



Detecting abnormal trading activities in option markets



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ABSTRACT

We develop an econometric method to detect “abnormal trades” in option markets, i.e., trades which are not driven by liquidity motives. Abnormal trades are characterized by unusually large increments in open interest, trading volume, and option returns, and are not used for option hedging purposes. We use a multiple hypothesis testing technique to control for false discoveries in abnormal trades. We apply the method to 9.6 million of daily option prices.

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1. Introduction

An important distinction of option trades is between liquidity and non-liquidity trades. The former is solely driven by liquidity shocks to option traders. The latter can be driven by various motives, including private information and hedging needs. Disentangling these option trades can potentially improve our understanding of the functioning of option markets.

This paper develops an econometric approach to detect certain non-liquidity option trades that we call *abnormal trades*. We define abnormal trades as unusual trades in option contracts which generate large gains, are not used for option hedging purposes, and are made a few days before the occurrence of a specific event.

We develop two statistical methods to detect abnormal trades. The first method uses only ex-ante information and aims to detect abnormal trades as soon as they take place. We look for option trades characterized by unusually large increments in open interest, i.e., number of outstanding contracts, which are close to daily trading volumes. In those cases the originator of such transactions is not interested in intraday speculations but has reasons for keeping her position for a longer period. As it turns out in our empirical study, the higher the increment in open interest and volume the higher the future return of the corresponding option. We refine the first method using a nonparametric test to check whether those option trades are hedged with the underlying asset or used for option hedging purposes. The second method uses also ex-post information and encompasses the first method by adding an additional criterion. An option trade is identified as abnormal when the increment in open interest and volume is unusual, not hedged (as in the first method), and generates large option gains.

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Our approach to detect option abnormal trading has two distinctive features: it controls for false discoveries in abnormal trades and accounts for option hedging. Addressing these issues is a challenging task. In any statistical method, the probability that any liquidity trade will appear to be abnormal simply by chance is not zero. This misclassification is induced by the Type I error in hypothesis testing, as the test of abnormal trade is repeated each day. However, this misclassification error can be formally quantified using multiple hypothesis testing techniques. Intuitively, liquidity trades should have zero return on average, while abnormal trades should have statistically large returns. Under the null hypothesis that all trades are liquidity trades, the proportion of lucky liquidity trades depends on the size of the test and can be calculated using option returns. When the difference between the actual fraction of large returns (due to abnormal and lucky trades) and the expected fraction of large returns due to lucky liquidity trades is statistically large, the test rejects the null hypothesis that all trades are liquidity trades.

We develop a nonparametric test to assess whether option hedging takes place or not. For example, when studying long positions in call options, the idea is to decompose the underlying stock seller-initiated trading volume in the hedging and non-hedging components. This decomposition is achieved using the theoretical amount of stock trading which would have been generated if no abnormal trading would have occurred. Then the test rejects the null hypothesis of absence of hedging when the hedging component is statistically large.

An obvious question at this stage is who originates abnormal trades. Although information on traders' identity is not available, it is conceivable that mainly informed traders are behind abnormal trades in call options. This conjecture would be consistent with the large returns generated by call option abnormal trades. For abnormal trades in put options the situation is different. Informed traders and/or corporate insiders hedging their human capital are most probably behind those trades.¹ Without knowing trader identities, it is not possible to disentangle whether put option abnormal trades are due to informed traders or corporate insiders hedging their human capital. We describe this situation as saying that we are testing a *joint hypothesis*.

We apply the two statistical methods to 9.6 million of daily option prices of 31 selected companies mainly from airline, banking and insurance sectors. Several millions of intraday stock price and volume data are also analyzed to assess whether an option trade is hedged or not. The sample period spans 14 years, from January 1996 to September 2009 (part of our sample ends in April 2006), and our analysis is at the level of individual option, rather than on the cross-section of stock returns.²

Our empirical findings can be summarized as follows. First, abnormal trades tend to cluster prior to certain events such as merger and acquisition (M&A) announcements, quarterly financial or earning related statements, the terrorist attacks of September 11th, and first announcements of financial disruptions of banking and insurance companies during the Subprime financial crisis 2007–2009. Second, prior to a particular event which will impact a particular company, abnormal trades can involve more than one option but rarely the cheapest option, i.e., deep out-of-the-money and with shortest maturity. Third, the majority of abnormal trades take place in put rather than call options. Fourth, estimated option gains of abnormal trades easily exceed several millions for a single event. Finally, the underlying stock price does not display any particular behavior on the day of the detected abnormal trade. Only some days later, for example when a negative company news is released, the stock price drops generating large gains in long put positions.

The paper is organized as follows. Section 2 reviews the related literature. Section 3 presents our method to detect abnormal trades. Section 4 describes the dataset. Section 5 summarizes the empirical results. Section 6 quantifies false discoveries in abnormal trades. Section 7 discusses various robustness checks. Section 8 concludes.

2. Related literature

Although we are testing a *joint hypothesis* for put options, abnormal trades can be related to informed trades which have been the subject of an extensive literature; see, e.g., Hasbrouck (1991), Easley and O'Hara (1992), Easley et al. (1998), Poteshman (2006), and Boulatov et al. (2013). As discussed in Grossman (1977), Diamond and Verrechia (1987), and others, option markets offer significant advantages to informed traders. Options provide potential downside protection, an alternative way of short selling when shorting stocks is expensive or forbidden, additional leverage which might not be possible in stock or bond markets (Biais and Hillion, 1994), and possibly more discreetness for trading on private signals. Indeed, Cao et al. (2005) show that call–volume imbalances prior to unscheduled takeover announcements are strongly related to stock returns on the announcement day. Pan and Poteshman (2006) report clear evidence that option trading volumes predict future price changes. Bali and Hovakimian (2009) show that the difference between realized and implied volatilities of individual stocks predicts the cross-sectional variation of expected returns. Cremers and Weibbaum (2010) find that deviations from put–call parity contain information about future stock returns. Yan (2011) documents a negative relation between the slope of implied volatility smile and stock return. In these studies (and others), the analysis is systematically conducted at an aggregate level, e.g., extracting information from *all* current option prices, while we conduct the analysis at *individual* option contracts.

Stephan and Whaley (1990), Chan et al. (1993), Manaster and Rendleman (1982), and Lee and Yi (2001), among others, discuss why informed traders may consider options as superior trading vehicles. Our results show that option markets can offer significant

¹ Human capital can be defined as the sum of the present value of the future cash income, shares, stock options, etc., and it represents the most significant risk faced by corporate insiders especially senior managers. To the extent that it is legal, a long put option is probably the only liquid instrument that can be used by corporate insiders to hedge the risk attached to their human capital.

² As mentioned above, we rely on statistical methods to detect abnormal trades. Therefore, those trades will be abnormal only with a certain probability. For brevity, we refer to those trades simply as abnormal trades. Moreover, detected abnormal trades might or might not be legal. From a legal viewpoint this study does not constitute proof per se of illegal activities. Legal proof would require trader identities and their motivations, information which is not contained in our dataset.

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