Options Trading Activity and Firm Valuation

by

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We study the effect of options trading volume on the value of the underlying firm after controlling for other variables that may affect firm value. The volume of options trading might have an effect on firm value because it helps to complete the market (allocational efficiency) and because the options market impounds information faster than the stock market (informational efficiency). We find that firms with more options trading have higher values, after controlling for other determinants of value. This result holds for all sample firms and for the subset of firms with positive options volume. We also find that the effect of options trading on firm valuation is greater in stocks with low analyst following. This suggests that the effect of options on information production is greater in stocks where analysts produce comparatively less public information.

1. Introduction

The question of how contingent claims such as options affect markets for the underlying assets is an enduring one in financial economics. More than thirty years ago Ross (1976) argued that options written on existing assets can improve market efficiency by permitting an expansion of the contingencies that are covered by traded securities. In the absence of complete markets, simple options are powerful abettors of efficiency in competitive equilibrium. Since Ross' writing, options markets have experienced an exponential growth, both in the number of underlying assets on which options are written, and in the volume of trading.

This paper provides empirical evidence about options trading activity and the market values of traded companies. Our hypotheses may be motivated by how options affect incentives to trade on private information. If options help to complete the market, agents with information about future contingencies should be able to trade more effectively on their information, thus improving informational efficiency. In addition, informed traders may prefer to trade options rather than stock, because of increased opportunities for leverage (Back, 1992, Biais and Hillion, 1992).

Supporting the preceding notions, Cao and Wei (2007) find evidence that information asymmetry is greater for options than for the underlying stock, implying that agents with information find the options market a more efficient venue for trading. This finding is bolstered further by Easley, O'Hara, and Srinivas (1998) and Chakravarty, Gulen, and Mayhew (2004) who find that options order flows contain information about the future direction of the underlying stock price. Finally, the analysis of Admati and Pfleiderer (1988) indicates that informed traders are more active when volume is greater. These arguments together imply that informational efficiency would be greater in more actively traded options.

In order to link informational efficiency to valuation, we allude to the argument that if prices reveal more information, then resources are allocated more efficiently, which translates to higher firm valuations. A more direct argument is that greater informational efficiency reduces the risk of investing in an asset because market prices reflect information more precisely; which also would tend to make the asset more valuable. In addition, as Conrad (1989) points out, options may simply improve the welfare of both informed and uninformed traders by completing markets, and thus affect market valuations. But these traders would be more attracted to options with greater trading activity that may have lower trading costs. All of these arguments taken together indicate that, *ceteris paribus*, markets for claims in firms with higher options trading volume should be valued more highly.

It is worth noting that the mere *listing* of an option does not necessarily imply a valuation benefit of the type discussed above. If the options market has insufficient volume, the incremental valuation benefit from listing would be minor or even immaterial because traders see no advantage to trading in options (Admati and Pfleiderer, 1988). Any valuation benefit of options listing should depend on substantial trading activity. Although the above arguments suggest a positive relation between options trading and valuation, there are competing hypotheses. For example, if options trading activity simply represents uninformed speculation and adds volatility to prices then such activity may actually decrease market values. Thus, our work can be viewed as resolving the tension between these opposing arguments. To the best of our knowledge, such an analysis of the relation between options trading activity and firm valuation has not previously been undertaken.

For a large sample of firm during the 10-year period 1996 to 2005 we analyze the effect of options trading volume on firm value after controlling for other variables that may also affect firm value such as firm size, share turnover, return on assets, capital expenditures, leverage and dividend payments. Following other studies (Lang and Stulz, 1992, Allayannis and Weston, 2001, and Carter, Rogers, and Simkins, 2006) we use a measure of Tobin's q as the valuation metric.

We find strong evidence that firms with more options trading have higher value. This result is robust to the inclusion of all sample firms, or to the restricted set of firms with positive options volume, and is present in every year of our sample period. We also find some evidence that firms with more options trading activity in a given period tend to have improved financial performance in the next period, which accords with the premise that options trading, by enhancing information flows, may lead to better corporate resource allocation.

In addition, our results indicate that the effect of options trading on firm valuation is greater in stocks with low analyst following. This indicates that the impact of options trading on information production is larger in stocks where investment analysis produces comparatively less public information.

Previous studies (Brennan, Chordia, and Subrahmanyam, 1998 or Datar, Naik, and Radcliffe, 1998) find a significant cross-sectional relation between stock trading activity and valuation, in that they find that high trading activity implies lower expected returns. Our finding of a positive contemporaneous relation between options trading activity and firm valuation complements these studies and indicates that valuation effects of trading are confined not just to trading activity in the own asset, but also on contingent claims on the asset. Thus, our results indicate that studies of the effect of trading activity on asset pricing should be broadened to include trading activity in derivative markets in the assets.

The paper proceeds as follows. Section 2 reviews the literature and describes our hypotheses. Section 3 describes the data. Section 4 presents the main empirical results, Section 5 presents some robustness checks, and Section 6 concludes.

2. Literature Review and Economic Hypotheses

This paper lies at the intersection of the literatures on derivatives pricing, market microstructure, and corporate finance. Black and Scholes (1973) treat options as securities that are redundant and can be replicated in continuous time by investments in stocks and bonds. However, it is well-known that when markets are incomplete, options cannot be replicated by simple securities such as stocks and bonds (see Ross, 1976, Hakansson, 1982, and Detemple and Selden, 1991). Another branch of the literature shows that options cannot be dynamically replicated with stocks and bonds when the dynamic process for the underlying stock involves features such as stochastic discontinuities (see, for example, Naik and Lee, 1990, and Pan and Liu, 2003).

If options are not redundant, then their introduction may allow agents to expand the set of contingencies available through trading and thus may be associated with a positive price effect on the underlying stock. Indeed, Conrad (1989) documents an upward effect on stock prices following an options listing using an event study approach. However, Sorescu (2000) find different results for a more recent sample period.[1] This indicates that there is not yet consensus on the effects of options *listing* on stock prices.

We contend, however, that the valuation benefit of options should depend on trading activity in options, not merely listing. Previous literature, both theoretical and empirical, has argued that options increase the amount of private information conveyed by prices (see Biais and Hillion, 1994, Easley, O'Hara, and Srinivas, 1998, or Chakravarty, Gulen, and Mayhew, 2004).[2] Such increases in price efficiency may occur

[1] Mayhew and Vihov (2000), after carefully accounting for exchanges' choices to list options on stocks, find evidence confirming the results of both Conrad (1989) and Sorescu (2000) for their different sample periods. Since many of our tests consider the link between firm valuation and volume on already-listed options, the listing choice is less relevant in our context.

[2] Jennings and Starks (1986) present evidence that options markets allow prices to adjust more quickly after earnings announcements. Mendenhall and Fehrs (1999) argue that options trading increases the speed of adjustment of prices to earnings before, rather than after the earnings announcement, by way of insider

because informed agents are able to cover more states when options markets are available.[3] In the presence of frictions, options may also allow informed agents to obtain leverage more readily.

Option listing does not automatically imply that informed agents can take better advantage of their information. Indeed, as Kyle (1985) points out, agents with private information need to camouflage their trades from other agents to be effective. Do new markets always attract a large number of agents? Pagano (1989) sheds light on this question by arguing that microstructure models have multiple equilibria where "liquidity begets liquidity." Thus, if agents conjecture that a new market will have no volume they optimally desist from trading and this belief becomes self-fulfilling. On the other hand if the conjecture is the opposite, then a market with active trading is sustainable. This line of thinking indicates that different options markets may have varying degrees of thinness, which also implies different degrees of informational efficiency, with greater option volumes implying greater price informativeness.

What is the link between informational efficiency and firm valuation? A vast literature examines this question. Fishman and Hagerty (1992), Khanna, Bradley, and Slezak (1994), Dow and Gorton (1997), and Subrahmanyam and Titman (1999) all conclude that if prices convey more information, corporate resources are allocated more efficiently, and this leads to greater firm valuation. Alternatively, one could also argue

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trading. Figlewski and Webb (1993) argue that options, by effectively alleviating short-sale constraints through put options and written calls, increase informational efficiency.

[3] Note that more informed trading affects the costs of liquidity trading. But the valuation effects of such costs are limited because they are a zero sum transfer from liquidity to informed traders.

that greater informational efficiency reduces the conditional risk of investing in a risky asset (Kyle, 1985), which would tend to make an asset more valuable.[4] Finally, even without alluding to informed trading, options may have a pricing effect by completing markets and thus enhance the welfare of traders wishing to cover more contingencies (Conrad, 1989). These traders may also be attracted to options with greater trading activity (and lower trading costs), and thus may value claims in such firms more highly.

All of the preceding arguments imply that options with greater trading activity would be accompanied by higher firm valuations. This hypothesis can be examined empirically. At the same time, it is worth noting other possible hypotheses. For example, if options lead to increased price uncertainty due to more speculative trading by uninformed agents (De Long, Shleifer, Summers, and Waldmann, 1990) and this effect dominates the potential positive effects delineated above then the valuation effect of options could be negative. Our tests may thus be viewed as an effort to distinguish between these competing hypotheses.

3. Data

Options Metrics provides data on options trading. This database includes daily numbers of contracts traded for each individual put and call option traded on U.S. listed equities along with daily closing bid and asked prices. This makes it possible to approximate the

[4] To see this consider the extreme case where informed agents have perfectly precise information and the price reveals all of their information. In this case the conditional risk of investing in the asset is zero and it is clearly worth more to invest in this asset, *ceteris paribus*, relative to an asset where the price reflects the information imprecisely.

total annual dollar options volume for each stock by first multiplying the total trade in each option by the end-of-day quote midpoint for that option and then aggregating this number annually across all trading days and all options listed on the stock.[5] The resulting annual options volume is then matched with data from Compustat on Tobin's q and with a constellation of control variables.[6]

Tobin's q is computed as the sum of the market capitalization of the firm's common equity, the liquidation value of its preferred stock, and the book value of its debt divided by the book value of the firm's assets.[7] While measurement of q necessarily requires judgment, any imperfection in the estimate would likely bias against finding significant results. The control variables are as follows. A proxy for the firm's leverage, long-term debt to total assets, is intended to measure the likelihood of distress.[8] Profitability, measured by return on assets (ROA), is net income divided by the book value of assets. This variable is intended to capture the notion that more profitable firms may have more favorable investment opportunities, leading to higher valuations. On the other hand, high ROA may also signal that the firm is in a mature phase, and has limited growth opportunities, so that the effect of ROA on q is an empirical issue.

[5] We cannot calculate the dollar value of trades by multiplying each trade by the execution price because intraday transactions prices are not available over the large sample period. Our method induces a slight errors-in-variables problem, but this should be mitigated by annual averaging. In any case, the usual effect of measurement error is to bias coefficients toward significance.

[6] An annual observation interval is dictated by the necessity of using reliable accounting data from the annual report.

[7] This simplified estimate of q is adapted from Chung and Pruitt (1994). Using total firm q to preserves comparability with the corporate finance literature, but results go through even if the market-to-book ratio of the firm's equity is used instead of q .

[8] Inclusion of an additional measure of the short-term debt burden, based on the ratio of current liabilities to current assets, does not alter any of the results substantively.

Capital expenditures divided by sales is a direct measure of investment opportunities actually undertaken. Firms that invest more presumably have higher growth opportunities and a higher q. A dummy variable for whether the firm pays a dividend proxies for capital constraints (firms that pay dividends may have more free cash flow, which may potentially be used to overinvest in marginal projects). We also include firm size (market value of the firm's shares) based on Peltzman (1977) who argues that size may reflect greater efficiency because it may be an outcome of a firm's discovery and exploitation of a superior technology (see also Mueller, 1987).[9] All these controls have been used in previous literature, e.g., Allayannis and Weston (2001), Carter, Rogers, and Simkins (2006). In addition, share turnover in the underlying stock is included to account for any spurious effects arising from co-movements in stock and options volume.

Table 1 gives the number of firms in each sample year. The number of firms with non-missing Compustat data ranges from more than 6300 in 1996 to about 4400 in 2005. The decrease is likely due to the tech bust, which was accompanied by financial distress, bankruptcy and eventual delisting. The number of firms with positive options trading volume increased modestly during this same period, from 1342 in 1996 to 1705 in 2004, its peak year.

Any firm with no options volume data in Options Metrics for a particular year is assumed to have an options volume of zero in that year. This suggests a natural

[9] The market value of the firm's shares proxies for size. However, using alternative proxies, such as the number of employees or the book value of the firm's assets leaves the central results qualitatively unchanged.

bifurcation of samples into one consisting of all firms, (with the majority having zero options volume), and a second consisting only of firms with positive options volume.[10]

Table 2 presents summary statistics (over all firms and years) for Tobin's q, the control variables, and options volume. Panel A, covers all firms while Panel B includes firms with positive options volume. The mean value of q for the whole sample is about 1.9. The mean value of return on assets is negative, presumably because small (tech) firms did not perform well during this period. Panel B shows that firms with positive options volume have a higher Tobin's q, both mean and median. Such firms are also larger and more profitable on average than those without options volume.

Table 3 presents correlations among the variables (again, pooled over firms and years.) Again, Panel A is for the full sample while Panel B is for firms with positive options volume. The correlation between Tobin's q and options volume is positive for both samples and reaches almost 18% for the subsample with positive options volume.

Options volume is strongly positively correlated with firm size as well as share turnover. Tobin's q is negatively related to return on assets, which is counterintuitive,

[10] We aggregate options volume across calls, puts, and times to maturity. While an analysis of volume disaggregated by maturity and type of option is possible, there are no clear hypotheses. For example, it may be conjectured that managers are more likely to act on positive signals that suggest investment as opposed to negative signals that indicate divestment, since irreversibility often implies that divestment is costly. But since calls and puts can be written or bought freely, and our data consists of unsigned volume and not signed order imbalance, call and put volume cannot be linked to bullish or bearish sentiment. Similarly, while it may be that managers are more likely to react to long-term information contained in long-maturity options, these options are also more illiquid, making them less attractive to informed traders. Because of these confounding issues, we look at aggregated options volume.

but may be because stocks with high current income are in the "mature" phase of their life-cycle with fewer opportunities for future growth.

As a pre-amble to the main analysis, consider the subsample of firms with positive options volume sorted into deciles by options volume each year. For each decile, the average value of Tobin's q across all years appears in Figure 1. As can be seen, average q increases monotonically with options volume, supporting the positive correlation between q and options trading activity documented in Table 3. Average q for the highest options volume decile is about 140% larger than for the lowest options volume decile, and an unreported test indicates that this difference is statistically significant.

We now examine sorts by market capitalization and options volume to allow for independent variation in size and options activity. Specifically, every year for the firms with positive options volume, we form quintile portfolios first by size, and then by options volume with each size quintile. The average values of Tobin's q for the resulting 25 portfolios are listed in Table 4. It can be seen that Tobin's q monotonically increases across the options volume quintiles in each of the five size groups; whereas there is no uniform monotonicity across the size quintiles though, on average, q tends to increase with size. Unreported tests indicate that each of the five differences in q across the extreme options volume portfolios is significant at 1% level.[11]

[11] Two-way sorts by stock trading activity (i.e., annual dollar value of shares traded, instead of size) and options volume lead to results qualitatively identical to those in Table 4.

The next section tests formally whether options volume has an incremental effect on q after accounting for the effects of controls.

4. Regression Results

This section examines the determinants of Tobin's q. Since the arguments above are cross-sectional in nature, the natural approach is to run year-by-year cross-sectional regressions and then test the significance of the time series means of the cross-sectional coefficients.[12] But the residuals of the cross-sectional regressions are likely to be serially correlated due to autocorrelation in Tobin's q, so simple t-statistics may be misleading. To overcome this potential problem, t-statistics are corrected according to the procedure of Newey and West (1987).[13] Results for the full sample of firms and for the subsample with positive options volume are reported in Tables 5 and 6, respectively.

Both dividends and leverage have significantly negative impacts on valuation for both samples, as postulated in the previous section. For the full sample, ROA also is inversely related to q, indicating that high ROA signals firm maturity and relative paucity of future growth options. On the other hand, capital expenditures, presumably proxying for future growth opportunities, have a positive impact on valuation in the full sample of firms. ROA and capital expenditures are not significant for the sample of firms with

[12] There is no evidence of non-stationarity in the aggregate q. Thus, the linear trend in the cross-sectional average value of q is insignificant, and the point estimates do not monotonically increase or decrease across the years. In any case, results with linearly detrended values of q are substantively similar to those reported.

[13] As suggested by Newey and West (1994), the lag-length equals the integer portion of $4(T/100\}^{2/9}$, where T is the number of observations.

positive options volume, suggesting that the role of these variables is more relevant in the smaller firms, where growth options may be more relevant to valuation.

We also find that share turnover has a positive impact on valuation, consistent with the presence of a liquidity premium in asset prices (Amihud and Mendelson, 1986). Size has a weak but positive impact on Tobin's q. In general, these results are consistent with the rationales for the controls provided in the previous section.

The coefficient of options volume is positive and significant for both subsamples indicating that options volume has an upward impact on firm valuation. For all firms, the magnitude of the coefficient implies that a one standard deviation move in options volume implies a 16% higher q relative to its mean value. The effect for the subsample of firms with positive options value is much stronger: in this case, a one-standard deviation move in options volume implies a q that is higher relative to its mean by 118%. Thus, the effect of options trading on firm valuation is both statistically and economically significant.

5. Robustness Checks

Various checks on the basic results are reported in this section; in all cases, the central results are unchanged. The tests consider panel regressions, endogeneity issues, skewness, industry effects, additional explanatory variables, and whether options trading is a substitute for information production by security analysts.

A. Panel Regression

The regressions in Tables 5 and 6 reported average coefficients from annual cross-sectional regressions, and thus did not use information contained in the time-series. To ensure that the results survive this consideration, we now present results from a panel regression that pools the time series and cross-sectional data. The Parks (1967) procedure (as described in Kmenta, 1986) is adopted to control for serial correlation as well as for cross-correlation in the error terms. This requires a balanced panel, so we use the 2290 firms that are present in every year of the sample. Details of the procedure are in the appendix.

Results from the panel procedure appear in Table 7, where it can be verified that the conclusions are qualitatively similar to those in Tables 5 and 6. Thus q is negatively associated with the dividend dummy and leverage, but positively associated with firm size. Options volume continues to be positively and significantly associated with q.[14]

B. Different Specifications for Options Trading Activity

[14] As an alternative, we estimate a standard panel model with firm and year fixed effects to account for any unobserved heterogeneity. The coefficient of options volume remains positive and significant with a t-statistic of 8.72 in this specification.

The next issue to consider is endogeneity; specifically, whether high Tobin's q causes increased options trading, rather than the reverse. One could argue, albeit implausibly, that high q firms may attract more attention and this may translate to greater options volume. One simple way to address this is to consider the relation between q and lagged options volume. We have verified that doing so preserves the significance of options volume in both the full sample as well as in the subsample of firms with positive options volume. However, this approach may not fully resolve the problem if there is persistence in q and options volume. Ideally, one needs an instrument for options volume that is inherently unrelated to q. But finding such an instrument is a difficult endeavor and inevitably involves an element of subjectivity.

We propose that options volume may be related to the average absolute moneyness, the relative difference between the stock's market price and the option's strike price. Since the vega of an option is highest at-the-money, agents speculating on volatility would prefer at-the-money options for their greater sensitivity. On the other hand, for someone without volatility information, at-the-money options have the greatest exposure to volatility risk and hence may be eschewed for this reason. Moreover, it could also be the case that informed traders may be attracted to out of the money options because they provide the maximum leverage, but uninformed traders may migrate to in the money options to avoid risky positions.[15]

[15] Pan and Poteshman (2006) document that volume from customers of discount brokers is slightly higher in out of the money options.

The previous arguments provide a link between absolute moneyness and options volume, but do not specify an unambiguous direction, which remains an empirical issue. There is no reason, however, that moneyness should be inherently related to q, since exchanges periodically list new options with strike prices close to the recent market price of the underlying stock, so there should be no mechanical link between moneyness and stock prices.

Given the preceding discussion, we calculate the annual average of the daily absolute deviation of the exercise price of each traded option from the closing price of the underlying stock.[16] We then compute an instrumental variable estimation of the regression in Table 6, using the average absolute moneyness as an instrument for options volume.[17] Estimates of this regression appear in Table 8.[18] (Note that this regression necessarily uses only that subsample for which the options volume is strictly positive because the instrument is undefined when no option is traded.) As can be seen, the coefficient for options volume remains significant in this regression and its magnitude is close to that in Table 6, suggesting that the main result is not due to reverse causality.

[16] For traded option k on stock j for day t, the absolute deviation is $|\ln(\text{price}_{j,t}/\text{strike}_k)|$. This is averaged over all k and t within a year for each stock j. Options without trades are not included in the calculation of the moneyness measure. Using a volume-weighted average annual moneyness measure for each stock j, where each option's moneyness is weighted by the proportion of total option volume for stock j contributed by that option, yields substantively similar results.

[17] The even-moneyness variable is positively and significantly related to options volume for the overall sample. Paradoxically, this does not necessarily mean that volume tends to be higher in options that are away from the money. It might also be induced if the options exchange lists a larger number of options, with different exercise prices, on firms with more overall options trading. But regardless of the underlying reason, so long as the instrument is well correlated with the explanatory variable (options volume) and does not inherently depend on the dependent variable (Tobin's q), the instrumental variable procedure is well-specified.

[18] This amounts to a two-stage least-squares estimation which is identified because the moneyness variable does not appear in the equation for q, and the only explanatory variable in the equation for options volume is the moneyness variable (i.e., the determinants of q other than options volume are excluded from this equation).

Next, from Table 2, it may be seen that the distribution of options volume is skewed because the mean is quite different from the median. To address this, we perform a robustness check using the logarithm of options volume (by definition, using only those firms with positive levels of options trading activity). Results from this alternative specification (the analog of Table 6) appear in Table 9. As can be seen, the coefficient of options volume remains positive and strongly significant, while the other coefficients are largely unchanged relative to those in Table 6.

C. Options Trading and Firm Profitability

One of our proposed arguments is that options trading volume affects firm valuation through its effects on corporate investment decisions. If this hypothesis is correct, then trading activity in options may also affect future firm performance. The effect may, however, be spread out over a number of years, making its statistical detection difficult. Nonetheless, to test this hypothesis, we regress return on assets (ROA -- our measure of financial performance) on one-year lagged values of log option volume plus the other controls in Table 9 (lagged ROA is included to account for serial dependence in the variable). Panel regressions using the Parks (1967) procedure to account for autocorrelation are presented in Table 10.[19]

[19] Inferences from averages of year-by-year coefficients are not substantively different from the ones presented.

As can be seen, firms that have paid dividends in the past are less profitable, which is consistent with the hypothesis that dividends may indicate free cash flow (Jensen, 1986) that can be overinvested in marginal projects. Further, in our sample, high leverage is associated with higher profits. This may simply reflect the disciplinary effect of debt (e.g., Hanka, 1998). There seems to be an interesting tendency for ROA to mean-revert, as reflected in the negative and significant coefficient for lagged ROA. The relevant result for our purposes is that firms with greater levels of past options volume tend to be more profitable in the future. This result supports our proposition that options trading can lead to better corporate resource allocation by increasing price efficiency.[20]

D. Year-by-Year Regression Coefficients

A potential concern is that the relation between Tobin's q and options trading may be driven by significant effects in only one or two years. In order to obtain a more complete picture of the effect of options trading on valuation, the second and third columns of Table 11 report the year-by-year regression coefficients that are used in computing the averages reported in Table 9, together with their corresponding t-statistics. In every year, the coefficient of options trading is positive and strongly significant. This provides reassurance that the results are not driven by high coefficient magnitudes in one

[20] Since options volume is significantly related to q, a potential concern with this result is simply that high q firms are more profitable in the future. To address this, we include past year's q in the regression. Doing so preserves the significance of the lagged options trading variable. The coefficient estimate is 0.132 (t=5.31).

or two years.[21] Overall, these results and Figure 1 suggest that the results are not driven by cross-sectional or time-series outliers.

There may a concern that industry effects may be driving the results, especially duing the height of the so-called technology "bubble" of the late 1990s. To address this issue, dummy variables for each of Fama and French's (1997), forty-eight industry groups are included in the regressions.[22] The resulting coefficients of options volume are reported in the last two columns of Table 11. The pattern of significance is not materially altered by inclusion of industry indicators, indicating that the results survive even after accounting for industry effects.

E. Miscellaneous Robustness Checks

Panel regression analogous to those in Table 7 (using the Parks, 1967, procedure) but using the logarithm of options volume produces a coefficient for options volume 0.1328, with a t-statistic of 23.88. The statistical significance of this coefficient is greater than that in Table 7. Thus, the results are qualitatively unchanged for the logarithmic transformation of options volume when a panel approach is used.

[21] Fiscal years do not always coincide with calendar years, thus causing some asynchronicity in the measurement of the regressors. To address this issue, we ran a regression restricting the sample to only those firms whose fiscal years ended in December. The coefficient of options volume remained significant in every year for this subsample as well, just as in Table 11. The overall Newey-West t-statistic also remained significant and the coefficient did not change materially from that in Table 5. Full details are available from the authors.

[22] The industry dummy definitions follow Appendix A of Fama and French (1997). Their last-listed classification, financial firms (SIC codes 6200-6299 and 6700-6799), is the base case.

In other unreported regressions we employ alternative specifications using logarithms of firm size and share turnover;[23] again, the coefficient of options volume does not change appreciably. Using share volume instead of share turnover and scaling options volume by shares outstanding also have little impact on the significance of the options volume coefficient.[24]

We also include a measure of return volatility (measured by the annual standard deviation of daily returns) in the regression corresponding to Table 8. The concern is that options trading activity proxies for stock riskiness which could potentially affect q. However, the return volatility variable is not significant (its t-statistic was 1.32), which indicates that perhaps some of the other variables, such as leverage, account for the effect of stock riskiness on q. Even in the presence of return volatility, however, the options volume variable remains significant with a coefficient of 0.094 and a t-statistic of 4.75. Full details of all of these additional robustness checks are available upon request.

F. Options Trading and Information Production by Investment Analysts

Finally, perhaps options volume proxies for another measure of information production, the extent of analyst following. To check this, the number of analysts

[23] The other variables in the regression are not constrained to be strictly positive, thus precluding us from taking their logarithms.
[24] Another issue is whether options volume is simply proxying for stock price runup (stocks that have gone up would attract options volume and past returns may also be related to q). It is debatable whether past return should be included as an explanatory variable for q over and above profitability measures such as ROA. We find, however, that including the past year's return in the equation for q does not alter the significance of options volume (though the past return is marginally significant at the 10% level).

following a company (from I/B/E/S) is included as another regressor. It is not significant in the analog to Table 6, whereas options volume remains significant.

As previously noted, options volume is influenced by uncertainty and a forward-looking measure of uncertainty is the dispersion of long-term growth forecasts by security analysts. Indeed, Pastor and Veronesi (2003) show that uncertainty about future growth rates can affect valuations, and this uncertainty may also affect options volume. To address whether options volume is proxying for uncertainty in growth forecasts, we include the standard deviation of analysts' growth forecasts as of December in each year. This reduces the sample size, since an analyst following of least two is required. Including this variable does not materially alter the significance of the options volume coefficient, even though the significance of the growth uncertainty variable is marginally positive and significant, consistent with Pastor and Veronesi (2003).

There may be an additional effect of analyst following on the results linking valuation to options trading activity. Specifically, Easley, O'Hara, and Paperman (1998) indicate that analysts are a source of publicly generated information for companies. If this is the case, then options trading may have a stronger role in enhancing informational efficiency in stocks with low analyst following (where trading on private information may be more important). To address this issue, we divide the sample into three equal groups by analyst following, labeling these groups (low to high analyst following) as 0, 1, and 2.

The indicator variable corresponding to the three groups is interacted with options volume and included with the other variables reported in Table 9. Results from this regression appear in Table 12. The coefficient of options volume remains positive and significant but the coefficient of the interaction variable is negative and significant.[25] This indicates that the impact of options volume on firm valuation is greater in stocks with low analyst following, which suggests that when public information production by analysts is less intense, then trading in options plays a more important role in enhancing firm valuation by way on its effect on information production.

Overall, the results provide considerable support for the hypothesis that options trading activity is associated with increased firm valuation.

5. Conclusion

Options markets may increase market valuations by allowing agents to cover more contingencies, and by stimulating more privately informed trading, which may enhance the efficacy of resource allocation. But these benefits are more likely in active options markets, because these are associated with easier and cheaper trading. Supporting this notion, we find evidence that firm values increase with options trading volume. This result survives the inclusion of a host of control variable and a variety of robustness checks.

[25] To preserve comparability with Table 9, we use the coefficient averages from year-by-year regressions to draw inferences, but the conclusions are unchanged in a panel regression using the Parks (1967) procedure (as in Table 7). Further, interacting options volume with the actual number of analysts, and dividing the sample into two (as opposed to three) groups by analyst following, also has no material impact on the results.

There is also evidence of a link between options trading activity and future firm profitability, which suggests that options trading can improve corporate resource by enhancing price efficiency.

The effect of options trading on firm valuation is stronger in “neglected” stocks, those with low levels of analyst following. This supports the notion that options trading plays a relatively stronger role in enhancing price efficiency for firms where analysts collectively generate less public information.

A key point of our paper is that the extent of options trading, not an option’s mere listing, is associated with higher valuations. It would be interesting to consider whether this notion extends to other scenarios. For example, countries such as India have futures contracts on individual stocks, and the effect of trading activity in such contracts on valuation could be ascertained. In addition, the impact of index options and futures on market valuation seems like a worthwhile exercise. Such issues are left for future research.

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Appendix: The Parks (1967) Procedure

This appendix describes details of the panel procedure used in Table 7. Consider a balanced panel regression:

$$Y_{it}=\beta_k X_{itk} + e_{it}$$

where i denotes the cross-sectional observation (the firm), k the k'th dependent variable, and t the time indicator.

The error terms e are contemporaneously correlated and serially dependent:

$$E(e_{it}^2)=\sigma_{ii,} E(e_{it},e_{jt})=\sigma_{ij},$$

and

$$e_{it}=\rho_i\ e_{i,t-1}+u_{it,}.$$

Further, u_{it} is an error term with the following assumed properties:

$$E(u_{it})=0,$$

$$E(u_{it},\ u_{jt})=C_{ij},$$

$$E(e_{i,t-1},u_{jt})=0,$$

and

$$E(u_{it}u_{jt'})=0 \text{ for } t\neq t'.$$

The procedure involves first using the OLS residuals to estimate the autoregression parameters for each firm. Denote these as $\hat{\rho}_i$ and construct the usual transformed variables $Y_{it} - \hat{\rho}_i Y_{i,t-1}$, $X_{itk} - \hat{\rho}_i X_{i,t-1,k}$ and $e_{it} - \hat{\rho}_i e_{i,t-1}$ to replace of the original Y_{it}, X_{itk} and e_{it}. OLS with the resulting transformed data provides a new set of residuals. These second stage residuals have a contemporaneous covariance matrix with elements C_{ij}. Finally, the estimated covariance matrix is used to form a GLS estimator for the vector with elements β_k. It is shown in Parks (1967) that this method results in consistent and efficient coefficient estimates.

Table 1
Number of firms with non-missing data.

This table contains the sample size of firms each year. The second column lists the total number of firms with available data for the dependent variable (Tobin's q) and the control variables. The third column lists the number of firms with positive options volume. Firms with no data on options trading activity are assumed to have options volume of zero.

Year	All firms	Positive options volume
1996	6376	1342
1997	6441	1575
1998	6185	1717
1999	5970	1686
2000	5817	1638
2001	5336	1503
2002	5087	1597
2003	4862	1565
2004	4886	1705
2005	4396	1655

Table 2
Summary statistics

Tobin's q is defined as the market capitalization of common stock plus liquidation value of preferred shares plus book value of long-term debt divided by total assets, Optvol is the annual options volume (in ten thousands of dollars), Size is market capitalization (in billions of dollars), Stkturn is the annual share turnover in the underlying stock, ROA is the return on assets defined as net income divided by the book value of assets, CapX is capital expenditures divided by sales, LTD is long-term debt divided by book value of assets, and DivDum is an indicator variable for whether the firm pays a dividend.

Panel A: All firms

Variable	Mean	Median	Standard Deviation
Tobin's q	1.930	1.157	3.378
Options volume	1842	0	23128
Size	2.157	0.1878	12.44
Share turnover	1.547	0.9500	3.405
ROA	-0.0695	0.0253	0.573
CapX	0.6855	0.0402	33.13
LTD	0.1813	0.1104	0.2685
DivDum	0.3168	0	0.465

Panel B: Firms with positive options volume

Variable	Mean	Median	Standard Deviation
Tobin's q	2.258	1.457	2.922
Options volume	6379	388.2	42706
Size	5.154	1.012	19.68
Share Turnover	2.242	1.602	2.455
ROA	-0.0109	0.0399	0.2990
CapX	0.6269	0.0492	41.46
LTD	0.1850	0.1333	0.2105
DivDum	0.3883	0	0.4874

Table 3
Correlation matrix

Tobin's q is defined as the market capitalization of common stock plus liquidation value of preferred shares plus book value of long-term debt divided by total assets, Optvol is the annual options volume (in ten thousands of dollars), Size is market capitalization (in billions of dollars), Stkturn is the annual share turnover in the underlying stock, ROA is the return on assets defined as net income divided by the book value of assets, CapX is capital expenditures divided by sales, LTD is long-term debt divided by book value of assets, and DivDum is an indicator variable for whether the firm pays a dividend.

Panel A: All firms

	Tobin's q	Options Volume	Size	Share turnover	ROA	CapX	LTD
Options volume	0.0899						
Size	0.0609	0.4134					
Share Turnover	0.0783	0.0691	-0.0084				
ROA	-0.1312	0.0156	0.0402	-0.0589			
CapX	0.0081	0.0003	-0.0013	-0.0007	-0.0075		
LTD	-0.0470	-0.0149	-0.0091	-0.0453	-0.0760	0.0141	
DivDum	-0.0993	0.0149	0.1495	-0.1024	0.1489	-0.0118	0.0838

Panel B: Firms with positive options volume

	Tobin's q	Options Volume	Size	Share turnover	ROA	CapX	LTD
Options volume	0.1778						
Size	0.1038	0.4676					
Share Turnover	0.1513	0.1376	-0.0788				
ROA	-0.0545	0.0266	0.0748	-0.0633			
CapX	0.0028	0.0006	-0.0006	-0.0004	-0.0045		
LTD	-0.1273	-0.0383	-0.0330	-0.0975	-0.0716	0.0127	
DivDum	-0.1667	0.0049	0.1829	-0.2933	0.1838	-0.0104	0.0655

Table 4
Average Tobin's q for portfolios sorted by size and options volume

This table presents the mean value of Tobin's q for portfolios sorted annually first by market capitalization (Size), then by options volume. The time-period is 1996 to 2005. Tobin's q is defined as the market capitalization of common stock plus liquidation value of preferred shares plus book value of long-term debt divided by total assets.

		Size quintile				
		1	2	3	4	5
Options volume quintile	1	1.381	1.535	1.780	1.583	1.591
	2	1.500	1.633	1.863	1.775	2.231
	3	1.727	1.968	2.162	2.319	2.519
	4	2.052	2.407	2.761	2.792	3.024
	5	2.249	2.771	3.165	3.409	4.250

Table 5
Time-series coefficient averages and Newey-West corrected t-statistics for year-by-year cross-sectional regressions from 1996 through 2005 for Tobin's q as the dependent variable, using the full sample of firms with available data.

Tobin's q is defined as the market capitalization of common stock plus liquidation value of preferred shares plus book value of long-term debt divided by total assets, Optvol is the annual options volume (in ten thousands of dollars), Size is market capitalization (in billions of dollars), Stkturn is the annual share turnover in the underlying stock, ROA is the return on assets defined as net income divided by the book value of assets, CapX is capital expenditures divided by sales, LTD is long-term debt divided by book value of assets, and DivDum is an indicator variable for whether the firm pays a dividend.

Variable	Coefficient	t-statistic
Optvol	0.1329	5.11
Size	0.9767	2.13
Stkturn	0.1123	2.95
ROA	-1.0257	-4.32
CapX*100	0.8206	4.05
LTD	-1.1218	-2.80
Divdum	-0.4502	-5.17

Average number of firms: 5536

Table 6
Time-series coefficient averages and Newey-West corrected t-statistics for year-by-year cross-sectional regressions from 1996 through 2005 for Tobin's q as the dependent variable, using only those firms with positive options volume.

Tobin's q is defined as the market capitalization of common stock plus liquidation value of preferred shares plus book value of long-term debt divided by total assets, Optvol is the annual options volume (in ten thousands of dollars), Size is market capitalization (in billions of dollars), Stkturn is the annual share turnover in the underlying stock, ROA is the return on assets defined as net income divided by the book value of assets, CapX is capital expenditures divided by sales, LTD is long-term debt divided by book value of assets, and DivDum is an indicator variable for whether the firm pays a dividend.

Variable	Coefficient	t-statistic
Optvol	0.1185	3.37
Size	7.110	2.05
Stkturn	0.1431	2.76
ROA	-0.6258	-1.39
CapX*100	4.690	1.29
LTD	-1.542	-4.01
Divdum	-0.7555	-5.52

Avg no. of firms: 1598

Table 7
Panel estimation for the period 1996 to 2005 with Tobin's q as the dependent variable.

Tobin's q is defined as the market capitalization of common stock plus liquidation value of preferred shares plus book value of long-term debt divided by total assets, Optvol is the annual options volume (in ten thousands of dollars), Size is market capitalization (in billions of dollars), Stkturn is the annual share turnover in the underlying stock, ROA is the return on assets defined as net income divided by the book value of assets, CapX is capital expenditures divided by sales, LTD is long-term debt divided by book value of assets, and DivDum is an indicator variable for whether the firm pays a dividend. The Parks (1967) procedure is used to account for autocorrelation, using a balanced panel of 2290 firms present in every year of the sample.

	Panel Estimates	
Variable	Coefficient	t-statistic
Optvol	0.0460	3.06
Size	36.41	4.78
Stkturn	0.0616	7.26
ROA	0.1781	1.20
CapX*100	-11.48	-1.70
LTD	-1.316	-16.80
Divdum	-0.3618	-4.57

Number of firms: 2290

Table 8
Time-series coefficient averages and Newey-West corrected t-statistics for year-by-year cross-sectional regressions from 1996 through 2005 for Tobin's q as the dependent variable, using only those firms with positive options volume and using annual average absolute moneyness as an instrument for options volume.

Tobin's q is defined as the market capitalization of common stock plus liquidation value of preferred shares plus book value of long-term debt divided by total assets, IV(Optvol) is the instrumental variable estimate of annual options volume (in ten thousands of dollars) using the average absolute deviations from even-moneyness as the instrument, Size is market capitalization (in billions of dollars), Stkturn is the annual share turnover in the underlying stock, ROA is the return on assets defined as net income divided by the book value of assets, CapX is capital expenditures divided by sales, LTD is long-term debt divided by book value of assets, and DivDum is an indicator variable for whether the firm pays a dividend.

Variable	Coefficient	t-statistic
IV(optvol)	0.0278	3.03
Size	15.26	3.16
Stkturn	0.0262	1.78
ROA	0.7266	4.03
CapX*100	12.77	2.51
LTD	-0.2265	-0.95
Divdum	-0.6284	-4.74

Average number of firms: 1598

Table 9
Time-series coefficient averages and Newey-West corrected t-statistics for year-by-year cross-sectional regressions from 1996 through 2005 for Tobin's q as the dependent variable, using the logarithm of options volume.

Tobin's q is defined as the market capitalization of common stock plus liquidation value of preferred shares plus book value of long-term debt divided by total assets, Optvol is the annual options volume (in ten thousands of dollars), Size is market capitalization (in billions of dollars), Stkturn is the annual share turnover in the underlying stock, ROA is the return on assets defined as net income divided by the book value of assets, CapX is capital expenditures divided by sales, LTD is long-term debt divided by book value of assets, and DivDum is an indicator variable for whether the firm pays a dividend.

Variable	Coefficient	t-statistic
Ln(Optvol)	0.1993	3.78
Size	8.209	3.77
Stkturn	0.0850	2.26
ROA	-0.7229	-1.59
CapX	4.247	1.26
LTD	-1.552	-4.14
Divdum	-0.8167	-5.84

Average number of firms: 1598

Table 10
Panel estimation for the period 1996 to 2005 for return on assets as the dependent variable.

ROA is the return on assets defined as net income divided by the book value of assets, Optvol is the annual options volume (in ten thousands of dollars), Size is market capitalization (in billions of dollars), Stkturn is the annual share turnover in the underlying stock, CapX is capital expenditures divided by sales, LTD is long-term debt divided by book value of assets, and DivDum is an indicator variable for whether the firm pays a dividend. The Parks (1967) procedure is used to account for autocorrelation, using a balanced panel of firms present in every year of the sample.

	Panel Estimates	
One-year lagged variables	Coefficient	t-statistic
Ln(Optvol)	0.0708	2.95
Size	5.141	0.95
Stkturn	0.0003	0.05
ROA	-0.930	-4.30
CapX	-0.0997	-0.30
LTD	1.893	5.29
Divdum	-0.307	-5.40

Table 11
Year-by-year coefficients and t-statistics for the logarithm of options volume from annual cross-sectional regressions from 1996 through 2005 with Tobin's q as the dependent variable, without and with industry dummies.

Tobin's q is defined as the market capitalization of common stock plus liquidation value of preferred shares plus book value of long-term debt divided by total assets. The explanatory variables are the natural logarithm of optvol, i.e., the annual options volume, Size: market capitalization, Stkturn: the annual share turnover in the underlying stock, ROA: the return on assets defined as net income divided by the book value of assets, CapX: capital expenditures divided by sales, LTD: long-term debt divided by book value of assets, and DivDum, which is an indicator variable for whether the firm pays a dividend. The last two columns report the results when the 48 industry dummies of Fama and French (1997) are included in the regression.

	Without industry controls		With Fama and French (1997) industry controls	
Year	Coefficient	t-statistic	Coefficient	t-statistic
1996	0.1453	4.06	0.1016	2.69
1997	0.1794	5.55	0.1365	4.63
1998	0.2211	6.23	0.2511	7.63
1999	0.5521	8.40	0.5707	9.39
2000	0.2845	9.41	0.2373	7.66
2001	0.1631	6.26	0.1493	6.47
2002	0.0997	5.45	0.0865	5.53
2003	0.0863	4.79	0.1019	6.36
2004	0.1058	5.57	0.1402	8.18
2005	0.1557	8.35	0.1319	7.84

Table 12
Time-series coefficient averages and Newey-West corrected t-statistics for year-by-year cross-sectional regressions from 1996 through 2005 with Tobin's q as the dependent variable, and analysts following interacted with options volume.

Tobin's q is defined as the market capitalization of common stock plus liquidation value of preferred shares plus book value of long-term debt divided by total assets, Optvol is the annual options volume (in ten thousands of dollars), Size is market capitalization (in billions of dollars), ANALYS is a variable that takes on the values 0, 1, or 2 for three equal portfolios sorted by low to high analyst following, Stkturn is the annual share turnover in the underlying stock, ROA is the return on assets defined as net income divided by the book value of assets, CapX is capital expenditures divided by sales, LTD is long-term debt divided by book value of assets, and DivDum is an indicator variable for whether the firm pays a dividend.

Variable	Coefficient	t-statistic
Ln(Optvol)	0.3346	3.51
Ln(Optvol)*ANALYS	-0.0563	-3.34
Size	9.002	2.80
Stkturn	0.0468	1.69
ROA	0.5618	3.29
CapX	0.3346	3.98
LTD	-0.0890	-0.46
Divdum	-0.6052	-5.44

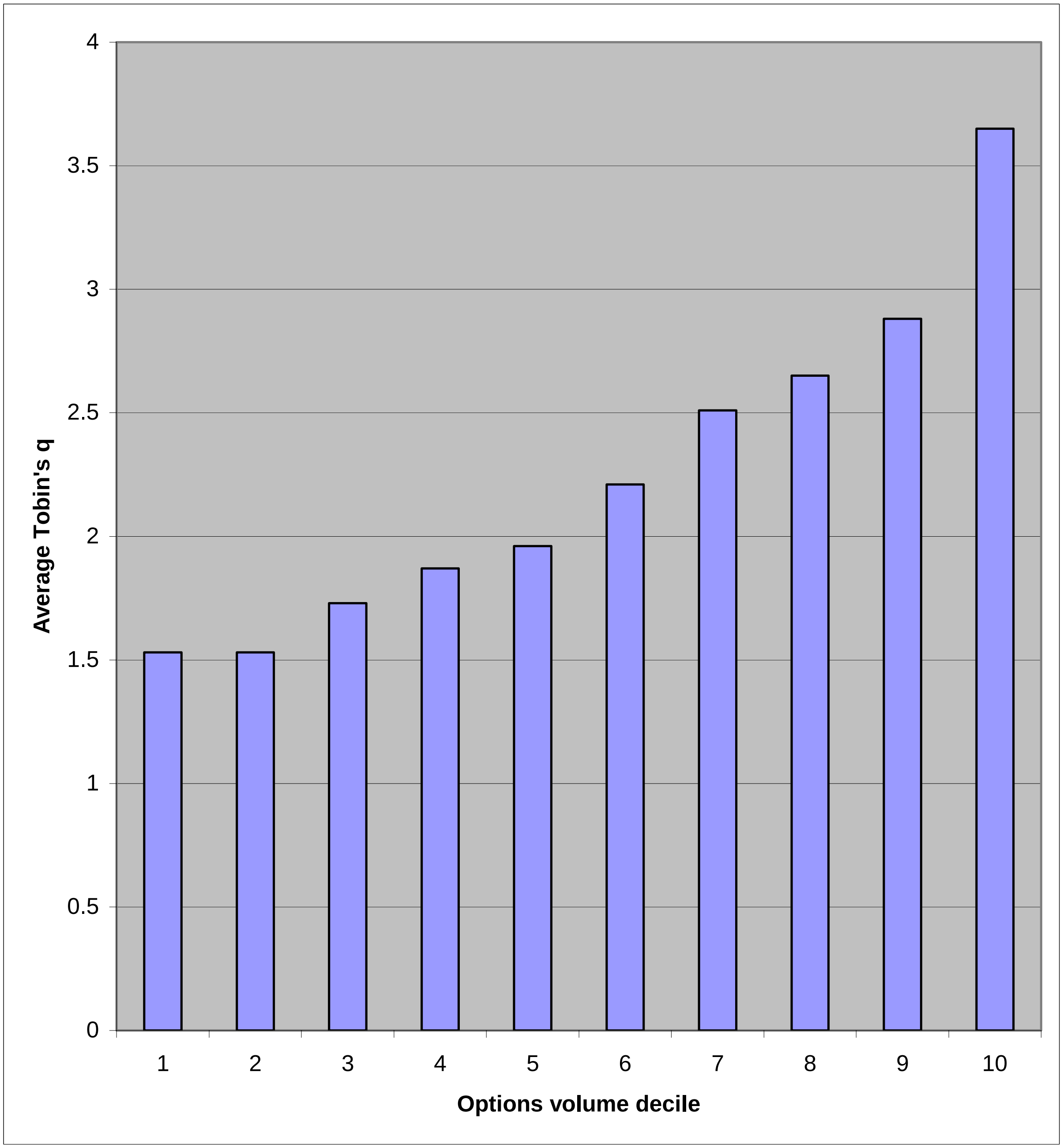

Figure 1. Average Tobin's q and Options Volume

Firms with positive options volume during 1996-2005 are sorted into ten deciles by options volume. The mean value of Tobin's q over all sample years within each decile is depicted above.