Who trades the stock of bankrupt firms?

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ABSTRACT

We examine the price dynamics of the stocks of firms that remain listed on a major U.S. exchange after their Chapter 11 filing, and document negative realized returns of at least -28% over the following year. We also find that retail investors own on average 90% of these firms' stock. Also, such bankrupt firms' stock displays unique lottery-like characteristics, which makes them attractive to retail investors with a propensity to gamble. We also find that arbitrageurs have little incentive to intervene in this peculiar market: implementation costs and risk are simply too high. We thus conclude that a combination of gambling-motivated trading by retail investors *and* limits to arbitrage explains the anomalous post-bankruptcy return evidence we document.

Keywords: bankruptcy, lottery stocks, limits to arbitrage, retail investors, event study

JEL classification: G14, G33

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1. Introduction

There is an extensive literature on corporate bankruptcy that addresses a wide range of bankruptcy-related issues.[1] However, we still know very little about the trading environment and price dynamics of bankrupt firm stocks. Part of the reason is that 90% of the stocks of firms filing for Chapter 11 cease trading on the main exchanges at or before the filing date (Dawkins, Bhattacharya and Bamber, 2007).

Our paper contributes to the literature in a number of ways. First, we investigate who trades the stock of bankrupt firms both pre- and post-event. To the best of our knowledge, only Dawkins et al (2007) consider a related issue but restrict their analysis to the first 10 trading days *after* bankruptcy. We complement and enrich this earlier contribution by exploring what happens prior to the actual filing and a much longer post-bankruptcy period. This allows us to present a much clearer picture of the shifts in the demand for the stock of firms undergoing Chapter 11 bankruptcy reorganization.

We also empirically explore a novel topic within this literature that relates to the *motivation* for trading bankrupt firms' stock. Our results suggest that such trading is driven by what Kumar (2009) portrays as gambling on the market by retail investors. Our findings are consistent with recent work by Han and Kumar (2009), who show that stocks with speculative features are the preferred habitat of retail investors exhibiting a stronger propensity to gamble and have utility functions accentuating risk-seeking behavior. Our result is also broadly consistent with recent work by Dorn and Huberman, (2009), Grinblatt and Keloharju (2009) and Dorn and Sengmueller (2009). These recent papers present evidence that trading by retail investors in certain speculative stocks may be the result of risk-seeking behavior, sensation seeking or the simple desire to trade for entertainment. In parallel to our own work, Li and

[1] E.g., Hotchkiss, John, Mooradian and Thorburn (2008) cite more than 70 related research papers.

Zhong (2009) explore a similar issue and claim that investors may be willing to trade on bankrupt firms' stock because these securities have a payoff structure that is similar to deep out-of-money call options on an equally weighted portfolio of matched firms. We explain why this is less likely to be the case in the body of our paper.

Next, we analyze what happens to stock prices in the post-bankruptcy period, also an original contribution to the literature. In 1988, Morse and Shaw appear to have considered a somewhat related issue. However, this early study works with a small sample of 56 firms using monthly data, and does not address the same questions as we do. Lily and Zhong (2009) also explore the stock price performance post-bankruptcy but there are important differences between the two papers that should be pointed out. Lily and Zhong (2009) work with a sample of firms that trade mainly on the Pink Sheets while we restrict our analysis to those that trade and keep on trading on a major U.S. exchange after filing for bankruptcy. This is important since, while in Chapter 11, our sample firms continue to comply with the requirements of both the SEC and the exchange where their securities are listed. The same *does not* apply to firms that start trading on the Pink Sheets post-bankruptcy. As such, our work focuses on those firms that post-bankruptcy continue to be of interest to the media, professional analysts and consequently to a wider number of investors. Our approach also minimizes problems with the measurement of returns of bankrupt firms' stock that arise due to illiquidity, thin trading, high bid-ask spreads and similar market microstructure issues. Finally, we use a more standardized method while examining the post-Chapter 11 stock return performance than Lily and Zhong (2009) do. Overall, are results are methodologically sounder and offer a higher degree of generalization than those of Lily and Zhong (2009) do.

In the last part of the paper we directly add to the literature by investigating how limits to arbitrage impact the pricing of highly distressed securities. In this respect our paper is one of the first to empirical test the theoretical predictions of Barberis and Huang (2008), who study the equilibrium that arises in an economy populated with cumulative prospect investors who trade in both normally distributed return securities and securities with positively skewed return distributions.

Our main results can be summarized as follows. First, we establish that retail investors are particularly drawn to the stock of bankrupt firms. Specifically, we show that, as the bankruptcy date approaches, institutional investors sell down their equity position on the soon-to-be bankrupt firms, and that that tendency is dramatically amplified once bankruptcy is formally announced. For the typical case, retail investors end up owning an average of 90% of the firm's equity while bankruptcy is underway. We also show that bankrupt firms' stocks are very similar to what Kumar (2009) defines as a lottery-like stock, i.e., low priced stocks that, for a small initial investment, offer a very low probability of a huge future reward, and a very high probability of a small loss. Kumar (2009) shows that poor, young, less educated single men who live in urban areas, undertake non-professional jobs, and belong to specific minority groups (African-American and Hispanic) tend to invest more in these lottery-type stocks. Our results thus indicate that bankrupt firms' stock may be used by a particular clientele as a means to gamble on the market, which in turn, partially explains why this type of security continues to trade very actively even after the formal announcement of Chapter 11.

Next, we find a negative, and statistically significant post-bankruptcy announcement drift of at least -28% over the following year. A negative expected return of this magnitude would be inconsistent with any mean-variance asset-pricing model. This puzzling finding raises several important questions about the risk-return trade-off that is anticipated by investors in these stocks that we discuss in our paper. Importantly, it cannot be explained by other established phenomena like the post-earnings announcement drift, and momentum, as well as the level of pre-event financial distress, and industry membership. The result is also insensitive to a whole range of different implementations of event-study methods including calendar-time portfolio formation.

Finally, we show that transaction costs severely hinder arbitrageurs' ability to intervene in the peculiar market we study. Specifically, in the best-case scenario a sophisticated investor may expect to lose at least 8.4% (10.3%) on average over a 6-month (12-month) period post-Chapter 11 filing when engaging in an arbitrage strategy involving bankrupt firms' stock. This

helps explain why the post-bankruptcy drift we uncover is not resolved by traditional market forces.

In summary, this paper documents an anomalous finding of a large negative realized return during the bankruptcy process on average (over and beyond the precipitous drop in stock price at the announcement of Chapter 11 filing). We examine investor biases and limits to arbitrage as potential explanations for this result. As mentioned above, retails are the main shareholders of firms in Chapter 11, with previous literature showing that such market participants are vulnerable to psychological biases that impair their ability to make rational investment decisions (e.g., Odean, 1998a; Barber and Odean, 2000, 2001 and 2002; Hvidkjaer, 2006 and 2008; Barber and Odean, 2008; Goetzmann and Kumar, 2008). Also, we show that bankrupt firms' stock share a number of characteristics with stocks that are typically used by a clientele of unsophisticated investors who gamble on the stock market *as if* they were playing state-lotteries. In addition, we demonstrate that significant limits to arbitrage in trading the stocks of bankrupt firms render such activities unattractive to arbitrageurs.

Our results constitute additional evidence showing that the market has problems in correctly assimilating the implications of public domain bad news events (e.g., ., Bernard and Thomas, 1989, 1990, Michaely, Thaler and Womack, 1995; Womack, 1996; Dichev and Piotroski, 2001; Chan, 2003; Taffler, Kausar and Lu, 2004 and, Kausar, Taffler and Tan, 2009). Exploring the market's reaction to bankruptcy is particularly interesting in this context since it is the most extreme and unambiguous bad news event in the corporate domain one can consider.

At a more general level, our paper helps understand the "distress anomaly" recently discussed in Campbell, Hilscher and Szilayi (2008).[2] The authors report that, since 1981, financially distressed stocks have delivered anomalously low returns, a result that clearly challenges standard models of rational asset pricing in which the structure of the economy is stable and well understood by investors. Campbell et al (2008) also show that after controlling for firm size, the distress anomaly is stronger among stocks with low analyst coverage, institutional ownership, price per share, and turnover. These findings are difficult to explain

[222] See also Dichev (1998) and Griffin and Lemmon (2002) for earlier evidence on the same issue.

using a fully rational model in which investors have homogeneous beliefs and preferences. Drawing on Barberis and Huang (2008), Campbell et al (2008) conjecture that the anomaly they uncover could be explained by the fact that distressed stocks have characteristics that appeal to certain investors, such as positive skewness of returns. We provide clear evidence in favor of this argument. On the other hand, Campbell et al (2008) argue that while non-standard preferences have the potential to explain why some investors hold distressed stocks despite their low average returns, they do not explain why rational outside investors fail to arbitrage the distress anomaly. We show that this is the case because limits to arbitrage are binding in the context we address. As such, based on our results, we argue that the distress anomaly discussed in Campbell et al (2008) is the result of non-standard preferences of retail investor *and* limits to arbitrage, much like what happens when firms file for Chapter 11 bankruptcy.

This paper proceeds as follows. The next section describes our data. In section 3 we investigate who is trading the stock of bankrupt firms pre- and post-event and why. Next, we study stock price-performance after bankruptcy is formally declared. In section 6 we explore the potential role of arbitrageurs in this context. Section 7 discusses our results and section 8 concludes.

2. Data and descriptive statistics

2.1 Sample and control firms

Our data consists of the 351 non-finance, non-utility 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. Table 1 summarizes our sample construction strategy, with all phases being sequential. In the first step all firms filing for bankruptcy between 1979 and 2005 are identified. Seven sources of data are used for this purpose: 1) the Bankruptcydata.com database;[3] 2) the SEC's Electronic Data Gathering, Analysis, and Retrieval system (EDGAR);[4]

[3] See http://www.bankruptcydata.com/ for more details.
[4] Companies filing for bankruptcy are required to report this to the SEC within 15 days using a Form 8-K. Accordingly, in order to find the bankruptcy cases reported on EDGAR, we search and manually analyze all 8-K forms available on EDGAR

3) COMPUSTAT's industrial file; 4) Professor Lynn Lopucki's Bankruptcy Research database;[5] 5) the SDC database; 6) Altman and Hotchkiss (2005:15-20), and 7) a list of bankrupt firms provided by Professor Edward Altman. Firms are combined into a single list and duplicates removed, yielding a total of 3,437 non-overlapping cases.

Table 1 here

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-event 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 is not available on COMPUSTAT for a 2-year period before the bankruptcy announcement year are then removed, together with 11 firms incorporated outside the US (as defined by COMPUSTAT). Penultimately, following prior research, we also remove all 40 financial and utility firms from our final sample.[6] The 10 firms filing for Chapter 7 are then finally 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.

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that mention the keywords "bankruptcy", "Chapter 11" or "reorganization". The initial search was conducted with the help of the 10kwizard software designed to facilitate keyword search on EDGAR. See http://www.10kwizard.com/ for details.

[5] See http://lopucki.law.ucla.edu/ for details.

[6] 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 for details.

We also collect information for a sample of control firms. We identify a control firm by matching each of our sample firms with the firm with most similar size and book-to-market ratio, a common practice in the literature dealing with firms facing high levels of financial distress (e.g., Dichev and Piotroski, 2001; Taffler et al, 2004; Ogneva and Subramanyam, 2007; Kausar et al, 2009). First, for each sample firm, market capitalization is measured one month before the bankruptcy filing date.[7] CRSP is then searched 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 then identified as that firm within this set with the closest book-to-market ratio. To ensure the numerator is available when market value is computed, we use the book value of equity taken from the last annual accounts reported before the bankruptcy year (Fama and French, 1992), and allow a three-month lag to measure the market value of equity.[8] The match is confirmed if: 1) the matched firm has at least 24 pre-event months of returns available on CRSP; 2) is not in bankruptcy; 3) is incorporated in the U.S.; 4) is not a financial or utility firm, and 5) it has sufficient information on COMPUSTAT to conduct our analysis.

2.2 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. For the typical firm, 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, average Altman (1968) z-score is low (mean=1.37, median=1.31), suggesting that these firms are likely to fail in the short-run. 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. The mean and median z-score and current ratio are higher, and leverage is appreciably lower (the differences between groups are

[7] As a robustness check, we measure size for all sample firms two, three, six and twelve months before their bankruptcy date and re-run the analysis. Results remain qualitatively unchanged.
[8] The market value of every sample firm is measured before its bankruptcy announcement date. This result is confirmed by manually inspecting all cases.

statistically significant at the 1% level). Nonetheless the typical control firm is also losing money: mean return on assets is -14.8%, 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.

Table 2 here

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, not surprisingly, have high book-to-market ratios. Panel B also shows that, despite their small average size, our bankrupt firms trade on average for 230 days (out of 252) in the 12-month period *following* the bankruptcy announcement month. In the comparable period, control firms trade for an average of 224 days, with difference in means significant at a 10% level. This suggests that the stock of bankrupt firms is of interest to a group of investors, a point also raised by Hubbard and Stephenson (1997b) and more recently by Li and Zhong (2009). Panel B also highlights the very significant impact of the bankruptcy filing on mean stock price, which falls from $4.97 before the event to $2.08 in the event month, a reduction of -58%. The equivalent decline in median price is from $3.12 to $0.97. In the case of the control firms, prices remain relatively stable, with a mean value of around $9 (median around $5).

Panel B of table 2 again shows that there is a market for the stock of bankrupt firms. In fact, in the 12-months before the bankruptcy date, the average daily turnover for these firms is 0.51%, implying an annual turnover rate of 129%. This rate spikes to 290% in the bankruptcy-announcement month, which shows the importance of the event under analysis. After the this initial effect dissipates, mean bankruptcy firm daily turnover stabilizes at 0.57%. The data also shows that the reported pattern is specific to our event firms; 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.

Finally, panel C shows that only 25% of the sample firms have positive earnings, and around the same percentage pay dividends. In line with panel A, panel C again presents evidence that the control firms are financially stronger than the sample firms. Almost 50% have positive earnings, and around 40% pay dividends. Panel C shows that both sample and control firms are usually audited by one of the Big 8 auditing firms.[9] 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.

3. Chapter 11 bankruptcy: who trades?

In this section we investigate the demand for the stock of the typical firm in Chapter 11. Bankrupt firms are very special in this regard. On the one hand, their equity is very appealing to vulture funds, which specialize in trading distressed securities such as bonds in or near default and equities that are in or near bankruptcy (Rosenberg, 2000). Hedge funds are also drawn to this type of security. Lhabitant (2006, pp. 230:231) explains that some hedge funds employ an investment strategy that entails taking a large equity position in the bankrupt firm and, at the same time, buying its outstanding debt. This ensures that the hedge fund is in command of the reorganization process, which improves the odds of maximizing its total payoff.

On the other hand, retail investors may also be interested in bankrupt firms' stock as they may perceive a considerable potential for price appreciation (Russel and Branch, 2001). Information available on the SEC's website supports this idea:[10] "*(…) Investors should be cautious when buying common stock of companies in Chapter 11 bankruptcy. It is extremely risky and is likely to lead to financial loss. (…)* ***In most instances, the company's plan of reorganization will cancel the existing equity shares***." The SEC's 2003 annual report further informs readers (p. 33): "*During 2003, we received numerous complaints from investors who*

[9] The following companies are considered as part of the Big 8 group: 1) Arthur Andersen; 2) Arthur Young; 3) Coopers & Lybrand; 4) Ernst & Young; 5) Deloitte; 6) Peat, Marwick and Main; 7) Price Waterhouse and 8) Touche Ross.
[10] See http://www.sec.gov/investor/pubs/bankrupt.htm for details.

purchased stock in bankrupt companies under the mistaken belief that the stock price would rise when the company emerged from bankruptcy. In each case, however, the company had announced in its plan of reorganization its intention to cancel its existing common stock and to issue new stock." Undoubtedly, the SEC has made an effort to clarify the dangers of investing in bankrupt firms' stock. Probably, this is because whoever is trading on these securities does so without fully understanding the risk he or she is taking, something we would not expect from professional managers working at the service of financial institutions.

So, who trades the stock of bankrupt firms? We help clarify this issue by examining how the stockholdings of institutional investors in bankrupt firms evolves through time. As Nofsinger and Sias (1999) point out, the fraction of shares held by institutional investors is one less the fraction of shares held by individuals and thus studying the variation in institutional stockholdings is the counterpart of studying the stockholdings of individuals. We gather the information relating to institutional holdings from the Thomson Financial Network CDA/Spectrum Institutional holdings file.[11] The data covers our entire sample period, beginning in the first quarter of 1980 and ending in the last quarter of 2006. We use the same source to collect data for our size and book-to-market control firms.[12]

We compute institutional stockholdings as follows (e.g., Nofsinger and Sias, 1999): [13]

$$Inst_{i,t} = Shares\ held_{i,t} \Big/ Shares\ outstanding_{i,t} \qquad (1)$$

[11] A 1978 amendment to the Securities and Exchange Act of 1934 requires all institutional investors with greater than 100 million dollars of securities under discretionary management to report their holdings to the SEC. Holdings need to be reported 45 days after the close of each quarter on the SEC's form 13F, where all common-stock positions greater than 10,000 shares or 200,000 dollars must be disclosed. See http://www.sec.gov/answers/form13f.htm and http://www.sec.gov/divisions/investment/13ffaq.htm for more details.

[12] Results are very similar if we use control firms matched on size and momentum, industry and stock-price, size and z-score and industry and size and book-to-market.

[13] We compute a similar measure for insiders' holdings in bankrupt and control firms using Thomson Financial Network Insider filing data. We do not explicitly report our results below because: 1) previous research emphasizes that working with these data is problematic (e.g., Lakonishok and Lee, 2001 and Frankel and Li, 2004) and 2) the insider data does not cover an important percentage of our initial cases since it begins in 1986.

where $Shares\,held_{i,t}$ is the number of shares of firm i held by institutional investors at quarter t and $Shares\,outstanding_{i,t}$ is firm i's number of outstanding shares at quarter t. For firm i, quarter 0 is the first post-Chapter 11 quarter for which institutions have to report their stockholdings to the SEC.

Table 3 summarizes our results. We find that in event-quarter -8 institutions own, on average, 25% of our sample firms' shares (median holdings are 20%).[14] Four quarters latter, they own, on average, 21% of the debtors' shares (median holdings are 16%).[15] Once Chapter 11 becomes effective (quarter 0), institutional investors own, on average, only around 11% of these firms' shares, a pattern that remains largely unchanged for another four post-event quarters.[16] Examining median holdings does not alter the qualitative nature of our findings: right after Chapter 11 institutions' median holdings are 8%, decreasing to 6% four quarters latter. We use a t-test and a Wilcoxon-Mann-Whitney test to verify whether institutional stockholdings in bankrupt firms is similar in event quarter 0 and event quarters -8, -4 and 4. When considering quarters -8 and 0 and -4 and 0 both the t-test and the Wilcoxon-Mann-Whitney test are significant at the 1% level. A completely opposite result emerges when considering quarters 0 and 4: in this case both the parametric and non-parametric test are not significant at normal levels (the p-value of the t-test and the Wilcoxon-Mann-Whitney test is 0.9479 and 0.4070, respectively). This suggests that institutions reduce their equity position in soon-to-be bankrupt firms as the Chapter 11 date approaches, and maintain low stockholdings in these firms at least for four post-event quarters.

Table 3 here

Previous research shows that institutional investors dislike small firms' stock (e.g., Gompers and Metrick, 2001) and, as such, the above results may not be specific to bankrupt firms. Table

[14] Insider's mean (median) holdings are 1.71% (0.5%).
[15] Insider's mean (median) holdings are 2.16% (0.4%).
[16] Insider's mean (median) holdings are 1.60% (0.3%) in event-quarter 0, dropping to 0.39% (0.01%) four quarters latter.

3, however, suggests otherwise. In event-quarter -8, institutions own on average 24% of our control firms (median holdings are 19%), a figure that is consistent with that of the bankrupt firms.[17] Not surprisingly, for this particular quarter, both the t-test and the Wilcoxon-Mann-Witney test for mean and median difference between groups are not significant at normal levels. This changes four quarters latter. In event-quarter -4, the mean and median difference between sample and benchmark firms is now around 5% and significant at normal levels.[18] Such difference increases with time and, in quarter 0, becomes very clear. In this quarter, institutions own, on average, 23% of control firms' shares (median holdings are 18%) and only 12% of the bankrupt firms (median holdings are 8%).[19] The mean and median difference between groups is significant at better than the 1% level, with the same pattern applying to the following four quarters. [20]

Two main ideas summarize our findings: 1) institutional investors steadily sell down debtors' stock as the Chapter 11 date approaches; 2) once bankruptcy is underway, their participation in the market for bankrupt firms is, at best, marginal. [21] An alternative and perhaps more interesting way to read our results is to realize that retail investors own, on average, around 90% of the stock of firms undergoing Chapter 11 reorganization. As such, they are likely to be setting these firms' stock price or, in the words of Thaler (1999), retail investors are the marginal investor in this peculiar market.

At best, our previous test can only provide *indirect* insight about who is actually *trading* the stock of bankrupt firms. We implement an additional test that uses data from the TAQ database to complement our previous analysis. In particular, we use trade size as a measure to distinguish between trades initiated by sophisticated investors and trades initiated retail investors. This approach has been previously used in the bankruptcy literature by Dawkins et al (2007) and also in a range of other contexts (e.g., Easley and O'Hara, 1987; Bhattacharya,

[17] Insider's mean (median) holdings are 1.10% (0.5%).
[18] Insider's mean (median) holdings are 1.20% (0.5%).
[19] Insider's mean (median) holdings remain relative stable at around 2.0% (0.5%) after event-quarter 0.
[20] Insider's mean (median) holdings are 1.71% (0.5%).
[21] A similar conclusion applies to insider's holdings. However, this result should be taken with caution as the insider data we have available does not cover our entire sample and is known for being of poor quality.

2001).[22] An important question here is defining "small" and "large" trades. Chakravarty (2001) shows that retail investors trade almost exclusively in lots of 500 or fewer shares. In addition, Dawkins et al (2007) argue that sellers who own 3,000 or more shares of stock available to sell are unlikely to be small retail traders. Hence, we classify transactions of 500 shares or less as small trades, and transactions of 3,000 shares or more as large trades.[23] Consequently, our main test ignores medium-size trades. This is in line with previous research and can be explained by the fact that the statistical power of the tests increases when medium-size trades are ignored (Lee and Radhakrishna, 2000). Moreover Chakravarty (2001) empirically show that sophisticated investors may use medium-size trades to avoid revealing their private information.

We measure small traders' abnormal trading response (SMALL) as the number of trades classified as small trades in a given post-event month divided by a non-announcement period benchmark. This allows us to express the post-event period number of transactions as a percentage of the typical non-announcement period number of transactions. We divide each post-event month in seven consecutive non-overlapping three-day windows (i.e., 21 trading days spanning approximately a month). We then count the number of small trades in each of these periods. The median of these seven numbers is used in each post-event month as the number of small trades. We define the benchmark month as that that starts six months before the bankruptcy announcement date. We also divide this non-announcement month in seven consecutive non-overlapping three-day windows and we count the number of small trades in each of these seven three-day non-announcement periods. Again the median of these seven numbers is used as the non-announcement period benchmark number of small trades. We

[22] A superior alternative would be to consider a dollar-based trade-size proxy to distinguish between retail and institutional transactions (Lee, 1992). However, as pointed out by Hvidkjaer, (2008) and Han and Kumar (2009) among others, the widespread introduction of decimalization in 2001 and order-splitting by institutions due to lower trading costs imply that such measure would not be an effective proxy for retail trading after 2000. Working with a sub-sample of firms that went bankrupt between 1993 (when the TAQ data becomes available) and 2000 (before the introduction of decimalization) would be a way to overcome this issue. However, this would considerably reduce our sample size, which profoundly impairs the robustness and interest of our results.

[23] In untabulated results we consider using alternative cutoffs of 300 shares, 700 shares, and 900 shares to identify small trades, and 2,500 shares, 3,500 shares, and 4,000 shares to identify large trades. Results remain qualitatively unchanged. Also, to assess the robustness of our results to a single cutoff approach, we repeat the analysis after including the medium-sized trades, by classifying transactions of less than 1,000 shares as small trades and transactions of 1,000 shares or more as large trades. Results also do not change considerably.

compute large traders' abnormal trading response (LARGE) in a similar manner but now we are interested in the number of trades classified as large trades.

Table 4 summarizes our results. Given the well-documented skewness of trading response metrics (e.g., Bhattacharya, 2001), we report cross-sectional medians as well as means, and the results of nonparametric statistical tests, as well as parametric tests. Using medians in our context is important because the number of firms available on the TAQ database drops as we move away from the event month, which reduces the power of the parametric tests. Table 4 shows that the announcement of bankruptcy deeply affects the trading pattern of unsophisticated investors: the mean and median value of SMALL exceeds 1.0 in every post-event month we consider. Results are very different for our LARGE variable: only in the first post-event month its median value exceeds 1.0. As such, in the longer-run, the announcement of bankruptcy seems to only significantly affect the trading behavior of unsophisticated investors. In addition, table 4 shows that in all post-event months, median values for SMALL are always greater than their counterparts values for LARGE.[24] This suggests that unsophisticated investors' abnormal trading activity considerably exceeds sophisticated investors' abnormal activity in *all* post-bankruptcy months we consider.

Table 4 here

4. Reasons for trading the stock of bankrupt firms?

So far we have shown that unsophisticated investors become key once bankruptcy is underway. In the typical case, they own around 90% of stock of the failed firm. In addition, such investors trade considerably more on this type of stock than sophisticated investors do. In this section we answer a complementary question: why should anyone be interested in trading bankrupt firms' stock anyway?

[24] We get a similar result with means only in the first three post-event months. However, after the third post-event month the number of firms in the sample drops below 50, which reduces the power of the t-test.

Extant literature suggests that there are two main reasons for doing so. First, trading on bankrupt firms may be the result of a fully rational investment decision. As Merton (1974) explains, the equity of bankrupt firms can be seen as a deep out-of-the money option. In this sense, investors may invest in bankrupt stocks just as they invest in call options, as argued by Li and Zhong (2009). Tax-related reasons also explain why someone may rationally decide to purchase bankrupt firms' stock as investors may offset capital gains with the losses they make on these securities. [25]

Irrationality may also drive the trading on bankrupt firms' stock. On 10 June 2009 Tom Petruno provides an excellent characterization of this situation, when writing for the Los Angeles Times: *"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 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."*[26] Tom Petruno words are even more striking when one realizes that in 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."*

In a recent paper, Kumar (2009) studies the impact of the well-known human propensity to gamble on our investment decisions. He focuses on stocks resembling state lotteries, i.e., stocks

[25] See http://www.sec.gov/investor/pubs/bankrupt.htm for further details.
[26] 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.

that for a very low cost offer a tiny probability of a huge future reward and a large probability of a small loss. Kumar (2009) finds that the gambling preferences of a relatively less sophisticated retail investor clientele are, in fact, reflected in their stock investment decisions. Bankrupt firms' stock possesses the key characteristics of Kumar's (2009) lottery- stocks. First, such securities usually trade at a very low price (e.g., Clark and Weinstein, 1983; Hubbard and Stephenson, 1997a; 1997 b; Dawkins et al, 2007). Second, buying these firms' stock offers the possibility of engaging in a gamble with two extremes outcomes. On the one hand, investors may end up losing all of their investment if the firm is liquidated (e.g., Hubbard and Stephenson, 1997a; 1997 b). In general, this is the most probable outcome. On the other hand, investors may be richly rewarded for their investment strategy, which eventually happens if the firm is able to emerge successfully from Chapter 11. Sadly, this is a rarer outcome.[27] Importantly, the very low market price that characterizes this type of stock makes it possible for investors to earn extremely generous short-term returns when prices appreciate only a few cents. Consequently, it is possible that the stock of bankrupt firms attracts a number of investors who trade this type of security *as if* they were playing lotteries.

We test this conjecture by replicating Kumar's (2009) table 2 using data from our sample and control firms for both the pre- and post-event period. [28] The objective is twofold. First, to more formally test to what extent our bankrupt firms are similar to Kumar's (2009) lottery-stocks. Second, to investigate if such characteristic are specific to our sample firms or, in contrast, are also common to our control firms.

Table 5 summarizes our results. Kumar (2009) relies on three stock characteristics to identify the set of CRSP stocks that conform to his definition of a lottery stock. The first is stock price, with Kumar (2009) arguing that lottery-like stocks should be relatively cheap. This is because, like lotteries, if investors are searching for cheap bets, they should naturally

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

[28] We report results for our size and book-to-market control firms. However, we find a very consistent pattern if we use alternative control firms benchmarked on size and momentum, industry and stock-price, size and z-score and industry, size and book-to-market).

gravitate toward low-priced stocks. Table 5 shows that our sample firms' mean stock price in the pre-bankruptcy period is around $4.97 dropping to $2.98 in the post-event period. Kumar (2009) reports that the mean lottery-stock price is $3.83. As such, post-event, our sample firms are even *cheaper* on average than those classified as Kumar (2009) as lottery-stocks. In addition, table 5 shows that the mean stock price of our control firms is $9.80 in the pre-event period and $8.84 in the post-event period (a t-test for difference in means for this variable between sample and control firms is significant at the 1% level). So, on average, bankrupt firms are also *cheaper* than our control firms.

Idiosyncratic skewness is also used by Kumar (2009) to define lottery-like stocks. He reasons that investors are likely to be attracted more toward stocks that *occasionally* generate extreme positive returns that cannot be justified by the movements in the market. In other words, investors are likely to find stocks with high stock-specific skewness attractive. Table 5 shows that in the pre-event period our sample firms mean idiosyncratic skewness is 0.16, which is reasonable lower than the 0.73 reported by Kumar (2009) for his lottery-stocks. Post-event, however, the mean idiosyncratic skewness of our sample firms increases to 0.94, a figure that is actually *higher* than that of Kumar's (2009) lottery-stocks. Importantly, the mean idiosyncratic skewness of our control firms is 0.53 in the pre-event period and 0.66 post-event (p-values for the t-test for differences in means for this variable between sample and control firms are significant at the 1% level both for the pre- and post-event period). So, on average, our bankrupt firms also have higher idiosyncratic skewness than our control firms.

Finally, Kumar (2009) argues that stocks with higher idiosyncratic volatility are more likely to be perceived as lotteries since investors might believe that the extreme return events observed *in the past* are more likely to be repeated when idiosyncratic volatility is high. Table 5 shows that in the pre-event period the mean idiosyncratic volatility of our bankrupt firms is 8.24, increasing to 12.47 post-event. Table 5 also shows that the mean pre-event idiosyncratic volatility of our control firms is 4.73, rising to 5.12 post-event (p-values for the t-test for differences in means are significant at the 1% level both for the pre- and post-event period). In his paper, Kumar reports a mean idiosyncratic volatility for his set of lottery-like stocks of

75.56, which is much higher than what we find for our sample and control firms. We think that this difference is not of critical importance in our context. In fact, as Kumar (2009) explains, high idiosyncratic volatility is important in the sense that it may lead investors to amplify their perception about skewness. This would be especially true if they adopt an asymmetric weighting scheme and assign a larger weight to upside volatility and ignore or assign lower weight to downside volatility. As mentioned above, in the post-event period, the mean idiosyncratic skewness that we find for our sample firms is *considerably higher* than what Kumar (2009) reports for his set of lottery-like stocks. As such, the lower idiosyncratic volatility that we find for our sample firms simply means that investors are likely to assign a *lower* probability of extreme positive return occurring in these firms than on Kumar's (2009) lottery-stocks. This is perfectly reasonable: after all, our sample firms are bankrupt.

In a nutshell, our bankrupt firms seem to comply very well with Kumar's definition of a lottery-stock. As such, they should be very appealing to a range of retail traders that use them as a mean to satisfy their craving for gambling on the market. This is consistent with the results of our previous section since we find that retail investors become key once Chapter 11 is underway. It is also consistent with a vast array of anecdotal evidence that seems to put irrationality at the top of the list when it comes down to explaining why anyone should be willing to buy the stock of bankrupt firms. Our results thus indicate that the human tendency to gamble, at the very minimum, partially explains why the stock of failed firms continues to be actively traded even after the formal announcement of bankruptcy.

5. Stock price performance after the announcement of Chapter 11 bankruptcy

In this section we examine the stock return pattern of firms that continue to trade after filing for Chapter 11. This is important since previous research only documents what happens to the stock price of these firms within a few days after the disclosure of such extreme bad news event.

5.1. Initial evidence

Following Barber and Lyon (1997), we compute buy-and-hold returns (BHAR), an approach consistent with recent studies focusing on highly financially distressed firms (Dichev and Piotrosky, 2001; Taffler, et al, 2004; Ogneva and Subramanyan, 2007; Kausar et al, 2009). Buy-and-hold abnormal returns are computed as follows:

$$BHAR_i(\tau_1,\tau_2) = \prod_{t=\tau_1}^{\tau_2}\left(1+r_{i,t}\right) - \prod_{t=\tau_1}^{\tau_2}\left[1+E\left(r_{i,t}\right)\right] \qquad (2)$$

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. Individual BHARs are averaged cross-sectionally as follows (e.g., Barber and Lyon, 1997):

$$\overline{BHAR(\tau_1,\tau_2)} = \frac{1}{n}\sum_{i=1}^{n} BHAR_i(\tau_1,\tau_2) \qquad (3)$$

where $BHAR_i(\tau_1,\tau_2)$ is defined as in (2), and n is the number of firms. As suggested by equation (3), we use equally weighted rather than value-weighted returns since this is more appropriate in the context under analysis (e.g., Gilson, 1995). Additionally, previous research shows that equal weighting captures the extent of underperformance better than value weighting does (Brav, Geczy and Gompers, 2000; Kadiyala and Rau, 2004), an important point given the particular nature of our bankrupt firms.

Unless otherwise stated, daily returns collected from CRSP are employed in the calculation of abnormal returns and we restrict our analysis to a one year post-filing period for two reasons. First, filing for bankruptcy often leads to firm delisting, and thus extending the period for computing abnormal returns is problematic due to the loss of many sample cases (Morse and Shaw, 1988). Second, firms usually start emerging from bankruptcy 15 months after their Chapter 11 filing date (e.g., Denis and Rodgers, 2007; Kalay, Singhal and Tashjian, 2007). Ending the abnormal return calculation period three months before minimizes the impact of this

important event on our results.[29] Following Michaely et al (1995) we define a year as twelve 21-trading day intervals. Event day $t=+1$ is included in the bankruptcy announcement window together with days $t=-1$, and $t=0$, the bankruptcy announcement date, as firms are able to file their bankruptcy petition after the market closes (Dawkins et al, 2007).

Some of our sample firms are delisted in the 12-month period subsequent to their Chapter 11 filing date.[30] Drawing on Shumway (1997), and Shumway and Warther (1999), we include the delisting return in the calculation of abnormal returns, a procedure also used by Campbell et al (2008). Following Kausar et al (2009) we assume that, in the post-delisting period, sample firms earn a zero abnormal return.[31]

Following Barber and Lyon (1997) and Ang and Zhang (2004), we use a single control firm approach in our main results. In our main results, firms are matched on size and book-to-market, which is consistent with a number of studies exploring the medium-term market reaction of highly financially distressed firms to specific events (Dichev and Piotroski, 2001; Taffler et al, 2004; Ogneva and Subramanyam, 2007; Kausar et al, 2009). 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. These procedures introduce no survivorship or look-ahead bias and minimize the number of transactions implicit in the calculations (Spiess and Affleck-Graves, 1995). 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.

[29] Our typical sample firm spends an average (median) of 24.4 (18.1) months in bankruptcy. This is consistent with previous research by Eberhart et al, (1999) and Denis and Rodgers (2007).
[30] Performance issues explain 94% of these delisting cases (CRSP delisting codes 500 to 599).
[31] Re-investing the proceeds from the delisting payment in a portfolio of stocks comprising the same size decile of 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.

We employ a conventional t-test to infer the statistical significance of the mean BHARs (Barber and Lyon, 1997 and Ang and Zhang, 2004). Importantly, we use the cross-section of the buy-and-hold abnormal returns to form an estimator of their variance, which allows it to change after the event (Boehmer, Musumeci and Poulsen, 1991). This is appropriate since previous research by Aharony, Jones and Swary (1980) shows that both the systematic and unsystematic risk of bankrupt firms varies as the bankruptcy date approaches. 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.

We also present median returns to check the validity of our parametric results. These returns are unaffected by extreme observations, and present some theoretical advantages over mean BHARs (Ang and Zhang, 2004). Drawing on previous research dealing with bankruptcy announcements, a Wilcoxon signed rank-test is employed to test the statistical significance of our median abnormal returns (Dawkins et al, 2007).

Table 6 summarizes our results. 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 6 shows that mean (median) one-year pre-event abnormal return is -49% (-43%). All values are statistically significant ($p<0.01$). In addition, panel B of table 6 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 benchmark, mean (median) abnormal return measured for the (-1,+1) window is around -26% (-27%), and highly significant ($p<0.01$).

Table 6 here

The key results of panel C on table 6, 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 grants the incumbent management of firms filing for Chapter 11 an exclusivity period of 120 days to develop a reorganization plan.[32] Accordingly, this is the period where the asymmetry of information between bankrupt firms' management and the market is most acute. Panel C of table 6 shows that for this particularly important period mean (median) BHAR is -13% ($p<0.01$) (-15%; $p<0.01$).[33]

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) BHAR = -16% ($p<0.01$) (-16%, $p<0.01$).[34] Importantly, our conclusions do not change even if we consider a one-year post-event period. In effect, mean (median) BHAR for the (+2,+252) period = -28% (-27%), both significant at $p<0.01$.[35]

Three ideas summarize our results. Firstly, the market is able to anticipate bankruptcy, This pattern has already been documented in previous work and is usually explained by information relating to the forthcoming bankruptcy being released to the market before the event date. Secondly, despite the market's anticipation of bankruptcy, the event in itself is still very important from an information perspective, with the short-term reaction to its announcement negative and very significant. This is, of course, not surprising, especially if one considers that filing for bankruptcy is surely the worst-case scenario in the corporate domain.

Our most interesting and original finding comes from the analysis of the stock return pattern *after* the bankruptcy event. Our results clearly suggest that the market *does not* fully and quickly incorporate the impact of Chapter 11 announcement on the affected firms' stock price.

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[32] Under some circumstances, the Bankruptcy Court may concede an extension of this deadline (Gilson, 1995). Of course, not presenting a reorganization plan is also an important news event for all investors involved in the bankruptcy proceedings.
[33] The point estimate for the mean unwinsorized size and book-to-market risk-adjusted abnormal return for the (+2,+84) window is -16.0% ($p<0.01$). Both winsorized and unwinsorized results remain highly statistically significant if we compute bootstrapped t-statistics as suggested by Lyon, Barber and Tsai (1997) or Ang and Zhang's (2004) non-parametric sign test.
[34] The point estimate for the mean unwinsorized size and book-to-market risk-adjusted abnormal return for the (+2,+126) window is -19.3%, ($p<0.01$). Both winsorized and unwinsorized results remain highly statistically significant if we compute bootstrapped t-statistics as suggested by Lyon et al (1997) or Ang and Zhang's (2004) non-parametric sign test.
[35] The point estimate for the mean unwinsorized size and book-to-market risk-adjusted abnormal return for the (+2,+252) window is -28.1% ($p<0.01$). Both winsorized and unwinsorized results remain highly statistically significant if we compute bootstrapped t-statistics as suggested by Lyon et al (1997) or Ang and Zhang's (2004) non-parametric sign test.

In particular, we find a strong, negative and statistically significant post-event drift that lasts for at least one full year after the Chapter 11 filing date with mean (median) BHAR of -28% (-27%). Our findings seem to be inconsistent with market efficiency and appear to support the argument that markets are unable to digest bad news events on an unbiased and timely basis (e.g., Bernard and Thomas, 1989, 1990; Michaely et al, 1995; Womack, 1996; Dichev and Piotroski, 2001; Chan, 2003; Taffler et al, 2004; Kausar et al, 2009).

5.2. Additional tests

Caution is needed when interpreting the results above; there is still much debate surrounding the appropriate measurement of longer-term abnormal returns (e.g., Lyon et al 1999). In this section, we address this issue by changing our initial event-study in an attempt to confirm that our results are not a mere statistical artifact. We do this in two stages. In the first we test for a range of competing explanations for our anomalous results, specifically the post-earnings announcement drift (PEAD), the post-going concern modification drift, the momentum effect, distress risk, and industry. In the second we implement a calendar-time portfolio approach to control for potential problems related to cross-section dependence in BHARs.

5.2.1. Testing for a post-earnings announcement drift explanation

A voluminous literature shows that earnings surprises are followed by an incomplete market reaction, which is usually more pronounced when the surprise is negative (e.g., Ball and Brown, 1968; Foster, Olsen and Shevlin, 1984; Bernard and Thomas, 1989 and 1990). As such, we investigate whether our results are, in fact, driven by the post-earnings announcement drift.

We seek to distinguish between the two drifts (post-bankruptcy announcement, and PEAD) in two ways. In the first case, we use a control firm similar to 5.1 above, but now match first by size then by closest earnings surprise to determine our benchmark firms. In this way we can separate out post-bankruptcy drift from any earnings surprise effect, since the benchmark firms

have essentially the same earnings surprise in terms of sign and magnitude but do not file for bankruptcy during the test period.

The second test is based on Dichev and Piotroski (2001) who divide their sample according to the *sign* of the quarterly earnings surprise. In particular, we split our sample into two groups conditional on the sign of their pre-bankruptcy earnings surprise and explore for a significant difference in performance between these two earnings surprise portfolios.

Drawing on Foster et al, (1984) we define earnings surprise as follows:

$$\Delta Q_{i,q} = \frac{Q_{i,q} - E\left(Q_{i,q}\right)}{\left|Q_{i,q}\right|} \tag{4}$$

where $\Delta Q_{i,q}$ is the earnings surprise for firm i for quarter q, $Q_{i,q}$ is the current quarterly earnings figure for firm i, $E\left(Q_{i,q}\right)$ is the expected earnings figure for firm i in the current quarter, and $\left|Q_{i,q}\right|$ is the absolute value of firm i's current quarter earnings. The current quarter is defined as the most recent quarter preceding the bankruptcy announcement date. Our naïve model assumes that the expected earnings figure for firm i in the current quarter is simply the realized quarterly earnings for the same quarter in the previous year.[36]

Table 7 summarizes our results. Panel A shows that our sample firms exhibit a strong post-bankruptcy drift even after controlling for earnings surprise. In fact, all mean and median BHARs are negative, with most statistically significant at p<0.01.

Table 7 here

Similar results apply in the case of panel B of table 7, which tests for difference depending on sign of earnings surprise, where both negative and positive earnings surprise portfolios exhibiting post-bankruptcy event drift. For instance, the point estimate for the one-year mean (median) BHAR for the negative earnings surprise portfolio is -32% (-30%) (p<0.01), while its

[36] The data for computing equation (4) are collected from COMPUSTAT's quarterly industrial files (COMPUSTAT item 8).

equivalent for the positive earnings surprise portfolio is -18% (-16%) ($p<0.05$). The t-test (Wilcoxon-Mann-Whitney test) for difference in means (medians), however, is significant at the 5% level (not-significant), providing some weak evidence that firms suffering pre-bankruptcy negative earnings surprise exhibit a more pronounced post-event drift, although this difference does not appear to hold in the case of other compounding windows. Based on these results we conclude that our findings are robust to any potential post-earnings announcement drift explanation.

5.2.2 Controlling for the post-going concern modification drift, momentum, distress risk and industry

In this section we attempt to explain our main results in terms of post-going concern modification drift, momentum, distress risk and industry.

Kausar et al (2009) investigate the stock price reaction to U.S. first-time going-concern audit report disclosures in the calendar year following publication. The authors document a downward drift around 14% over the one-year period after the announcement date. This is an important result for our research since panel C of table 2 shows that around a quarter of our sample firms receive a first-time going-concern audit report modification in their last accounts prior to filing for Chapter 11. As such, it could be that the post-bankruptcy drift is simply a manifestation of post-going concern underperformance as already documented in the literature. We explore this issue by dividing our sample into two groups. The GC portfolio refers to those firms receiving a first-time GC audit report in their last published annual accounts before entering into bankruptcy proceeding. All other firms are allocated to the non-GC portfolio. We then compare subsequent 12-month bankrupt and control firm returns across the two sets of firms.[37]

[37] The results presented below also control for the GC status of the benchmark firms. In particular, 7 companies had to be replaced for this test because they received a first-time GCM report when were being used as control firms.

We find that 12-month (6-month) BHAR for the non-GM portfolio = -21% (-18%) with median BHAR = -24% (-22%), all significant at the 1% (1%) level. The equivalent results for the GC portfolio are mean 12-month BHAR = -28% (-12%), and median BHAR = -21% (-9%), with the one year results significant at the 1% (1%) level, and the 6-month results at the 5% (5%) level. On this basis our anomalous findings are not driven by a post-GC underperformance effect, and, in fact, difference in portfolio returns is not significant on a 6- or 12-month time horizon basis.

Panel A of table 2 clearly shows that stock prices fall steeply in the pre-bankruptcy period, and it could be possible that our findings are no more than a continuation of such negative returns as with Jegadeesh and Titman (1993; 2001). To test whether stock momentum is, in fact, driving our results we match each of our bankrupt firms with a new control firm as follows. First, we identify all non-bankrupt, non-finance, non-utility firms with a market capitalization between 70% and 130% of that of each our sample firm's market capitalization. Second, from this set, we choose the firm with prior 12-month raw returns closest to that of the sample firm.[38] We then compare subsequent 12-month bankrupt and control firm returns.

We find that our main results are unaffected. Mean 12-month (6-month) BHARs are -25% (-16%), and median 12-month (6-month) BHARs are -32% (-17%), all significant at better than the 1% (1%) level. As such, we cannot explain our results in terms of prior return continuation.

Panel A of table 2 shows that mean (median) Altman's (1968) z-score for our sample companies is 1.37 (1.31), where z-score < 1.81 indicates firms which "*clearly fall into the bankruptcy category*". On this basis, the majority of our sample firms are financially distressed when filing for Chapter 11. Dichev (1998) suggests that firms with higher distress risk significantly underperform in the following year. As such, we need to distinguish between a

[38] In particular, we compute momentum for both sample and control firms as:

$Mom_i = \frac{1}{12} \sum_{t=-12}^{-1} R_{i,t}$, where Mom_i is the momentum for firm i and $R_{i,t}$ is the raw monthly return of firm i in month t, with $t = 0$ being the bankruptcy announcement month. The data for computing momentum are taken from CRSP's monthly stock return file.

financial distress explanation and a bankruptcy-based explanation for our anomalous results. To do this, we adopt the same approach as for the momentum test and now match our bankrupt firms with control firms based on size and z-score.

Our main results are unaffected. The post-bankruptcy abnormal returns are still strong and negative, with mean 12-month (6-month) BHARs -34% (-15%) and median 12-month (6-month) BHARs -35% (-18%), all significant at better than the 1% (1%) level. Such findings suggest our results are not driven by financial distress risk.

Industry clustering arises when events are concentrated in a few particular industries. This is problematic because it reduces the power of statistical tests used to verify the significance of abnormal returns . This issue is important in the context of our research since there is a potential contagion/competitive industry effect when a firm files for bankruptcy (e.g., Lang and Stulz, 1992). Accordingly, and despite our descriptive analysis indicating that our sample is not affected by a significant degree of industry clustering, we still test for the possibility that our results are driven by an industry clustering explanation.

To control for an industry-specific explanation we match each of our bankrupt firms with control firms on industry, size and book-to-market in that order. First, industry is matched using COMPUSTAT's two-digit SIC code. The second step is to identify, for each bankrupt firm, all potential control firms that belong to the same industry class and that lie within the sample firm's size decile. Finally, the firm with closest book-to-market ratio to that of the sample firm is chosen as the control firm.

After controlling for industry, we find mean 12-month (6-month) BHARs of -32% (-16%) and median 12-month (6-month) BHARs of -32% (-17%), all significant at better than the 1% (1%) level. These results indicate that our original findings cannot be explained by an industry-specific explanation.

5.2.3 Calendar-time portfolios

Fama (1998) and Mitchell and Stafford (2000) highlight some potential pitfalls with the BHAR method, and thus favor the calendar-time portfolio approach introduced by Jaffe (1974), and Mandelker (1974). As a final robustness test, we also use this alternative methodology here. Sample firms are added to a portfolio at the end of the month following their Chapter 11 filing date, and are held there for 6 or 12 months.[39] The portfolio is rebalanced monthly to drop all firms that reach the end of their 6- or 12-month holding period, and to add all firms filing for bankruptcy in the previous calendar month. Importantly, given the high degree of skewness affecting the distribution of bankrupt firm market capitalization, we employ equally weighted portfolio rebalancing strategies (Ikenberry and Ramnath, 2002; Loughran and Ritter, 2000). Also, drawing on Mitchell and Stafford (2000) and Ikenberry and Ramnath (2002) we drop from the analysis all months where the calendar portfolio holds fewer than 10 firms.

Calendar-portfolio abnormal performance is assessed using Carhart's (1997) four-factor model. The model takes the form:[40, 41]

$$r_{p,t} - rf_t = \alpha_p + b_p\left(rm_t - rf_t\right) + s_p SMB_t + h_p HML_t + u_p UMD_t + \varepsilon_{p,t} \qquad (5)$$

where r_p is the return of portfolio p, rf is the risk-free rate, $r_m - r_f$, SMB_t, HML_t and UMD_t are, respectively, the premia on a broad market portfolio; the difference between the return on a portfolio of small stocks and the return on a portfolio of large stocks; the difference between the return on a portfolio of high book-to-market stocks and the return on a portfolio of low book-to-market stocks; and the difference between the return on the two high prior return portfolios and the return on the two low prior-return portfolios. Parameters b_p, s_p, h_p, and u_p measure portfolio p's sensitivity to each of the four factors considered in the model. Finally, $\varepsilon_{p,t}$ is a disturbance term, assumed to be white noise.

[39] Monthly returns are used to conduct this test (e.g., Ikenberry and Ramnath, 2002).
[40] Using the Fama and French (1993) three-factor model does not alter the qualitative nature of our results.
[41] Using Ikenberry and Ramnath (2002) adjusted intercepts does not alter the qualitative nature of our results.

We use the intercept α_p as a measure of abnormal return. If the predictions of the EMH hold, this intercept should not differ significantly from zero at conventional levels (Mitchell and Stafford, 2000). The heteroskedastic-consistent t-statistic proposed by White (1980) is used to test the null hypothesis of no abnormal performance and we employ both ordinary least squares (OLS) and weighted least squares (WLS) to estimate our equation parameters.

Table 8 summarizes our results. Irrespective of the estimation procedure and holding period, all intercepts are negative and statistically significant at conventional levels. This is consistent with our previous findings reported in table 6, and indicates that a post-bankruptcy announcement drift equally occurs on a calendar-time basis. For the one-year horizon, abnormal performance estimated using OLS (WLS) is -2.7% (-2.6%) per month. The equivalent annualized figure of -32% (-31%) is higher than the mean BHAR estimate of -28% in table 6, panel C. However, as Ikenberry and Ramnath (2002) point out, as the BHAR and calendar-time portfolio approaches differ in several ways, differences in results *are* to be expected, quite apart from potential misspecification problems.

Table 8 here

In summary, the results we obtain with the calendar-time method are very consistent with those obtained when using BHARs. Both clearly suggest that the market is unable to deal appropriately with the bankruptcy event, leading to at least a 12-month post-Chapter 11 drift that is highly negative and statistically significant.

6. Limits to arbitrage

Our results suggest that retail traders are likely to use the stock of bankrupt firms as a substitute of state lotteries, which would explain why these securities continue to be actively traded *after* firms have formally filed for Federal Protection. However, this does *not* fully

explain why the market underreacts to a Chapter 11 bankruptcy announcement. In effect, as the EMH proponents argue, it takes just one arbitrageur to ensure that markets, on average, reflect fundamental values (Shleifer, 2000, p. 4). As a result, in the next paragraphs, we explore the role of arbitrage implementation costs in the pricing of bankrupt firms' stock. As Barberis and Thaler (2005, p. 6) explain, these costs matter because they hinder arbitrageurs' ability to exploit a 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 on it (Merton, 1987).

We use a similar approach to that of Taffler et al (2004) and 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 sharing similar size and book-to-market. For each pair of bankrupt and control firms, these initial trades occur two trading days after the Chapter 11 date. These positions are 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, the position on both bankrupt and control firm is prematurely closed at the delisting date. Variations to the base scenario include using alternative control firms (size and momentum, industry and stock-price, size and z-score and industry, size and book-to-market), opening the initial position at different post-event days, considering alternative holding periods and inferring the stock price behavior after the delisting date, as suggested by Taffler et al (2004) and Kausar et al (2009).

A crucial aspect is how transaction costs are handled here. Following Taffler et al (2004) and Kausar et al (2009), we consider three types of transaction cost: 1) stock borrowing costs; 2) trading commissions, and 3) the bid-ask spread. The first affects the arbitrage strategy's profitability because the arbitrageur needs to borrow the bankrupt firms' stock before conducting the required short sale. Drawing on Kausar et al (2009), we use a conservative approach and assume a shorting cost of 4.3% per annum for bankrupt companies below the sample's median market capitalization and 1% per annum for all other firms.

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, Schill and Zhou (2004) and use a 4% commission rate for stocks under $1 per share, and 0.25% for all remaining stocks.

The bid-ask spread plays a key role in assessing the transaction costs faced by investors, especially when dealing with small, less liquid stocks (Pontiff, 1996; Lesmond et al 2004). This variable's impact 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 follow Kausar et al (2009) and estimate its value. In particular, 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.

The literature provides a menu of procedures for estimating the bid-ask spread. Due to the varying strengths and weaknesses of the various methods, we use three alternative techniques to determine complementary estimates for the bid-ask spread of both sample and control firms. The first is the quoted spread method of Stoll and Whaley (1983), and Bhardwaj and Brooks (1992). This method requires closing bid and ask prices, which we collect from CRSP's daily database. We consider two estimation periods defined around two key moments: 1) $t = 0$, the bankruptcy date and 2) $t = \alpha$, which occurs one year after $t = 0$ or at the delisting date of the bankrupt firm, whichever comes first.[42] The first estimation period begins one year before $t = 0$ and ends two weeks prior to that date. The second starts one week after $t = 0$ and terminates two weeks earlier than $t = \alpha$.[43] Equation (6) for the pre-bankruptcy period and (7) for the post-bankruptcy period are then used to calculate the quoted spread estimate for each of our sample and control firms:

$$Spread_{i,t} = \frac{1}{t} \sum_{t=-252}^{-10} \frac{\left(Ask_{i,t} - Bid_{i,t}\right)}{\frac{1}{2}\left(Ask_{i,t} + Bid_{i,t}\right)} \qquad (6)$$

[42] For each pair of sample and control firms, $t=0$ and $t = \alpha$ are the same.

[43] Alternative estimation windows are also considered for robustness purposes. In particular, I use a 2- and a 3-month period before $t=0$ and $t = \alpha$ as an alternative to our original framework as well as ending the estimation period two, five, and ten trading days before these key dates. Results remain qualitatively unchanged.

$$Spread_{i,t} = \frac{1}{t} \sum_{t=\alpha-247}^{\alpha-10} \frac{\left(Ask_{i,t} - Bid_{i,t}\right)}{\frac{1}{2}\left(Ask_{i,t} + Bid_{i,t}\right)} \tag{7}$$

where $Ask_{i,t}$ is the closing ask price for firm i on day t, $Bid_{i,t}$ is the closing bid price for firm i on day t and α is defined as above.

Direct effective spread estimates are calculated as in Lesmond et al (2004). In addition to closing bid and ask prices, this alternative measure also requires information about the closing price of the security under analysis. As a result, daily closing prices collected from CRSP are matched with the contemporaneous closing bid and ask prices. Once again, two estimation periods are considered for both sample and matched firms, along the lines described above. The bid-ask estimates are now given by equation (8) for the pre-bankruptcy period and (9) for the post-bankruptcy period:

$$Spread_{i,t} = \frac{1}{t} \sum_{t=-252}^{-10} \frac{\left(P_{i,t} - \frac{1}{2}\left(Ask_{i,t} + Bid_{i,t}\right)\right)}{P_{i,t}} \tag{8}$$

$$Spread_{i,t} = \frac{1}{t} \sum_{t=\alpha-247}^{\alpha-10} \frac{\left(P_{i,t} - \frac{1}{2}\left(Ask_{i,t} + Bid_{i,t}\right)\right)}{P_{i,t}} \tag{9}$$

where $Ask_{i,t}$ is the closing ask price for firm i in day t, $Bid_{i,t}$ is the closing bid price for firm i in day t, $P_{i,t}$ is the closing price for firm i in day t and α is defined as above.

The limited dependent variable threshold (LDV) model of Lesmond, Ogden and Trzcinka (1999) is the last method employed to estimate the bid-ask spread:

$$R_{i,t} = \begin{cases} R^*_{i,t} - \alpha_{1,i} & if \quad R^*_{i,t} < \alpha_{1,i}, \quad \alpha_{1,i} < 0 \\ 0 & if \quad \alpha_{1,i} \le R^*_{i,t} \le \alpha_{2,i} \\ R^*_{i,t} - \alpha_{2,i} & if \quad R^*_{i,t} > \alpha_{2,i}, \quad \alpha_{2,i} > 0 \end{cases} \tag{10}$$

where $R_{i,t}$ is the observed return of sample firm i, $R^*_{i,t} = \beta R_{i,t} + \varepsilon_{i,t}$ is the expected return of sample firm i based on the market model, $\alpha_{1,i} < 0$ is the trading cost on selling the stock, $\alpha_{2,i} > 0$ is the trading cost on buying the stock. In the LDV model, the all-in (explicit and implicit) roundtrip cost for sample firm i is given by $\alpha_{2,i} - \alpha_{1,i}$. The model is estimated by maximum likelihood using daily returns from a 6-month period, collected from CRSP's daily stock file.

We start by presenting the results obtained for the different bid-ask estimates. Table 9 shows that investors face large spreads when trading bankrupt companies' stock. In the pre-event period, the mean estimates vary between 5.8% and 8.3% (median values range from 5.2% to 6.9%). These values are much larger than the 1.0% or 2.0% round-trip costs estimated in previous studies for large capitalization stocks (e.g., Stoll and Whaley, 1983). The analysis of the post-bankruptcy period is even more revealing. Table 8 shows that the mean bid-ask spread estimates for that particular period now vary between 8.9% and 12.5% (median values range from 6.6% and 10.7%).

This sharp increase in the bid-ask spread sheds some light on how market makers react to the bankruptcy event. Copeland and Galai (1983) and Glosten and Milgrom (1985) posit that dealers are confronted with two types of traders: liquidity-motivated traders and informed traders. The models assume that dealers and liquidity-motivated traders possess identical sets of information, while informed traders have unique, non-public information. Consequently, dealers stand to lose to informed traders and react by increasing spreads to liquidity-traders. Our results provide direct support for these theoretical models. In effect, the information

asymmetry affecting bankrupt companies is dramatic, especially right after the announcement of Chapter 11. In these initial moments, only a few insiders know precisely what is going on with the company and can use their privileged information to earn abnormal returns. Not surprisingly, Seyhun and Bradley (1997) and Ma (2001) show that corporate insiders of bankrupt firms *do* use their superior information to trade. As predicted by Copeland and Galai (1983) and Glosten and Milgrom (1985), dealers respond by widening their bid-ask spreads thus recouping from liquidity-traders what they (potentially) lose to informed traders.

Table 9 here

Table 9 also shows the different spread estimates for our set of control firms. We find that the bid-ask spread for these firms is still relatively high, both in the pre- and post-event period. In effect the lowest mean estimate for the pre-event period is 3.8% and for the post-event period is 3.9%. A possible explanation for this result lies on the fact that all benchmark firms must comply with a certain size requirement, which is defined around the sample firms' rather small market capitalization. Table 9 also shows that, irrespective of the period, the control firms' bid-ask spread is lower than that of the bankrupt firms. Moreover, in sharp contrast with what happens to event firms, the bid-ask spread estimates for the benchmark firms *do* not suffer a dramatic increase from the pre- to the post-event period. This finding clearly suggests that the bankruptcy announcement is actually driving this effect in the case of our sample firms.

The results obtained with the LDV model are largely consistent with the evidence above. In fact, both in the pre- and post-event period, bankrupt firms exhibit higher round trip transaction costs than the respective control firms. Panel D of table 9 also suggests that event and non-event firms' total transaction costs increase significantly from the pre- to the post-event period. Complementary tests, however, show that the variation in total transaction costs between the pre- and post-event period, as measured by the LDV model, is always higher for sample than for control firms.

We now turn to the analysis of the arbitrage strategy presented above. Panel A of table 10 summarizes our base scenario's results. Our main finding is that, on average, a sophisticated investor engaging in an arbitrage strategy involving bankrupt firms' stock may expect loose a significant percentage of her investment (best case scenario 18.0% for a 6-month holding period; 11.2% for a 12-month holding period). Median returns largely confirm that arbitrageurs *will not* be able to make a profit with such strategy since most are negative *and* significant, with some being positive *but not* statistically different from zero at normal levels. Panel A of table 10 also provides evidence that the arbitrage strategy under analysis is very risky for the arbitrageur. The large figures for the standard deviation and inter-quartile range obtained for the arbitrage strategy's return justify such claim.

Table 10 here

Our main findings do not change in any meaningful way when we consider firms matched on size and in our simulation. Panel B of table 10 shows that, in this case, the best average result available is a loss of 10.5% (17.6%) for a 12-month (6-month) holing period. This alternative simulation also generates a high standard deviation and inter-quartile range for the returns of the arbitrage strategy. Such a result again highlights the degree of risk that sophisticated investors must be willing to bear if/when engaging in the arbitrage strategy under examination.

In order to save space we do not report the results that we obtain when considering numerous variations of the base scenario. Nevertheless, it should be stressed that using alternative control samples based on industry, size and book-to-market, size and z-score and industry and stock price, opening the arbitrage strategy initial positions in the third, fifth and tenth post-event day, and holding the positions open for four, five and nine months *does not* affect our findings in any meaningful way. As such, we conclude that only an "*illusory profit opportunity*" (Lesmond et al, 2004) seems to exist in the market for bankrupt firms' stock. This

helps explain why the stock price of such firms drifts away from its fundamental value even in the medium-term without traditional market forces being able to correct this situation.

7. Discussion

This paper addresses two central questions regarding the post-filing trading of the stocks of Chapter 11 firms: (i) who trades these stocks and why, and (ii) what explains the negative returns of these stocks? Our evidence shows that such stocks earn on average a highly significant negative return of -28% over the year after the bankruptcy filing date. (This is over and above the average adverse market reaction of -25% to the announcement of a Chapter 11 filing.) This seems inconsistent with any risk-return equilibrium model. However, our main results are robust for a wide range of alternative specifications and event-study methods which provide some comfort to the robustness of our findings.

The natural question is why would risk-averse investors trade bankrupt stocks? By examining the characteristics of the investors who hold them, and the lottery-like return distribution characteristics of these stocks, as well as the limits to arbitrage in trading these stocks, we provide some plausible explanations for our anomalous results. Our tests suggest that retail investors are the key market participants once bankruptcy is underway, typically holding 90% of these firms' stock. We also find that retail investors are responsible for most of the trading in bankrupt firm stock. These results may be due to the regulatory restrictions preventing many institutional investors from holding and trading the stock of bankrupt firms (Del Guercio, 1996). Some institutional investors, however, specialize in this market. This is the case, for example, of vulture funds (Rosenberg, 2000), and some hedge funds that invest only in distressed firms (Lhabitant, 2006, pp. 230-231). Nonetheless, it is interesting that retail investors should be the main stockholders and traders of firms undergoing Chapter 11 reorganization. We show that bankrupt firms' stock possesses the fundamental characteristics of what Kumar (2009) defines as a lottery-stock. In other words, for a small initial investment, this particular type of security offers a low probability of a high future reward, and a high

probability of a small loss. Importantly, the very low market price that characterizes bankrupt firms' stock makes it possible for investors to earn extremely generous short-term returns when prices appreciate only a few cents. As such, the desire to gamble on the market may at least partially explain why so many retail investors actively trade the stock of firms that are in bankruptcy. Our key result is consistent with contemporaneous literature showing that certain types of retail investors are drawn toward stocks with speculative features such as high skewness, high volatility and low prices (Han and Kumar, 2009). It is also broadly consistent with the results of Dorn and Huberman (2009) who show that risk-seeking or less risk-averse retail investors hold and actively trade high volatility stocks and with the work of Grinblatt and Keloharju (2009) and Dorn and Sengmueller (2009), who establish that sensation-seeking investors as well as investors who trade for entertainment exhibit a preference for speculative stocks.

Of course, we cannot rule out other possibilities. For instance, our results could simply be a manifestation of a preference for skewness. Mitton and Vorkink (2007) introduce a model that departs from the standard expected utility theory of von Neuman and Morgenstern (1944) by allowing investors to have *heterogeneous* preferences for skewness. They demonstrate that investors with greater preference for skewness will, in equilibrium, select securities (and portfolios) with greater levels of skewness, especially those with higher levels of idiosyncratic skewness. In contrast to Mitton and Vorkink (2007), Barberis and Huang (2008) study an economy populated with cumulative prospect investors that trade in both normally distributed return securities and securities with positively skewed return distributions.[44] They demonstrate that in such an economy there are non-unique global optima, so that even though investors have *homogeneous* preferences they can hold different portfolios. In particular, investors who overweight tails find it desirable to take a large, undiversified position in the skewed security (or securities) since this helps them achieve a portfolio that behaves more like a lottery. Others,

[44] As the authors explain, a positively skewed security is simply one that earns an excess return *infinitesimally* above the risk-free rate. Barberis and Huang (2008) also show that the skewness of security's excess returns is primarily determined by the probability of a large payoff: the higher such probability is the more skewed is the excess return of the security.

who do not overweigh tails as much, will rather hold a more diversified portfolio because this investment strategy is more mean-variance efficient.

Interestingly, Kumar's (2009) lottery-like stocks fit well with both the theoretical models of Mitton and Vorkink (2007) and Barberis and Huang (2008) since the main characteristic of the security that generates the non-standard equilibriums in both these models is idiosyncratic skewness. In the context of the Mitton and Vorking (2007) model, underdiversified investors (i.e., those who exhibit a more extreme preference for skewness) receive a constant reward in skewness that partially compensates for the lack of mean-variance efficiency in their portfolios. As such, the abnormal negative performance we document for bankrupt firms' stock should be mitigated (or even disappear) if we account correctly for the compensation these investors get from the skewness of the returns. Barberis and Huang (2008) explain that investors who overweigh tails are willing to pay a premium for the skewed security since this allows them to maximize their utility. As a result, they will earn a lower return on this security than that that would be expectable on a standard mean-variance context. So, in the setting put forward by Barberis and Huang (2008), buying bankrupt firms' stock allows these investors to maximize their utility, at the cost of the final portfolio they hold not being mean-variance efficient. Overall, irrespective of the particular theoretical model that underlies the market underreaction to bankruptcy we uncover, the desire to gamble seems to be *the* human trait that triggers the behavior we document when explaining why so many people actively trade the stock of bankrupt firms. The myriad of anecdotal evidence available on this issue is very consistent with our conjecture.

In parallel to our own work, Lily and Zhong (2009) run a test where the post-bankruptcy buy-and-hold return on each of their sample firms is regressed on the buy-and-hold return of control firms matched on industry and size decile. Lily and Zhong (2009) report that the correlation between returns is significantly positive when the performance of matching firms is relatively good and zero otherwise. Based on this evidence, Lily and Zhong (2009) conclude that bankrupt stocks' returns are similar to those obtained from buying out-of-the money call options on an equally weighted portfolio of matched firms, which could explain why someone

should be willing to buy-and-hold these securities. We would like to make two comments here. First, the authors define matching firm only on industry and size, and do not provide a single robustness test to ensure that their result is not benchmark-specific. Second, at a more fundamental level, we question the implications of Lily and Zhong's result. In fact, it implies that investors are buying and holding bankrupt firms' stock hopping that the "industry" the firm belongs to will perform well *in the future*. This would require investors to be able to forecasts the future performance of different industries in order to determine which bankrupt firms to buy-and-hold. This seems difficult to occur in practice since most of these firms' stock is owned and traded by retail investors, as we show above. Moreover, the findings of Lily and Zhong (2009) only justify why one should *buy* and *hold* bankrupt firms' stock. It fails to explain why investors actively trade these securities *throughout* the bankruptcy process, which is something that does occur in practice.

In the last part of the paper we explore the role of arbitrageurs in the market for bankrupt firms. We find that arbitrageurs will likely have little incentive to act in the particular case of bankrupt firms. This is because an arbitrage strategy developed to exploit the potential mispricing of such firms not only is very risky, but generates, on average, negative returns. Our analysis is even conservative in that it fails to account for all possible sources of risk/implementation costs that a sophisticated investor needs to deal with when engaging in arbitrage transactions involving the stock of bankrupt firms. Difficulty in shorting these stocks is a relevant illustration of this issue. For example, D'Avolio (2002) finds that over 50% of the stocks with prices below $5 present in the CRSP database are hard to short. 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 impact of other costs like holding costs or 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 that we address (Pontiff, 2006). However, in practice, these limitations only strengthen the robustness of our results. Importantly, our finding provides empirical support to one of Barberis and Huang's (2008) theoretical predictions: that the arbitrage mechanism will probably collapse in an economy

populated with cumulative prospect investors. This is because arbitrageurs will be faced with significant risks and costs when attempting to resolve the mispricing of the skewed security.

Our results are also very interesting because they shed light on the "distress anomaly" recently discussed in Campbell et al (2008). One of the key contributions of this paper is showing that, since 1981, financially distressed stocks have delivered anomalously low returns. This result is clearly inconsistent with standard models of rational asset pricing but Campbell et al (2008) fail to provide a definitive explanation for it. We would argue that, given our results, the distress anomaly is the result of non-standard preferences of retail investor *and* limits to arbitrage, much like what happens when firms file for Chapter 11 bankruptcy.

8. Conclusion

We examine the realized returns of the stocks of firms that continue to trade on major stock exchanges after filing for Chapter 11 and find these returns to be highly negative on average. We also document there are significant costs to arbitrage in this market such that these negative returns are not arbitraged away. We also examine the characteristics of the traders in this market as well as the distributional characteristics of these stocks post-bankruptcy. In a recent paper, Kumar (2009) shows that retail investors have a predisposition to invest disproportionally more in stocks that, for a small price, offer the opportunity to realize a large profit with low probability, and a small loss with high probability. He calls them "lottery-type stocks". We show that the stock of bankrupt firms conforms to this definition. Our results suggest that retail investors are particularly drawn to such stocks. Moreover, we show that, when such market participants are allowed to trade without the correction of traditional arbitrage forces, market prices do not reflect fundamental value. As such, gambling-motivated trading combined with limits to arbitrage in the market for bankrupt stocks can explain the puzzling return evidence we document. We conjecture that a similar mechanism may well explain the distress anomaly discussed by Campbell et al (2008).

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Table 1

Defining the sample

This table summarizes the steps undertaken to identify this study's sample. The first stage is combining seven different data sources to identify an initial set of non-overlapping firms that filed for bankruptcy in the U.S. between 10/01/1979 and 10/17/2005. In order to be included in the final sample a given company must comply with the following criteria: 1) have enough data on CRSP and COMPUSTAT to conduct the analysis, 2) be listed and remain listed on a major exchange after the bankruptcy announcement date, trading common stock and 3) be a domestic company, filing for Chapter 11. Financial or utility firms are not considered in the final sample.

	Nº
Non-overlapping firm-year observations identified from the different data sources	3,437
Firm-year observations not found or with insuficient data on CRSP	1,411
Firm-year observations delisted before or at the bankruptcy filing month	1,556
Firm-year observations with insuficient data on COMPUSTAT	58
Firm-year observations classified as foreign	11
Utilities and financial firms	40
Firms filing Chapter 7	10
Final sample size	351

Table 2

Summary statistics

This table presents summary statistics relating to our population of 351 non-finance, non-utility industry firms, listed on the NYSE, AMEX or NASDAQ before and after filing for Chapter 11 between 10/01/1979 and 10/17/2005. The table also presents summary statistics for a control sample matched on size and book-to-market. Specifically, for each sample company, we identify all CRPS 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 of 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)		Matched firms (B)		Difference (A-B)			
	Mean	Median	Mean	Median	Mean	P-value	Median	P-value
Sales	596.4	116.9	634.9	129.5	-38.5	0.7786	-12.6	0.3301
TA	646.6	89.7	754.6	128.1	-108.0	0.5532	-38.4	0.2360
ROA	-19%	-6%	-15%	1%	-4%	0.2592	-7%	<0.0001
Z-Score	1.37	1.31	2.14	2.12	-0.77	0.0040	-0.81	0.0049
CUR	169%	128%	231%	178%	-62%	0.0008	-50%	<0.0001
LEV	45%	40%	36%	33%	9%	0.0006	7%	0.0005

Sales: sales in million of dollars. TA: total assets in millions of dollars. 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 variables are computed with are taken from the last annual accounts reported before the bankruptcy year.

Table 2 (cont.): Summary statistics

Panel B: Market related variables

	Sample firms (A)		Matched firms (B)		Difference (A-B)			
	Mean	Median	Mean	Median	Mean	P-value	Median	P-value
Size	160.0	32.3	159.6	32.2	0.5	0.9901	0.04	0.7378
Book/Market	4.2	2.3	3.8	2.2	0.4	0.4321	0.1	0.5432
Pre price	4.97	3.12	9.80	5.49	-4.83	<0.0001	-2.37	<0.0001
Event Price	2.08	0.97	8.67	4.38	-6.59	<0.0001	-3.41	<0.0001
Pos Price	2.98	0.71	8.84	4.27	-5.86	<0.0001	-3.56	<0.0001
Pre Volume	0.51%	0.34%	0.44%	0.25%	0.07%	0.0559	0.09%	0.0026
Event Volume	1.15%	0.61%	0.42%	0.23%	0.73%	<0.0001	0.38%	<0.0001
Pos Volume	0.57%	0.30%	0.43%	0.24%	0.14%	0.1887	0.06%	0.0275
Pre Tdays	250	252	227	249	23	<0.0001	3	<0.0001
Pos Tdays	230	246	224	248	6	0.0951	-2	0.0058

Size: market capitalization (price times shares outstanding), in millions of dollars. Book/Market: book-to-market ratio. Pre Price: daily average stock price measured 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 centred on the bankruptcy announcement date. Pos Price: some as Pre Price, but for the 12-month period after the bankruptcy announcement month. Pre Volume: average daily trading volume (volume/shares outstanding) measured for the 12-month period preceding the bankruptcy announcement month. Event Volume: same as Pre Volume but for the 30-calendar day period centred on the bankruptcy announcement date. Pos Volume: same as Pre Volume but for the 12-month period after the bankruptcy announcement month. Pre Tdays: number of days on which trading takes place in the calendar year preceding the bankruptcy announcement month. Pos Tdays: same as Pre Tdays but for the calendar year following the bankruptcy announcement month.

Table 2 (cont.): Summary statistics

Panel C: Other Characteristics

	Sample firms		Matched firms	
	Positive cases	% of sample	Positive cases	% of sample
EPS	88	25.1	172	49.0
Divid	91	25.9	134	38.2
Big8	287	81.8	294	83.8
Opinion	263	0.75	344	0.98
Delist	195	55.6	-	-

EPS: earnings per share dummy (1 if positive, 0 otherwise). Divid: dividend paid dummy (1 if dividend paid, 0 otherwise). Big8: auditor quality proxy dummy (1 if Big eight, 0 otherwise). Opinion: auditor opinion dummy (1 if clean – 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 (as well as Big8) are taken from the last annual accounts reported before the bankruptcy year.

Table 3

Stockholdings in Chapter 11 firms

This table presents institutional stockholdings for our population of 351 non-finance, non-utility industry firms, listed on the NYSE, AMEX or NASDAQ before and after filing for Chapter 11 between 10/01/1979 and 10/17/2005. Information about institutional stockholdings for a control sample matched on size and book-to-market is also provided. Specifically, for each sample company, we identify all CRPS 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. Below, institutional ownership is computed as $Inst_{i,t} = Shares\ held_{i,t} \Big/ Shares\ outstanding_{i,t}$, where $Shares\ held_{i,t}$ is the number of shares of firm i held by the institutional investors at the end of event-quarter t and $Shares\ outstanding_{i,t}$ is firm i's outstanding shares at the end of event-quarter t. Event-quarter 0 is the first post-Chapter 11 quarter for which institutions have to report their stockholdings to the SEC. The last two columns report the two-tailed significance level from a t-test and a Wilcoxon-Man-Whitney test for the difference in means and medians, respectively. *N* reports the number of firms with available information to compute $Inst_{i,t}$ in event-quarter t.

	Sample firms			Control firms			Significance	
Quarter	Mean	Median	N	Mean	Median	N	Mean	Median
-8	24.4%	20.1%	263	24.2%	19.4%	323	0.9192	0.5043
-7	24.1%	20.1%	274	23.9%	19.5%	324	0.9348	0.6282
-6	22.5%	17.6%	282	24.4%	20.0%	326	0.2699	0.6156
-5	21.9%	17.1%	288	24.1%	19.9%	330	0.1725	0.4696
-4	20.6%	15.5%	299	25.4%	20.4%	327	0.0042	0.0283
-3	19.6%	14.3%	303	24.1%	19.4%	330	0.0036	0.0267
-2	18.0%	12.7%	306	24.0%	19.7%	326	<0.0001	0.0010
-1	16.1%	10.7%	310	23.4%	19.5%	330	<0.0001	<0.0001
0	11.6%	7.9%	306	23.2%	17.9%	333	<0.0001	<0.0001
1	11.0%	6.7%	264	23.4%	17.5%	333	<0.0001	<0.0001
2	11.1%	6.1%	229	23.8%	17.5%	331	<0.0001	<0.0001
3	11.2%	5.9%	198	22.9%	16.5%	335	<0.0001	<0.0001
4	11.7%	5.7%	189	22.7%	16.4%	335	<0.0001	<0.0001

Table 4

Differences between small and large traders abnormal trading responses after bankruptcy filing dates

This table presents small and large abnormal trading performance following the announcement of bankruptcy for our population of 351 non-finance, non-utility industry firms, listed on the NYSE, AMEX or NASDAQ before and after filing for Chapter 11 between 10/01/1979 and 10/17/2005. We measure small traders' abnormal trading response (SMALL) as follows. We divide each post-event month in seven consecutive non-overlapping three-day windows (i.e., 21 trading days spanning approximately a month) and we count the number of small trades in each of these seven three-day non-announcement periods. We then use the median of these seven numbers as the post-event month number of small trades. We define the benchmark month as that that starts six months before the bankruptcy filing date and determine the normal level of trade in a similar manner to that of post-event trading activity. We compute large traders' abnormal trading response (LARGE) in a similar manner. The last two columns report the two-tailed significance level from a t-test and a Wilcoxon-Man-Whitney test for the difference in means and medians, respectively. *N* reports the number of companies with available information to compute SMALL and LARGE each post-event month.

Post-event days	N	SMALL		LARGE		Significance	
		Mean	Median	Mean	Median	Mean	Median
(+2,+31)	119	5.8	2.5	2.1	1.3	<0.0001	<0.0001
(+32,+62)	56	2.4	2.3	1.6	0.9	0.021	<0.0001
(+63,+93)	51	2.1	2.0	1.4	0.8	0.061	<0.0001
(+94,+124)	46	1.9	1.7	1.7	0.7	0.084	<0.0001
(+125,+155)	43	1.8	1.6	1.3	0.6	0.071	0.021
(+156,+186)	42	1.8	1.7	1.2	0.7	0.074	0.031
(+187,+217)	42	1.9	1.8	1.3	0.7	0.061	0.025
(+218,+248)	42	1.5	1.3	1.1	0.6	0.415	0.035
(+249,+279)	40	1.7	1.4	1.2	0.8	0.512	0.031
(+280,+310)	38	1.9	1.4	1.5	0.8	0.612	0.041
(+311,+341)	37	2.0	1.3	1.7	0.7	0.812	0.081
(+342,+372)	35	3.2	1.5	2.2	0.9	0.741	0.072

Table 5

Bankrupt firms as lottery-stocks: basic characteristics

This table presents lottery-stocks characteristics for our population of 351 non-finance, non-utility industry firms, listed on the NYSE, AMEX or NASDAQ before and after filing for Chapter 11 between 10/01/1979 and 10/17/2005. The sample firms column reports the characteristics of our bankrupt firms. All variables are computed as in Kumar (2009). The control firms column reports the characteristics of a matched sample based on size and book-to-market. Specifically, for each sample company, we identify all CRPS 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. All variables are computed as in Kumar (2009). The Kumar (2009) column is adapted from table II of Kumar (2009).

Stock Characteristics	Sample Firms		Control Firms		Kumar (2009)		
	Pre	Post	Pre	Post	Lottery	Non-Lottery	Other
Total Volatility	8.51	13.8	4.91	5.32	78.57	3.29	22.14
Idiosyncratic Volatility	8.24	12.47	4.73	5.12	75.56	2.96	20.36
Total Skewness	0.17	1.06	0.527	0.688	0.33	0.175	0.237
Systematic Skewness	-1.6	-44.22	-4.84	-7.38	-0.20	-0.061	-0.11
Idiosyncratic Skewness	0.16	0.94	0.53	0.66	0.73	-0.041	0.332
Stock Price	$4.97	$2.98	$9.80	$8.84	$3.83	$31.68	$17.51
Market Beta	0.94	1.39	1.022	1.11	1.09	0.906	0.897
Amihud Illiquidity	43.77	124.9	12.98	10.91	70.16	0.465	15.13
Firm Age	8.87	-	15.1	-	5.78	12.1	11.87
Percentage Without Analyst Coverage	50.14%	58.60%	47.29%	48.10%	71.3%	21.2%	36.9%
Mean Number of Analysts	5.2	4.11	6.4	6.48	3.93	12.4	6.49
Percentage of Institutional Ownership	16.10%	11.60%	23.40%	23.40%	7.35%	49.34%	30.09%

Table 6

Market reaction to Chapter 11

This table presents buy-and-hold abnormal returns for our population of 351 non-finance, non-utility industry firms, listed on the NYSE, AMEX or NASDAQ before and after filing for Chapter 11 between 10/01/1979 and 10/17/2005. All compounding periods are in trading days, where day zero is the Chapter 11 date. Market adjusted (using CRSP equally weighted index as benchmark) are reported in the two first columns. The two last columns report the results using a control firm approach where firms are matched according to size and book-to-market. Specifically, for each sample company, we identify all CRPS 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 two-tailed significance level from t-statistics (Wilcoxon signed rank-test) is reported below the corresponding mean (median).

Panel A: Pre-event returns

	Market Adjusted Returns		Control Firm Benchmark	
	Mean	Median	Mean	Median
(-252,-2)	-0.89	-0.91	-0.49	-0.43
	<0.0001	<0.0001	<0.0001	<0.0001
(-126,-2)	-0.62	-0.64	-0.42	-0.42
	<0.0001	<0.0001	<0.0001	<0.0001

Panel B: Short-term market reaction

	Market Adjusted Returns		Control Firm Benchmark	
	Mean	Median	Mean	Median
(-1,+1)	-0.27	-0.28	-0.26	-0.27
	<0.0001	<0.0001	<0.0001	<0.0001
(-2,+2)	-0.28	-0.31	-0.27	-0.31
	<0.0001	<0.0001	<0.0001	<0.0001

Table 6 (cont.): Market reaction to Chapter 11

Panel C: Medium-term market reaction

	Market Adjusted Returns		Control Firm Benchmark	
	Mean	Median	Mean	Median
(+2,+84)	-0.14	-0.24	-0.13	-0.15
	<0.0001	<0.0001	0.0014	<0.0001
(+2,+126)	-0.20	-0.33	-0.16	-0.16
	<0.0001	<0.0001	0.0005	0.0001
(+2,+252)	-0.48	-0.67	-0.28	-0.27
	<0.0001	<0.0001	<0.0001	<0.0001

Table 7

Controlling for earnings surprise

Panel A presents buy-and-hold abnormal returns for our population of 351 non-finance, non-utility industry firms, listed on the NYSE, AMEX or NASDAQ before and after filing for Chapter 11 between 10/01/1979 and 10/17/2005. All compounding periods are defined in trading days, where day zero is the Chapter 11 date. A control firm approach is used to estimate the abnormal returns. Firms are matched according to size and earnings surprise. Specifically, for each sample company, we identify all CRPS 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 earnings surprise value closest to that of the sample firm. The two-tailed significance level from t-statistics (Wilcoxon signed rank-test) is reported below the corresponding mean (median).

Panel A: Controlling for size and earnings surprise - adjusted returns

	Control Firm Benchmark	
	Mean	Median
(+2,+84)	-0.09	-0.11
	0.0267	0.0011
(+2,+126)	-0.15	-0.16
	0.0008	<0.0001
(+2,+252)	-0.32	-0.33
	<0.0001	<0.0001

Panel B presents buy-and-hold abnormal returns for our population of 351 non-finance, non-utility industry firms, listed on the NYSE, AMEX or NASDAQ before and after filing for Chapter 11 between 10/01/1979 and 10/17/2005, conditional on the sign of the quarterly earnings change. Firms with a negative pre-event earnings surprise are allocated to the negative earnings portfolio; all others are classified as the positive earnings surprise portfolio. All compounding periods are defined in trading days, where day zero is the Chapter 11 date. A control firm approach based on size and book-to-market is used to estimate the abnormal returns. Specifically, for each sample company, we identify all CRPS firms with a market capitalization between 70% 130% of its equity market value. The control firm is that firm with book-to-market closest to that of the sample firm. For the Negative and Positive earnings columns, the two-tailed significance level from t-statistics (Wilcoxon signed rank-test) is reported below the corresponding mean (median). In the two last columns, the two-tailed significance level from t-statistics or a Wilcoxon-Mann-Whitney test are reported below the corresponding mean or median difference.

Table 7 (cont.): Controlling for earnings surprise

Panel B: Controlling for earnings surprise – earnings surprise sign

	Negative Earnings (n=263)		Positive Earnings (n=88)		Difference (Neg - Pos)	
	Mean	Median	Mean	Median	Mean	Median
(+2,+84)	-0.15	-0.18	-0.06	-0.10	-0.10	-0.08
	0.0011	0.0001	0.0486	0.0251	0.2944	0.4177
(+2,+126)	-0.18	-0.18	-0.10	-0.14	-0.08	-0.04
	0.0002	<0.0001	0.0541	0.036	0.1762	0.2547
(+2,+252)	-0.32	-0.30	-0.18	-0.16	-0.14	-0.14
	<0.0001	<0.0001	0.0397	0.0214	0.0247	0.1563

Table 8

Calendar-time portfolios

This table reports abnormal stock returns for calendar-time portfolios formed using a sample of 351 non-finance, non-utility firms listed on the NYSE, AMEX or NASDAQ before and after filing for Chapter 11 between 10/01/1979 and 10/17/2005. Firms are added to the portfolio at the end of the month following the Chapter 11 announcement and are held for 6 or 12 months. Portfolio returns are computed assuming an equally weighted investment strategy. Months where the portfolio holds less then 10 stocks are deleted. The abnormal returns are determined using the Carhart (1997) factor model. The parameters are estimated using both OLS and WLS. Monthly returns in the WLS model are weighted by the square root of the number of firms contained in the calendar-time portfolio in that month. The regression intercept provides an estimate of monthly abnormal performance. Heteroskedasticy robust t-statistics are reported. *N* indicates the number of observations (months) included in the estimation procedure.

	WLS		OLS	
	6 months	12 months	6 months	12 months
Intercept	-0,0473	-0,0264	-0,0531	-0,0269
	-3.88***	-2.99**	-4.08***	-2.70*
b	1,1364	1,0008	0,9422	0,9716
	3.75***	4.56***	3.53***	4.75***
s	3,5050	2,9909	2,4418	2,0126
	8.34***	9.90***	3.84***	4.16***
h	2,2097	1,8031	0,9712	0,9200
	4.44***	4.92***	1,5	1,87
u	-0,8609	-0,6232	-0,8979	-0,7035
	-2.61*	-2.62*	-1,95	-1,71
N	108	204	108	204
Adj R^2	0,2631	0,3111	0,1672	0,2156

*, **, *** indicate significance at the 5%, 1%, and 0.1% levels respectively.

Table 9

Bid-ask spread estimates for sample and control firms

This table presents bid-ask spread estimates for our population of 351 non-finance, non-utility industry firms, listed on the NYSE, AMEX or NASDAQ before and after filing for Chapter 11 between 10/01/1979 and 10/17/2005. The table also shows the results for size and book-to-market matched sample. Specifically, for each sample firm, we identify all CRPS 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 quoted spread measure is computed as in Stoll and Whaley (1983). The direct effective spread estimate is computed as in Lesmond, Schill and Zhou (2004). The LDV measure is computed as in Lesmond et al (1999). In panels A, B and C the Pre bank. column refers to the pre-event period bid-ask estimates. All pre-event estimates are computed with daily data collected from CRSP using a period that begins one year before the bankruptcy date of the event firm and ends two weeks before that date. The same bankruptcy date is used for each pair of event and non-event companies. In panels A, B and, C the Post bank. column refers to the post-event period bid-ask estimates. All post-event estimates are computed with daily data collected from CRSP using a period that begins one weak after the bankruptcy date of the event firm and ends one year after that date or at the delisting date of the event firm, whichever comes first. The same bankruptcy date is used for event and non-event companies. In panels A, B and C *N* reports the number of companies with available information to compute the respective bid-ask estimate.

Panel A: Quoted spread estimate

	Sample Firms		Size and B/M	
	Pre bank.	Post bank.	Pre bank.	Post bank.
Mean	8.27%	12.50%	6.25%	7.18%
Median	6.85%	10.70%	4.30%	4.38%
N	205	211	191	197
St. Dev.	6.26%	7.33%	6.14%	8.89%

Panel B: Direct effective estimate

	Sample Firms		Size and B/M	
	Pre bank.	Post bank.	Pre bank.	Post bank.
Mean	5.83%	8.94%	3.79%	3.94%
Median	5.16%	6.61%	2.96%	2.64%
N	205	211	191	197
St. Dev.	4.16%	5.09%	3.48%	3.96%

Table 9 (cont.): Bid-ask spread estimates for sample and control firms

Panel C: LDV effective estimate

	Sample Firms		Size and B/M	
	Pre bank.	Post bank.	Pre bank.	Post bank.
Mean	11.22%	14.48%	8.89%	10.44%
Median	9.03%	12.30%	6.85%	8.34%
N	351	351	351	351
St. Dev.	7.73%	5.28%	8.51%	9.42%

Table 10

Illustrative profits earned with an arbitrage strategy involving bankrupt firms' stock

This table presents the results obtained with an illustrative zero-investment strategy in event time using our population of 351 non-finance, non-utility industry firms, listed on the NYSE, AMEX or NASDAQ before and after filing for Chapter 11 between 10/01/1979 and 10/17/2005. The arbitrageur goes short on each bankrupt firm and uses the net proceeds to buy shares of a matched firm sharing similar characteristics. In panel A (B), firms are matched according to size and book-to-market (size and momentum). Specifically, for each sample company, we identify all CRPS firms with a market capitalization between 70% and 130% (70% and 130%) of its equity market value. The respective control firm is then selected as that firm with book-to-market (momentum) closest to that of the sample firm. The initial trades occur two trading days after the event date and the 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 the bankrupt companies 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 event and non-event 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. Three different bid-ask estimates are considered. In panels A and B, the Direct effective spread column refers to the bid-ask spread computed as in Lesmond et al (2004). In panels A and B, the Quoted spread column refers to the bid-ask spread computed as in Stoll and Whaley (1983). In panels A and B, the LDV effective spread column refers to the bid-ask spread computed as in Lesmond et al (1999). In panels A and B, the two-tailed significance level from t-statistics (Wilcoxon signed rank-test) is reported below the corresponding mean (median).

Table 10 (cont.): Illustrative profits earned with an arbitrage strategy involving bankrupt firms' stock

Panel A: Base scenario - firms are matched according to size and book to market

	Direct effective spread		Quoted spread		LDV effective spread	
	6-months	12-months	6-months	12-months	6-months	12-months
Mean	-18.0%	-11.2%	-20.3%	-14.4%	-21.5%	-15.4%
p-value	0.0001	0.0646	<0.0001	0.0266	<0.0001	0.0183
Median	-5.1%	1.2%	-5.7%	1.0%	-6.1%	-2.1%
p-value	0.0104	0.3421	0.0021	0.1681	0.0009	0.1159
St.Dev.	89.0%	120.1%	90.2%	121.3%	79.8%	122.6%
25th percentil	-54.5%	-57.4%	-57.8%	-60.1%	-59.3%	-61.6%
75th percentil	37.5%	48.1%	35.6%	46.4%	35.0%	44.8%

Panel B: Alternative scenario - firms are matched according to size and momentum

	Direct effective spread		Quoted spread		LDV effective spread	
	6-months	12-months	6-months	12-months	6-months	12-months
Mean	-17.6%	-10.5%	-19.8%	-12.8%	-22.1%	-15.0%
p-value	0.0080	0.1260	0.0002	0.0622	<0.0001	0.0288
Median	-7.3%	1.5%	-10.1%	-1.1%	-11.4%	-3.1%
p-value	0.0011	0.3140	0.0002	0.1850	<0.0001	0.0984
St.Dev.	96.4%	128.4%	97.3%	129.7%	97.0%	128.9%
25th percentil	-58.2%	-54.3%	-60.4%	-55.1%	-65.2%	-57.3%
75th percentil	33.9%	45.2%	31.9%	43.6%	29.8%	42.3%