Bankruptcy Sells Stocks… But Who's Buying (and Why)?*

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Abstract

Firms that file for Chapter 11 are actively traded. This paper investigates who trades these bankrupt firms and why. We also examine the impact of this abnormal trading on stock prices. Using a sample of firms that enter into Chapter 11 and remain listed on the main exchanges post-filing, we find that the unique lottery-like characteristics of these stocks make them attractive to a particular retail investor clientele who use them to gamble in the market. Such speculative trading behavior leads, on average, to a negative abnormal return of around −28% over the year post-Chapter 11 filing. Further, arbitrageurs are not able to fully exploit this pricing anomaly. Overall, the combination of gambling-motivated trading by retail investors and limits to arbitrage generate the anomalous market underreaction we document.

Keywords: Post-Chapter 11 trading, gambling, lottery-like stocks, retail investors, limits to arbitrage, market under-reaction.

JEL classification: G14, G33.

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I. Introduction

There is an extensive literature that addresses a wide range of bankruptcy-related issues.[1] However, we still know little about the trading environment of bankrupt firms. Part of the reason is that 90% of the stocks of publicly-listed firms filing for Chapter 11 cease trading on the main exchanges at or before the filing date (Dawkins, Bhattacharya and Bamber, 2007). This paper examines the performance of stocks that remain listed on the main exchanges post-bankruptcy. In particular, we demonstrate that such stocks earn abnormal negative returns of almost −30% in the year following Chapter 11 filing.

We start by examining the main characteristics of bankrupt firms and find that such securities are very similar to what Kumar (2009) defines as "lottery-like" stocks, i.e., stocks that for a reduced cost offer a very low probability of a large future reward, and a very high probability of a small loss. In fact, post-bankruptcy, our sample of bankrupt firms are cheaper, and have higher idiosyncratic volatility than the average CRSP lottery-type stock, and offer parallel levels of idiosyncratic skewness. This finding is not driven by their risk-return profile, as companies that share similar size and book-to-market ratios do not exhibit comparable stock characteristics. Importantly, our analysis shows that the relative proportions of lottery-like and nonlottery-like bankrupt firms in our sample are respectively far higher, and significantly lower, than in the CRSP population as a whole. The same holds when we compare the proportions of lottery and nonlottery-like stocks across our sample firms, and their control-firm equivalents.

Previous studies show that poor, young, less educated single men who live in urban areas, undertake nonprofessional jobs, and belong to specific minority groups (African-American, and Hispanic) tend to invest more in lottery-type stocks (Kumar, 2009). Han and Kumar (2013) additionally report that stocks with speculative features (i.e., low price, high idiosyncratic skewness, and volatility) are the preferred habit of retail investors with a strong propensity to

[1] See Hotchkiss, John, Mooradian and Thorburn (2008) for a survey.

gamble. Our results thus suggest that a natural demand for the stock of bankrupt firms is likely to exist, namely that originating from retail investors who trade in such securities as if they are gambling in the market.

The second part of the paper tests this conjecture, and establishes that retail investors are, in fact, particularly drawn to bankrupt firms. Specifically, we show that retail investors extensively trade bankrupt firms, and especially so when such firms are likely to be perceived as lottery-like. Further, our empirical evidence shows that the socioeconomic and demographic characteristics of retail investors who invest in bankrupt firms are similar to investors who are attracted towards lottery-type stocks more generally (Kumar, 2009; Kumar, Page and Spalt, 2011).

We additionally explore how the retail trading behavior we document affects the stock price dynamics of bankrupt firms. In line with previous studies, we show that the stock price falls, on average, 26% over the three-day window surrounding the formal bankruptcy announcement date. In addition, we document a highly significant post-bankruptcy drift of at least -28% over the following 12 months. In a novel contribution to the literature, we show that all else being equal, such underperformance is more extreme for bankrupt firms that have a lottery-like profile, and are more heavily traded by retail investors.

In the last part of the paper, we show that transaction costs severely hinder an arbitrageur's ability to intervene in the particular market we study, even absent such issues as the amount of capital that may need to be posted, and buy-in risk. Specifically, in the *best case* scenario a sophisticated investor may expect to lose at least 18.0% (11.2%) on average over a 6-month (12-month) period post-Chapter 11 filing when engaging in an arbitrage strategy involving bankrupt firms' securities.

These findings contribute to the finance literature in a number of ways. First, we investigate who trades the stock of bankrupt firms and why. To our knowledge, no previous

study has examined the clientele characteristics of the stocks of bankrupt firms in detail. This is an important issue particularly in the light of the recent spate of large bankruptcies.[2] Our evidence indicates that it is those particular retail investors who are attracted to lottery-type stocks also exhibit a greater propensity to trade bankrupt firms.

Our findings also complement the evidence in Han and Kumar (2013) who find that stocks with speculative features are the preferred habitat of retail investors with a strong propensity to gamble. Our results are, likewise, broadly consistent with the sensation seeking, and desire to trade for entertainment, explanations for such retail investor behavior (e.g., Dorn and Huberman (2010), Grinblatt and Keloharju (2009), and Dorn and Sengmueller (2009)).

Second, we analyze what happens to stock prices during the bankruptcy process. The market's anticipation of the bankruptcy event, and the stock price reaction to formal filing for Chapter 11, are well explored in the literature (e.g., Clark and Weinstein, 1983; Datta and Iskander-Datta, 1995; Dawkins et al., 2007), as is the market response to firm emergence from Chapter 11 (Eberhart, Altman and Aggarwal, 1999). However, still relatively little is known about what happens to the stock prices of firms that remain listed on the main exchanges during the period following the bankruptcy proceedings (Altman and Hotchkiss, 2005, p.83; Dawkins et al., 2007). Morse and Shaw (1988) do discuss this issue; however, their early study uses a small sample of 56 firms and monthly data, and does not address the same questions as we do.

In a related paper, Li and Zhong (2013) present more recent evidence of abnormal negative performance following Chapter 11 bankruptcy announcements, but their sample consists predominantly of Pink Sheet stocks, and they do not explore directly the underlying reasons for the fall in prices in the first place. We contribute to the literature specifically by identifying the reasons for the post-bankruptcy announcement drift, which is relatively more

[2] For example, MF Global Holdings Ltd. (10/31/2011), CIT Group (11/01/2009), General Motors Corporation (06/01/2009), Thornburg Mortgage, Inc. (05/01/2009), Chrysler LLC (04/30/2009), General Growth Properties, Inc. (04/16/2009), Lyondell Chemical Company (01/06/2009), Washington Mutual (09/26/2008), and Lehman Brothers Holdings Inc. (09/15/2008). See http://www.bankruptcydata.com/Research/Largest_Overall_All-Time.pdf for more details.

negative when retail investors trade more actively, and such firms have greater lottery-type characteristics. Our study provides a new insight into what may happen to market prices when retail investors trade, at least partially motivated by gambling reasons.

The negative post-event returns we document demonstrates that the market is not always able fully to incorporate negative information contained in public news events (e.g., Bernard and Thomas, 1989, 1990; Michaely, Thaler and Womack, 1995; Dichev and Piotroski, 2001; Taffler, Kausar and Lu, 2004; Kausar, Taffler and Tan, 2009). Our findings are consistent with the theoretical models of Mitton and Vorkink (2007), and Barberis and Huang (2008).

In the Mitton and Vorking (2007) model, underdiversified investors exhibit a preference for skewness, with skewness in portfolio return partially compensating for the lower mean return (for a given level of variance) in their portfolios. In addition, Barberis and Huang (2008) posit that investors who overweight tails are willing to pay a premium for the skewed security since this allows them to maximize their utility. Consequently, they will earn a lower return on this security than standard benchmarks. Both arguments provide a theoretical explanation for why retail investors who trade bankrupt firms with lottery-like characteristics are willing to accept lower returns from such investments. This behavior, in turn, explains the puzzling post-bankruptcy announcement market-pricing anomaly.

Our findings are qualitatively consistent with, although much stronger than, those reported in Kumar (2009), and Han and Kumar (2013). The former study shows that investors who allocate at least one-third of their portfolios to lottery-type stocks underperform by over 2.5% per annum, while the latter authors demonstrate that stocks highly traded by retail investors have an associated risk-adjusted premium of −7% per annum. In our case, bankrupt firms underperform by no less than 28% in the 12 months following the Chapter 11 filing date. This evidence suggests that the mispricing of bankrupt firms is more extreme than the

underperformance of non-bankrupt lottery-stocks, or other stocks that are mainly traded by retail investors.

We also directly investigate how arbitrage costs affect the pricing of bankrupt firms. Limits to arbitrage is an important part of our story as theory suggests that a market-pricing anomaly cannot last long since trading by arbitrageurs will eliminate it (Shleifer, 2000, p. 4). We find that arbitrage activity is likely to be very costly in the context of bankrupt firms. In particular, an arbitrage strategy designed to exploit the mispricing of such firms is not only very risky, but generates, on average, highly negative returns. Our analysis is conservative in that it fails to account for all possible sources of risk and implementation costs faced by a sophisticated arbitrageur who may try to profit from the anomalous return patterns of bankrupt firms.

Difficulty in shorting these stocks is a relevant illustration of this issue. For example, D'Avolio (2002) finds that a third of stocks with prices below $5 present in the CRSP database are hard to short. In fact, given their legal status, it is very likely that bankrupt firms are almost impossible to short. In addition, our results do not explicitly consider the full impact of other costs, such as holding costs, and idiosyncratic risk, which previous research has shown to play an important role in the profitability of arbitrage strategies, and, are highly relevant in the context of bankrupt stocks (Pontiff, 2006).[3]

At a more general level, our results could help explain the well-known inverse relation between stock returns and distress risk. Campbell, Hilscher and Szilayi (2008) document that firms with a high risk of failure earn abnormally low returns, benchmarked against the expected return derived from standard asset pricing models. Our evidence on the behavior of bankrupt firm stocks offers a potential explanation. We find that arbitrageurs face high risks, and low average returns when arbitraging such highly financially distressed firms, and are thus likely not to engage in such strategies. Therefore, the "distress anomaly" discussed in Campbell et al.

[3] In a broader context, such effects have been documented by Taffler et al. (2004), Lesmond, Schill and Zhou (2004), and Kausar et al. (2009), among others.

(2008) may be the result of the nonstandard preferences of retail investors (with a high preference for skewness) *and* limits to arbitrage, much like we find with firms in Chapter 11 reorganization.

The rest of the paper proceeds as follows. The next section describes our data. In Section III, we examine the characteristics of bankrupt firm stocks. In Section IV, we investigate who trades those firms pre-, and post-bankruptcy, and why. Section V describes the performance of bankrupt firms both before and, more importantly, after the Chapter 11 filing. We also study how active retail trading, the lottery-like characteristics of such stocks, and limits to arbitrage jointly explain this market anomaly. Section VI concludes.

II. Data and descriptive statistics

This section summarizes our sample collection strategy, and the key characteristics of our sample of bankrupt firms and the corresponding control firms.

A. Sample and control firms

Our data consists of the 351 nonfinance, nonutility industry firms which file for Chapter 11 between 01/10/1979 and 12/10/2005, and remain listed on the NYSE, AMEX or NASDAQ after their bankruptcy date.[4] Table 1 summarizes our sample construction strategy. As can be seen, in the first step all firms filing for bankruptcy between 1979 and 2005 are identified. Seven sources of data are used for this purpose: (i) the bankruptcydata.com database,[5] (ii) the SEC's Electronic Data Gathering, Analysis, and Retrieval system (EDGAR),[6] (iii) COMPUSTAT's

[4] Bankruptcies in the U.S. were governed by the Bankruptcy Reform Act of 1978 between 10/01/1979 and 10/17/2005. In 2005, this Act was substantially revised by the Bankruptcy Abuse Prevention and Consumer Protection Act. Although most of the provisions of the new Act affect consumer bankruptcies, it also had an important impact on corporate bankruptcy as, in general, the new code treats the creditors of bankrupt firms more favorably than its predecessor (Altman and Hotchkiss, 2005, p.47). Accordingly, restricting our analysis to the 10/01/1979 to 10/17/2005 period limits the impacts of the changes in legal setting on our results.

[5] See http://www.bankruptcydata.com/.

[6] Companies filing for bankruptcy are required to report this to the SEC within 15 days using Form 8-K. Accordingly, to find the bankruptcy cases reported on EDGAR, we search and manually analyze all 8-K forms available on EDGAR that mention the keywords "bankruptcy", "Chapter 11" or "reorganization".

industrial file, (iv) Professor Lynn Lopucki's Bankruptcy Research database,[7] (v) the SDC database, (vi) Altman and Hotchkiss (2005, pp.15-20), and (vii) a list of bankrupt firms provided by Professor Edward Altman. All firms are combined into a single list and duplicates removed, yielding a total of 3,437 nonoverlapping cases.

Firms are next located on the Center for Research in Security Prices (CRSP) database leading to 1,411 firms being eliminated, the main reason being that firms could not be found in CRSP. However, a few other cases are also excluded because the firm's ordinary common stock (CRSP share code 10 or 11) is not traded on a major U.S. stock exchange (CRSP exchange codes 1, 2 or 3) during this period, or the firm does not have at least 24 months of pre-bankruptcy returns available on CRSP.

In the next step, the 1,556 firms delisted prior to or at their bankruptcy filing date are deleted. From the 470 surviving cases, the 58 firms for which accounting data are not available on COMPUSTAT for a 2-year period before the bankruptcy announcement year are then removed, together with 11 firms incorporated outside the U.S. (as defined by COMPUSTAT). We also remove 40 financial and utility firms from our final sample.[8] The 10 firms filing for Chapter 7 are excluded in the last step of the screening process.

Our 351 sample firms have 53 different two-digit SIC codes (168 different four-digit codes) indicating no significant degree of industry clustering. Sixty percent of our firms trade on the NASDAQ (209), 31% (109) on the NYSE, and the remaining 9% (33) on the AMEX.

We also construct a sample of control firms by matching each of our bankrupt firms with the non-bankrupt firm with most similar size, and book-to-market ratio.[9] First, for each bankrupt

[7] See http://lopucki.law.ucla.edu/.

[8] Utility firms are generally regulated enterprises leading to bankruptcy having a different meaning, and financials have dissimilar characteristics to industrial firms with Chapter 11 applying differently. Financial and utility firms are defined as in the 49 industry portfolios available at Professor Kenneth French's website. See http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/det_49_ind_port.html.

[9] The results of our analysis are very similar if we use control firms matched on size and momentum, industry and stock-price, size and z-score, and industry, size and book-to-market.

firm, we measure market capitalization one month before the bankruptcy filing date.[10] We then search CRSP for an initial pool of matching candidates with market capitalization of 70% to 130% of the sample firm's equity value. The control firm is identified as that firm within this set with closest book-to-market ratio, and the match is confirmed if (i) the matched firm has at least 24 pre-event months of returns available on CRSP, (ii) is not in bankruptcy, (iii) is incorporated in the U.S., (iv) is not a financial or utility firm, and (v) it has sufficient information on COMPUSTAT to conduct our analysis.

B. Descriptive statistics

Table 2 provides sample and control firm descriptive statistics. Panel A shows that our sample firms are severely financially distressed before filing for Chapter 11. Return on assets is negative (mean = −19%, median = −6%), current ratio is low (mean = 169%, median = 128%), and leverage is relatively high (mean = 45%, median = 40%). Not surprisingly, the average Altman (1968) z-score is low (mean = 1.37, median = 1.31), suggesting that these firms are likely to fail.

The results for control firms are somewhat different. For instance, even though matched on size and book-to-market, these businesses are in a stronger financial position than the bankrupt sample. Mean and median z-score, and current ratio are higher, and leverage is appreciably lower (differences between groups are statistically significant at the 1% level). Nonetheless, control firms also seem to be losing money: mean return on assets is −15%, with the corresponding median not significantly different from zero at conventional levels. Panel A also shows bankrupt and control firms have similar total assets and sales.

Panel B of Table 2 summarizes a number of market variables. Both sample and control firms are small, with average market capitalization of around $160m (median = $32m) and have

[10] As a robustness check, we measure size for all sample firms one, three, six and 12 months before their bankruptcy date and re-run our analysis. Results do not change. In all cases, the market value of every sample firm is measured before its bankruptcy announcement date.

high book-to-market ratios. Panel B highlights the significant impact of the bankruptcy filing on mean stock price, which falls from $4.97 in the 12-month period before the event to $2.08 in the event month, a reduction of almost 60%. The equivalent decline in the median price is from $3.12 to $0.97. For the 12 months post the Chapter 11 filing month equivalent mean and median stock prices are $2.98 and $0.71 for those firms remaining listed. In the case of control firms, prices remain relatively stable, with a mean value of around $9 (median around $5) across the full 25-month period.

Further, Panel B of Table 2 suggests that bankrupt firms are of interest to certain investors, a point also raised by Hubbard and Stephenson (1997). In fact, in the 12 months before the bankruptcy date average daily turnover for these firms is 0.51%, implying an annual turnover rate of 130%. This rate spikes to 290% in the bankruptcy-announcement month, which shows the importance of the event to investors. After such initial effect dissipates, mean bankrupt firm daily turnover stabilizes at 0.57%, equivalent to an annual rate of 145%. This is clearly specific to our event firms as in the case of the control sample, daily turnover does not exhibit any obvious variation, with a mean value of around 0.43% over the entire period (median around 0.23%).

In addition, Panel B of Table 2 shows that investors face large bid-ask spreads when they trade bankrupt firms. In particular, using the quoted bid-ask spread of Stoll and Whaley (1983), we estimate the pre-Chapter 11 mean (median) bid-ask spread for our bankrupt firms to be 8.27% (6.85%); post-bankruptcy, the equivalent figure is 12.50% (10.70%). Equivalent figures for control firms are significantly lower with mean (median) pre-event bid-ask spreads of 6.25% (4.30%), and 7.18% (4.38%) post-event. Estimates using the alternative direct effective bid-ask spread computed as in Lesmond et al. (2004) are similar, although of smaller magnitude. Taken together, our findings suggest that Chapter 11 filing leads to a sharp increase in the bid-ask spread of announcing firms.

Finally, Panel C of Table 2 shows that only 25% of our sample firms have positive earnings, and around the same percentage pay dividends. In line with the results in Panel A, Panel C shows that control firms are financially stronger than sample firms. Almost 50% of control firms have positive earnings, and around 40% pay dividends. Around a quarter of the bankrupt firms have a first time going-concern audit opinion in their accounts for the fiscal year preceding Chapter 11. Only two percent of the control firms are in the same situation.

III. Why are bankrupt firms so actively traded?

Our evidence so far shows that bankrupt firms that remain listed on the main exchanges post-Chapter 11 are heavily traded. This section investigates why the stocks of firms undergoing Chapter 11 reorganization are so actively traded. Why should anyone be interested in trading bankrupt firms anyway? Our main hypothesis is that investors trade bankrupt firms because those securities exhibit the characteristics of lottery-like stocks, and offer investors an opportunity to gamble in the stock market.

The extant literature suggests there may be two main reasons for trading bankrupt firms. On the one hand, trading bankrupt firms may be a fully rational investment decision. As Merton (1974) suggests, bankrupt firm equity is a deep out-of-the money option.[11] In this way, investors may buy bankrupt stocks just as they buy call options. On the other hand, non-standard economic reasons may also drive trading in bankrupt firms. Tom Petruno provides an excellent characterization of this situation in the *Los Angeles Times* on June 10, 2009:

> *"General Motors Corp. filed for bankruptcy protection, got kicked off the New York Stock Exchange and out of the Dow Jones industrial average. And its stock has mostly been rising ever since. In fact, GM has been one of the hottest issues on Wall Street over the last six trading sessions, surging from 61 cents to today's closing price of $1.59 in the*

[11] Eugene Fama also speculates on this in his blog with Kenneth French. The blog is available at http://www.dimensional.com/famafrench/2010/02/qa-bankrupt-firms-whos-buying-1.html.

electronic pinksheets.com market - a gain of 161%. (…) As I've written before, there's a universe of traders out there who love to play around with big-name stocks that end up in bankruptcy. You can't explain the action based on any fundamentals. It's just a minute-to-minute, hour-to-hour trading game. (…) We know how this will end. But between now and then, for some gamblers playing GM is better than a trip to Vegas."[12]

Tom Petruno's words are even more striking when one realizes that on the same day GM issued a press release stating:

"*GM management has noticed a recent elevation in the volume and price of its common stock. While GM does not control the market or its stock price, GM management strongly believes that any recovery for the common stockholders in the Chapter 11 bankruptcy process is highly unlikely, even under the most optimistic of scenarios."*

Kumar (2009) studies the impact of the well-known human propensity to gamble in investment decisions. It focuses on stocks that have the features of lottery tickets, i.e., "(…) that for a very low cost (…) offer a tiny probability of a huge future reward and a large probability of a small loss (…)" (p.1890), and shows that the investment decisions of relatively less sophisticated retail investors reflect their gambling preferences. Bankrupt firms seem to possess the key characteristics of such lottery-like stocks, which could make them particularly attractive to investors with gambling proclivities.

In fact, bankrupt firms usually trade at a very low price (e.g., Clark and Weinstein, 1983; Hubbard and Stephenson, 1997; Dawkins et al., 2007), and buying such stock offers investors the opportunity to gamble with two extreme outcomes. The more probable outcome is losing most, if not all, of the original investment made in the bankrupt firm's equity, which would typically occur if the firm ends up liquidated (e.g., Hubbard and Stephenson, 1997). However, investors may also be richly rewarded if the firm emerges successfully from Chapter 11, although this is a

[12] See http://latimesblogs.latimes.com/money_co/2009/06/general-motors-corp-filed-for-bankruptcy-protection-got-kicked-off-the-new-york-stock-exchange-and-out-of-the-dow-jones-i.html for further details.

much rarer outcome.[13] Importantly, the very low market price that characterizes this type of stock makes it possible for investors to earn generous short-term returns when prices appreciate only a few cents.

Motivated by the previous anecdotes and empirical findings, we investigate whether investors perceive bankrupt firms as lotteries. We first compare the three key characteristics used in Kumar (2009) to define a lottery-like stock across our sample firms, the CRSP population, and our non-bankrupt control firms. Next, we investigate the extent to which our bankrupt firms' stocks increasingly take on lottery-type characteristics leading up to, and post-Chapter 11. In the final part of this section, we discuss why bankrupt firms are so actively traded.

A. Bankrupt firms as lottery-type stocks

Kumar (2009) considers stocks that are concurrently below (above) the 50th stock price percentile, above (below) the 50th idiosyncratic volatility percentile, and above (below) the 50th idiosyncratic skewness percentile based on independent sorts as likely to be perceived by investors as lottery-type (nonlottery-type) stocks. He classifies the remaining stocks as "others". To examine whether our bankrupt firm stocks resemble lottery-type stocks we compare them along key dimensions with the CRSP stock population, and matched control firms.

In particular, we derive market price, idiosyncratic volatility, and idiosyncratic skewness measures for all stocks in the CRSP database for each month from 1980 to 2006.[14] Market price is the price per share at the end of the previous month. Idiosyncratic volatility is computed as the standard deviation of the residual obtained from the Fama and French 4-factor model (Carhart,

[13] Hubbard and Stephenson (1997) show that pre-existing shareholders are rarely left with nothing when the firm emerges from bankruptcy. Additionally, Eberhart et al. (1999) report large, positive excess stock returns in the 200-day post-emergence period.

[14] Different methods of computing idiosyncratic volatility and skewness are used in the literature. Kumar (2009), and Han and Kumar (2013) follow Harvey and Siddique (2000), and Kumar et al. (2011) follow Boyer, Mitton, and Vorkink (2009). We apply both approaches, and find our results are insensitive to method. The analysis reported here follows Kumar (2009).

1997) estimated using the previous 6 months of daily returns data.[15] Idiosyncratic skewness is the skewness of the residual obtained by fitting a two-factor model to the previous 6 months of daily returns data as in Harvey and Siddique (2000). We repeat this process for computing the same three lottery-stock characteristic measures for our sample of bankrupt firms for the 24-month period centered on the bankruptcy announcement date. We do the same calculations for our matched sample of control firms.

Panel A of Table 3 summarizes the results for all CRSP stocks. Mean (median) stock price is $21.6 ($11.8), and mean (median) idiosyncratic volatility, and skewness, are 3.5% (2.6%), and 0.55 (0.33), respectively. As expected, we find clear differences when we group the CRSP stocks according to their lottery-like profile. Lottery-type stocks have much lower market price than their nonlottery stock counterparts (mean = $4.2 vs. $38.9; median = $3.3 vs. $24.0), much higher idiosyncratic volatility (mean = 5.9% vs. 1.6%; median = $4.9 vs. $1.6), and very different levels of idiosyncratic skewness (mean = 1.32 vs. −0.19; median = 0.98 vs. −0.01).

Next, to examine whether our bankrupt firm stocks resemble lottery-type stocks, and increasingly take on their essential features as Chapter 11 approaches, and post-bankruptcy, we describe what happens to their lottery-stock characteristics across four different 6-month event periods centered on the bankruptcy filing date: (−12, −7), (−6, −1), (1,6), and (7,12).[16]

Panel B of Table 3 shows our bankrupt firm stocks do not resemble the typical CRSP lottery-type stock in the penultimate 6-month period before bankruptcy (i.e., months −12 to −7). Average stock price is higher ($6.1 vs. $4.2) (median = $3.8 vs. $3.3), and mean idiosyncratic volatility, and particularly mean idiosyncratic skewness, are lower (5.4% vs. 5.9%, and 0.49 vs. 1.32, respectively) (medians = 4.3% vs. 4.9%, and 0.43 vs. 0.98).

[15] Stocks are required to have at least 10 daily returns available on CRSP each month to be retained in our calculations.

[16] We ignore the five trading days centered on the bankruptcy announcement date (i.e., (-2, 2), where t=0 is the bankruptcy filing date), because of the distorting effect on our statistics of the collapse in price associated with the Chapter 11 filing.

However, in the 6-month period immediately prior to the bankruptcy event (i.e., months −6 to −1), bankrupt firm stock prices are now essentially the same as those of CRSP lottery-type stocks, as is idiosyncratic volatility. Nonetheless, bankrupt firm idiosyncratic skewness is still below that of CRSP lottery-type stocks (mean = 0.47 vs. 1.32; median = 0.40 vs. 0.98) in this second event window.

Kumar (2009) argues that gambling-motivated investors should gravitate towards stocks with high stock-specific skewness as such stocks are likely to occasionally generate extreme positive returns. This is, however, something unlikely to be experienced with soon-to-be-bankrupt firms. Indeed, prior to filing for bankruptcy, such firms are usually battered by a number of negative firm-specific events, which depress their market price.[17] Nonetheless, on average, our sample firms still enjoy *positive* idiosyncratic skewness in the 12 months that precede their bankruptcy announcement date.

This evidence is consistent with investors treating such stocks as a lottery, and simply assigning a lower probability to an extreme positive return occurring prior to the announcement of Chapter 11 than they would with a typical CRSP lottery-like stock. This is perfectly reasonable. After all, our sample firms will shortly be filing for bankruptcy.

Panel C of Table 3 shows what happens after Chapter 11 filing. As can be seen, on average, our sample of bankrupt firms are always *much cheaper* (e.g., mean price = $2.2 vs. $4.2 in event-period (7, 12)), and *more volatile* than CRSP lottery-like stocks (e.g., mean idiosyncratic volatility = 9.4% vs. 5.9% in the same period). In addition, the average idiosyncratic skewness of bankrupt firms increases very significantly once Chapter 11 is declared. In particular, this reaches 1.07 in event-period (7, 12), which is quite similar to 1.32 for the full set of CRSP stocks classified as lottery-type (median = 0.79 vs. 0.98). Based on this

[17] Our sample firms lose, on average, around 50% of their market value over the 6-month period preceding their Chapter 11 filing.

analysis we conclude that our sample firms increasingly exhibit the key characteristics of lottery-like stocks, especially after filing for Chapter 11.

Beyond this evidence, we also need to demonstrate that it is because our stocks are bankrupt that they possess lottery-like characteristics, and that this does not apply equally to other firms with similar risk-return profile. To this end, we compare the lottery-like characteristics of our bankrupt firms to those of our size and book-to-market matched control firms over the same four 6-month event periods as above.

Panels B and C of Table 3 show that the average stock price (idiosyncratic volatility) of bankrupt firms is significantly lower (higher) vis-à-vis that of our control firms, irrespective of the event period considered. Moreover, our control firms are always more expensive per share, and less volatile, than the typical CRSP lottery-like stock. Taken together, these results start to indicate that our bankrupt firms are more likely to be perceived by investors as lottery stocks than their benchmark counterparts.

Panel C of Table 3 also shows that although before the formal announcement of bankruptcy the average idiosyncratic skewness of control firms is significantly higher than that for our bankrupt firms, in the second post-bankruptcy period (7, 12) this pattern is completely reversed. Here, mean (median) bankrupt firm idiosyncratic skewness of 1.07 (0.79) compares with only 0.69 (0.52) for benchmark firms.

In short, in all event periods we consider, firms benchmarked on size and book-to-market generally lack any of the characteristics of lottery-type stocks. In addition, these stocks are always considerably more expensive, and less volatile, than those of bankrupt firms, and with significantly less skewed returns than such stocks post-bankruptcy. These results are consistent with such extreme stock characteristics reflecting the specific nature of bankrupt firms, and not simply their risk-return profile. We thus conclude that it is the bankruptcy profile of our sample firms that gives them the features of lottery-like stocks.

B. Bankrupt firms as lottery-type stocks: further analysis

We perform further tests to confirm the results of the previous sub-section that bankrupt firms possess the characteristics of lottery-type stocks. Specifically, we compare the percentage of bankrupt firms with and without lottery-like characteristics with the equivalent proportions of such stocks in: (i) the CRSP population, and (ii) our matched control-firm sample. If we find that a much greater proportion of our sample of bankrupt firms have lottery-like (much smaller proportion have nonlottery-like) characteristics than in the CRSP population, and compared with their matched control firms, then we would have further evidence that it is the nature of bankrupt firms, per se, that makes them perceived as lottery-like stocks.

In particular, as in Section III.A above, for each month between 1980 and 2006, we allocate each CRSP stock to one of our three stock categories: lottery-type, nonlottery-like, and other. Next, we repeat the same classification process for our bankrupt firm stocks for the 24-month period centered on the Chapter 11 filing date. Finally, we do the same for our size and book-to-market matched control firms for the same period.

Table 4 summarizes our results across the same four 6-month event periods as in Section III.A. The first column of Panel A of Table 4 provides the average monthly CRSP population proportions of lottery-like, nonlottery-like, and other stocks between 1980 and 2006.[18] As can be seen, 23.0% of CRSP firms are lottery-type stocks, jointly characterized by below median price, and above median levels of idiosyncratic volatility, and idiosyncratic skewness; 22.2 % of those firms are nonlottery-like with the opposite set of characteristics, and the remaining 54.8% are classified as other.

Panel A also shows the relative proportions of bankrupt firms with lottery and nonlottery-type characteristics before the Chapter 11 filing date. In the first pre-bankruptcy period (−12, −7) 43.5% of our bankrupt firms are classified as lottery-type stocks, and 4.9% as nonlottery-like

[18] The relevant percentages are derived each month, and then averaged across the whole 27 year period.

stocks, which differ from the respective CRSP population-based figures of 23.0% and 22.2% ($p < 0.01$). Results are very similar for the following 6-month period (−6, −1) leading up to the Chapter 11 filing date.

Much more interesting is what happens post-Chapter 11. Indeed, in the first post-bankruptcy period (1, 6), 60.4% of bankrupt firm stocks now resemble lottery-type stocks, and less than 1% have nonlottery-like characteristics. This is even more pronounced in the second 6-month period post-bankruptcy (7, 12), where 71.5% of bankrupt firms represent lotteries, and *no* firms are allocated to the nonlottery-type category. Again, in all cases, the test of sample proportions vis-à-vis the CRSP population is significant at least at the 1% level.

Similar to Section III.A, we also test whether it is the particular nature of bankrupt firms that make them to be perceived as lotteries. To this end, we compare the relative percentages of lottery-type and nonlottery-like stocks among bankrupt firms with our control firm proportions in Table 4. Panel A shows that, pre-Chapter 11, the proportion of lottery-like bankrupt firms is significantly higher than for their benchmark firms in both 6-month periods, and their nonlottery-like stock proportions far lower.

Nonetheless, once again, it is the results for the 12 months post-Chapter 11 that are of principal interest. Panel B of Table 4 shows that in the first 6-month period post-bankruptcy filing (1, 6), the proportion of lottery-type stocks among bankrupt firms is much greater than that for the sample of control firms (60.4% vs. 42.4%, $p < 0.01$), and in the second post-event period (7, 12) the proportion is even higher (71.5% vs. 44.9 %, $p < 0.01$). However, just as interesting is that there are now virtually no nonlottery bankrupt firm stocks compared with 7.3% of cases in both periods for our control firm sample. On the basis of these findings, we conclude again that it is the bankruptcy status of our sample of firms that turns them into lottery-type stocks rather than their risk characteristics, which, to a large extent, are common to their control firm counterparts.

Overall, our empirical evidence is consistent with the conjecture that investors trade bankrupt firms due to their lottery features. In particular, we first show that, post-Chapter 11 filing, bankrupt firms are cheaper, and more volatile than the average CRSP lottery-type stock, and they offer comparable levels of idiosyncratic skewness. Importantly, this finding is specific to our bankrupt firms since control firms sharing a similar risk-return profile as measured by size and book-to-market ratio generally lack the same extreme stock characteristics.

Further analysis shows that the relative proportions of lottery-like and nonlottery-like bankrupt firms in our sample are respectively far higher, and significantly lower, than in the CRSP population as a whole, and also in the case of their benchmark counterparts. Together, our results suggest that bankrupt firms have the characteristics of lottery-type stocks which, we conjecture, could explain why such securities are so heavily traded even after formally entering into Chapter 11 bankruptcy proceedings.

IV. Who trades the stock of bankrupt firms?

In this section, we investigate who, in the typical case, trades the stock of bankrupt firms. We know that stocks exhibiting lottery-like features are particularly attractive to a type of retail investor who uses them to gamble in the market, and the more lottery-like stocks are, the greater their retail investor clientele (Kumar, 2009; Han and Kumar, 2013). Motivated by this evidence, we conjecture that bankrupt firms are more likely to appeal to retail investors who trade in them as if they are playing lotteries. Such trading could at least partially explain the very high trading volume statistics we report in Panel B of Table 2. Here, we explore this conjecture in three different ways.

A. Initial evidence

Our first test analyzes the trading behavior of retail (i.e., unsophisticated) (SMALL) and institutional (i.e., sophisticated) (LARGE) investors in our sample of bankrupt firms using the following measures:

$$SMALL_{i,t} = STRI_{i,t} \Big/ TOTAL_{i,t} \quad (1)$$

and,

$$LARGE_{i,t} = STSI_{i,t} \Big/ TOTAL_{i,t} \quad (2)$$

where $STRI_{i,t}$ ($STSI_{i,t}$) is the number of trades of retail (institutional) investors in firm i during event month t, and $TOTAL_{i,t}$ is the total number of trades in firm i during event month t. Event months are defined as 21 trading-day periods counted from the bankruptcy announcement date, and we compute our two measures for a total of 24 event-month periods centered on this date.

We use trading data collected from the Trade and Quotes (TAQ) database for the period from 1993 to 2000. This is because (i) the TAQ database first becomes available in 199,3 and (ii) in 2001 the widespread introduction of decimalization and order-splitting by institutions (due to lower trading costs) profoundly affected the distribution of trade size (e.g., Hvidkjaer, 2008; Han and Kumar, 2013). This policy had a significant negative impact on the accuracy of existing methods for distinguishing between informed and noninformed trades, a key issue in our analysis.

Drawing on the evidence in Lee and Radhakrishna (2000), and Barber, Odean and Zhu (2009), we use trade size to distinguish between trades initiated by sophisticated investors (proxying for institutional trades), and trades initiated by unsophisticated retail investors. In particular, trades less than $5,000 are used to proxy for retail investor trades, while trades greater than $50,000 are used as a proxy for institutional trades.[19] Consequently, our test ignores medium-size trades, which helps increase the statistical power of our tests (Lee and Radhakrishna, 2000). Moreover, as Chakravarty (2001) shows, sophisticated investors may use medium-size trades to avoid revealing their private information. Thus, considering medium-size

[19] Results are very similar when we classify transactions of 500 shares or less as small trades, and transactions of 3,000 shares or more as large trades.

trades in our analysis would reduce our ability to successfully separate trades initiated by retail investors from those initiated by sophisticated investors.

Table 5 summarizes the results. Panel A shows that in event month −12, retail (institutional) investors are responsible for around 61% (7%) of all the trades in the stock of bankrupt firms. Put differently, 12 months before the Chapter 11 filing date, the volume of retail investor trades in these stocks is about 9 times that of institutional investors. Panel A further shows that the relative weight of retail investors' trades in subsequently bankrupt firm stock increases almost monotonically as the Chapter 11 date approaches. In fact, by event month −1, such investors' trades account for no less than 86% of all the trades in such stocks.

A very different picture is manifest when we consider the trades of institutional investors. From event month −8 onwards, the percentage of trades accounted for by these investors decreases monotonically as the bankruptcy date approaches. In fact, by the event month directly preceding Chapter 11 filing institutional investors are responsible for only 1.9% of the total number of trades in the stock of the soon-to-be-bankrupt firms. In other words, immediately prior to the Chapter 11 filing, retail investors trade the stock of our subsequently bankrupt firms no less than 44 times more than institutional investors.

Interestingly, Panel B of Table 5 shows that the Chapter 11 announcement event even further increases the relative propensity of retail investors to trade bankrupt firms. In the first post-event month, retail investors are responsible for 89% of all the trades in such firms, trading almost 58 times more than institutional investors in these stocks, with a similar picture in subsequent months. In fact, only after event month 4 does the relative weight of retail investors' trades drop below 80%, and even then such trades still account for around 70%-80% of all trades in bankrupt firms with data available on TAQ, until event month 12.

Panel B also shows that institutional investors continue to be reluctant traders in bankrupt firms post-event. In the first three months after the formal announcement of Chapter 11, the

number of trades by such investors represents less than 2% of all the trades in the stock of our sample firms, and this percentage does not increase much over the following 9 months. These figures compare with the monthly average of 5% of all trades in the stocks of these firms accounted for by institutional investors in the pre-event period. We conclude that, in contrast to institutional investors, retail investors like trading the stock of bankrupt firms.[20]

B. Lottery-like characteristics of bankrupt firms and retail trading

We have established that retail investors are the main traders in our sample of bankrupt firms, both in the pre- and post-event periods. However, we have not explicitly linked such trading behavior to the lottery-like nature of bankrupt firm stock. In this sub-section, we estimate the following regression to examine this issue:

$$RTP_{i,t} = \alpha_0 + \lambda_1 Lot\_index_{i,t} + \sum_{j=1}^{9} \beta_j Z_{i,t} + \varepsilon_{i,t} \qquad (3)$$

where $RTP_{i,t}$ is the level of retail trading in firm *i* in month *t*, $Lot\_index_{i,t}$ is the value of the lottery index for firm *i* in month *t*, $Z_{i,t}$ represents 9 firm-specific control variables, and $\varepsilon_{i,t}$ is the error term.[21] To capture the dynamics of the determinants of retail trading in our bankrupt firms, equation (3) is estimated separately for event months −12, −6, −1, 1, 6, and 12.

The dependent variable in equation (3), $RTP_{i,t}$, is defined as in Han and Kumar (2013) as the ratio of total dollar volume of buy-and sell-initiated small trades (trade size below $5,000) in

[20] As a robustness test, we compute institutional holdings in our sample of bankrupt firms using data from the Thomson Financial Network CDA/Spectrum 13F Institutional Holdings File. In unreported results, we find that one year before Chapter 11 filing, institutional investors own, on average, 21% of the stock of our sample firms (median holdings are 16%). After Chapter 11 filing, such investors own, on average, only 12% of these firms' shares, a pattern that remains effectively unchanged over the following three post-event quarters (institutions' median holdings are 8% in the first post-Chapter 11 quarter, decreasing to 6% three quarters later).

[21] We also use year dummies and five industry dummies when estimating equation (3) to overcome potential problems of omitted variables. Industry dummies are defined according to Professor Kenneth French's five industry portfolios. See http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/det_5_ind_port.html for more details.

firm *i* in month *t*, to total stock dollar trading volume in the same month.[22] Han and Kumar show that this measure captures the preferences, and trading behavior, of retail investors reasonably well. As such, we use the measure to determine whether retail investors' preferences for bankrupt firms depend on their lottery-like profile.

Lottery index (*Lot_index*) is our main independent variable, proxying for the lottery-like status of our bankrupt firms. We compute its value for each sample firm in each event month by summing its stock price, idiosyncratic skewness, and idiosyncratic volatility vigintile assignments, and then dividing the total by 60 (i.e. the higher the value of the lottery index the more the bankrupt firm is likely to be perceived by the market as a lottery stock). Accordingly, λ_1 should be *positive*, and statistically significant, if indeed retail investors are more likely to trade bankrupt firms that display lottery-like features.

Our control variables are as follows: (i) market beta (*beta*), estimated using 6 months of daily returns, (ii) systematic skewness (*sys_skew*), obtained by fitting a 2-factor model to the previous 6 months of daily returns data as in Harvey and Siddique (2000) to estimate idiosyncratic skewness, (iii) firm size (*size*), measured as the log of market capitalization at the end of the previous month, (iv) a Nasdaq dummy (*Nasdaq_d*), =1 if the firm trades on Nasdaq in the previous month, 0 otherwise, (v) momentum (*mom*), computed over the previous 12 months, (vi) a dividend dummy (*div_d*), =1 if the firm pays a cash dividend in the previous calendar year, 0 otherwise, (vii) trading volume (*tvol*), measured as trading volume over the previous month divided by shares outstanding, (viii) firm age (*age*), the number of years since its first stock return appears in the CRSP monthly file, and (ix) book-to-market ratio (*bm*), computed as book value of equity at the end of the previous fiscal year divided by market capitalization at the previous fiscal year-end.

[22] Data is again from TAQ for the period from 1993 to 2000.

Table 6 summarizes the RTP regression results. While estimating equation (3), we conduct a Reset test to identify potential problems associated with incorrectly omitted variables, and/or incorrect functional form, together with Breush-Pagan, and White tests to account for heteroskedasticity. None of these test estimates is significant at the 10% level, which indicates that problems associated with omitted variables, functional form, or heteroskedasticity do not exist. Thus, we are justified in using ordinary least squares (OLS) and employing standard *t*-tests to examine the statistical significance of the estimated parameters. The regression estimates show that all lottery index coefficients are positive and significant at normal levels. This evidence suggests that, *ceteris paribus*, in line with our initial expectation, the more pronounced the lottery-like characteristics of our bankrupt firms are, the more attractive such stocks are to retail investors as measured by their greater propensity to trade in these stocks.

C. Trading analysis using brokerage data

In this sub-section, we provide more direct tests of the predisposition of retail investors to trade bankrupt firms using data collected from a major U.S. discount brokerage house. This data set contains all the trades of a set of individual investors made via this brokerage firm during the 1991 to 1996 period.[23] Its main advantage over the TAQ database we employ in the previous sub-sections is that there is no need to draw inferences about the nature of particular traders based on trade size as all of them are retail investors.[24]

Our first test directly explores the extent to which retail investors buy bankrupt firm stocks. To do this, we broadly follow Kumar (2009), and estimate the following regression:

$$BuySell_{i,t} = \alpha_0 + \lambda_1 Lot\_index_{i,t} + \lambda_2 Bank_{i,t} + \lambda_3 Lot\_index_{i,t} * Bank_{i,t} + \sum_{j=1}^{10} \beta_j Z_{i,t} + \varepsilon_{i,t} \quad (4)$$

[23] See Barber and Odean (2000; 2001) for additional details about the brokerage data.
[24] Despite the database covering trades made only over a six year period, nonetheless 135 of our bankrupt firms (38.4% of the total sample) lie within the 1991 to 1996 window.

where $Lot\_index_{i,t}$ is the value of the lottery index for firm *i* in month *t*, $Bank_{i,t}$ is a dummy variable = 1 if the Chapter 11 filing date for firm *i* lies within 24 months of month *t*, $Lot\_index_{i,t} * Bank_{i,t}$ is an interaction variable, $Z_{i,t}$ is a set of 10 control variables, and $\varepsilon_{i,t}$ is the error term.

The dependent variable in equation (4) is defined as in Hvidkjaer (2008), and is the net amount of shares of firm *i* bought by retail investors in month *t*. Specifically, $BuySell_{i,t}$ is the difference in aggregate buy-initiated trading volume, and aggregate sell-initiated trading volume divided by the number of shares outstanding at the end of month *t*. As such, $BuySell_{i,t}$ becomes more positive as the buying pressure on the stock increases.

The two main independent variables in equation (4) are the lottery index, and the bankruptcy dummy. As before, we compute *Lot_index* so that higher values indicate the firm is more likely to be perceived by the market as a lottery stock. We use the bankruptcy dummy to separate out the firms in the data set that belong to our sample from all others.

The set of control variables is the same as in equation (3) except that dividend yield (*yield*), i.e., total cash dividend paid per share in the previous month divided by the price per share at the month end, is substituted for a dividend dummy (*div_d*), and there is an additional control variable, price (*prc*), which is defined as stock price per share at the end of the previous month.

Table 7 presents the results of running equation (4) estimated using fixed-effects.[25] Model I is the base case containing only our two main independent variables, and their interaction. The coefficient associated with the lottery index is 0.327 ($p < 0.01$), suggesting that, *ceteris paribus*, retail investors like to buy stocks exhibiting lottery-like characteristics. In addition, the estimated coefficient for the bankruptcy dummy is 0.321 ($p = 0.060$), which shows that retail investors are

[25] Pooled OLS is invalid in our context, and the Hausman test for fixed vs. random effects yields a *p*-value of less than 1%. Using a Fama-MacBeth cross-sectional regression method leads to essentially the same results, which are available from the first author.

relatively more prone to be net buyers of firms when such companies are about to, or have formally, filed for Chapter 11 bankruptcy protection.

Further insight can be gained by considering the coefficient on the interaction variable, $Lot\_index_{i,t} * Bank_{i,t}$, which is positive and statistically significant at normal levels. This evidence suggests that retail investors exert more buying pressure when our sample of bankrupt firms display obvious speculative features, as captured by the lottery index. Model II in Table 7 is essentially the same but now includes our full set of control variables. As can be seen, however, our main conclusions are unaffected as the coefficients on our key independent variables are remarkably similar to our baseline estimates reported for model I.

Our second test using the brokerage data is motivated by the evidence in Kumar (2009), who finds that younger, relatively poorer, non-professional, male, and single retail investors from particular religious and racial backgrounds have a greater propensity to trade stocks with clear speculative features. To investigate whether retail investors trading bankrupt firms exhibit similar characteristics, we draw on the same retail investor discount brokerage house data set together with additional demographic and county-based socio-economic measures. Specifically, for each stock in the database, we derive the average profile of its retail investor clientele. Using these investor characteristics, we then estimate a logistic regression model in which the dependent variable = 1 if one or more of the retail investors in the database trade the bankrupt stock in the one-year period centered on its Chapter 11 filing date, and 0 otherwise.

Independent variables in this regression specification are the average retail investor clientele characteristics of the stock. These include age (*Age*), annual household income (*Income*), proportion professional or managerial (*Professional*), percentage male (*Male*), proportion married (*Married*), and portfolio concentration (Herfindahl index of portfolio weights) (*Concentration*). Our county-based measures are education level (percentage of county residents above age 25 that has completed a bachelor's degree or higher) (*Edu*), non-white

percentage (*Minority*), percentage foreign born (*Foreign*), proportion urban (located within 100 miles of the top 25 U.S. metropolitan regions) (*Urban*), average state-level lottery sales (*Lottery_sales*), and ratio of Catholics to Protestants (*CPratio*).

Regression results are presented in Table 8. We first report estimates from a specification that includes only those individual investor characteristics reported in the brokerage database. In our second logistic regression, we consider additional attributes associated with investor location. Our first regression estimates show that bankrupt firm stocks have a younger ($p = 0.06$), poorer ($p < 0.01$) clientele. These firms also have a greater proportion of single ($p = 0.07$), and male ($p = 0.03$) investors. In addition, retail investors in bankrupt stocks tend to hold less diversified, and thus more risky, portfolios ($p = 0.00$).

The results from our second model are very similar but reveal that our bankrupt firms are also more likely to be traded by less educated ($p = 0.02$) investors, who live in counties with higher non-White percentage of inhabitants ($p = 0.06$), and reside in areas with greater per-capita lottery expenditures ($p = 0.09$). Also, consistent with the evidence in prior research (e.g., Kumar et al., 2011) investors in those counties with a higher ratio of Catholics to Protestants are more likely to trade bankrupt firms ($p = 0.03$).

Collectively, the results using the brokerage data provide further support to our main conjecture. We demonstrate that retail investors are the main traders of bankrupt firms, both in the pre- and post-Chapter 11 filing periods. Further, our evidence shows that such investors display a higher propensity to trade bankrupt firms that exhibit lottery-like characteristics. Finally, we demonstrate that bankrupt firms have a particular retail investor clientele who use them for speculative purposes, and such investors have the same socio-economic and demographic characteristics as those who find lottery-type stocks appealing more generally.

V. Retail trading, gambling, and post-bankruptcy stock prices

This section investigates the pricing implications of the propensity of retail investors to use the stock of bankrupt firms to gamble in the market. We expect the market to underreact to the announcement of Chapter 11 filing. In fact, uncovering the fundamental value of bankrupt firms is, in its own right, a difficult task.

For instance, Gilson, Hotchkiss and Rubak (2000) show that usual valuation methods yield estimates of firm value after emergence from Chapter 11 that are too widely dispersed around the mean, and claim that such valuation errors are due to the lack of reliable information about such firms. Gilson (1995) further notes that lack of information is a common issue when dealing with distressed securities, which our bankrupt firms constitute. Indeed, our stocks are poorly followed by analysts with half (48%) not covered by a single analyst in the 6-month period preceding the bankruptcy filing date.

Further, a search in Factiva highlights that almost one in four (24%) of our bankrupt firms are not mentioned in the media more than 10 times over the same period despite their highly newsworthy status. Institutional investors are largely absent from the market for bankrupt firm equity (after the Chapter 11 filing date, such investors only own, on average, 11.6% of our sample firms' stock). Arguably, such investors possess superior knowledge, and information processing abilities, which places them in a more privileged position when it comes to evaluating the fundamentals of such bankrupt firms, and their future prospects. Thus, we might expect their only marginal engagement in this market will significantly reduce its informational efficiency.

Limits to arbitrage are also likely to be binding in the case of our sample firms. As pointed out by Barberis and Thaler (2005), there are many reasons why arbitrageurs may refrain from correcting a market-pricing anomaly. One of them is the difficulty in shorting stocks, with D'Avolio (2002) reporting that a third of stocks with prices below $5 present in the CRSP database are hard to short. In fact, our sample of firms fall within this category as the average (median) price is $2.98 ($0.71) after bankruptcy filing (see Table 2).

Given all the above, if our gambling story holds, when limits to arbitrage are likely to apply, then the buying pressure exerted by a considerable number of retail investors trading bankrupt firms should push prices to levels above what one would expect in an informationally efficient market. We run three different tests to explore this proposition empirically.

A. Initial evidence

We compute buy-and-hold abnormal returns (BHARs) as in Barber and Lyon (1997) to begin investigating the market pricing implications of the propensity of retail investors to use bankrupt firms to gamble in the market. Buy-and-hold abnormal returns are computed as follows:

$$BHAR_i(\tau_1,\tau_2) = \prod_{t=\tau_1}^{\tau_2}\left(1+r_{i,t}\right) - \prod_{t=\tau_1}^{\tau_2}\left[1+E\left(r_{i,t}\right)\right] \tag{5}$$

where $BHAR_i(\tau_1,\tau_2)$ is the buy-and-hold abnormal return for firm i from time τ_1 to τ_2, $r_{i,t}$ is the raw return for firm i at time t, and $E\left(r_{i,t}\right)$ is the expected return for firm i at time t. Daily returns are employed in the calculation of abnormal returns, and months are represented by 21-trading day intervals (e.g., Michaely et al., 1995).[26] The bankruptcy announcement date is denoted by t = 0, and event day $t=+1$ is included in the bankruptcy announcement window, together with day $t=-1$, as firms can file their bankruptcy petition after the market closes (Dawkins et al., 2007).

We restrict our analysis to the one year post-filing period as filing for bankruptcy often leads to firm delisting within the following 12 months. Extending the period for computing abnormal returns is consequently problematic due to the loss of many sample cases (Morse and Shaw, 1988).[27] Drawing on Shumway (1997), and Shumway and Warther (1999), we include the

[26] In untabulated results we re-run our analysis using CRSP monthly returns. Results are consistent with those reported below.

[27] Our typical sample firm spends an average (median) of 24.4 (18.1) months in bankruptcy, consistent with Eberhart et al. (1999), and Denis and Rodgers (2007).

delisting return in the calculation of abnormal returns and, as with Kausar et al. (2009), we assume that in the post-delisting period sample firms earn a zero abnormal return.[28, 29]

Following Barber and Lyon (1997), we use a single control firm approach to control for risk. Sample firms are matched on size and book-to-market as in previous studies dealing with severely distressed firms (Dichev and Piotroski, 2001; Taffler et al., 2004; Kausar et al., 2009).[30] For illustrative purposes, and to allow comparisons with prior research on the market's reaction to bankruptcy announcements, we also report parallel market-adjusted return results using the equally weighted CRSP index including dividends as an alternative proxy for expected returns.

We employ a conventional *t*-test to infer the statistical significance of the mean BHARs (Barber and Lyon, 1997) using the cross-section of the buy-and-hold abnormal returns to estimate their variance. Drawing on Kraft, Leone and Wasley (2006), we report mean BHARs that are winsorized at the 1% and 99% levels to reduce the impact of extreme outliers in our analysis.[31] We also present median returns to check the validity of our parametric results. A Wilcoxon signed rank-test is used to infer the statistical significance of such abnormal returns (Dawkins et al., 2007).[32]

Table 9 summarizes our results. Not surprisingly, we find that the market anticipates the formal announcement of bankruptcy, a phenomenon already documented in the literature (e.g., Clark and Weinstein, 1983; Datta and Iskandar-Datta, 1995; Dawkins et al., 2007). In fact, Panel A of Table 9 shows that the mean (median) one-year pre-event size and book-to-market-adjusted abnormal return is −49% (−43%). All values are statistically significant ($p<0.01$). In addition,

[28] Reinvesting the proceeds from the delisting payment in a portfolio of stocks comprising the same size decile as the delisted firm, or in the CRSP value-weighted index, for the remainder of the compounding period, however, does not alter our results in any meaningful way.

[29] If a control firm is delisted before the ending date for its corresponding bankrupt firm period, a second firm is spliced in after its delisting date, that with second closest size and book-to-market to that of the delisted firm in the original ranking. Finally, if a chosen control firm itself subsequently files for bankruptcy, we treat it as if it is delisted on its bankruptcy date (Spiess and Affleck-Graves, 1995).

[30] See sub-section II.A for details on our matching procedure.

[31] For robustness, we also conduct unwinsorized tests and compute bootstrapped t-tests as suggested by Lyon, Barber and Tsai (1999). Results are essentially identical.

[32] We obtain the same results when we employ the nonparametric sign test.

Panel B of Table 9 shows a strong, negative reaction to the bankruptcy event, a result also in line with previous research on this topic (e.g., Datta and Iskandar-Datta, 1995; Dawkins et al., 2007). Regardless of the benchmark, mean (median) abnormal return measured for the (−1, 1) window is around −26% (−27%), and highly significant ($p < 0.01$).

The key results in Panel C of Table 9, however, point to a strongly negative and statistically significant post-bankruptcy drift. Of special interest in this context is the (+2, +84) compounding window, which represents roughly a four-month post-event period. The Bankruptcy Reform Act of 1978 granted the incumbent management of firms filing for Chapter 11 an exclusivity period of 120 days to develop a reorganization plan. Accordingly, this is the period where information asymmetry between the management and the market is most acute.

Panel C of Table 9 shows that for this particularly important period mean (median) size and book-to-market BHAR is −13% ($p < 0.01$) (−15%; $p < 0.01$). The 6-month post-event period represented by the (+2, +126) compounding window provides further evidence in favor of the incomplete market reaction to bankruptcy announcement argument, with mean (median) size and book-to-market BHAR = −16% ($p < 0.01$) (−16%, $p < 0.01$).

Importantly, our conclusions do not change even when we consider a one-year post-event period with mean (median) size and book-to-market BHAR for the (+2, +252) period = −28% (−27%), both significant at $p < 0.01$. Interestingly, this post-event drift is of identical magnitude to the loss in firm-value associated with the Chapter 11 filing itself, as shown in Panel B.[33]

B. Gambling by retail investors and post-bankruptcy stock prices

The evidence in the previous sub-section shows that the market is not able fully and quickly to impound the adverse information conveyed by the Chapter 11 filing into the stock

[33] Caution is needed when interpreting our findings as there is still much debate surrounding the appropriate measurement of longer-term abnormal returns (e.g., Lyon et al., 1999). In unreported results, we run our event study controlling for other known risk factors (e.g., earnings surprises, and momentum), and employ the calendar-time portfolio approach introduced by Jaffe (1974), and Mandelker (1974) as suggested by Fama (1998), and Mitchell and Stafford (2000). Results are similar to those presented here, and are available upon request from the first author.

prices of bankrupt firms that continue to remain listed on the main exchanges. In this sub-section, we explicitly test whether it is the lottery-like characteristics of bankrupt firms that make them attractive to retail investors, which slows down the market reaction to this bad news event. We investigate this issue by estimating the following regression:

$$BHAR_i = \alpha_0 + \lambda_1 Lot_i + \delta_1 RTP_i + \gamma_1 Lot_i * RTP_i + \sum_{j=1}^{6} \beta_j Y_i + \varepsilon_i \qquad (6)$$

where $BHAR_i$ is the abnormal return of firm *i* over a given compounding period τ.[34] Lot_i is a dummy variable that equals 1 if firm *i* is lottery-like in the month preceding the compounding period of interest, otherwise 0. RTP_i is the ratio of total buy-and sell-initiated small trade (trade size below $5,000) dollar volume to total dollar trading volume for firm *i*, in the same month, while $Lot_i * RTP_i$ is the interaction term between Lot_i and RTP_i. Finally, Y_i represents 6 firm-specific control variables, and ε_i is the error term.[35]

The control variables are: (i) momentum (*mom*), computed over the previous six months, (ii) price (*prc*), the natural logarithm of the price per share at the end of the previous month, (iii) Amihud illiquidity (*illiq*), computed as in Amihud (2002), over the previous six months, (iv) institutional ownership (*inst*), the percentage of stock owned by institutional investors at the end of the previous reporting quarter, (v) firm size (*size*), measured as log of total assets at the previous fiscal year-end, and (vi) book-to-market ratio (*bm*), computed as the book value of equity at the end of the previous fiscal year divided by the market capitalization at the previous fiscal year-end.

The results are presented in Table 10. None of our specification tests is significant suggesting that we do not have problems of incorrectly omitted variables, functional form, or

[34] We consider our three main post-bankruptcy event-windows: (+2, +84), (+2, +126), and (+2, +252).
[35] We again use year dummies and five industry dummies when estimating equation (6) to overcome potential problems of omitted variables. Industry dummies are defined according to Professor Kenneth French's five industry portfolios. See http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/det_5_ind_port.html.

heteroskedasticity. Thus, we are justified in using OLS to estimate parameters in equation (6) and employing standard *t*-tests to infer their statistical significance.

The evidence in Table 10 shows that the coefficients associated with Lot_i, and $Lot_i * RTP_i$ are negative and significant at conventional levels in each of the three regressions we consider. Our evidence thus suggests that the market-pricing anomaly we uncover in the previous section is driven both by the speculative characteristics of our bankrupt firm stocks *and* that they are more heavily traded by retail investors.

C. Limits to arbitrage

The empirical evidence collected so far suggests that a particular retail investor clientele who like to gamble in the market are particularly attracted to bankrupt firm stocks which exhibit clear lottery-type characteristics. We have also shown that the buying pressure exerted by these retail investors leads to the market's underreaction to the Chapter 11 filing event, and consequent significant downward drift in prices over the following year. However, this is probably not the entire story as, in theory, it takes only a single arbitrageur for prices to converge to fundamental value (Shleifer, 2000, p. 4). Thus, we also need to explore the existence of limits to arbitrage in this particular market context.

Specifically, in this section we explore the role of arbitrage implementation costs, and their likely implications for the level of arbitrage in this market. As Barberis and Thaler (2005, p. 6) explain, these costs matter because they hinder arbitrageurs' ability to exploit a market mispricing. Additionally, in extreme cases, when it is too costly to learn about the mispricing, or the resources required to exploit it are too expensive, arbitrageurs may simply choose not to act (Merton, 1987).[36]

[36] Kenneth French, in his blog discussion with Eugene Fama, also points out that the amount of capital that the arbitrageur may need to post to be able to short bankrupt stocks could well be prohibitive in practice. In addition, he is exposed to substantial buy-in risk, the risk that the lender may call the shares, which may be very difficult or expensive to replace. See http://www.dimensional.com/famafrench/2010/02/qa-bankrupt-firms-whos-buying-1.html.

To measure implementation costs we adopt a similar approach to Kausar et al. (2009). In our base scenario, the arbitrageur goes short in bankrupt firms and uses the net proceeds to buy shares of firms matched on size and book-to-market. For each pair of bankrupt and control firms we open positions two trading days after the Chapter 11 date. These positions are then closed after a holding period of 252 trading days (i.e., roughly one year). When a given bankrupt firm is delisted during the holding period, open positions on both the bankrupt and associated control firms are prematurely closed at the delisting date. [37]

A crucial issue is how transactions costs are handled. We consider three types of transaction cost: (i) stock borrowing costs, (ii) trading commissions, and (iii) the bid-ask spread.[38] The first affects the arbitrage strategy's profitability because the arbitrageur needs to borrow a bankrupt firm's stock before conducting the required short sale. Following D'Avolio (2002), we assume a shorting cost of 4.3% per annum for bankrupt firms below sample median market capitalization in size, and 1% per annum for all other firms.[39]

Commission costs are also very important because they have to be paid per transaction (both for bankrupt and control firms), thus reducing the financial benefit of engaging in any given trade. We follow Lesmond et al. (2004), and use a 4% commission rate for stocks under $1 per share, and 0.25% for all remaining stocks.

In addition, the bid-ask spread plays a key role in assessing the transactions costs faced by investors, especially when dealing with small, less liquid stocks (Lesmond et al., 2004). This variable's impact is incorporated into the analysis by allowing all trades to be conducted at the

[37] Variations to the base scenario include using control firms matched on alternative bases (i.e., size and momentum, industry and stock-price, size and *z*-score, and industry, size and book-to-market), opening the initial position on different post-event days, considering alternative holding periods, and inferring stock price behavior after the delisting date. Results are very similar to those reported here and are available from the first author.

[38] We ignore other trading cost components such as price impact, immediacy costs, and short-selling costs which will further add to the costs of implementing the arbitrage strategy (Lesmond et al., 2004). For example, in the case of short-sale constraints, D'Avolio (2002) document that 16% of stocks contained in CRSP files are potentially impossible to short (i.e., with, in effect, infinite shorting costs). Usually, such firms are in the bottom NYSE size decile, and/or have stock prices per share under $5, both typical characteristics of bankrupt firm stocks.

[39] Since the estimates of D'Avolio (2002) largely pertain to normal (i.e., not financially-distressed firm) stocks, the figure of 4.3% per annum is likely to significantly underestimate the actual cost of shorting the stocks of our bankrupt firms.

respective bid or ask closing price (for both sample and control firms). Whenever one of these prices is not available, we estimate its value. The missing figure is inferred using the closing price for the relevant trading day, and half of the median bid-ask spread across all cases in the sample with available data. We estimate the bid-ask spread of both sample and control firms in two different ways. Specifically, we use both the quoted spread method of Stoll and Whaley (1983), and Bhardwaj and Brooks (1992), and also the direct effective spread of Lesmond et al. (2004).

Table 11 summarizes our results. Our main finding is that, on average, sophisticated investors engaging in an arbitrage strategy involving bankrupt firm stocks may expect to lose a significant percentage of their investments. Indeed, in the best case scenario, we find a loss of −11.2% for a 12-month holding period, and −18.0% for a 6-month holding period. Median statistics also largely confirm that such arbitrageurs will not be able to make a profit since the majority of such returns are both negative *and* significant, and positive returns do not differ significantly from zero at normal levels. Table 11 also shows that arbitraging bankrupt stocks is very risky, with very high return standard deviations, and inter-quartile ranges.

Thus, it appears that only an "illusory profit opportunity" (Lesmond et al., 2004) exists in the market for bankrupt firm stock. This evidence helps explain why the gambling-motivated behavior of retail investors, who predominate in this market, leads to the price of bankrupt firm stock being at variance with firm fundamental value even in the medium-term, without traditional market forces being able to correct this situation.

D. Summary

Overall, the evidence from pricing tests indicates that the proclivity of retail investors to use the stock of bankrupt firms to gamble in the market affects their in-bankruptcy stock price dynamics. In line with extant research, we find that the bankruptcy announcement leads to a very significant and negative market reaction. Further, we show that investors buying such securities

immediately following the Chapter 11 bankruptcy announcement lose, on average, around −28% of their investment on a risk-adjusted basis over the following year. Our findings are inconsistent with market efficiency, and appear to support the argument that the market is not always able to digest bad news events in an unbiased way on a timely basis.

Additional analysis reveals that post-Chapter 11 abnormal stock price performance is more negative among the subset of our bankrupt firms that have lottery-like characteristics, and that are more heavily traded by retail investors. Our findings are in line with recent theoretical models of investor behavior that explicitly incorporate investor preference for skewness (e.g., Mitton and Vorkink, 2007; Barberis and Huang, 2008), and are qualitatively consistent with, although much stronger than, those reported by Kumar (2009), and Han and Kumar (2013). Specifically, Kumar (2009) reports that investors who allocate at least one-third of their portfolios to lottery-type stocks underperform by over 2.5% per annum, while Han and Kumar (2013) demonstrate that stocks highly traded by retail investors have an associated risk-adjusted premium of −7% per annum.

In the last part of this section, we investigate whether smart investors can earn a profit by engaging in an arbitrage strategy involving bankrupt firm stock. Our test results, however, suggest that this is highly unlikely. Specifically, our very conservative simulations show that arbitrageurs can expect to lose up to −11.2% of their wealth over a 12-month period following the announcement of Chapter 11 bankruptcy. Moreover, such an arbitrage strategy is particularly risky as it yields very high return standard deviations, and inter-quartile ranges.

VI. Summary and Conclusion

This paper examines two main questions: (i) why is the stock of bankrupt firms so actively traded, and (ii) who trades these stocks. Our empirical evidence provides a clear answer to both questions. In particular, we find that bankrupt firms' stocks display striking lottery-like features, i.e., high idiosyncratic skewness, and volatility, and low price. As such, for a small cost,

these stocks offer the opportunity to realize a large profit with low probability, and a small loss with high probability.

We also establish that retail investors are the main traders in the stock of bankrupt firms both in the pre- and post-event periods. More importantly, we show that a particular set of retail investors is very active in trading the stock of bankrupt firms, especially when such securities exhibit clear-cut lottery-like characteristics. These traders are young, relative less educated, poor, single males, who hold poorly diversified portfolios, and who live in counties with higher non-white percentage of inhabitants, and a higher ratio of Catholics to Protestants, and reside in areas with greater per-capita lottery spend. Overall, our results suggest that a certain retail investor clientele buy the stocks of bankrupt firms *as if* they were playing lotteries or, put differently, to "gamble in the market."

When we examine the pricing implications of this gambling-motivated retail trading, we find that, on average, holders of bankrupt firm stocks that remain listed on the main exchanges post-Chapter 11 filing lose around -28% on a risk-adjusted basis over the year following the bankruptcy announcement. More importantly, however, for our story is that the post-Chapter 11 abnormal stock price performance we document is more negative among the subset of our bankrupt firms that have clear lottery-like characteristics, and those that are more heavily traded by retail investors.

Our evidence further shows that smart investors are likely to be absent from this market as any arbitrage strategy involving the stock of bankrupt firms is very costly and risky. Consequently, the preferences of gambling-motivated retail investors, who represent the marginal traders in the stock of bankrupt firms, and thus set market prices, combined with limits to arbitrage, can explain the puzzling post Chapter 11 market-pricing anomaly we document.

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Table 1

Sample definition

This table summarizes the steps undertaken to derive our final sample. We start by identifying the set of firms that filed for bankruptcy between 10/01/1979 and 10/17/2005 from seven data sources. The firms considered in the final sample: 1) have enough data on CRSP and COMPUSTAT, and 2) are domestic firms, trading common stock on a major exchange after filing for Chapter 11 bankruptcy. Financial and utility firms are excluded from the final sample.

	N
Initial non-overlapping bankruptcy cases	3.437
Cases not found or with insufficient data on CRSP	1.411
Cases delisted before or at the bankruptcy filing month	1.556
Cases with insufficient data on COMPUSTAT	58
Non-US incorporated firms	11
Utilities and financials	40
Chapter 7	10
Final sample size	351

Table 2

Summary statistics

This table presents summary statistics relating to our sample of bankrupt firms and a control sample matched on size and book-to-market. For each sample firm, we identify all CRSP firms with a market capitalization between 70% and 130% of its equity market value. The respective control firm is then selected as that firm with book-to-market closest to that of the sample firm. Panel A reports fundamental accounting information. Panel B summarizes market-related variables. Panel C presents other relevant firm characteristics. The p-value column in panels A and B shows the significance of a two-tailed t-test (Wilcoxon-Mann-Whitney test) for difference in means (medians).

Panel A. Accounting variables

	Sample Firms (A)		Size and B/M control firms (B)		Difference (A-B)			
Variable	Mean	Median	Mean	Median	Mean	p-value	Median	p-value
SALES ($m)	596.4	116.9	634.9	129.5	-38.5	0.779	-12.6	0.330
TA ($m)	646.6	89.7	754.6	128.1	-108.0	0.553	-38.4	0.236
ROA	-19%	-6%	-15%	1%	-4%	0.259	-7%	<0.001
Z-Score	1.37	1.31	2.14	2.12	-0.77	0.004	-0.81	0.005
CUR	169%	128%	231%	178%	-62%	<0.001	-50%	<0.001
LEV	45%	40%	36%	33%	9%	<0.001	7%	<0.001

SALES: sales in $m. TA: total assets in $m. ROA: return on assets (net income/total assets). Z-Score: bankruptcy-risk proxy (Altman, 1968). CUR: current ratio (current assets/current liabilities). LEV: leverage proxy (total debt/total assets). All data is taken from the firm's last available 10K prior to its Chapter 11 filing.

Table 2 (cont.): Summary statistics

Panel B. Market-related variables

	Sample Firms (A)		Size and B/M (B)		Difference (A-B)			
Variable	Mean	Median	Mean	Median	Mean	p-value	Median	p-value
Size ($m)	160.0	32.3	159.6	32.2	0.5	0.990	0.04	0.738
Book/Market	4.2	2.3	3.8	2.2	0.4	0.432	0.1	0.543
Pre_Price ($)	4.97	3.12	9.80	5.49	-4.83	<0.001	-2.37	<0.001
Event_Price($)	2.08	0.97	8.67	4.38	-6.59	<0.001	-3.41	<0.001
Post_Price ($)	2.98	0.71	8.84	4.27	-5.86	<0.001	-3.56	<0.001
Pre_Volume	0.51%	0.34%	0.44%	0.25%	0.07%	0.056	0.09%	0.003
Event_Volume	1.15%	0.61%	0.42%	0.23%	0.73%	<0.001	0.38%	<0.001
Post_Volume	0.57%	0.30%	0.43%	0.24%	0.14%	0.189	0.06%	0.028
Pre_Qs	8.27%	6.85%	6.25%	4.30%	2.02%	<0.001	2.55%	<0.001
Post_Qs	12.50%	10.70%	7.18%	4.38%	5.32%	<0.001	6.32%	<0.001
Pre_Direct	5.83%	5.16%	3.79%	2.96%	2.04%	<0.001	2.20%	<0.001
Post_Direct	8.94%	6.61%	3.94%	2.64%	5.00%	<0.001	3.97%	<0.001

Size: market capitalization in $m. Book/Market: book-to-market ratio. Pre_Price: average daily stock price for the 12-month period preceding the bankruptcy filing month (in dollars). Event_Price: same as Pre_Price, but for the 30-calendar day period centered on the bankruptcy announcement date. Post_Price: same as Pre_Price, but for the 12-month period after the bankruptcy announcement month. Pre_Volume: average daily trading volume (volume/shares outstanding) computed for the 12-month period preceding the bankruptcy announcement month. Event_Volume: same as Pre_Volume but for the 30-calendar day period centered on the bankruptcy announcement date. Post_Volume: same as Pre_Volume but for the 12-month period after the bankruptcy announcement month. Pre_Qs: quoted bid-ask spread for the pre-event period, computed as in Stoll and Whaley (1983). Post_Qs: same as Pre_Qs, but for the post-event period. Pre_Direct: direct effective bid-ask spread estimate for the pre-event period, computed as in Lesmond, et al. (2004). Post_Direct: same as Pre_Direct, but for the post-event period. All pre-event (post-event) bid-ask estimates are computed with daily data collected from CRSP using a period that begins one year before (one week after) the bankruptcy date of the event firm and ends two weeks before that date (one year after that date or at the delisting date of the event firm, whichever comes first). The same event date is used for each pair of bankrupt and control firms.

Table 2 (cont.): Summary statistics

Panel C. Other characteristics

	Sample Firms		Size and B/M	
Variable	Positive Cases	% of Sample	Positive Cases	% of Sample
EPS	88	25.1	172	49.0
Divid	91	25.9	134	38.2
GC	88	25.3	7	2.0
Delist	195	55.6	-	-

EPS: earnings per share dummy (1 if positive, 0 otherwise). Divid: dividend paid dummy (1 if dividend paid, 0 otherwise). GC: auditor opinion dummy (1 if going-concern modified audit report – defined as per Kausar et al. (2009), 0 otherwise). Delist: delist dummy (1 if company is delisted within one-calendar year of the bankruptcy date, 0 otherwise). All accounting variables are computed using data taken from the last available10K prior to the Chapter 11 filing.

Table 3

Lottery-like characteristics of CRSP stocks, bankrupt firms, and control firms

This table reports the average monthly characteristics of lottery-type stocks as defined by Kumar (2009). Market price (Price) is the price per share at the end of the previous month. Idiosyncratic volatility (Idio. Vol.) is the standard deviation of the residual obtained from the Fama and French 4-factor model (Carhart, 1997). Idiosyncratic skewness (Idio. Skew.) is a scaled measure of the third moment of the residual obtained as in Harvey and Siddique (2000). At the end of month *t*, each firm's idiosyncratic volatility, and idiosyncratic skewness are estimated using the previous 6 months of daily returns data. Stocks in the lowest (highest) 50th stock price percentile, the highest (lowest) 50th idiosyncratic volatility percentile, and the highest (lowest) 50th idiosyncratic skewness percentile are labeled as lottery-like (nonlottery-like) stocks. All remaining stocks are classified to the "other" category. Panel A provides the lottery-type, nonlottery-like, and other statistics for the population of CRSP stocks in the 1980 to 2006 period. Panels B and C provide related statistics for our bankrupt firms (Bank.), and control firms matched on size and book-to-market (Control) broken down by 6-month event period centered on the Chapter 11 filing date. Control firms are matched as follows. First, for each sample firm, we select all CRSP firms with a market capitalization between 70% and 130% of its equity market value. The control firm is then selected as that firm with book-to-market closest to that of the sample firm.

Panel A. CRSP stocks (1980 to 2006)

	All CRSP		Lottery-type		Nonlottery-like		Other	
Variable	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Price ($)	21.6	11.8	4.2	3.3	38.9	24.0	21.7	11.8
Idio. Vol.	3.5%	2.6%	5.9%	4.9%	1.6%	1.6%	3.0%	2.6%
Idio. Skew.	0.55	0.33	1.32	0.98	-0.19	-0.01	0.42	0.34

Panel B. Bankrupt and control firms: pre-Chapter 11 period

	Event-period in months (-12,-7)				Event-period in months (-6,-1)			
	Bankrupt		Control		Bankrupt		Control	
Variable	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Price ($)	6.1	3.8	10.5	6.1	4.2	2.5	9.3	5.1
p-value*	(<0.01)	(<0.01)	[<0.01]	[<0.01]	(0.71)	(0.41)	[<0.01]	[<0.01]
Idio. Vol.	5.4%	4.3%	4.3%	3.6%	6.4%	5.2%	4.5%	3.8%
p-value*	(0.06)	(0.24)	[<0.01]	[<0.01]	(0.04)	(0.39)	[<0.01]	[<0.01]
Idio. Skew.	0.49	0.43	0.63	0.50	0.47	0.40	0.61	0.48
p-value*	(<0.01)	(<0.01)	[<0.01]	[0.01]	(<0.01)	(<0.01)	[<0.01]	[0.02]

*(t-test (Wilcoxon Mann-Whitney test) for differences in means (medians) for bankrupt firm stocks vs. CRSP lottery-like stocks) [t-test (Wilcoxon Mann-Whitney test) for differences in means (medians) for bankrupt firm stocks vs. control firm stocks].

Table 3 (cont.): Lottery-like characteristics of CRSP stocks, bankrupt firms, and control firms

Panel C. Bankrupt and control firms: post-Chapter 11 period

	Event-period in months (1,6)				Event-period in months (7,12)			
	Bankrupt		Control		Bankrupt		Control	
Variable	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Price ($)	3.1	1.3	8.7	4.3	2.2	0.9	9.0	4.0
p-value*	(<0.01)	(<0.01)	[<0.01]	[<0.01]	(<0.01)	(<0.01)	[<0.01]	[<0.01]
Idio. Vol.	9.3%	7.3%	4.9%	4.1%	9.4%	8.3%	5.2%	4.2%
p-value*	(<0.01)	(<0.01)	[<0.01]	[<0.01]	(<0.01)	(<0.01)	[<0.01]	[<0.01]
Idio. Skew.	0.64	0.57	0.61	0.46	1.07	0.79	0.69	0.52
p-value*	(<0.01)	(<0.01)	[0.77]	[0.05]	(0.08)	(0.07)	[<0.01]	[<0.01]

*(t-test (Wilcoxon Mann-Whitney test) for differences in means (medians) for bankrupt firm stocks vs. CRSP lottery-like stocks) [t-test (Wilcoxon Mann-Whitney test) for differences in means (medians) for bankrupt firm stocks vs. control firm stocks].

Table 4

Bankrupt firms and control firms as lottery-like stocks

This table presents the percentage of bankrupt firms, and matched control firms classified as lottery-type stocks in event-time. Panel A provides analysis for the 12-month period pre-Chapter 11 filing, and Panel B for the 12-month period post-Chapter 11 filing. Control firms are identified as follows. First, for each sample firm, we select all CRSP firms with a market capitalization between 70% and 130% of its equity market value. The control firm is then selected as that firm with book-to-market closest to that of the sample firm. We use Kumar's (2009) classification schema to determine whether a given stock belongs to the lottery-type, nonlottery-like or other category in a given period. Stocks in the lowest (highest) 50th stock price percentile, the highest (lowest) 50th idiosyncratic volatility percentile, and the highest (lowest) 50th idiosyncratic skewness percentile are labeled as lottery-like (nonlottery-like) stocks. Remaining firms are allocated to the "other" category. The CRSP column in both panels reports the average monthly percentage of CRSP stocks classified to each stock category over the 1980 to 2006 period. The Bank. (Control) columns show the averages of the monthly percentages of bankrupt (control) firms classified to each stock category in the specified 6-month event-period. *N* is the average number of firms analyzed each month in the respective 6-month event period. *P*-value represents the significance level of the test for difference in proportions between bankrupt and control firms.

Panel A. Pre-Chapter 11 period

Event-period (in months)		(-12,-7)			(-6,-1)		
	CRSP	Bank.	Control	p-value	Bank.	Control	p-value
Lottery-type	23.0%	43.5%	37.3%	0.04	45.3%	38.8%	0.08
Nonlottery-like	22.2%	4.9%	10.8%	<0.01	2.4%	8.8%	<0.01
Other	54.8%	51.6%	51.9%	0.94	52.3%	52.3%	1.00
N	6,689	336	350		346	351	

Panel B. Post-Chapter 11 period

Event-period (in months)		(1,6)			(7,12)		
	CRSP	Bank.	Control	p-value	Bank.	Control	p-value
Lottery-type	23.0%	60.4%	42.4%	<0.01	71.5%	44.9%	<0.01
Nonlottery-like	22.2%	0.8%	7.3%	<0.01	0.0%	7.3%	<0.01
Other	54.8%	38.9%	50.3%	<0.01	28.4%	47.8%	<0.01
N	6,689	283	351		176	351	

Table 5

Retail and institutional investors' trades in bankrupt firms

This table presents retail and sophisticated investor relative trading activity in the stocks of our sample of bankrupt firms. The period is from 01/01/1993 to 12/31/2000. Trades less than (greater than) $5,000 ($50,000) are used to proxy for retail (sophisticated) investor trades. We measure retail investors' trading (SMALL) for each firm *i* in event month *t* as the ratio of the number of retail investors' trades over the total number of trades. We measure institutional investors' trading (LARGE) in a similar way but the numerator is now the number of trades by institutional investors. For each event month *t*, the SMALL/LARGE column displays the proportion of retail trades to institutional trades. Each event month is defined as a 21 trading-day period counted from the bankruptcy announcement date. Event month 1 is the first post-bankruptcy month. *N* reports the number of firms with available information to compute SMALL and LARGE trading percentages each event month.

Panel A. Pre-bankruptcy period

Event Month	SMALL	LARGE	SMALL / LARGE	N
-12	61.3%	6.5%	9.36	98
-11	66.3%	6.3%	10.57	102
-10	66.6%	6.0%	11.16	103
-9	60.7%	7.7%	7.85	103
-8	67.3%	6.4%	10.46	103
-7	71.5%	5.2%	13.75	100
-6	73.2%	4.3%	16.95	101
-5	73.7%	4.2%	17.62	102
-4	77.2%	3.4%	22.51	99
-3	81.3%	2.7%	30.65	104
-2	82.9%	2.5%	32.53	101
-1	85.5%	1.9%	44.10	107

Table 5 (cont.): Retail and institutional investors' trades in bankrupt firms

Panel B. Post-bankruptcy period

Event Month	SMALL	LARGE	SMALL / LARGE	N
1	88.5%	1.5%	57.66	102
2	87.6%	1.4%	63.90	42
3	86.6%	1.9%	45.95	38
4	82.2%	2.4%	34.02	34
5	72.1%	3.5%	20.53	32
6	68.0%	2.9%	23.39	32
7	69.6%	4.2%	16.52	32
8	70.5%	3.2%	21.98	32
9	71.8%	3.2%	22.30	30
10	73.2%	3.9%	18.74	30
11	75.7%	2.7%	28.15	32
12	78.4%	2.9%	15.84	33

Table 6

Lottery status and retail trading on bankrupt firms

This table presents the coefficient estimates of a regression that examines the determinants of bankrupt firm retail trading percentage. The dependent variable, retail trading, is the ratio of $month_t$ total buy- and sell-initiated small trade (trade size below $5,000) dollar volume, and total trading dollar trading volume in the same month. Lottery index (*Lot_index*) is the main independent variable proxying for the lottery-like status of bankrupt firms, and is computed as the sum of the vigintile assignments of each firm based on stock price, idiosyncratic skewness, and idiosyncratic volatility measures, then divided by 60. Market beta (*Beta*) is estimated using 6 months of daily returns. Systematic skewness (*Sys_skew*) is obtained by fitting a 2-factor model to the previous 6 months of daily returns data as in Harvey and Siddique (2000). Firm size (*Size*) is the log of market capitalization at the end of the previous month. We use a dummy (*Nasdaq_d*) =1 if the firm trades on the Nasdaq in the previous month, 0 otherwise. Momentum (*Mom*) is computed over the previous 12 months. We employ a dividend paying dummy (*Div_d*) = 1 if the firm pays a cash dividend in the previous calendar year, 0 otherwise. Trading volume (*Tvol*) is measured as previous month trading volume divided by shares outstanding at the end of the previous month. Firm age (*Age*) is the number of years since its first return appears in the CRSP monthly file. Book-to-market ratio (*Bm*) is computed as the book value of equity at the end of the previous fiscal year divided by the market capitalization at the previous fiscal year-end. Parameters are estimated using OLS, and we report the *p*-value of standard *t*-statistics. *N* is the number of firms employed in the regression.

Table 6 (cont.): Lottery status and retail trading on bankrupt firms

Month	-12		-6		-1		1		6		12	
Independent Variable	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value
Intercept	0.101	0.381	0.357	<0.01	0.249	0.014	0.359	<0.01	0.288	0.215	0.464	0.086
Lot_index	0.509	<0.01	0.273	<0.01	0.476	<0.01	0.387	<0.01	0.555	0.012	0.163	0.053
Beta	0.009	0.412	0.012	0.213	-0.008	0.516	0.003	0.799	-0.005	0.667	-0.028	0.157
Sys_skew	0.001	0.444	0.001	0.511	0.001	0.305	0.001	0.602	-0.001	0.557	0.002	0.546
Size	-0.052	<0.01	-0.076	<0.01	-0.067	<0.01	-0.098	<0.01	-0.096	<0.01	-0.052	<0.01
Nasdaq_d	0.010	0.828	0.012	0.786	0.053	0.222	0.111	0.016	0.119	0.135	-0.103	0.189
Momentum	-0.586	0.019	-0.236	0.351	-0.509	0.110	-0.454	0.081	-0.138	0.719	-0.165	0.618
Dividend_d	-0.024	0.660	-0.012	0.827	-0.012	0.766	-0.007	0.906	0.032	0.679	-0.044	0.753
Tvol	1.413	0.502	0.272	0.911	0.265	0.480	-0.664	0.164	-5.956	0.321	0.354	0.928
Age	-0.004	0.173	-0.005	0.123	-0.003	0.332	-0.007	0.012	-0.007	0.118	-0.002	0.967
Bm	0.002	0.903	-0.003	0.701	-0.003	0.058	-0.002	0.481	-0.002	0.667	-0.004	0.317
Reset (F-Stat. Sig.)	0.102		0.129		0.350		0.411		0.325		0.401	
White (F-Stat. Sig.)	0.334		0.328		0.438		0.996		0.431		0.427	
Breush-Pagan (F-stat. Sig.)	0.237		0.254		0.301		0.754		0.424		0.838	
R^2	59.9%		48.6%		45.6%		69.5%		67.5%		52.7%	
N	98		101		107		102		32		33	

Table 7

Lottery status and retail trading in bankrupt firms: additional evidence

This table presents the coefficient estimates of a regression that examines the determinants of retail investor bankrupt firm net buy behavior. Data is from a major discount brokerage house and covers the 1991 to 1996 period. Dependent variable ($BuySell_{i,t}$) is the net amount of shares of firm *i* bought by retail investors in month *t*, and calculated as the difference in aggregate buy-initiated trading volume and aggregate sell-initiated trading volume divided by the number of shares outstanding at the end of month *t*. Independent variables of interest are the lottery index ($Lot\_index_{i,t}$), and a bankruptcy dummy ($Bank_{i,t}$). The former proxies for the lottery-like status of firms, and is computed as the sum of the vigintile assignments of each firm based on stock price, idiosyncratic skewness, and idiosyncratic volatility, divided by 60. The latter is a dummy variable =1 if the bankruptcy date for firm *i* lies within 24-months of month *t*, 0 otherwise, and is used to separate out the firms in the data set that belong to our sample from all the others. The regression model also encompasses an interaction variable between $Lot\_index_{i,t}$ and $Bank_{i,t}$. We consider 9 additional control variables in Model II. These are market beta (*Beta*), estimated using 6 months of daily returns, systematic skewness (*Sys_skew*), obtained by fitting a two-factor model to the previous 6 months of daily returns data as in Harvey and Siddique (2000), firm size (*Size*), which is the log of market capitalization at the end of the previous month, a Nasdaq dummy (*Nasdaq_d*) = 1 if the firm trades on the Nasdaq in the previous month, 0 otherwise, momentum (*Mom*), computed over the previous twelve months, dividend yield (*Yield*), given by cash dividend paid per share in the previous month to share price at the month end, trading volume (*Tvol*), measured as previous month trading volume to shares outstanding, firm age (*Age*), the number of months since its first return appears in the CRSP monthly file, book-to-market ratio (*Bm*), computed as the book value of equity at the end of the previous fiscal year divided by the market capitalization at the previous fiscal year-end, and price (*Prc*), price per share at the end of the previous month. Parameters are estimated using fixed-effects. *N* is the number of trades in all the stocks in the database employed in the regression.

Table 7 (cont.): Lottery status and retail trading on bankrupt firms: additional evidence

	I		II	
Independent Variable	Estimate	Sig.	Estimate	Sig.
Intercept	0.612	0.681	0.681	0.348
Lot_index	0.327	0.005	0.339	0.007
Bank	0.321	0.060	0.427	0.050
Lot_index * Bank	0.213	0.079	0.197	0.081
Beta			-0.007	0.633
Sys_skew			0.001	0.558
Size			-0.085	0.008
Mom			-2.270	<0.001
Yield			1.700	0.621
Tvol			0.124	<0.001
Age			-0.034	0.418
Bm			-0.025	0.298
Prc			0.006	<0.001
R^2	7.8%		8.0%	
N	47,303		47,303	

Table 8

Gambling clientele of bankrupt firm stocks

This table reports the results of logistic regression models relating retail investor propensity to trade bankrupt stocks with their socioeconomic and local demographic characteristics using data from a large discount brokerage house over the 1991 to 1996 time period. Independent variables are investor age (Age), annual household income (Income), proportion professional or managerial (Professional), percentage male (Male), proportion married (Married), portfolio concentration (Herfindahl index of portfolio weights) (Concentration), county education level (percentage of county residents above age 25 that has completed a bachelor's degree or higher) (Edu), county non-white percentage (Minority), county-level percentage of foreign-born inhabitants (Foreign), proportion urban (located within 100 miles of the top 25 U.S. metropolitan regions) (Urban), average state-level lottery sales (Lottery_sales), and county-level ratio of Catholics to Protestants (CPratio). Independent variables are the average clientele characteristics of the stock.

Independent Variables	Estimate	p-value	Estimate	p-value
Intercept	-0.007	0.552	-0.005	0.689
Age	-0.021	0.054	-0.016	0.219
Income	-0.022	0.006	-0.021	0.011
Professional	-0.004	0.779	0.001	0.952
Male	0.036	0.032	0.036	0.042
Married	-0.023	0.072	-0.021	0.097
Concentration	0.053	0.000	0.052	0.001
Edu			-0.032	0.023
Minority			0.018	0.055
Foreign			0.009	0.582
Urban			0.008	0.124
Lottery sales			0.019	0.093
CPratio			0.029	0.026
No. of firms		7,427		6,951
Pseudo-R^2		0.039		0.073

Table 9

Market reaction to Chapter 11 filing

This table presents the risk-adjusted buy-and-hold abnormal returns for our sample firms. All compounding periods are in trading days, where day zero is the date of entering into Chapter 11 proceedings. Market-adjusted returns (using the CRSP equally weighted index as benchmark) are reported in the two first columns. The two last columns report size and book-to-market risk-adjusted results. Control firms are determined as follows. For each sample firm, we identify all CRSP firms with a market capitalization between 70% and 130% of its equity market value. The respective control firm is then selected as that firm with book-to-market ratio closest to that of the sample firm. The two-tailed significance level derived from the *t*-statistic (Wilcoxon signed rank-test) is reported below the corresponding mean (median).

Panel A. Pre-event abnormal returns

	Market Adjusted		Size and B/M Adjusted	
Period	Mean	Median	Mean	Median
(-252,-2)	-0.89	-0.91	-0.49	-0.43
	<0.001	<0.001	<0.001	<0.001
(-126,-2)	-0.62	-0.64	-0.42	-0.42
	<0.001	<0.001	<0.001	<0.001

Panel B. Short-term market reaction

	Market Adjusted		Size and B/M Adjusted	
Period	Mean	Median	Mean	Median
(-1,+1)	-0.27	-0.28	-0.26	-0.27
	<0.001	<0.001	<0.001	<0.001
(-2,+2)	-0.28	-0.31	-0.27	-0.31
	<0.001	<0.001	<0.001	<0.001

Panel C. Post-event abnormal returns

	Market Adjusted		Size and B/M Adjusted	
Period	Mean	Median	Mean	Median
(+2,+84)	-0.14	-0.24	-0.13	-0.15
	<0.001	<0.001	0.014	<0.001
(+2,+126)	-0.20	-0.33	-0.16	-0.16
	<0.001	<0.001	0.005	0.001
(+2,+252)	-0.48	-0.67	-0.28	-0.27
	<0.001	<0.001	<0.001	<0.001

Table 10

Stock price performance post Chapter11filing: role of retail investors

This table presents the coefficient estimates of a regression that examines the determinants of our bankrupt firms' post-Chapter 11 abnormal performance. The dependent variable is the abnormal return of firm *i* over a given compounding period τ . Lot_i is a dummy variable = 1 if firm *i* lies within the lottery-like category in the month preceding the compounding period of interest, 0 otherwise. RTP_i is the ratio of total buy- and sell-initiated small trade (trade size below $5,000) dollar volume for firm *i*, to total dollar trading volume in the same month. $Lot*RTP_i$ is the interaction term between Lot_i and RTP_i. Momentum (*Mom*) is computed over the previous 6 months. Price (*Prc*) is the natural logarithm of the price per share at the end of the previous month. Amihud illiquidity (*Illiq*) is computed as in Amihud (2002) over the previous 6 months. Institutional Ownership (*Inst*) is the percentage of stock owned by institutional investors in the previous reporting quarter. Firm size (*Size*) is the log of total assets at the previous fiscal year-end. The book-to-market ratio (*Bm*) is the book value of equity at the end of the previous fiscal year divided by market capitalization at the previous fiscal year-end. Parameters are estimated using OLS, and we report the *p*-value of standard *t*-statistic. *N* is the number of firms in the regression.

Period	(+2,+84)		(+2,+126)		(+2,+252)	
Independent Variable	Estimate	p-value	Estimate	p-value	Estimate	p-value
Intercept	-0.337	0.401	-0.294	0.582	-0.591	0.435
Lot	-0.288	0.037	-0.115	0.079	-0.421	0.048
RTP	-0.046	0.094	0.068	0.929	0.284	0.792
Lot*RTP	-0.679	0.027	-0.365	0.066	-0.195	0.087
Mom	0.699	0.357	0.696	0.491	2.203	0.126
Prc	-0.051	0.641	-0.030	0.837	-0.075	0.718
Illiq	0.001	0.961	0.001	0.982	-0.001	0.835
Inst	0.072	0.098	0.062	0.029	0.077	0.035
Size	0.002	0.996	-0.002	0.999	0.635	0.431
Bm	0.004	0.704	0.011	0.471	-0.024	0.253
Reset (F-Stat. Sig.)	0.567		0.222		0.966	
White (F-Stat. Sig.)	0.999		0.995		0.9982	
Breush-Pagan (F-stat. Sig.)	0.712		0.781		0.645	
R^2	6.1%		2.5%		7.2%	
N	105		105		105	

Table 11

Illustrative profits earned from an arbitrage strategy involving bankrupt firms

This table presents the results obtained with an illustrative zero-investment strategy in event time using our sample firms. The arbitrageur goes short in each bankrupt firm, and uses the net proceeds to buy shares of a matched non-bankrupt firm sharing similar characteristics. For each sample company, we identify all CRSP firms with a market capitalization between 70% and 130% of its equity market value. The respective control firm is then selected as that firm with book-to-market closest to that of the sample firm. The initial trades occur two trading days after the event date, and positions are closed after a period of 252 (126) trading days or at the delisting date of the event firm, whichever comes first. Three types of transaction costs are considered in the computation of the results presented below: 1) stock borrowing costs; 2) trading commissions, and 3) the bid-ask spread. A shorting cost of 4.3% *per annum* is used for bankrupt firms below the sample's median market capitalization, and a shorting cost of 1% *per annum* is used for all other firms. A 4% commission rate is used for both bankrupt and control firms with stock prices below $1 per share; a 0.25% commission rate is used in the remaining cases. The impact of the bid-ask spread is incorporated into the analysis by allowing all trades to be conducted at the respective bid or ask closing price (for both sample and control firms). Whenever one of these prices is not available, we estimate its value. The missing figure is inferred using the closing price for the relevant trading day, and half of the median bid-ask spread across all cases in the sample with available data. Two different bid-ask estimates are considered: the direct effective spread column refers to the bid-ask spread computed as in Lesmond et al. (2004), and the quoted spread column refers to the bid-ask spread computed as in Stoll and Whaley (1983). The two-tailed significance level derived from t-statistics (Wilcoxon signed rank-test) is reported below the corresponding mean (median).

	Direct Effective Spread		Quoted Spread	
Variable	6-months	12-months	6-months	12-months
Mean	-18.0%	-11.2%	-20.3%	-14.4%
p-value	0.001	0.065	<0.001	0.027
Median	-5.1%	1.2%	-5.7%	1.0%
p-value	0.010	0.342	0.002	0.168
St. dev.	89.0%	120.1%	90.2%	121.3%
25th percentile	-54.5%	-57.4%	-57.8%	-60.1%
75th percentile	37.5%	48.1%	35.6%	46.4%