercises the put, then the seller keeps the premium and acquires the stock by paying the strike price which is lower than the price of the

stock at the time the short put position was established. Being forced to buy the stock at this lower strike price, however, is not painful for the investor, because he already believed the stock was attractive at the higher price at which it was trading when he originally sold the put.

We also 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. Our results also provide an interesting complement to stock market studies, both because our tests measure absolute rather than relative trend-chasing and also because the stock market studies have been inconclusive.

Finally, we assess option trading during subperiods of 1990 through 2001. 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 March 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. The more sophisticated full-service customers, on the other hand, did not increase their overall activity in options during the bubble, although they did moderately increase their activity in call options on growth companies and decrease their activity on value companies. Despite the fact that the bubble had little impact on

the overall level of full-service customer option activity, it did significantly alter the trend-chasing behavior of these investors. Specifically, their appetite for buying calls on strongly performing stocks increased substantially. In contrast to the other investors, the bubble was a non-event for the firm proprietary traders in terms of their option market activity. Finally, it is quite interesting that 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.

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Table 1
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 2
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 3
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	Independent Variables								
	Intercept	Rsameday	Rweek	Rmonth	Rquarter	Ryear	R2years	ln(B/M)	Volatility
Panel A: Firm Proprietary Traders									
Open Buy Call Volume	-0.0002 (-1.69)	0.0074 (5.03)	0.0048 (4.85)	0.0023 (3.96)	0.0011 (2.71)	0.0005 (3.20)	0.0000 (-0.09)	0.0002 (4.08)	0.0048 (5.69)
Open Sell Call Volume	-0.0001 (-1.26)	0.0064 (4.78)	0.0025 (2.55)	0.0016 (2.81)	0.0010 (3.03)	0.0007 (5.39)	0.0002 (2.43)	0.0002 (5.18)	0.0038 (6.02)
Open Buy Put Volume	-0.0001 (-1.39)	-0.0057 (-8.04)	-0.0017 (-6.23)	0.0000 (-0.01)	0.0001 (0.80)	0.0001 (1.63)	0.0002 (3.82)	0.0001 (5.54)	0.0019 (7.21)
Open Sell Put Volume	-0.0001 (-1.76)	-0.0074 (-11.36)	-0.0015 (-6.47)	-0.0003 (-1.63)	0.0000 (0.49)	0.0001 (3.83)	0.0001 (2.51)	0.0000 (4.09)	0.0014 (9.38)
Panel B: Discount Customers									
Open Buy Call Volume	-0.0013 (-16.40)	0.0023 (4.11)	0.0007 (1.83)	0.0006 (2.59)	0.0006 (3.94)	0.0008 (9.49)	0.0005 (8.49)	0.0000 (0.65)	0.0062 (24.17)
Open Sell Call Volume	-0.0007 (-26.70)	0.0066 (22.79)	0.0009 (6.25)	-0.0002 (-1.89)	-0.0002 (-2.98)	0.0001 (3.12)	0.0002 (7.03)	0.0000 (2.18)	0.0037 (33.10)
Open Buy Put Volume	-0.0003 (-11.98)	-0.0005 (-3.08)	0.0004 (4.12)	0.0002 (2.69)	0.0001 (1.75)	0.0002 (7.83)	0.0001 (5.88)	0.0000 (-1.96)	0.0014 (20.13)
Open Sell Put Volume	-0.0003 (-20.65)	-0.0023 (-17.60)	-0.0008 (-11.24)	-0.0004 (-8.54)	-0.0001 (-5.04)	0.0001 (4.44)	0.0001 (7.36)	0.0000 (0.33)	0.0015 (26.96)
Panel C: Full-Service Customers									
Open Buy Call Volume	-0.0048 (-13.68)	0.0411 (8.23)	0.0089 (2.64)	0.0050 (2.95)	0.0030 (2.53)	0.0021 (4.98)	0.0010 (4.11)	0.0005 (4.80)	0.0360 (18.28)
Open Sell Call Volume	-0.0035 (-13.43)	0.0496 (14.20)	0.0145 (5.61)	0.0051 (3.70)	0.0018 (2.15)	0.0015 (4.45)	0.0011 (4.55)	0.0003 (4.02)	0.0285 (19.02)
Open Buy Put Volume	-0.0015 (-14.28)	-0.0278 (-17.94)	-0.0031 (-3.69)	-0.0004 (-0.53)	0.0003 (0.95)	0.0009 (7.32)	0.0006 (5.32)	0.0002 (4.89)	0.0117 (21.25)
Open Sell Put Volume	-0.0016 (-10.01)	-0.0188 (-15.35)	-0.0061 (-5.61)	-0.0019 (-2.74)	-0.0005 (-1.65)	0.0002 (1.75)	0.0007 (5.25)	0.0002 (5.93)	0.0118 (18.26)
Panel D: Average Standard Deviation									
		0.0224	0.0488	0.0843	0.1344	0.2832	0.3335	0.8200	0.1027

Table 4
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 5
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 6
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	Independent Variables								
	Intercept	Rsameday	Rweek	Rmonth	Rquarter	Ryear	R2years	ln(B/M)	Volatility
Panel A: Firm Proprietary Traders									
1990-1994	-0.00029 (-0.86)	0.01120 (3.57)	0.00758 (3.41)	0.00362 (2.77)	0.00165 (1.78)	0.00078 (2.01)	0.00006 (0.27)	0.00030 (3.61)	0.00655 (3.31)
1995-1997	-0.00044 (-4.66)	0.00595 (2.87)	0.00429 (3.97)	0.00193 (3.98)	0.00103 (2.74)	0.00034 (2.20)	-0.00033 (-2.68)	0.00004 (0.74)	0.00498 (9.61)
1998 - March 2000	-0.00011 (-1.36)	0.00461 (2.53)	0.00202 (2.74)	0.00107 (2.48)	0.00056 (3.17)	0.00048 (3.04)	0.00016 (1.41)	0.00015 (2.60)	0.00348 (6.38)
April 2000 - 2001	0.00004 (0.35)	0.00239 (3.00)	0.00124 (4.36)	0.00041 (2.06)	0.00023 (2.04)	0.00030 (6.36)	0.00014 (1.90)	0.00000 (-0.06)	0.00141 (6.68)
Panel B: Discount Customers									
1990-1994	-0.00064 (-13.63)	0.00215 (2.99)	0.00033 (0.65)	0.00063 (2.15)	0.00064 (3.17)	0.00021 (3.30)	0.00004 (0.76)	-0.00003 (-2.24)	0.00457 (20.95)
1995-1997	-0.00164 (-18.13)	0.00212 (1.51)	-0.00040 (-0.42)	-0.00060 (-1.20)	-0.00030 (-0.76)	0.00073 (5.06)	0.00060 (6.09)	0.00011 (3.14)	0.00940 (20.84)
1998 - March 2000	-0.00283 (-10.32)	0.00615 (4.07)	0.00401 (4.21)	0.00257 (4.43)	0.00206 (8.26)	0.00248 (9.65)	0.00132 (7.51)	-0.00007 (-1.95)	0.00892 (12.10)
April 2000 - 2001	-0.00034 (-8.60)	-0.00196 (-4.66)	-0.00068 (-3.55)	-0.00025 (-2.25)	-0.00002 (-0.40)	0.00021 (8.01)	0.00030 (7.85)	0.00004 (3.38)	0.00153 (12.36)
Panel C: Full-Service Customers									
1990-1994	-0.00519 (-6.78)	0.05502 (5.15)	0.01482 (2.01)	0.00937 (2.53)	0.00630 (2.40)	0.00309 (3.38)	0.00092 (1.71)	0.00092 (4.24)	0.04506 (10.92)
1995-1997	-0.00616 (-20.70)	0.04728 (7.06)	0.00586 (1.31)	0.00142 (0.59)	-0.00084 (-0.48)	-0.00030 (-0.68)	0.00013 (0.42)	0.00011 (0.52)	0.04455 (27.42)
1998 - March 2000	-0.00510 (-12.36)	0.02975 (5.21)	0.00795 (2.43)	0.00450 (3.09)	0.00345 (4.57)	0.00407 (10.00)	0.00269 (8.17)	0.00070 (4.39)	0.02740 (13.90)
April 2000 - 2001	-0.00084 (-5.99)	0.00457 (2.10)	-0.00201 (-2.72)	-0.00072 (-1.64)	-0.00024 (-1.07)	0.00064 (6.58)	0.00076 (4.96)	-0.00006 (-0.67)	0.00575 (16.78)

Table 7
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 8
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	Independent Variables								
	Intercept	Rsameday	Rweek	Rmonth	Rquarter	Ryear	R2years	ln(B/M)	Volatility
Panel A: Firm Proprietary Traders									
1990-1994	-0.0002 (-0.68)	0.0076 (2.64)	0.0048 (2.18)	0.0031 (2.45)	0.0016 (2.24)	0.0014 (5.16)	0.0003 (1.60)	0.0005 (5.98)	0.0054 (3.67)
1995-1997	-0.0003 (-2.99)	0.0094 (5.35)	0.0019 (2.07)	0.0010 (2.10)	0.0007 (1.75)	-0.0002 (-0.95)	-0.0002 (-1.78)	-0.0001 (-1.10)	0.0035 (8.35)
1998 - March 2000	-0.0001 (-0.63)	0.0022 (1.15)	0.0002 (0.17)	0.0000 (-0.05)	0.0005 (1.77)	0.0006 (3.77)	0.0006 (4.01)	0.0002 (3.04)	0.0028 (5.94)
April 2000 - 2001	0.0001 (0.55)	0.0033 (4.67)	0.0000 (-0.04)	0.0001 (0.76)	0.0002 (1.92)	0.0002 (6.45)	0.0001 (2.43)	0.0000 (0.03)	0.0011 (6.90)
Panel B: Discount Customers									
1990-1994	-0.0005 (-17.10)	0.0052 (15.44)	0.0008 (4.64)	-0.0001 (-0.71)	-0.0001 (-1.26)	0.0000 (-1.23)	0.0001 (1.69)	0.0000 (-0.93)	0.0029 (24.19)
1995-1997	-0.0009 (-22.04)	0.0090 (11.25)	0.0009 (2.19)	-0.0009 (-4.07)	-0.0010 (-4.93)	0.0000 (0.51)	0.0003 (4.66)	0.0001 (4.09)	0.0055 (25.14)
1998 - March 2000	-0.0012 (-17.59)	0.0084 (15.77)	0.0014 (5.42)	0.0005 (2.66)	0.0004 (3.68)	0.0005 (7.63)	0.0003 (5.28)	0.0000 (-2.00)	0.0045 (20.63)
April 2000 - 2001	-0.0004 (-12.67)	0.0042 (11.13)	0.0003 (1.85)	0.0000 (-0.43)	0.0000 (0.07)	0.0001 (3.04)	0.0002 (6.82)	0.0000 (1.63)	0.0018 (20.09)
Panel C: Full-Service Customers									
1990-1994	-0.0043 (-7.38)	0.0619 (8.61)	0.0212 (3.64)	0.0095 (3.03)	0.0042 (2.31)	0.0018 (2.43)	0.0013 (2.50)	0.0005 (3.04)	0.0377 (11.95)
1995-1997	-0.0036 (-21.68)	0.0564 (11.28)	0.0124 (4.95)	0.0008 (0.56)	-0.0025 (-2.13)	0.0000 (-0.09)	0.0004 (1.68)	0.0002 (1.27)	0.0310 (28.70)
1998 - March 2000	-0.0034 (-12.52)	0.0386 (8.22)	0.0115 (5.71)	0.0042 (4.25)	0.0027 (5.37)	0.0030 (9.77)	0.0017 (6.40)	0.0005 (3.78)	0.0207 (13.30)
April 2000 - 2001	-0.0010 (-5.74)	0.0166 (7.76)	0.0023 (2.25)	0.0012 (2.52)	0.0010 (4.05)	0.0012 (9.51)	0.0008 (5.42)	-0.0001 (-1.17)	0.0073 (15.10)

Table 9
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 10
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	<i>Rsameday</i>	<i>Rweek</i>	<i>Rmonth</i>	<i>Rquarter</i>	<i>Ryear</i>	<i>R2years</i>	ln(B/M)	Volatility
Panel A: Firm Proprietary Traders									
Large	-0.0001 (-1.36)	0.0046 (2.53)	0.0020 (2.74)	0.0011 (2.48)	0.0006 (3.17)	0.0005 (3.04)	0.0002 (1.41)	0.0002 (2.60)	0.0035 (6.38)
Large, Growth	0.0003 (1.84)	0.0060 (3.06)	0.0013 (1.61)	0.0009 (2.24)	0.0004 (1.49)	0.0004 (2.40)	-0.0002 (-1.52)	0.0001 (1.42)	0.0019 (4.62)
Large, Value	0.0000 (0.05)	0.0041 (1.19)	0.0039 (3.88)	0.0023 (2.47)	0.0010 (3.75)	0.0000 (0.07)	0.0009 (3.90)	0.0009 (3.39)	0.0036 (3.45)
Panel B: Discount Customers									
Large	-0.0028 (-10.32)	0.0062 (4.07)	0.0040 (4.21)	0.0026 (4.43)	0.0021 (8.26)	0.0025 (9.65)	0.0013 (7.51)	-0.0001 (-1.95)	0.0089 (12.10)
Large, Growth	-0.0085 (-7.61)	0.0124 (3.94)	0.0074 (4.07)	0.0047 (3.77)	0.0041 (7.25)	0.0046 (7.42)	0.0014 (5.23)	-0.0017 (-5.95)	0.0098 (6.69)
Large, Value	-0.0005 (-7.79)	0.0034 (3.53)	0.0026 (4.10)	0.0010 (2.90)	0.0002 (0.66)	-0.0003 (-2.56)	0.0004 (3.64)	0.0002 (2.93)	0.0036 (10.91)
Panel C: Full-Service Customers									
Large	-0.0051 (-12.36)	0.0297 (5.21)	0.0080 (2.43)	0.0045 (3.09)	0.0035 (4.57)	0.0041 (10.00)	0.0027 (8.17)	0.0007 (4.39)	0.0274 (13.90)
Large, Growth	-0.0117 (-7.80)	0.0336 (4.53)	0.0065 (1.83)	0.0066 (3.06)	0.0063 (5.90)	0.0068 (7.10)	0.0012 (2.43)	-0.0021 (-4.77)	0.0218 (9.60)
Large, Value	-0.0008 (-1.79)	0.0338 (4.18)	0.0120 (3.07)	0.0031 (1.56)	0.0020 (1.25)	-0.0022 (-2.96)	0.0037 (3.88)	0.0036 (5.09)	0.0196 (7.75)

Table 11
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 12
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	<i>Rsameday</i>	<i>Rweek</i>	<i>Rmonth</i>	<i>Rquarter</i>	<i>Ryear</i>	<i>R2years</i>	ln(B/M)	Volatility
Panel A: Firm Proprietary Traders									
Large	-0.00007 (-0.63)	0.00215 (1.15)	0.00021 (0.17)	-0.00003 (-0.05)	0.00055 (1.77)	0.00063 (3.77)	0.00063 (4.01)	0.00018 (3.04)	0.00282 (5.94)
Large, Growth	0.00000 (-0.02)	0.00283 (2.01)	-0.00099 (-1.03)	0.00028 (0.41)	0.00048 (1.14)	0.00064 (2.01)	0.00050 (2.65)	0.00002 (0.35)	0.00116 (2.53)
Large, Value	-0.00023 (-1.23)	0.00218 (0.65)	0.00267 (2.36)	0.00043 (0.61)	0.00061 (1.48)	0.00001 (0.02)	0.00085 (3.50)	0.00075 (3.15)	0.00460 (5.38)
Panel B: Discount Customers									
Large	-0.0012 (-17.59)	0.0084 (15.77)	0.0014 (5.42)	0.0005 (2.66)	0.0004 (3.68)	0.0005 (7.63)	0.0003 (5.28)	0.0000 (-2.00)	0.0045 (20.63)
Large, Growth	-0.0026 (-11.59)	0.0115 (11.51)	0.0017 (3.75)	0.0005 (1.34)	0.0007 (3.59)	0.0009 (7.56)	0.0003 (3.73)	-0.0004 (-5.49)	0.0055 (13.77)
Large, Value	-0.0003 (-3.58)	0.0054 (8.43)	0.0017 (3.50)	0.0005 (2.77)	0.0000 (0.23)	-0.0004 (-5.90)	0.0000 (-0.19)	0.0001 (1.88)	0.0022 (9.29)
Panel C: Full-Service Customers									
Large	-0.0034 (-12.52)	0.0386 (8.22)	0.0115 (5.71)	0.0042 (4.25)	0.0027 (5.37)	0.0030 (9.77)	0.0017 (6.40)	0.0005 (3.78)	0.0207 (13.30)
Large, Growth	-0.0075 (-8.24)	0.0505 (10.33)	0.0129 (5.53)	0.0060 (4.29)	0.0042 (4.73)	0.0047 (6.53)	0.0002 (0.44)	-0.0012 (-5.53)	0.0175 (10.55)
Large, Value	-0.0009 (-2.22)	0.0366 (5.19)	0.0129 (4.14)	0.0038 (2.83)	0.0022 (2.07)	-0.0005 (-0.97)	0.0039 (5.10)	0.0032 (5.87)	0.0167 (8.07)

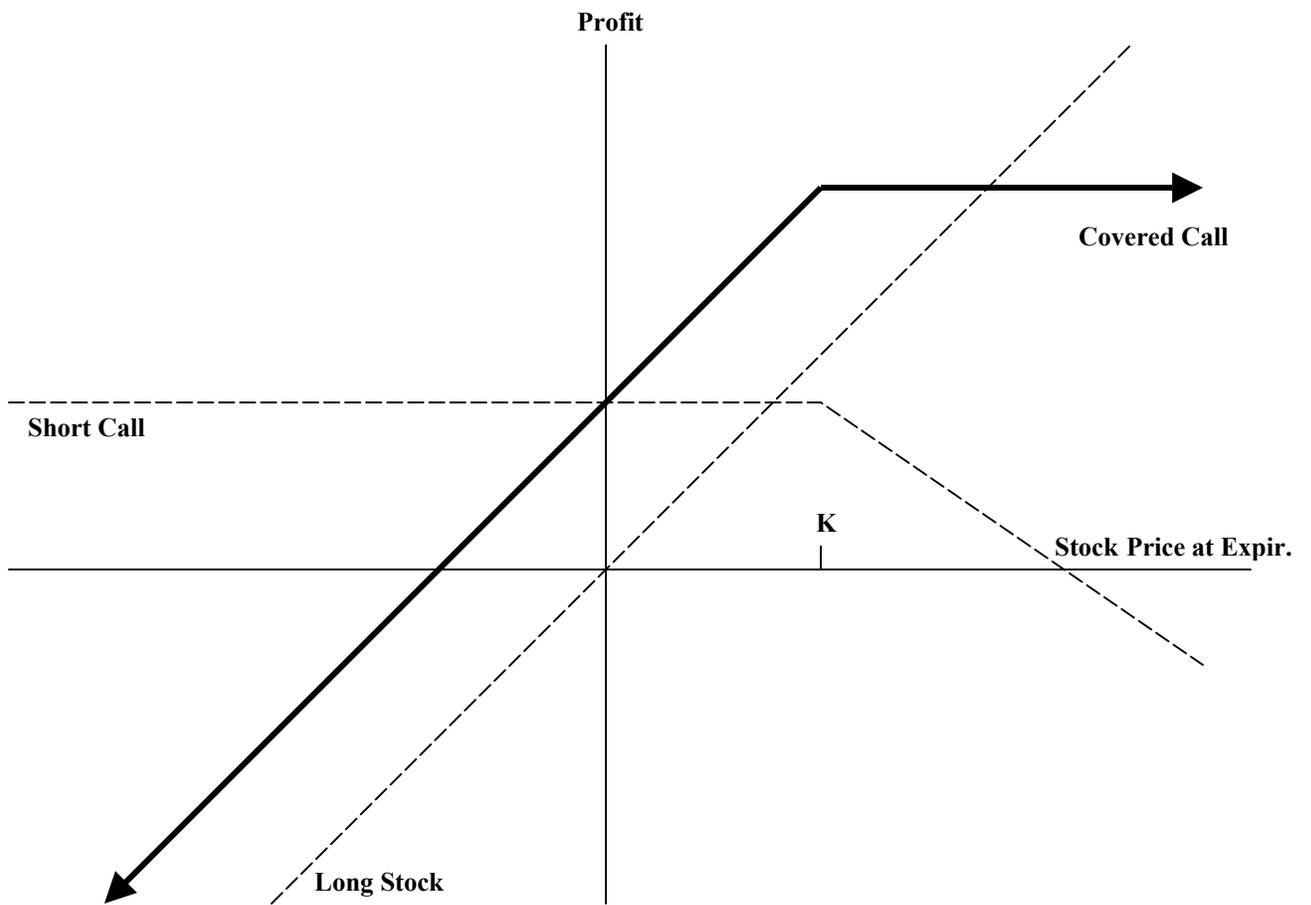


Figure 1. Profit to covered call position as a function of the stock price at expiration. The bold line depicts the profit at expiration to a covered call position as a function of the stock price at expiration. The covered call position consists of one long share of stock held in combination with one short call position with strike price K .

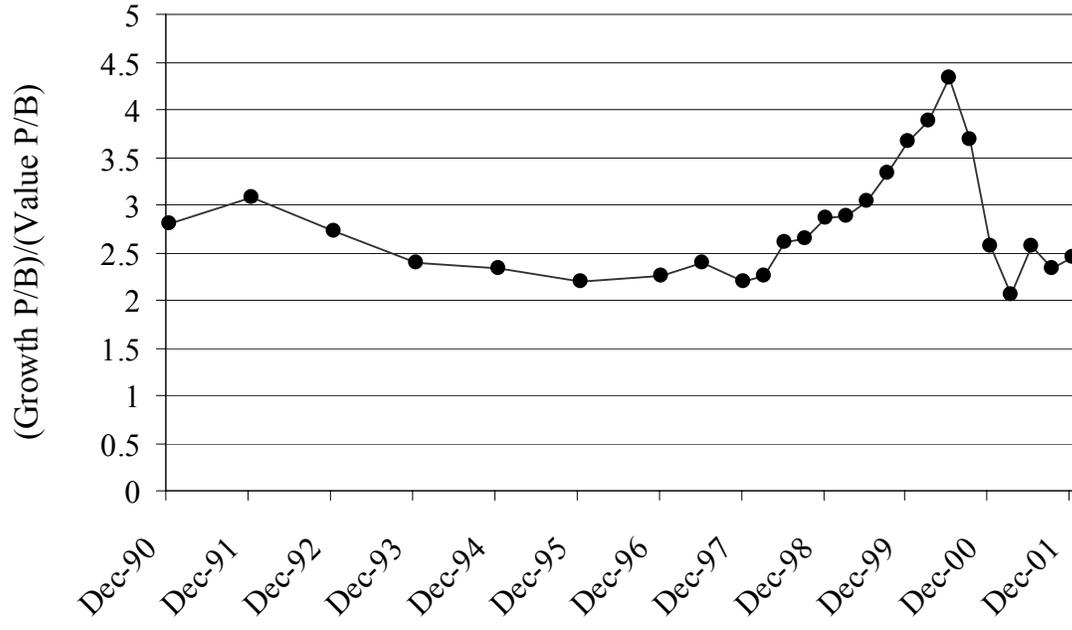


Figure 2: Price to book ratio of growth stocks divided by price to book ratio of value stocks, 1990 through 2001. This figure depicts the ratio of market capitalization to book value for the Russell 1000 growth stocks divided by the same ratio for the Russell 1000 value stocks from 1990 through 2001. The data used to construct the figure are from the Frank Russell Company.